Torres Rojas, Genara

From: jsg@cohmlaw.com
Sent: Monday, October 27, 2014 12:16 PM
To: Duffy, Daniel; American, Heavyn-Leigh
Cc: Torres Rojas, Genara; Van Duyne, Sheree
Subject: Freedom of Information Online Request Form

Information:

First Name: John
Last Name: Groarke
Company: Colleran OHara Mills
Mailing Address 1: 100 Crossways Park Drive West
Mailing Address 2: Suite 200
City: Woodbury
State: NY
Zip Code: 11797
Email Address: jsg@cohmlaw.com
Phone: 5162485757
Required copies of the records: Yes

List of specific record(s):
Please provided me with a copy of the contract for sign installation work to be performed at the east parking garage structure at the LaGuardia LGA airport parking field.

THE PORT AUTHORITY OF NY & NJ

FOI Administrator

November 17, 2014

Mr. John Groarke
Colleran Ohara Mills
100 Crossways Park Drive West
Woodbury, NY 11797

Re: Freedom of Information Reference No. 15432

Dear Mr. Groarke:

This is in response to your October 27, 2014 request, which has been processed under the Port Authority's Freedom of Information Code (the "Code") for a copy of the contract for the sign installation work to be performed at the east parking garage structure at the LaGuardia Airport Parking Field.

Material responsive to your request and available under the Code can be found on the Port Authority's website at http://www.panynj.gov/corporate-information/foi/15432-C.pdf. Paper copies of the available records are available upon request.

Certain portions of the material responsive to your request are exempt from disclosure pursuant to exemptions (1) and (4) of the Code.

Please refer to the above FOI reference number in any future correspondence relating to your request.

Very truly yours,

Daniel D. Duffy
FOI Administrator

225 Park Avenue South, 17th FL
New York, NY 10003
T: 212 435 3642 F: 212 435 7555

THE PORT AUTHORITY OF NY & NJ

Lillian D. Valenti
Director, Procurement

October 3, 2013

VIA FACSIMILE AND UPS NEXT DAY DELIVERY

Yonkers Contracting Company, Inc.
969 Midland Avenue
Yonkers, NY 10704

SUBJECT: LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE - CONTRACT LGA-124.201
PURCHASE ORDER ULGA124201

Gentlemen:

The Port Authority of New York and New Jersey hereby accepts your proposal on the above Contract.

The Port Authority elects not to require you to furnish a performance and payment bond.

Your attention is directed to the clause of the Contract entitled "Time for Completion and Damages for Delay" and to the fact that before you may commence performance of the work you must furnish whichever of the documents mentioned in that clause are applicable.

Forwarded herewith for your use and compliance are "General Instructions Relating to the Direction and Processing of Correspondence and of Those Other Items Specified to be Submitted to the Port Authority Under the Terms of the Contract".

In order to ensure that payments are processed properly, please include the above-referenced Purchase Order No. on all payment invoices and correspondence.

Very truly yours,

THE PORT AUTHORITY OF NEW YORK
AND NEW JERSEY

BY _____
Director of Procurement

Approved as to form: F. F.

Darrell Buchbinder
General Counsel

By _____
Attorney Tracy C. Shikel
Date 9/16/13

2 Montgomery Street, 3rd Floor
Jersey City, NJ 07302
T: 201 395 7477

Yonkers Contracting Company, Inc.

1

THE PORT AUTHORITY OF NY & NJ

CA02-124.201
PQL

F.F.
C.M.

LAGUARDIA AIRPORT

DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

CONTRACT LGA-124.201

VOLUME 1 OF 2

JUNE 2013

This proposal is not complete unless bidder's Signature appears on page 24

THE PORT AUTHORITY OF NY & NJ

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Notification of MBE/WBE On-Line Directory & Forms

Schedule A

Schedule B

Schedule C

Schedule D

Analysis of Bid

INFORMATION FOR BIDDERS

1. FORM AND SUBMISSION OF PROPOSALS

*Thursday, July 18, 2013 (A#10)

The Port Authority of New York and New Jersey, hereinafter called "the Authority", invites Proposals in the annexed form. Proposals will be received until 2:30 P.M. on ~~Thursday, June 13, 2013~~ in the office of the Director of Procurement, Attn: Bid Custodian, Two Montgomery Street, 3rd Floor, Jersey City, NJ 07302 at which time they will be opened and publicly read in the Bid Room. Each Proposal must be contained in the envelope furnished by the Authority, which shall be sealed and conspicuously endorsed with the bidder's name and the number of this Contract in the space provided. This Contract booklet shall not be unstapled or taken apart.

The Proposal must be submitted upon the blank form bound herewith and must give all information required. [1] The Proposal must be signed and the acknowledgment taken on the appropriate form following the Proposal.

No effort is made to emphasize any particular provision of the Contract, but bidders must familiarize themselves with every provision and its effect.

2. PAPERS ACCOMPANYING PROPOSALS

Each Proposal must be accompanied by the following papers, which, unless otherwise indicated, should be enclosed with the Proposal:

A. If the bidder be a corporation, a statement of the names and residences of its officers, which should be included on the page following the Proposal. Attached.

If the bidder be a partnership, a statement of the names and residences of its members, indicating which are general and which are special partners, which should be included on the page following the Proposal.

If the bidder be an individual, a statement of his residence, which should be included on the page following the Proposal.

B. Either the Bid Bond bound herewith, duly executed by the bidder as principal and by one or more surety companies duly authorized to carry on the business of suretyship in the state(s) in which the construction site is located, whose names appear on the current list of the Treasury Department of the United States as acceptable as sureties upon federal contracts; or, in lieu of a Bid Bond; Attached.

A certified check, payable to the order of The Port Authority of New York and New Jersey, in the same amount appearing in the Bid Bond form, which check shall be placed in an envelope marked "Bid Security" and enclosed with the Proposal.

C.

07-18-13P03:35 RCVD

[1] While two or more copies of this booklet may be furnished to each prospective bidder, only one should be submitted. The extra copies are for the bidders use.

1.) Certified financial statements, including applicable notes, reflecting the bidder's assets, liabilities, net worth, revenues, expenses, profit or loss and cash flow for the most recent calendar year or the bidder's most recent fiscal year. Attached.

2.) Where such certified financial statements are not available, then either reviewed or compiled statements from an independent accountant setting forth the information described in Paragraph 1, above.

3.) Where neither certified financial statements nor financial statements from an independent accountant are available, then financial statements containing the information described in Paragraph 1, above, prepared directly by the bidder. However, such financial statements must be accompanied by a signed copy of the bidder's most recent Federal income tax return and a statement in writing, signed by a duly authorized representative of the bidder, that such statements accurately reflect the current financial condition of the bidder.

Where statements submitted pursuant to either Paragraph 1 or 2, above, show the position of the bidder as of a date more than forty-five (45) days prior to the date on which Proposals are opened, the bidder shall also submit a statement in writing signed by a duly authorized representative of the bidder, that the present financial condition of the bidder is at least as good as that shown on the statements submitted. Attached.

4.) A statement of work which the bidder has on hand, including any work on which a bid has been submitted, containing a description of the work, the dollar value, the location by city and state, the current percentage of completion and the expected date for completion. Attached.

5.) Fill in below the name and address of the bidder's chief banking representative handling the bidder's account.

Banking Institution:	Bank of America
Address:	300 Broadhollow Road
	Melville, NY 11747
Bank Representative:	Mary Ellen Connors, Senior Vice President
Telephone Number:	631-547-7453

6.) Fill in below the bidder's Federal Employer Identification Number (i.e., the number assigned to firms by the Federal Government for tax purposes); the bidder's Dun and Bradstreet number, if any; the name of any other credit service to which the bidder has furnished information and the number, if any, assigned by such service to the bidder's account.

Exemption (1/4)

Federal Employer Identification No.
00-699-5682

Dun and Bradstreet No.
-

-	-
Other Credit Service	Account No.

D. The Form of Contract bound herewith, with the bidder's Lump Sum inserted in the clause thereof entitled "General Agreement". The amount must be given both in figures and in writing and, in case of discrepancy, the writing shall control. One copy of each addendum, if any, issued during the bidding period shall be initialled and attached to the Proposal, but any Proposal submitted without such addendum initialled and attached will nevertheless be construed as though such addendum had been initialled and attached. Attached.

E. The bidder's analysis of bid filled in on the form furnished herewith. The Contractor will be required to furnish a more detailed analysis of bid at a later date in accordance with the requirements of the Section of Division 1 of the Specifications referring to the Analysis of Bid. Attached.

07-18-13P03:35 RCVD

3. QUALIFICATION INFORMATION

At any time after the opening of Proposals, the Chief Engineer may give oral or written notice to one or more bidders to attend a pre-award meeting and to furnish the Authority with information relating to his qualifications to perform the Work, including the following, which information shall be furnished within seven (7) days thereafter:

A. The bidders MBE/WBE Participation Plan submitted on the form annexed hereto as Schedule C (see the clause hereof entitled "Minority and Women's Business Enterprises Program") and a detailed list of the plant and equipment which the bidder proposes to use, indicating which portions it already possesses.

B. Detailed information relating to work which the bidder has completed for others, including personal and corporate references, sufficient to the Authority to determine the Contractor's responsibility, experience and capacity to perform the Work. If required by the Chief Engineer, the foregoing information shall include information to demonstrate to the satisfaction of the Chief Engineer that the Contractor has within the past five years been a contractor on at least one contract of the same general type, extent and complexity as the Contract on which the Proposal has been submitted, and completed the work skillfully, in a satisfactory manner and on time.

C. Information to supplement a) data shown in the financial statements and the statement of work on hand required to be submitted with the Proposal; and b) any statement submitted under the clauses hereof entitled "Certification of No Investigation (Criminal or Civil Anti-Trust), Indictment, Conviction, Suspension, Debarment, Disqualification, Prequalification Denial or Termination, etc, Disclosure of Other Required Information", "Certification of Participation in a State-Registered Apprenticeship Program" or "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee".

D. Moreover, in the event that the bidder's performance on a past Port Authority or PATH contract or contracts has been rated less than satisfactory, the Chief Engineer may give oral or written notice to the bidder to furnish information demonstrating to the satisfaction of the Chief Engineer that, notwithstanding such rating, such performance was, in fact, satisfactory, or that the circumstances which gave rise to such unsatisfactory rating have changed or will not apply to performance of the Contract, and that such performance will be satisfactory.

E. If the bidder has performed a contract for the States of New York or New Jersey, or any governmental entity within such States and has filed a questionnaire or other document required to be submitted in order for the bidder to qualify to perform the contract, the bidder may be requested by the Chief Engineer to submit the most recent completed questionnaire or other such document, or if the most recent completed questionnaire or other such document is not available, to submit a written statement indicating the approximate date of the contract and the name of the governmental entity which awarded them the contract.

F. Any additional information relevant to the bidder's Proposal including information to supplement the bidder's initial analysis of bid.

In the event that any of the foregoing is requested and is not furnished within seven days thereafter or within such additional time as the Chief Engineer, in his sole discretion, may allow, the Authority may not be in a position to determine whether the bidder is qualified, whether the bidder understands the requirements of the contract or whether the bid is responsive and may, in its sole discretion, reject the bidder's Proposal.

The giving of such notice to the bidder in connection with any of the foregoing lists, statement or information shall not be construed as an acceptance of his Proposal. However, the Authority reserves the right in its sole and absolute discretion, to accept the Proposal of a bidder despite the fact that said bidder has not submitted any information, list or statement required pursuant to this Section within the above-stated time period.

4. ACCEPTANCE OR REJECTION OF PROPOSAL

Within ninety (90) days after the opening of the Proposals, the Authority will accept one of the Proposals, if it accepts any. The acceptance of a Proposal will be only by mailing to or delivering at the office designated in the Proposal a notice in writing specifically indicating acceptance signed by an authorized representative on behalf of the Authority who is at present the Authority's Director of Procurement. No other act of the Authority, its Commissioners, officers, agents, or employees shall constitute acceptance of a Proposal. Such notice will state whether or not the Authority elects to require the bidder to furnish a Performance and Payment Bond. Rejection of a Proposal will be only by either (a) a notice in writing specifically stating that the Proposal is rejected, signed by an authorized representative on behalf of the Authority who is at present the Authority's Director of Procurement and mailed to or delivered at the office designated in the Proposal or (b) omission of the Authority to accept a Proposal within ninety (90) days after the opening of Proposals; and no other act of the Authority, its Commissioners, officers, agents or employees shall constitute rejection of a Proposal, including any counter offer or other act of the Authority, its Commissioners, officers, agents or employees.

The Authority reserves the unqualified right, in its sole and absolute discretion, to reject all Proposals or to accept that Proposal if any, which in its judgment will under all the circumstances best serve the public interest and to waive defects in any Proposal.

In the event that a successful bidder defaults upon the Contract by failing to furnish a satisfactory Performance and Payment Bond, if required, and the Authority terminates the Contract, the Authority reserves the option to accept the Proposal of any other bidder within ninety (90) days after the opening of Proposals, in which case such acceptance shall have the same effect as to such other bidder as though he were the originally successful bidder.

5. RETURN OF CERTIFIED CHECKS

Within ten (10) days after the opening of the Proposals the Authority will return all certified checks deposited by bidders, except those deposited by three bidders to be selected by the Authority, which will be returned within three days after one Proposal is accepted by the Authority; or if a Performance and Payment Bond is required, within three days after a satisfactory Performance and Payment Bond is furnished to the Authority; or if all Proposals are rejected, not later than three days after such rejection. The return of a bidder's check shall not, however, be deemed to be a rejection of his Proposal.

6. WEBSITE POSTINGS OF CONTRACT DOCUMENTS

Recipients of Contract documents marked Confidential (Privileged) may not post them or any of them to a website except in accordance with the Authority's prior written approval, which may require a written non-disclosure agreement.

Recipients of Contract documents not marked Confidential (Privileged) may not post them or any of them to a website unless the website (1) is non-public, (2) is password protected and (3) is accessible only to the recipient's prospective subcontractors and suppliers. Recipient's prospective subcontractors and suppliers shall also be deemed recipients and shall be required to conform to the terms of this numbered clause. Recipients shall be deemed to include both bidders and those who do not submit bids.

No later than 180 days after the date of receipt of Proposals, all recipients shall remove all Contract Documents from their websites.

7. DISPOSAL OF CONTRACT DOCUMENTS

All recipients of Contract documents, including bidders and those who do not bid and their prospective subcontractors and suppliers who may receive all or a part of the Contract documents or copies thereof, shall make every effort to ensure the secure and appropriate disposal of the Contract documents to prevent further disclosure of the information contained in the documents. Secure and appropriate disposal includes methods of document destruction such as shredding or arrangements with refuse handlers that ensure that third persons will not have access to the documents' contents either before, during, or after disposal. Documents may also be returned for disposal purposes to the Contract Desk on the 3rd Floor, 3 Gateway Center, Newark, NJ 07102 or the office of the Director of Procurement, Two Montgomery Street, 3rd Floor, Jersey City, NJ 07302.

8. AVAILABLE DOCUMENTS

Certain documents, specified below, are available for reference and examination by bidders by contacting Gary Greer at (973) 792-3934, 3 Gateway Center, 3rd Floor, Newark, NJ 07102 during regular business hours. These documents were not prepared for the purpose of providing information for bidders upon the present Contract but they were prepared for other purposes, such as for other contracts or for design purposes for this or other contracts, and they do not form a part of this Contract. The Authority makes no representation or guarantee as to, and shall not be responsible for their accuracy, completeness or pertinence, and, in addition, shall not be responsible for the conclusions to be drawn therefrom. They are made available to the bidders merely for the purpose of providing them with such information as is in the possession of the Authority, whether or not such information may be accurate, complete or pertinent or of any value to the bidders. Questions concerning the content of the documents shall be submitted in accordance with the clause entitled "Questions By Bidders".

Said documents are as follows:

*A. PA Engineering Department Civil Design Guidelines.

*B. PA Engineering Departm Civil Standard Details.

*C. Geotechnical Subsurface Investigation Stage I Report East Garage Building and related appendices.

*D. PANYNJ Airport Roadway Sign Design Manual

* NOTE: For the Bidder's convenience, these documents will be transmitted with the Contract Drawings.

9. INSPECTION OF SITE

Each bidder or his authorized representative must make proper arrangements with the Resident Engineer at the construction site before inspecting the construction site. To make such arrangements call Armando Martinez, at (718) 533-3535.

10. MINORITY AND WOMEN'S BUSINESS ENTERPRISES PROGRAM (MBE/WBE)

The Authority has a long-standing practice of making its contract opportunities available to as many firms as possible and has taken affirmative steps to encourage Minority Business Enterprises (MBEs) and Women's Business Enterprises (WBEs) to seek business opportunities with it.

"Minority-owned business" or "MBE" means a business entity which is at least 51 percent owned by one or more members of one or more minority groups, or, in the case of a publicly held corporation, at least 51 percent of the stock of which is owned by one or more members of one or more minority groups, and whose management and daily business operations are controlled by one or more such individuals who are citizens or permanent resident aliens.

"Women-owned business" or "WBE" means a business which is at least 51 percent owned by one or more women, or, in the case of a publicly held corporation, 51 percent of the stock of which is owned by one or more women, and whose management and daily business operations are controlled by one or more women who are citizens or permanent resident aliens.

"Minority group" means any of the following racial or ethnic groups:

A. Black persons having origins in any of the black African racial groups not of Hispanic origin;

B. Hispanic persons of Puerto Rican, Mexican, Dominican, Cuban, Central, or South American culture or origin, regardless of race;

C. Asian and Pacific Islander persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent or the Pacific Islands;

D. Native American or Alaskan native persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification.

To ensure meaningful participation of MBEs and WBEs on this Contract, the Authority has set a combined goal of 19 percent for firms owned and controlled by minorities and firms owned and controlled by women.

In the event that any portion of the Work is subcontracted in accordance with the clause of the Form of Contract entitled "Assignments and Subcontracts", every good faith effort to meet the above goals for MBE and WBE participation in the Work shall be made and documented. Such good faith efforts shall include at least the following:

A. Attendance at pre-bid meetings, if any, scheduled by the Authority;

B. Utilization of the Authority's Directory of certified MBE/WBEs available on-line (see Notification of M/WBE On-line Directory and Forms in back of Contract booklet) and/or proposing for certification other MBE/WBEs which appear to meet the Authority's criteria for MBE/WBE certification and which are technically competent to perform the Work which the bidder plans to subcontract;

C. Active and affirmative solicitation of bids for subcontracts from MBE/WBEs;

D. Advertisement in general circulation media, trade association publications and minority-focused media for a reasonable period before bids or proposals are due;

E. Dividing the work to be subcontracted into smaller portions or encouraging the formation of joint ventures, partnerships or similar arrangements among subcontractorsin order to increase the likelihood of achieving the MBE/WBE goals;

F. Providing a sufficient supply of drawings and specifications of prospective work to MBE/WBEs and providing appropriate materials to each in sufficient time to review; and

G. Utilizing the services of available minority and women's community organizations; contractors' groups; local, State and Federal business assistance/development offices and other organizations that provide assistance to MBE/WBEs.

Subsequent to acceptance by the Authority of the Contractor's Proposal, the Contractor shall use and document every good faith effort to comply with his MBE/WBE Participation Plan and to permit his MBE/WBE subcontractors to perform. Participation percentages shall be monitored throughout the performance of this Contract. Such good faith efforts shall include at least the following:

H. Ensuring that progress payments are made in a timely fashion in accordance with the requirements of this Contract;

I. Not requiring bonds from and/or providing bonds and insurance for subcontractors where appropriate;

J. Soliciting specific recommendations on methods for enhancing MBE/WBE participation from Authority staff responsible for such participation; and

K. Nominating subcontractors for participation in business assistance programs sponsored by the Authority or the Regional Alliance of Small Contractors such as the Loaned Executive Assistance Program (L.E.A.P.).

Subsequent to acceptance by the Authority of the Contractor's Proposal, the Contractor shall also provide the Engineer, at his request, with a trade breakdown schedule showing when the Contractor's MBE/WBE subcontractors are scheduled to perform. The Contractor shall also submit to the Engineer, on a monthly basis, the Statement of Subcontractor's Payments annexed hereto as Schedule D.

In the event that, prior to acceptance by the Authority of the Contractor's Proposal and following review of the MBE/WBE Participation Plan submitted by the bidder pursuant to the clause hereof entitled "Qualification Information", the Chief Engineer determines that the bidder has not made a good faith effort to meet the MBE/WBE participation goals set forth above and that the bidder has not demonstrated that a full or partial waiver of such goals is appropriate, the Chief Engineer may advise the bidder that it is not responsible and may reject the bidder's Proposal.

If, during the performance of the Contract, the Contractor fails to demonstrate good faith in carrying out his MBE/WBE Participation Plan and in permitting his MBE/WBE subcontractors to perform and the Contractor has not demonstrated that a full or partial waiver of the above referenced MBE/WBE participation goals is appropriate, then, upon receipt of a future proposal or proposals from the Contractor, the Chief Engineer may advise the Contractor that he is not a responsible bidder and may reject such proposal(s).

Either prior or subsequent to acceptance of the bidder's Proposal, the bidder may request a full or partial waiver of the above described MBE/WBE participation goals by providing a reasonable demonstration to the Chief Engineer that his good faith efforts will not result in compliance with the goals set forth above because participation by eligible MBE/WBEs could not be obtained at a reasonable price or that such MBE/WBEs were not available or refused to perform as subcontractors. The bidder shall provide such documentation to support his request as the Chief Engineer may require.

Once approved, the MBE/WBE Participation Plan submitted by the bidder may be modified only with the written approval of the Engineer.

Following approval by the Engineer under the clause entitled "Assignments and Subcontracts" of one or more subcontractors who are either MBEs or WBEs and listed in the MBE/WBE Directory or determined to be "eligible" by the Chief Engineer in accordance with this numbered clause, the Authority may, at its sole option, provide to said approved M/WBEs, without charge, whatever appropriate consultant services may be available under the L.E.A.P. Program; provided, however, that such consultant services will only be furnished pursuant to a request in writing from the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, 233 Park Avenue South - 4th Floor, New York, NY 10003.

Such services will be discontinued following a written request from the Contractor to the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, to discontinue them.

The L.E.A.P. services include advising on scheduling, purchasing, planning and other aspects of construction to firms to mitigate business or management problems which could negatively impact on their performance. These services do not include engineering or legal advice. The determination as to whether or not to follow the advice given lies solely with the M/WBE subcontractor. Prior to being accepted as a participant in the L.E.A.P. Program, the M/WBE subcontractor will be required to release the Authority and the individuals furnishing consultant advice of all liability and responsibility in connection therewith.

The Authority has compiled and made available on-line an MBE/WBE Directory which specifies the firms the Authority has determined to be (1) MBEs/WBEs and (2) experienced in performing work in the trades and contract dollar ranges indicated in the Directory. The Authority makes no representation as to the financial responsibility of such firms or their ability to perform Work required under this Contract. Subject to the following paragraph, only MBEs/WBEs listed in the Directory will count toward the required MBE/WBE participation.

If the Contractor wishes to perform a portion of the Work through a firm not listed in the Directory [2] but which the Contractor believes should be eligible because it is (1) an MBE/WBE, as defined above and (2) technically competent to perform portions of the Work or the Contractor believes it is such a firm, the Contractor shall submit to the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, a written request for a determination that the proposed firm is eligible. This shall be done by completing and forwarding a) the form labeled "Schedule A" and, if appropriate, "Schedule B" which are annexed hereto and form a part hereof and b) technical references of jobs completed of similar scope and complexity on the form annexed hereto and made a part hereof labeled "MBE/WBE Approval Request" and such other information as may be necessary to permit the Authority to determine whether the firm is in fact an MBE/WBE and technically competent to perform portions of the Work.

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2 The following organizations may be able to refer the Contractor to MBEs/WBEs who are technically competent to perform portions of the Work. Any referrals which are not listed in the Directory shall be submitted to the Authority for a determination as to eligibility as provided above.

1. Queens Air Services Development Office
JFK International Airport
Building #141
Federal Circle, First Floor
Jamaica, NY 11430
(718) 244-6852
Fax (718) 244-7371
www.asdoonline.com

2. Chinatown Manpower Project, Inc.
70 Mulberry Street
New York, NY 10031
(212) 571-1690
www.cmpny.org

3. Association of Minority Enterprises of NY, Inc.
135-20 Liberty Avenue
Richmond Hill, NY 11419
(718) 291-1641
Fax (718) 291-1641
www.ameny.org

4. Statewide Hispanic Chamber of Commerce of New Jersey
150 Warren Street, Suite 110
Jersey City, NJ 07302
(201) 451-9512
Fax (201) 451-9547
www.shccnj.org

5. Greater Newark Business Development Consortium
744 Broad Street, 26th Floor
Newark, NJ 07102
(973) 242-5563
www.gnbdc.org

6. Jamaica Business Resource Center
90-33 160th Street
Jamaica, NY 11432
(718) 206-2255
Fax (718) 206-3693
www.jbrc.org

7. Council for Airport Opportunity
Newark Liberty International Airport
Building 80
Newark, NJ 07014
(973) 961-4382
www.caonj.com

8. National Hispanic Business Group
1230 Avenue of the Americas,
7th Floor
New York, NY 10020
(212) 265-2664
www.nhbg.org

9. Greater Jamaica Development Corp.
90-04 161st Street
Jamaica, NY 11432
(718) 291-0282
Fax (718) 291-7918
www.gjdc.org

10. NYS Assn. Of Minority Contractors
Brooklyn Navy Yard
Building 280, 4th Floor, Suite 414
Brooklyn, NY 11205
(212) 246-8380
Fax (718) 246-8376
www.nysamc.org

11. Professional Women in Construction
315 E. 56th Street, Suite 202
New York, NY 10022
(212) 486-7745
Fax (212) 486-0228
www.pwcusa.org

12. NY/NJ Minority Purchasing Council
330 Seventh Avenue, 8th Floor
New York, NY 10001
(212) 502-5663
www.nynjmsdc.org

13. National Minority Business Council
120 Broadway, 19th Floor
New York, NY 10271
(212) 693-5050
www.nmbc.org

14. Queens Overall Economic Development Office
120-55 Queens Boulevard, Suite 309 Kew Gardens, NY 11424
(718) 263-0546
Fax (718) 263-0594
www.queensny.org

15. York College Small Business Development Center
94-50 159th Street
York College,
Room S 107
Jamaica, NY 11451
(718) 262-2880
Fax (718) 262-2881
www.nyssbdc.org

16. Small Business Development Center - Rutgers University, University Heights
43 Bleeker Street
Newark, NJ 07102
(973) 353-1927
Fax (973) 353-1110
www.msbdc.newark.rutgers.edu

17. New Jersey Association of Women Business Owners (NJAWBO)
186 Princeton Hightstown Road
West Windsor, NJ 08550
(609) 799-5101
www.njawbo.org

18. New Jersey Air Services Development Office
Newark Liberty International Airport
Building #80 - Second Floor
Newark, NJ 07114
(973) 961-4278
Fax (973) 961-4282
www.asdonline.com

19. Caribbean-American Chamber of Commerce
Brooklyn Navy Yard
63 Flushing Avenue
Brooklyn, NY 11205
(718) 834-4544
Fax (718) 834-9774
www.caribbeantradecenter.com

20. Northeast Region – Small Business Resource Transportation Center
29-10 Thomson Avenue
Long Island City, NY 11101
(718) 482-5941
www.osdbu.dot.gov/regional/northeast.cfm

21. Asian Women in Business
42 Broadway, Suite 1748
New York, NY 10004
(212) 868-1368
Fax (212) 868-1373
www.awib.org

22. Asian American Business Development Center
80 Wall Street, Suite 418
New York, NY 10005
(212) 966-0100
Fax (212) 966-2786
www.aabdc.com

23. New York State Federation of Hispanic Chambers of Commerce
2710 Broadway
New York, NY 10025
(212) 222-8300
Fax (212) 222-8412
www.nysfhcc.com

24. Orange County Chamber of Commerce
30 Scott Corners Drive
Montgomery, NY 12549
(845) 457-9700 Ext. 1101
www.orangeny.com

25. Regional Alliance For Small Contractors
625 Eighth Avenue, 2nd Floor,
North Wing
New York, NY 10018
(212) 268-2991
www.regional-alliance.org

26 Women Builders Council
500 Hampton Avenue
Brooklyn, NY 11235
(212) 367-2130
www.wbcnyc.org

All such requests shall be in writing addressed to the Chief Engineer. If any such firm is determined to be eligible it shall only be by a writing over the name of the Chief Engineer. In the event that such firm is found not to be eligible, the Chief Engineer will only consider as a substitute for such firm, a firm listed in the Authority's MBE/WBE Directory available on-line.

The Contractor shall submit the names of proposed MBEs/WBEs for work on this Contract if their names do not appear in the Authority's MBE/WBE Directory available on-line in accordance with the requirements of this clause and all other requirements of this Contract. MBEs/WBEs proposed as lessors of equipment or materialmen shall be deemed "subcontractors" for the purpose of this numbered clause and the clause hereof entitled "Assignments and Subcontracts" but shall not be deemed subcontractors for any other purpose. However only 60% of the amounts paid by the Contractor to such materialmen who are MBEs/WBEs, except in the case of firms who themselves manufacture materials for use under the Contract, shall be allowed in computing the percentages of the Contract Price required to be paid to MBEs/WBEs hereunder.

The Contractor shall ensure that all approved MBE/WBE subcontractors maintain a regular on site presence at the construction site for the portions of the Work they are subcontracted to perform and that they exercise financial and operation management and control of such portions of the Work.

Nothing herein shall be deemed to supersede or to otherwise modify the clause of the Form of Contract entitled "Assignments and Subcontracts".

11. QUESTIONS BY BIDDERS

Questions by prospective bidders concerning the Contract may be addressed to Jessamma Vatakencherry, at (201) 395-3453 or email at jvataken@panynj.gov, who however is authorized only to direct the attention of prospective bidders to various portions of the Contract so that they may read and interpret such portions for themselves. Neither Jessamma Vatakencherry nor any other employee or representative of the Authority is authorized to give interpretations of any portion of the Contract or to give information as to the requirements of the Contract in addition to that contained in the Contract. Interpretations of the Contract or additional information as to its requirements, where necessary, shall be communicated to bidders only by written addendum issued over the name of the Chief Engineer, which addendum shall be considered part of this Contract. Accordingly, nothing contained herein and no representation, statement or promise, oral or in writing, of the Authority, its Commissioners, officers, agents, representatives or employees shall impair or limit the effect of the warranties of the Contractor contained in the clause of the Form of Contract entitled "Contractor's Warranties" or elsewhere in this Contract. The provisions of this clause shall apply to questions addressed by prospective bidders both before and after their receipt of Contract Documents.

12. PREVAILING RATE OF WAGE CERTIFICATION

The bidders' attention is directed specifically to the clause of the Form of Contract entitled "Prevailing Rate of Wage" and to the fact that the Authority requires a certification in writing from the successful bidder, in such form as may be required pursuant to such clause, that he has paid and caused his subcontractors to pay at least the prevailing rate of wage and supplements required by such clause. This certification is required prior to his receipt of any payment from the Authority hereunder as provided in the clauses of the Form of Contract entitled "Monthly Advances" and "Final Payment" or at any other time.

13. CERTIFICATION OF NO INVESTIGATION (CRIMINAL OR CIVIL ANTI-TRUST), INDICTMENT, CONVICTION, SUSPENSION, DEBARMENT, DISQUALIFICATION, PREQUALIFICATION DENIAL OR TERMINATION, ETC; DISCLOSURE OF OTHER REQUIRED INFORMATION Attached.

By bidding on this Contract, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, that the bidder and each parent and/or affiliate of the bidder has not (a) been indicted or convicted in any jurisdiction; (b) been suspended, debarred, found not responsible or otherwise disqualified from entering into contracts with any governmental agency or been denied a government contract for failure to meet prequalification standards; (c) had a contract terminated by any governmental agency for breach of contract or for any cause related directly or indirectly to an indictment or conviction; (d) changed its name and/or Employer Identification Number (taxpayer identification number) following its having been indicted, convicted, suspended, debarred or otherwise disqualified, or had a contract terminated as more fully provided in (a), (b) and (c) above; (e) ever used a name, trade name or abbreviated name, or an Employer Identification Number different from those inserted in the Proposal; (f) been denied a contract by any governmental agency for failure to provide the required security, including bid, payment or performance bonds or any alternative security deemed acceptable by the agency letting the contract; (g) failed to file any required tax returns or failed to pay any applicable federal, state or local taxes; (h) had a lien imposed upon its property based on taxes owed and fines and penalties assessed by any agency of the federal, state or local government; (i) been, and is not currently, the subject of a criminal investigation by any federal, state or local prosecuting or investigative agency and/or a civil anti-trust investigation by any federal, state or local prosecuting or investigative agency, including an inspector general of a governmental agency or public authority; (j) had any sanctions imposed as a result of a judicial or administrative proceeding with respect to any professional license held or with respect to any violation of a federal, state or local environmental law, rule or regulation; and (k) shared space, staff, or equipment with any business entity.

The foregoing certification as to "(a)" through "(k)" shall be deemed to have been made by the bidder as follows: if the bidder is a corporation, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each director and officer, as well as, to the best of the certifier's knowledge and belief, each stockholder with an ownership interest in excess of 10%; if the bidder is a partnership, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each partner. Moreover, the foregoing certification, if made by a corporate bidder, shall be deemed to have been authorized by the Board of Directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the signed bid a signed statement which sets forth in detail the reasons therefor. If the bidder is uncertain as to whether it can make the foregoing certification, it shall so indicate in a signed statement furnished with its bid, setting forth an explanation for its uncertainty.

Notwithstanding that the certification may be an accurate representation of the bidder's status with respect to the enumerated circumstances provided for in this clause as requiring disclosure at the time that the bid is submitted, the bidder agrees to immediately notify the Authority in writing of any change in circumstances during the period of irrevocability, or any extension thereof.

The foregoing certification or signed statement shall be deemed to have been made by the bidder with full knowledge that it would become a part of the records of the Authority and that the Authority will rely on its truth and accuracy in awarding this Contract. In the event that the Authority determines at any time prior or subsequent to the award of the Contract that the bidder has falsely certified as to any material item in the foregoing certification; willfully or fraudulently submitted any signed statement pursuant to this clause which is false in any material respect; or has not completely and accurately represented its status with respect to the circumstances provided for in this clause as requiring disclosure, the Authority may determine that the bidder is not a responsible bidder with respect to its bid on this Contract or with respect to future bids and may, in addition to exercising any other rights or remedies available to it, exercise any of the rights or remedies set forth in the clause of the Form of Contract entitled "Rights and Remedies of Authority". In addition, bidders are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see e.g., New York Penal Law, Section 175.30 et seq.). Bidders are also advised that the inability to make such certification will not in and of itself disqualify a bidder, and that in each instance the Authority will evaluate the reasons therefor provided by the bidder.

Under certain circumstances the bidder may be required as a condition of this Contract award to enter into a Monitoring Agreement under which it will be required to take certain specified actions, including compensating an independent Monitor to be selected by the Port Authority. Said Monitor shall be charged with, among other things, auditing the actions of the bidder to determine whether its business practices and relationships indicate a level of integrity sufficient to permit it to continue business with the Port Authority.

As used in this clause, the following terms shall mean:

Affiliate - An entity in which the parent of the bidder owns more than fifty percent of the voting stock, or an entity in which a group of principal owners which owns more than fifty percent of the bidder also owns more than fifty percent of the voting stock.

Agency or Governmental Agency - Any federal, state, city or other local agency, including departments, offices, quasi-public agencies, public authorities and corporations, boards of education and higher education, public development corporations, local development corporations and others.

Employer Identification Number - The tax identification number assigned to firms by the Federal government for tax purposes.

Investigation - Any inquiries made by any federal, state or local criminal prosecuting or investigative agency, including an inspector general of a governmental agency or public authority, and any inquiries concerning civil anti-trust investigations made by any federal, state or local governmental agency. Except for inquiries concerning civil anti-trust investigations, the term does not include inquiries made by any civil government agency concerning compliance with any regulation, the nature of which does not carry criminal penalties, nor does it include any background investigations for employment, or Federal, state, and local inquiries into tax returns.

Officer - Any individual who serves as chief executive officer, chief financial officer, or chief operating officer of the bidder by whatever titles known.

Parent - An individual, partnership, joint venture or corporation which owns more than 50% of the voting stock of the bidder.

Space Sharing - Space shall be considered to be shared when any part of the floor space utilized by the submitting business at any of its sites is also utilized on a regular or intermittent basis for any purpose by any other business or not-for-profit organization, and where there is no lease or sublease in effect between the submitting business and any other business or not-for-profit organization that is sharing space with the submitting business.

Staff Sharing - Staff shall be considered to be shared when any individual provides the services of an employee, whether paid or unpaid, to the bidder and also, on either a regular or irregular basis, provides the services of an employee, paid or unpaid, to one or more other business(es) and/or not-for-profit organization(s), if such services are provided during any part of the same hours the individual is providing services to the bidder or if such services are provided on an alternating or interchangeable basis between the bidder and the other business(es) or not-for-profit organization(s). "The services of an employee" should be understood to include services of any type or level, including managerial or supervisory. This type of sharing may include, but is not limited to, individuals who provide the following services: telephone answering, receptionist, delivery, custodial, and driving.

Equipment Sharing - Equipment shall be considered to be shared whenever the bidder shares the ownership and/or the use of any equipment with any other business or not-for-profit organization. Such equipment may include, but is not limited to, telephones or telephone systems, photocopiers, computers, motor vehicles, and construction equipment. Equipment shall not be considered to be shared under the following two circumstances: when, although the equipment is owned by another business or not-for-profit organization, the bidder has entered into a formal lease for the use of the equipment and exercises exclusive use of the equipment; or when the bidder owns equipment that it has formally leased to another business or not-for-profit organization, and for the duration of such lease the bidder has relinquished all right to the use of such leased equipment.

14. NON-COLLUSIVE BIDDING AND CODE OF ETHICS CERTIFICATION; CERTIFICATION OF NO SOLICITATION BASED ON COMMISSION, PERCENTAGE, BROKERAGE, CONTINGENT FEE OR OTHER FEE

By bidding on this Contract, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, that: (a) the prices in its bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor; (b) the prices quoted in its bid have not been and will not be knowingly disclosed, directly or indirectly, by the bidder prior to the official opening of such bid to any other bidder or to any competitor; (c) no attempt has been made and none will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition; (d) this organization has not made any offers or agreements, or given or agreed to give anything of value (see definition of "anything of value" appearing in the clause of the Form of Contract entitled "No Gifts, Gratuities, Offers of Employment, etc.") or taken any other action with respect to any Authority employee or former employee or immediate family member of either which would constitute a breach of ethical standards under the Code of Ethics and Financial Disclosure dated as of April 11, 1996 (a copy of which is available upon request to the individual named in the clause hereof entitled "Questions by Bidders"), nor does this organization have any knowledge of any act on the part of an Authority employee or former Authority employee relating either directly or indirectly to this organization which constitutes a breach of the ethical standards set forth in said Code; (e) no person or selling agency, other than a bona fide employee or bona fide established commercial or selling agency maintained by the bidder for the purpose of securing business, has been employed or retained by the bidder to solicit or secure this Contract on the understanding that a commission, percentage, brokerage, contingent or other fee would be paid to such person or selling agency; (f) the bidder has not offered, promised or given, demanded or accepted, any undue advantage, directly or indirectly, to or from a public official or employee, political candidate, party or party official, or any private sector employee (including a person who directs or works for a private sector enterprise in any capacity), in order to obtain, retain, or direct business or to secure any other improper advantage in connection with this Contract.

The foregoing certification as to "(a)", "(b)", "(c)", "(d)", "(e)" and "(f)" shall be deemed to have been made by the bidder as follows: if the bidder is a corporation, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each parent, affiliate, director and officer of the bidder, as well as, to the best of the certifier's knowledge and belief, each stockholder of the bidder with an ownership interest in excess of 10%; if the bidder is a partnership, such certification shall be deemed to have been made not only with respect to the bidder itself, but also with respect to each partner. Moreover, the foregoing certification, if made by a corporate bidder, shall be deemed to have been authorized by the Board of Directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the signed bid a signed statement which sets forth in detail the reasons therefor. If the bidder is uncertain as to whether it can make the foregoing certification, it shall so indicate in a signed statement furnished with its bid, setting forth in such statement the reasons for its uncertainty. As a result of such disclosure, the Port Authority shall take appropriate action up to and including a finding of non-responsibility.

Failure to make the required disclosures shall lead to administrative actions up to and including a finding of non-responsibility.

Notwithstanding that the bidder may be able to make the foregoing certification at the time the bid is submitted, the bidder shall immediately notify the Authority in writing during the period of irrevocability of bids on this Contract or any extension of such period, of any change of circumstances which might under this clause make it unable to make the foregoing certification or required disclosure. The foregoing certification or signed statement shall be deemed to have been made by the bidder with full knowledge that it would become a part of the records of the Authority and that the Authority will rely on its truth and accuracy in awarding this Contract. In the event that the Authority should determine at any time prior or subsequent to the award of this Contract that the bidder has falsely certified as to any material item in the foregoing certification or has willfully or fraudulently furnished a signed statement which is false in any material respect, or has not fully and accurately represented any circumstance with respect to any item in the foregoing certification required to be disclosed, the Authority may determine that the bidder is not a responsible bidder with respect to its bid on this Contract or with respect to future bids on Authority contracts and may, in addition to exercising any other rights or remedies it may have, exercise any of the rights or remedies set forth in the clause of the Form of Contract entitled "Rights and Remedies of Authority".

In addition, bidders are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see e.g., New York Penal Law, Section 175.30 et seq.). Bidders are also advised that the inability to make such certification will not in and of itself disqualify a bidder, and that in each instance the Authority will evaluate the reasons therefor provided by the bidder.

Under certain circumstances the bidder may be required as a condition of this Contract award to enter into a Monitoring Agreement under which it will be required to take certain specified actions, including compensating an independent Monitor to be selected by the Port Authority. Said Monitor shall be charged with, among other things, auditing the actions of the bidder to determine whether its business practices and relationships indicate a level of integrity sufficient to permit it to continue business with the Port Authority.

15. BIDDER ELIGIBILITY FOR AWARD OF CONTRACTS - DETERMINATIONS BY AN AGENCY OF THE STATE OF NEW YORK OR NEW JERSEY CONCERNING ELIGIBILITY TO RECEIVE PUBLIC CONTRACTS

Bidders are advised that the Authority has adopted a policy to the effect that in awarding its contracts it will honor any determination by an agency of the State of New York or New Jersey that a bidder is not eligible to bid on or be awarded public contracts because the bidder has been determined to have engaged in illegal or dishonest conduct or to have violated prevailing rate of wage legislation.

The policy permits a bidder whose ineligibility has been so determined by an agency of the State of New York or New Jersey to submit a bid on a Port Authority contract and then to establish that it is eligible to be awarded the contract on which it has bid because (i) the state agency determination relied upon does not apply to the bidder, or (ii) the state agency determination relied upon was made without affording the bidder the notice and hearing to which the bidder was entitled by the requirements of due process of law, or (iii) the state agency determination was clearly erroneous or (iv) the state agency determination relied upon was not based on a finding of conduct demonstrating a lack of integrity or a violation of a prevailing rate of wage law.

The full text of the resolution adopting the policy may be found in the Minutes of the Authority's Board of Commissioners meeting of September 9, 1993.

16. THE EDWARD J. MALLOY CONSTRUCTION INITIATIVE FOR CONSTRUCTION SKILLS - APPRENTICESHIP PROGRAM

The Authority is a participant in the Edward J. Malloy Construction Initiative for Construction Skills (formerly known as Construction Skills 2000), a cooperative program among New York City schools, unions and public agencies. The Edward J. Malloy Construction Initiative for Construction Skills creates career opportunities in the construction industry for high school graduates by providing a systematic pathway into union-sponsored, skilled trade apprenticeship programs. The Authority encourages contractors and their subcontractors to maximize the use of apprentices under the applicable collective bargaining agreements or as contained in the applicable program approved by the New York State Department of Labor. The Contractor's plan for utilizing apprentices will be discussed at the pre-construction meeting.

Each subcontractor proposed for approval under the Contract whose total amount of subcontracts under this Contract is greater than $1 million and each bidder (except as set forth in the certification below) will be required to certify as to their participation in a New York State-registered apprenticeship program.

17. CERTIFICATION OF PARTICIPATION IN A STATE-REGISTERED APPRENTICESHIP PROGRAM

By bidding on this Contract, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, that the bidder participates in an apprenticeship program registered by the New York State Department of Labor. Participation in such an apprenticeship program shall mean that the bidder either (a) is a signatory to a collective bargaining agreement with a labor organization which sponsors an apprenticeship program registered with the New York State Department of Labor or (b) individually sponsors an apprenticeship program registered by the New York State Department of Labor and, in the case of both (a) and (b) above, such apprenticeship program shall be in the trade(s) in which Work is to be performed. This clause shall not apply to bidders who will perform all Work at the construction site through the use of subcontractors.

The foregoing certification, if made by a corporate bidder, shall be deemed to have been authorized by the Board of Directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the signed bid a signed statement which sets forth in detail the reasons therefor. If the bidder is uncertain as to whether it can make the foregoing certification, it shall so indicate in a signed statement furnished with its bid, setting forth an explanation for its uncertainty.

Notwithstanding that the certification may be an accurate representation of the bidder's status with respect to the enumerated circumstances provided for in this clause as requiring disclosure at the time that the bid is submitted, the bidder agrees to immediately notify the Authority in writing of any change in circumstances during the period of irrevocability, or any extension thereof.

The foregoing certification or signed statement shall be deemed to have been made by the bidder with full knowledge that it would become a part of the records of the Authority and that the Authority will rely on its truth and accuracy in awarding this Contract. In the event that the Authority determines at any time prior or subsequent to the award of the Contract that the bidder has falsely certified as to any material item in the foregoing certification; willfully or fraudulently submitted any signed statement pursuant to this clause which is false in any material respect; or has not completely and accurately represented its status with respect to the circumstances provided for in this clause as requiring disclosure, the Authority may determine that the bidder is not a responsible bidder with respect to its bid on this Contract or with respect to future bids and may, in addition to exercising any other rights or remedies available to it, exercise any of the rights or remedies set forth in the clause of the Form of Contract entitled "Rights and Remedies of Authority". In addition, bidders are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see, e.g., New York Penal Law, Section 175.30 et seq.).

18. NOT USED

PROPOSAL

To The Port Authority of New York and New Jersey:

The undersigned[3] Yonkers Contracting Company, Inc., a Corporation organized under the laws of the State of New York,

(hereinafter called "the Contractor") hereby offers to perform all the obligations and to assume all the duties and liabilities of the Contractor provided for in the annexed Contract, at the price inserted by the undersigned in the clause of the Form of Contract entitled "General Agreement".

This offer shall be irrevocable for ninety (90) days after the date on which The Port Authority of New York and New Jersey opens this Proposal.

To induce the acceptance of this Proposal, the undersigned hereby makes each and every certification, statement, assurance, representation and warranty made by the Contractor in said Contract. Moreover as a condition to receipt and consideration by the Authority of the Proposal whether or not it is accepted, the undersigned agrees that all information of any nature whatsoever, regardless of the form of the communication, received from the undersigned (including its officers, agents, or employees) by the Authority, its Commissioners, officers, agents or employees, and notwithstanding any statement therein to the contrary, has not been given in confidence and may be used or disclosed by or on behalf of the Authority without liability of any kind except as may arise under letters patent of the undersigned, if any.

---

3 Insert bidder's name at the top of the page. After the bidder's name, insert one of the following phrases:

If a corporation, give state of incorporation, using the phrase, "a corporation organized under the laws of the State of ."

If a partnership, give full names of partners, using also the phrase, "co-partners doing business under the firm name of ."

If an individual using a trade name, give individual name, using also the phrase, "an individual doing business under the trade name of ."

If a joint venture, give the information required above for each participant in the joint venture.

Unless expressly stated otherwise, the Information for Bidders, all papers required by it and submitted in connection herewith at any time, said Form of Contract, and all papers made part of the Contract by the terms of the Form of Contract are made part of this Proposal.

The undersigned hereby designates the following as the bidders office[4]:

969 Midland Avenue

Yonkers, NY 10704

The telephone number of the bidder is: 914-965-1500

The fax number of the bidder is: 914-378-8880

The E-Mail address of the bidder is: rmcgrath@yonkerscontractingco.com

[4] Insert office address.

SIGNATURE AND CERTIFICATE OF AUTHORITY[5]

Dated, July 18, 2013, 20 13

(Signature of individual or name of corporation or partnership)

Yonkers Contracting Company, Inc.

(Signature of agent, partner or corporate officer)

By[6 7] Richard D. McGrath

(Acknowledgment of signature to be taken on proper form on following page(s))

Richard D. McGrath
Vice President

CERTIFICATE OF AUTHORITY, IF BIDDER IS A CORPORATION

I, the undersigned, as Secretary of the corporation submitting the foregoing Proposal, hereby certify that under and pursuant to the by-laws and resolutions of said corporation, each officer who has signed said Proposal on behalf of the corporation is fully and completely authorized so to do.

(Corporate Seal)

Deborah A. Nargi

Deborah A. Nargi
Corporate Secretary
Yonkers Contracting Company, Inc.

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5 If bidder is a joint venture, insert signatures as appropriate for one participant of the joint venture on this page and attach and complete an additional signature sheet in the same form as appears on this page for each other participant as required.

6 If Proposal is signed by an officer or agent, give title.

7 NOTE: The foregoing signature shall be deemed to have been provided with full knowledge that the foregoing Proposal, the accompanying Contract booklet, as well as any certification, statement, assurance, representation, warranty, schedule or other document submitted by the bidder with the Proposal will become a part of the records of the Authority and that the Authority will rely in awarding the Contract on the truth and accuracy of such Proposal and each such certification, statement, assurance, representation, warranty and schedule made therein by the Contractor. Knowingly submitting a false statement in connection with any of the foregoing may be the basis for prosecution for offering a false instrument for filing (see, e.g., N.Y. Penal Law, Section 175.30 et seq.).

ACKNOWLEDGMENT[8]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New York

SS:

County of Westchester

On this 18th day of July, 20 13, before me personally came and appeared Richard D. McGrath, to me known, who, being by me duly sworn, did depose and say that he resides at New Hempstead, NY, that he is the Vice President of Yonkers Contracting Company, Inc., the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal) Anna Spathos
Notary Public, State of New York
No. 01SP4728188
Qualified in Westchester County
Commission Expires Dec. 31, 20 14

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal)

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal)

(Notary Signature)

---

8 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

STATEMENT ACCOMPANYING PROPOSAL[9]

Names and Residences of Officers, If Bidder is a Corporation - Attached.

Name	Title	Residence[10]

Names and Residences of Partners, If Bidder is a Partnership

Name	General or Limited Partner	Residence[11]

Bidder's Residence, If an Individual[12]

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9 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Statement Accompanying Proposal sheet in the same form as appears on this page for each other participant as required.

10 Give Street and Number of Residence. Do not give business address.

11 Give Street and Number of Residence. Do not give business address.

12 Give Street and Number of Residence. Do not give business address.

Yonkers Contracting Company, Inc.

Building Quality for Over 65 Years *969 Midland Avenue Yonkers, NY 10704* ***Tel*** *914.965.1500* ***Fax*** *914.378.8880*

ATTACHMENT to: Form of Proposal Page 26 – Statement Accompanying Proposal:

PROJECT:
Bidder: Yonkers Contracting Company, Inc.
The Port Authority of New York and New Jersey
LaGuardia Airport - Design and Construction of the East Parking Garage.
Contract No.: LGA-124.201
Bid Date/Time: July 18, 2013, 2:30 PM

Yonkers Contracting Company, Inc., submits the Names, Titles and Residences of the Corporation's Officers:

Name/Title	Residence
Carl E. Petrillo, Chairman and Chief Executive Officer/Director	
John L. Kolaya, President and Chief Operating Officer/Director	
Ali M. Catik, Executive Vice President	
Dennis Capolino, Vice President, Procurement	
Paul R. Hubert, Vice President, Construction/Director	
William B. Jordan, Vice President, Construction/Director	
James P. Strobel, Vice President, Construction	Exemption (1)
Michael J. Keller, Chief Financial Officer	
Louis V. Marino, Vice President, Equipment	
Richard D. McGrath, Vice President, Estimating	
Gregory J. Petrillo, Vice President, Real Estate/Director	
John Chrysogelos, Jr., Assistant Vice President	
James A. Clemente, Assistant Vice President	
Deborah A. Nargi, Corporate Secretary	

YONKERS CONTRACTING COMPANY, INC.

Richard D. McGrath

Richard D. McGrath, Vice President – Estimating Department
Dated: July 18, 2013

w/as13/071813.doc

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned[13] Yonkers Contracting Company, Inc., a corporation organized under the laws of the State of New York, 969 Midland Avenue, Yonkers, NY 10704

as principal(s); and[14] Zurich American Insurance Company, 1400 American Lane, Schaumburg, IL 60196

as surety are hereby held and firmly bound unto The Port Authority of New York and New Jersey (herein called the "Authority") in the penal sum of Six Million Dollars ($6,000,000), for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this 31st day of May , 20 13.

The condition of the above obligation is such that whereas the above named principal(s) has submitted to the Authority a certain Proposal, bound herewith and hereby made a part hereof, to perform the obligations of the Contractor under a contract in writing, known as Contract LGA-124.201, "LaGuardia Airport – Design and Construction of the East Parking Garage", now therefore:

A. If said Proposal shall not be accepted, or

B. If said Proposal shall be accepted and the Authority does not require the principal(s) to furnish a Performance and Payment Bond, or

C. If said Proposal shall be accepted and the Authority requires the principal(s) to furnish a Performance and Payment Bond and either the principal(s) furnishes a Performance and Payment Bond satisfactory to the Authority in accordance with the requirements of said Proposal or the Authority does not terminate the Contract as provided therein on account of the failure to furnish such a bond,

Then, this obligation shall be void, otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

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13 Insert bidder's name. If a corporation, give the state of incorporation using the phrase "a corporation organized under the laws of the ".

If a partnership, give full names of partners, using also the phrase, "co-partners doing business under the firm name of ".

If an individual using a trade name, give individual name, using also the phrase, "an individual doing business under the trade name of ".

If a joint venture, give the information required above for each participant in the joint venture.

14 Insert name of surety.

The surety, for value received, hereby stipulates and agrees that the obligations of said surety and its bond shall be in no way impaired or affected by any extensions of the times within which the Authority may receive or accept such Proposal or within which the principal(s) may furnish a Performance and Payment Bond or by any waiver by the Authority of any of the requirements of said Proposal; and said surety does hereby waive notice of any such extensions or waivers.

IN WITNESS WHEREOF, the principal(s) and surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Yonkers Contracting Company, Inc.

Principal [15]

(Seal)

By[16] Richard D. McGrath

Richard D. McGrath, Vice President

Zurich American Insurance Company

Surety

(Seal)

By[17] Andrea E. Gorbert

Andrea E. Gorbert, Attorney-in-Fact

15 If bidder is a joint venture, insert signature and information required as appropriate for one participant of the joint venture on this page and attach and complete an additional sheet in the same form as appears on this page for each other participant as required.

16 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

17 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

ACKNOWLEDGMENT[18]

ACKNOWLEDGMENT OF BIDDER, IF A CORPORATION

State of New York

SS:

County of Westchester

On this 31st day of May, 2013, before me personally came and appeared Richard D. McGrath, to me known, who, being by me duly sworn, did depose and say that he resides at New Hempstead, NY, that he is the Vice President of Yonkers Contracting Company, Inc., the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation; and that he signed his name thereto by like order.

(Notary Seal)

Anna Spatha
Notary Public, State of New York
No. 01SP4728188
Qualified in Westchester County
Commission Expires Dec. 31, 2014

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF A PARTNERSHIP

State of _____

SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be one of the members of the firm of _____, described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal)

(Notary Signature)

ACKNOWLEDGMENT OF BIDDER, IF AN INDIVIDUAL

State of _____

SS:

County of _____

On this _____ day of. _____, 20 , before me personally came and appeared _____ to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal)

(Notary Signature)

AFFIX ACKNOWLEDGMENT AND JUSTIFICATION OF SURETY

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18 If bidder is a joint venture, insert signature as appropriate for one participant of the joint venture on this page and attach and complete an additional Acknowledgment sheet in the same form as appears on this page for each other participant as required.

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ACKNOWLEDGEMENT OF SURETY

STATE OF New York,)
COUNTY OF Nassau,)

ON THE 31st DAY OF May, 2013 , BEFORE ME PERSONALLY CAME Andrea E. Gorbert TO ME KNOWN, WHO, BEING BY ME DULY SWORN, DID DEPOSE AND SAY THAT (S)HE RESIDES AT Suffolk County, New York THAT (S)HE IS THE ATTORNEY-IN-FACT OF Zurich American Insurance Company THE CORPORATION DESCRIBED IN AND WHICH EXECUTED THE ABOVE INSTRUMENT; THAT (S)HE KNOWS THE SEAL OF SAID CORPORATION; THAT ONE OF THE SEALS AFFIXED TO THE FOREFGOING INSTRUMENT IS SUCH SEAL; THAT IT WAS SO AFFIXED BY ORDER OF THE BOARD OF DIRECTORS OF SAID CORPORATION; AND THAT (S)HE SIGNED HIS/HER NAME THERETO BY LIKE ORDER.

BEVERLY A. WOOLFORD
NOTARY PUBLIC, State of New York
No. 01WO6132857
Qualified in Queens County
Commission Expires August 29, 2013

Beverly A. Woolford
Notary Public

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Maryland, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Maryland (herein collectively called the "Companies"), by **THOMAS O. MCCLELLAN, Vice President,** in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **James E. MARRAN, JR, David W. ROSEHILL, Nancy SCHNEE, Andrea E. GORBERT, Annette LEUSCHNER, Valorie SPATES, Beverly A. WOOLFORD and Anne POTTER, all of Jericho, New York, EACH** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND**, this 5th day of February, A.D. 2013.

ATTEST:

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Eric D. Barnes

Assistant Secretary
Eric D. Barnes

Th O. McClellan

Vice President
Thomas O. McClellan

State of Maryland
City of Baltimore

On this 5th day of February, A.D. 2013, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **THOMAS O. MCCLELLAN, Vice President, and ERIC D. BARNES, Assistant Secretary,** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Constance A. Dunn

Constance A. Dunn, Notary Public
My Commission Expires: July 14, 2015

POA-F 093-7185C

EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify of revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this ____ day of MAY 31 2013, 20____.

Geoffrey Delisio

Geoffrey Delisio, Vice President

ZURICH AMERICAN INSURANCE COMPANY
COMPARATIVE BALANCE SHEET
ONE LIBERTY PLAZA, 165 BROADWAY, 32nd FLOOR, NEW YORK, NY 10006
As of December 31, 2012 and December 31, 2011

	12/31/2012	12/31/2011
Assets		
Bonds	$ 18,907,466,866	$ 18,985,096,131
Preferred Stock	-	259,036
Common Stock	2,123,025,432	2,068,881,919
Other Invested Assets	2,035,077,824	2,065,634,039
Short-term Investments	126,053,209	107,298,374
Receivable for securities	134,410,839	18,523,294
Cash and cash equivalents	728,298,115	(128,716,627)
Securities lending reinvested collateral assets	225,335,750	120,821,061
Employee Trust for Deferred Compensation Plan	130,493,778	124,809,033
Total Cash and Invested Assets	$ 24,410,161,814	$ 23,362,606,260
Premiums Receivable	$ 3,649,247,239	$ 3,611,868,304
Funds Held with Reinsurers	3,681,443	28,073,922
Reinsurance Recoverable	215,451,507	233,357,918
Accrued Investment Income	121,729,727	149,372,442
Federal Income Tax Recoverable	930,267,731	788,664,462
Due from Affiliates	187,274,289	95,583,016
Other Assets	493,265,075	459,639,011
Total Assets	$ 30,011,078,824	$ 28,729,165,335
Liabilities and Policyholders' Surplus		
Liabilities:		
Loss and LAE Reserves	$ 14,244,436,264	$ 14,401,632,170
Unearned Premium Reserve	4,159,670,241	4,066,273,586
Funds Held with Reinsurers	212,412,675	218,214,563
Loss In Course of Payment	408,170,112	353,274,509
Commission Reserve	64,038,359	63,749,920
Federal Income Tax Payable	16,190,044	47,352,138
Remittances and Items Unallocated	196,410,982	69,677,903
Payable to parent, subs and affiliates	57,540,814	92,111,683
Provision for Reinsurance	66,649,220	60,498,188
Ceded Reinsurance Premiums Payable	551,510,878	278,235,370
Securities Lending Collateral Liability	225,335,750	120,821,061
Other Liabilities	2,166,453,164	1,938,544,837
Total Liabilities	$ 22,368,818,502	$ 21,710,385,928
Policyholders' Surplus:		
Common Capital Stock	$ 5,000,000	$ 5,000,000
Paid-In and Contributed Surplus	4,394,131,321	4,394,131,320
Surplus Notes	430,000,000	883,000,000
Special Surplus Funds	43,259,000	396,438,437
Cumulative Unrealized Gain	331,857,594	209,454,958
Unassigned Surplus	2,438,012,408	1,130,754,692
Total Policyholders' Surplus	$ 7,642,260,323	$ 7,018,779,407
Total Liabilities and Policyholders' Surplus	$ 30,011,078,824	$ 28,729,165,335

I, Dennis F. Kerrigan, Corporate Secretary of ZURICH AMERICAN INSURANCE COMPANY do hereby certify that the foregoing statement is a correct exhibit of the assets and liabilities of the said Company, on the 31st day of December, 2012, according to the best of my information, knowledge and belief.

Corporate Secretary

State of Illinois
County of Cook } SS:

Subscribed and sworn to, before me, a Notary Public of the State of Illinois, in the City of Schaumburg, this 15th day of March, 2013.

Notary public

OFFICIAL SEAL
DARRYL JOINER
Notary Public - State of Illinois
My Commission Expires May 3, 2014

FORM OF CONTRACT

CHAPTER I

GENERAL PROVISIONS

19. DEFINITIONS

To avoid undue repetition, the following terms whenever they occur in this Form of Contract or any of the other papers forming a part of the Contract shall be construed as follows:

"Contract" shall mean, in addition to this Form of Contract, the Information for Bidders, the Proposal, the Authority's acceptance, the Basic Specifications and the Basic Contract Drawings (including written addenda issued over the name of the Chief Engineer), all of which are made part hereof as though herein set forth in full. The Contract as so defined shall constitute the complete and exclusive statement of the terms of the agreement between the parties and the Contract may not be explained or supplemented by course of dealing, usage of trade or course of performance.

The term "days" or "calendar days" in reference to a period of time shall mean consecutive calendar days, Saturdays, Sundays and holidays, included.

The term "construction site" or words of similar import shall mean the Westerly end of existing Parking Lot 4 and the vicinities thereof at LaGuardia Airport.

"Work" shall mean all structures, equipment, plant, labor, materials (including materials and equipment, if any, furnished by the Authority) and other facilities and all other things necessary or proper for or incidental to performing the design and construction of a multi-level parking garage and related Work at the Westerly end of existing Parking Lot 4 and the vicinities thereof at LaGuardia Airport and "performance of Work" and words of similar import shall mean the furnishing of such facilities and the doing of such things.

"Work required by the Contract Drawings and Specifications in their present form" or words of similar import shall include all Work required by the Specifications in their present form (whether or not shown upon the Contract Drawings), all Work shown upon the Contract Drawings in their present form (whether or not mentioned in the Specifications), and all Work involved in or incidental to the accomplishment of the results intended by the Specifications and Contract Drawings in their present form (whether or not mentioned therein or shown thereon).

"Extra Work" shall mean Work which is in addition to that required to obtain the results intended by the Basic Contract Drawings and Basic Specifications in their present form as interpreted in the light of all the provisions of this Contract. Inasmuch as the Authority will rely on the specialized qualifications of the Contractor to prepare Detailed Contract Drawings and Detailed Specifications in all respects complete and adequate for the proper construction and use of the extensions of the runway decks and related Work, and inasmuch as one of the purposes the Authority in entering into this Contract is to alleviate the workload of its own engineering staff, and inasmuch as the Chief Engineer, in approving such Detailed Contract Drawings and Detailed Specifications, will therefore not fully avail himself of engineering services to have such Detailed Contract Drawings and Detailed Specifications analyzed, the materials and Work required to obtain the aforementioned results intended by the Basic Contract Drawings and Basic Specifications shall not be "Extra Work" even though not mentioned in the Detailed Contract Drawings and Detailed Specifications approved by the Chief Engineer. The decisions and interpretations of the Chief Engineer regarding what constitutes "Extra Work" shall be conclusive and binding on the parties. Nothing contained in this Contract however, shall be construed to prevent the Chief Engineer from consulting whatever sources he may deem proper for engineering advice and assistance in rendering any of the opinions, decisions or interpretations referred to in this Contract.

"Specifications" shall mean:

A. The "Basic Specifications", which shall mean Division 1 – General Provisions and Technical Specifications bound with this Contract Booklet.

B. The "Detailed Specifications", which shall mean the specifications prepared by the Contractor in accordance with this Contract in the form in which they are finally approved by the Chief Engineer in accordance with the provisions of this Contract.

"Contract Drawings" shall mean:

A. The "Basic Contract Drawings", which shall mean the Basic Contract Drawings designated in the clause of the Basic Specifications entitled "Basic Contract Drawings" and except as used in the phrase "Basic Contract Drawings in their present form" shall include any future alterations and revisions of said drawings by the Authority and;

B. The "Detailed Contract Drawings", which shall mean the drawings prepared by the Contractor in accordance with this Contract in the form in which they are finally approved by the Chief Engineer in accordance with the provisions of this Contract.

"Shop Drawings" shall mean all drawings, diagrams, illustrations, schedules, including supporting data, which are specifically prepared for this Contract and submitted by the Contractor pursuant to the requirements of the Basic Specifications or the Engineer to illustrate some portion of the Work. The terms "shop drawings", "placing drawings" and "working drawings" are used interchangeably in this Contract.

"Catalog Cuts" shall mean all standard drawings, diagrams, illustrations, brochures, schedules, performance charts and instructions submitted by the Contractor pursuant to the requirements of the Basic Specifications or the Engineer to illustrate some portion of the Work.

"Director of Procurement" shall mean the Director of Procurement of the Authority for the time being, or her successor in duties, acting either personally or through her duly authorized representatives acting within the scope of the particular authority vested in them.

"Chief Engineer" shall mean the Chief Engineer of the Authority for the time being, or his successor in duties, acting personally.

"Director" shall mean the Director of Aviation of the Authority for the time being, or his successor in duties for the purpose of this Contract, acting personally or through his authorized representative for the purpose of this Contract, who is at present the Authority's Director of Aviation Operations.

"Engineer" shall mean the Chief Engineer, acting either personally or through his duly authorized representatives acting within the scope of the particular authority vested in them.

"Assistant Chief Engineer for Construction" shall mean the Assistant Chief Engineer for Construction of the Authority for the time being, or his successor in duties, acting personally.

"Engineer of Construction" shall mean the designated Engineer of Construction for the facility at which the Work is being performed or his successor in duties, acting personally.

"Inspector" shall mean any representative of the Engineer designated by him as Inspector and acting within the scope of the particular authority vested in him.

The term "permanent construction" shall include all construction, installation, structures, equipment and materials (including materials and equipment, if any, furnished by the Authority) to be constructed, installed or left by the Contractor at or about the construction site (or elsewhere in the possession of the Authority) after the completion of the Work (whether or not they are yet delivered or installed), even though they are subsequently to be removed by others. The terms, "permanent installation", "permanent structure", "permanent materials", and words of similar import shall have the same meaning as the term "permanent construction".

"Subcontractor" shall mean anyone who performs Work (other than or in addition to the furnishing of materials, plant or equipment) at or about the construction site, directly or indirectly for or in behalf of the Contractor (and whether or not in privity of contract with the Contractor), but shall not include any person who furnished merely his own personal labor or his own personal services or who performs Work which consists only of the operation of construction equipment of which he is the lessor.

"Materialman" shall mean anyone who furnishes materials, plant or equipment to the Contractor or any subcontractor for use at or about the construction site in the performance of Work.

"Materialman" or "subcontractor", however, shall exclude the Contractor or any subsidiary or parent of the Contractor or any person, firm or corporation which has a substantial interest in the Contractor or in which the Contractor or the parent or the subsidiary of the Contractor, or an officer or principal of the Contractor or of the parent or the subsidiary of the Contractor has a substantial interest, provided, however, that for the purpose of the clause hereof entitled "Assignments and Subcontracts" the exclusion in this paragraph shall not apply to anyone but the Contractor himself.

"Workingman" or "workman" shall mean any employee of the Contractor or of a subcontractor who performs personal labor or personal services at the construction site.

"Lump Sum" shall mean the amount stipulated in the clause hereof entitled "General Agreement".

"Notice" shall mean a written notice.

Whenever they refer to the Work or its performance, "directed", "required", "permitted", "ordered", "designated", "prescribed" and words of similar import shall mean directed, required permitted, ordered, designated or prescribed by the Engineer; and "approved", "acceptable", "satisfactory" and words of similar import shall mean approved by or acceptable or satisfactory to the Engineer; and "necessary", "reasonable", "proper", "correct" and words of similar import shall mean necessary, reasonable, proper or correct in the judgment of the Engineer.

Whenever "including", "such as" or words of similar import are used, the specific things thereafter enumerated shall not limit the generality of the things preceding such words.

20. GENERAL AGREEMENT

The Contractor agrees to perform the design and construction of a multi-level parking garage and related Work at the Westerly end of existing Parking Lot 4 and the vicinities thereof at LaGuardia Airport and to furnish all structures, equipment, plant, labor, materials and other facilities and to do all other things necessary or proper therefor or incidental thereto, all in strict accordance with the Contract Drawings and Specifications and any future changes therein; and the Contractor further agrees to assume and perform all other duties and obligations imposed upon him by this Contract.

The Authority agrees to pay to the Contractor and the Contractor agrees to accept from the Authority, in full consideration for the performance by the Contractor of his duties and obligations under this Contract and the whole thereof, a compensation of:

FORTY-EIGHT MILLION THREE HUNDRED ELEVEN THOUSAND
SIX HUNDRED SIXTY Dollars
ZERO Cents
($ 48,311,660 .00)[19]

(throughout this Contract called the "Lump Sum"), and such compensation only, subject only to the express provisions of this Contract specifically setting forth actual, defined additions to or deductions from such compensation.

The enumeration in this Form of Contract and in the Specifications of particular things to be furnished or done at the Contractor's expense, or without cost or expense to the Authority, or without additional compensation to the Contractor shall not be deemed to imply that only things of a nature similar to those enumerated shall be so furnished and done; but the Contractor shall perform all Work as required without other compensation than that specifically provided, whatsoever changes may be made in the Contract Drawings and Specifications, whatsoever Work may be required in addition to that required by the Contract Drawings and Specifications in their present form, and whatsoever obstacles or unforeseen conditions may arise or be encountered.

21. AUTHORITY ACCESS TO RECORDS

The Authority shall have access during normal business hours to all records and documents of the Contractor relating to any amounts for which the Contractor has been compensated, or claims he should be compensated, by the Authority by payment determined on any basis other than by payment of a lump sum or unit price amount agreed upon in writing by the Contractor and the Authority; provided, however, such access shall extend to certified payroll records as described in the clause of the Form of Contract entitled "Prevailing Rate of Wage" regardless of the method by which the Contractor is compensated under this Contract. The Contractor shall obtain for the Authority similar access to similar records and documents of subcontractors. Such access shall be given or obtained both before and within a period of three years after Final Payment to the Contractor; provided, however, that if within the aforesaid three year period the Authority has notified the Contractor in writing of a pending claim by the Authority under or in connection with this Contract to which any of the aforesaid records and documents of the Contractor or of his subcontractors relate either directly or indirectly, then the period of such right of access shall be extended to the expiration of 6 years from the date of Final Payment with respect to the records and documents involved.

Upon request of the Authority, the Contractor shall furnish or provide access to the federal Form I-9 (Employment Eligibility Verification) for each individual performing Work under this Contract, including both citizens and non-citizens.

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[19] For sales tax exemptions, see clause entitled "Exemptions from New York State and New York City Sales Taxes".

No provision in this Contract giving the Authority a right of access to records and documents is intended to impair or affect any right of access to records and documents which the Authority would have in the absence of such provision.

22. RENTAL OF CONSTRUCTION EQUIPMENT

The rental of construction equipment shall be subject to all applicable New York sales and use taxes notwithstanding the Authority's status as an Exempt Organization in New York, as such term is defined in section eleven hundred sixteen of the New York State Sales and Compensating Use Tax Act.

The Contractor shall indemnify the Authority against any claim of any kind whatsoever made against the Authority by a lessor of construction equipment and the Contractor assumes the risk of all claims against him by any lessor of construction equipment, including in both cases, claims in connection with a subcontractor.

23. EXEMPTION FROM NEW YORK STATE AND NEW YORK CITY SALES TAXES

The attention of the Contractor and his subcontractors and materialmen, if any, is directed to the New York State and New York City tax laws, as they apply to the Work of this Contract, and the New York State Department of Taxation and Finance (herein called the "Department") Form ST-120.1, Contractor Exempt Purchase Certificate, available on the Department's website: www.tax.ny.gov/forms/.

Subdivision (a) of section eleven hundred fifteen of the New York State Sales and Compensating Use Tax Act (herein called the "Act") provides contractors with an exemption from sales and compensating use taxes (herein called "Sales Tax") for, among other things:

> (15) Tangible personal property sold to a contractor, subcontractor or repairman for use in erecting a structure or building of an organization described in subdivision (a) of section eleven hundred sixteen, or adding to, altering or improving real property, property or land of such an organization, as the terms real property, property or land are defined in the real property tax law; provided, however, no exemption shall exist under this paragraph unless such tangible personal property is to become an integral component part of such structure, building or real property."

The Authority is an exempt organization of the type described in subdivision (a) of section eleven hundred sixteen of the Act.

In view of the foregoing, the Contractor should not include in his price(s) any amounts for Sales Tax on such tangible personal property (herein called "Exempt Purchases"). The Contractor shall execute and provide his vendors with a properly completed Form ST-120.1 when effectuating such Exempt Purchases.

As provided in the clause hereof entitled "Rental of Construction Equipment", the Contractor's rental of equipment and the Contractor's purchases of tangible personal property that does not become an integral component part of the permanent construction are, in all cases, subject to Sales Tax.

If (i) any claim is made against the Contractor by the State of New York or City of New York for such Sales Tax on Exempt Purchases, or (ii) any claim is made against the Contractor by a materialman or a subcontractor on account of a claim against such materialman or subcontractor by the State of New York or City of New York for such Sales Tax on Exempt Purchases, then the Authority will reimburse the Contractor in an amount equal to the amount of such tax required to be paid in accordance with the Act, provided that:

1.) The Contractor's liability for such Sales Tax is caused solely by a finding by the Department that the Authority is not an Exempt Organization of the type described in subdivision (a) of section eleven hundred sixteen of the Act; and

2.) the Contractor, or the Contractor and any such subcontractor, as the case may be, have complied with such rules and regulations as may have been promulgated relating to the claiming of the exemption from such Sales Tax and have furnished to vendors all the forms and certificates required by the applicable laws, rules and regulations in connection therewith; and

3.) the Authority is afforded the opportunity before any payment of tax is made, to contest said claim in the manner and to the extent that the Authority may choose and to settle or satisfy said claim and such attorney as the Authority may designate is authorized to act for the purpose of contesting, settling and satisfying said claim; and

4.) the Contractor, or the Contractor and any such subcontractor, as the case may be, give immediate notice to the Authority of any such claim, cooperate with the Authority and its designated attorney in contesting said claim and furnish promptly to the Authority and said attorney all information and documents necessary or convenient for contesting said claim, said information and documents to be preserved for six years after the date of Final Payment or longer if such a claim is pending or threatened at the end of such six years.

If the Authority elects to contest any such claim, it will bear the expense of such contest.

24. PERFORMANCE AND PAYMENT BOND

If the Authority shall in its sole discretion so elect at the time of accepting the Contractor's Proposal, the Contractor shall furnish a bond for the faithful performance of all obligations imposed upon him by the Contract and also for the payment of all lawful claims of subcontractors, materialmen and workmen arising out of the performance of the Contract. Such bond shall be in the form bound herewith entitled, "Performance and Payment Bond", shall be in a penal sum equal to the Lump Sum and such bond shall be signed by one or more sureties[20] satisfactory to the Authority. The bond may be executed on a separate copy of such form not physically attached to this Contract booklet. In any case, both the form of bond bound herewith and any unattached executed copy thereof shall form a part of this Form of Contract as though herein set forth in full.

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20 Sureties must be corporations (commonly known as "surety companies"), authorized to do business as sureties in the state(s) in which the construction site is located, whose names appear on the current list of the Treasury Department of the United States in effect at the time of submission of the Performance and Payment Bond to the Authority as acceptable as sureties to the Treasury Department. In addition, the aggregate underwriting limitations on any one risk as set forth in the aforementioned list of the Treasury Department of the sureties shall equal or exceed the penal sum of the Performance and Payment Bond.

At any time after the opening of Proposals, the Authority may give notice to one or more bidders to advise the Authority as to the names of their proposed sureties. Within forty-eight hours thereafter each bidder so notified shall so advise the Authority. The giving of such notice to a bidder shall not be construed as an acceptance of his Proposal, and omission to give such notice shall not be construed as an election by the Authority not to require a bond.

If the Authority elects to require the Contractor to furnish a bond, he shall deliver such bond to the Authority within seven days after receipt by him of the acceptance of his Proposal, and the sureties thereon shall be as proposed by him, provided, that if the Authority has theretofore given notice to him that his proposed sureties or any of them are not satisfactory, the bond shall be executed by other sureties satisfactory to the Authority.

The Authority shall give notice to the Contractor within ten (10) days after receipt of the Performance and Payment Bond as to whether or not such bond is satisfactory.

In the event of a default by the Contractor in his obligation to furnish a satisfactory bond within seven (7) days after he received an acceptance of his Proposal, such default shall entitle the Authority in its discretion to terminate this Contract at any time within forty-five (45) days after the acceptance of the Proposal, without any liability on the part of the Authority. Inasmuch as the damages to the Authority resulting from a termination by it upon the failure of the Contractor to furnish a satisfactory bond will include items whose accurate amount will be difficult or impossible to compute, such damages shall be liquidated in the sum of the following amounts:

A. The excess, if any, of the Lump Sum in the Proposal finally accepted over that in the Proposal of the Contractor; and

B. The expense of such new advertisement of the Contract, if any, as may be deemed necessary by the Authority; and

C. The sum of $5000 for each day after the receipt by the Contractor of the acceptance of his Proposal that the performance of the Contract is not commenced by reason of the failure of the Contractor to furnish the required bond.

In the recovery of the damages above specified, the Authority may proceed against the sum represented by the certified check deposited with it or against the Bid Bond and take such other action as it may deem best in the public interest.

If the Contractor furnishes a bond in accordance with the requirements of the Authority under this numbered clause, the Authority shall reimburse the Contractor for the net amount actually paid by him to the surety or sureties as the premium on such bond. The Contractor shall deliver to the Engineer receipts from the surety or sureties evidencing such payment and the amount thereof. Within fifteen days after receipt of such evidence satisfactory to the Engineer, the Authority shall pay to the Contractor by check the amount provided in this numbered clause.

If at any time the Authority shall be or become dissatisfied with any surety or sureties then upon any bond furnished in accordance with the requirements of the Authority, or if for any other reason such bond shall cease to be adequate security to the Authority, the Contractor shall, within five days after notice from the Authority so to do, substitute a new bond in such form and sum and signed by such other sureties as may be necessary in the opinion of the Authority to constitute adequate security.

25. DESIGN

The Contractor shall submit to the Engineer completed Final Detailed Contract Drawings and Final Detailed Specifications within 150 calendar days after receipt by him of the acceptance of his Proposal.

The designs shall be based upon the Basic Contract Drawings and Basic Specifications and shall result in a design in the form and detail generally used by the Authority in its construction contracts, examples of which are available at reasonable times for inspection and will be furnished upon request. Twenty copies each of the Detailed Contract Drawings and Detailed Specifications shall be furnished for initial review purposes and twenty copies of each shall be furnished at the time of each resubmittal. The approved Detailed Contract Drawings and the approved Detailed Specifications shall bear the signature and seal of an architect or engineer authorized to practice in the State of New York.

The Basic Contract Drawings and Basic Specifications are intended as the general requirements for the Work under this Contract. The Basic Contract Drawings and Basic Specifications are not to be construed as a complete outline of or a limitation on the Work, nor do they include specific mention of all materials, equipment, construction and other things required to be included in the design or to be furnished or done by the Contractor. It is, nevertheless, the intent of the Basic Contract Drawings and Basic Specifications that the Contractor shall include in the Detailed Contract Drawings and Detailed Specifications all materials, equipment and construction which may be necessary or desirable to carry out the functions and purposes as indicated on the Basic Contract Drawings and the Basic Specifications and to make the extension of the runway decks and related Work suitable for the purpose for which it is intended, whether or not such materials, equipment, and construction are specifically mentioned or indicated in the Basic Contract Drawings and Basic Specifications.

All designs, drawings, specifications, reports, records, data, charts, documents, renderings, and other papers of any type whatsoever, whether in the form of writing, figures or delineations, and any models which are prepared in connection with this Contract, shall become the property of the Authority and the originals thereof shall be delivered to the Authority as soon as practicable but in no event later than the completion of all Work. The Contractor may, however, at his own expense, make copies thereof before delivery to the Authority is required. Except to the extent that the rights are reserved to others under valid patents for which the Authority is not given a license under the provisions of the clause of the Basic Specifications entitled "Workmanship and Materials", the Authority shall have the nonexclusive right to use or permit the use of all such designs, drawings, specifications, reports, records, data, charts, documents, renderings, and other papers and models, and any ideas or methods represented thereby for any purpose and at any time, without other compensation than that specifically provided herein. No such matter shall be deemed to have been given in confidence. Any statement or legend to the contrary in connection with any such matter and in conflict with the provisions of this paragraph shall be void and of no effect as to the Authority.

Under no circumstances shall the Contractor communicate in any way with any board, agency, commission or other organization whether governmental or private (including any utility company) in connection with the services to be performed hereunder except when this Contract specifically requires such communication and except upon prior written approval and instructions of the Engineer, provided, however, that data from manufacturers and suppliers of materials shall be obtained by him when and as he finds such data necessary, unless otherwise instructed by the Engineer.

The Contractor shall promptly and fully inform the Authority of any patents or disputes, whether existing or potential, of which he has knowledge, relating to any idea, design, method, materials, equipment or other matter involved in the Work.

CHAPTER II

ADJUSTMENTS AND PAYMENTS

26. ADJUSTMENTS OF LUMP SUM

If any Work required by the Contract Drawings and Specifications in their present form shall be countermanded or reduced, the Engineer shall have full authority on behalf of both parties to make such adjustment by way of reduction in the Lump Sum as he may in his sole discretion deem equitable and reasonable, and in making such adjustment, no allowance to the Contractor shall be made for anticipated profits.

The Chief Engineer shall have authority to agree in writing with the Contractor for adjustments by way of reduction in the Lump Sum in lieu of those for which provision is heretofore made in this numbered clause.

27. COMPENSATION FOR EXTRA WORK

The Chief Engineer shall have authority to agree in writing with the Contractor on behalf of the Authority upon lump sum or other compensation for Extra Work in lieu of the compensation for which provision is hereinafter made in this numbered clause.

If such agreement on compensation is not made, and Extra Work be performed, the Contractor's compensation shall be increased by the following amounts and such amounts only:

1.) For Extra Work consisting of design services, an amount equal to the salaries paid to technical employees for time actually spent in performing such services, plus one hundred per cent (100%) of the portion of such salaries representing "straight time" payments.

2.) For Extra Work consisting of refuse container services, an amount equal to the actual net cost in money of the labor and materials required for the provision of such services, plus seven per cent (7%) of such net cost.

3.) For Extra Work consisting of performance of construction work at the construction site, an amount determined as follows:

   a. In the case of Extra Work performed by the Contractor personally, an amount equal to the actual net cost in money of the labor and materials required for such Extra Work, plus twenty per cent (20%) of such net cost, plus such rental for equipment (other than small tools) required for such Extra Work as the Engineer deems reasonable.

   b. In the case of Extra Work performed by a subcontractor, an amount equal to the actual net cost in money of the labor and materials required for such Extra Work, plus twenty per cent (20%) of such net cost plus such rental for equipment (other than small tools) required for such Extra Work as the Engineer deems reasonable, plus seven per cent (7%) of the sum of the foregoing cost, percentage of cost, and rental.

As used in this numbered clause (and in this clause only):

"Design Services" means the preparation of Detailed Contract Drawings and Detailed Specifications for approval of the Engineer in accordance with the clause hereof entitled "Design" but shall not include the preparation of working or shop drawings.

"Salaries paid to technical employees" means salaries actually paid (excluding payments and factors for holidays, vacations, sick time, bonuses, profit participations and other similar payments) to architects, engineers, designers, draftsmen and other technical employees of the Contractor or of the subcontractor performing such design services, excluding however, any partners, corporate officers and clerical or administrative personnel.

"Refuse Container Services" means the delivery, removal and emptying of refuse containers as required during the performance of Extra Work subject to approval by the Engineer.

"Labor" means foremen, surveyors, laborers, mechanics and other employees below the rank of superintendent, exclusive of timekeepers, directly employed at the construction site, whether employed by the Contractor or by the subcontractors, subject to the Engineer's authority to determine what employees of any category are "required for Extra Work" and as to the portion of their time allotted to Extra Work; and "cost of labor" means the wages actually paid to and received by such employees; however, all wages actually paid that are in excess of the prevailing wages in the performance of Extra Work shall be subject, on each occasion, to the initial and continuing approval of the Engineer in advance of the performance of such Extra Work; plus a proper proportion of (a) vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligation upon the basis of such wages, and (b) taxes actually paid by the employer pursuant to law upon the basis of such wages. "Employees" as used above means only the employees of one employer.

"Materials" means temporary and consumable materials as well as permanent materials; and "cost of materials" means the price (including taxes actually paid by the Contractor pursuant to law upon the basis of such materials) for which such materials are sold for cash by the manufacturers or producers thereof, or by regular dealers therein, whether or not such materials are purchased directly from the manufacturer, producer or dealer (or if the Contractor is the manufacturer or producer thereof, the reasonable cost to the Contractor of the manufacture and production), plus the reasonable cost of delivering such materials to the construction site in the event that the price paid to the manufacturer, producer or dealer does not include delivery and in case of temporary materials, less their salvage value, if any.

"Work day" in reference to an item of equipment means a day other than a Saturday, Sunday or legal holiday except that if the particular item of equipment is actually utilized at the construction site by the Contractor or subcontractors under this or any other Contract with the Authority on a Saturday, Sunday or legal holiday said day shall be deemed a work day.

The rental for equipment, whether owned by the Contractor or subcontractors or rented from others and notwithstanding the actual price of any rental or actual costs associated with such equipment, shall be computed by the Engineer on the basis of the following:

A.

1.) Hourly rental for those items of equipment listed in the "Rental Rate Blue Book" published by Machinery Information Division, K-III Directory Corporation, 1735 Technology Drive, Suite 410, San Jose, California 95110, (hereinafter called "the Blue Book"), shall be 100% of the applicable rates as listed in said book, reduced to an hourly basis (see formula below) except that such applicable rates shall be reduced by 50% for all hours of rental payable hereunder in excess of 8 hours each day. The edition of this publication to be used shall be the one in effect on the date of the actual rental of the equipment. The "Estimated Operating Cost per Hour" as set forth for such item of equipment in the Blue Book shall be added to the hourly rental for each hour that such equipment is actually engaged in performing Extra Work. No amount for operating cost will be allowed during periods when such equipment is not actually engaged in performing Extra Work (i.e., standby rental time). None of the provisions of the Blue Book shall be deemed referred to or included in this Contract except as specifically set forth in this Section.

2.) If no listing of rental rate and/or hourly operating cost for the item of equipment is in the Blue Book, the Engineer shall determine the reasonable rate of rental and/or hourly operating cost of the particular item of equipment by such other means as he finds appropriate.

3.) In the event the Contractor is directed by the Engineer to immediately perform Extra Work within 24 hours of the direction to proceed, the Engineer shall determine the reasonable rate of rental and/all hourly operating cost of the items of equipment necessary to perform such Extra Work by such means as he finds appropriate. However, if the equipment is owned by the Contractor or owned by a subsidiary of the Contractor, the Blue Book rates will apply as set forth in this clause.

B. When utilizing the rental rates appearing in the Blue Book, the Engineer shall determine the applicable rate and the hourly rental determined therefrom by applying the following criteria:

1.) The rate to be applied for an item of equipment used on a particular Extra Work order shall be the monthly rates from the foregoing publication.

The pro rata portion which one hour bears to the applicable rate shall be determined in accordance with the following formula:

Hourly rate based on monthly rental.	1/176 of monthly rental from Blue Book

2.) The rental rate shall be multiplied by the applicable regional adjustment factor shown for such item of equipment in the Blue Book. The adjustment factor shall not apply to the hourly operating cost.

3.) If the Engineer should determine that the nature or size of the equipment used by the Contractor in connection with Extra Work is larger or more elaborate, as the case may be, than the size or nature of the minimum equipment determined by the Engineer to be suitable for the Extra Work, the reasonable rental will not be based upon the equipment used by the Contractor but will be based on the smallest or least elaborate equipment determined by the Engineer to have been suitable for the performance of the Extra Work.

C. In the case of equipment utilized only for Extra Work: (a) in addition to amounts determined as provided in subparagraphs A and B above, there will be added to the rental as computed above the taxes on the rental actually paid by the Contractor or subcontractor and the reasonable cost of transporting such equipment to and from the construction site, including applicable tolls, and (b) notwithstanding the number of hours during which such equipment is utilized, the minimum rental therefor will be for a period of eight hours.

In computing the Contractor's compensation insofar as it is based upon Extra Work, and notwithstanding any provision to the contrary appearing in the Blue Book, no consideration shall be given to any items of cost or expense not expressly set forth above, it being expressly agreed that the costs and percentage additions hereinbefore provided cover items of cost and expense to the Contractor of any type whatsoever, including administration, overhead, taxes (other than those enumerated above), clean-up, consumables including gas and oil, drafting (including printing or other reproduction), coordination, field measurements, maintenance, repairs, insurance, profit to the Contractor and small tools.

Whenever any Extra Work is performed (whether by the Contractor directly or through a subcontractor), the Contractor shall, at the end of each day, submit to the Engineer (a) daily time slips showing the name and number of each workman employed on such Work, the number of hours which he is employed thereon, the character of his duties, and the wages to be paid to him, (b) a memorandum showing the state and federal taxes based on such wages, and vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligation upon the basis of such wages (c) a memorandum showing the amount and character of the materials furnished for such Work, from whom they were purchased and the amount to be paid therefor, and (d) a memorandum of equipment used in the performance of such Work, listing the actual hours of operation for each piece of equipment, together with the rental claimed therefor. Such memoranda and time slips are for the purpose of enabling the Engineer to determine the amounts to be paid by the Authority under this numbered clause; and accordingly, they shall constitute a condition precedent to such payment and the failure of the Contractor or his subcontractors to furnish them with respect to any Work shall constitute a conclusive and binding determination on his part that such Work is not Extra Work and shall constitute a waiver by the Contractor of claims for payment for such Work. The Contractor's compensation for Extra Work shall be subject to audit review by the Authority. The Engineer will notify the Contractor that an audit review will be conducted no later than 90 days from the date of such notification. The Engineer will also provide the Contractor with an estimated duration of the audit. During the audit review, the Contractor shall provide records to substantiate the memorandum and time slips submitted to the Engineer. Failure to provide such Contractor or subcontractor records may result in a reduction or total denial of material, equipment and labor costs for Extra Work. Upon completion of the audit review, the Contractor will be provided with the audit findings of the Authority. If the Contractor disagrees in whole or in part with the audit findings, the Contractor shall notify the Authority of such disagreement in writing within 30 days of receipt of said audit findings or the Authority will deem the audit findings to be final and acceptable to the Contractor. In the event that the Chief Engineer and the Contractor shall agree in writing upon a lump sum or other compensation for Extra Work in lieu of compensation as provided in the second paragraph of this clause, the daily time slips and memoranda required by this paragraph shall not be required subsequent to the date on which such agreement has been reached.

28. COMPENSATION FOR PREMIUM TIME

Where the Engineer directs that the Contractor perform Work at times other than those elsewhere specified in the Contract, and the Contractor directly or through a subcontractor is obligated by the provisions of its applicable collective bargaining agreement to pay premium time rates for such Work then, the Contractor shall be compensated for the cost differential between regular time rates and premium time rates at an amount equal to the total of the following:

A. For premium time rates paid by the Contractor to its own forces, an amount equal to the premium time portion of the salaries and wages which the employer is required to pay and actually pays to its employees pursuant to the terms of its applicable collective bargaining agreement for the overtime period or periods described above, plus a proper proportion, if any, computed upon the basis of premium time salaries and wages of (1) taxes actually paid by the employer pursuant to law, (2) vacation allowances, other fringe benefits and union dues and assessments which the employer actually pays pursuant to contractual obligations, and (3) increased premiums paid by the Contractor personally, specifically allocable to the insurance required by this Contract, plus five per cent (5%) of such premium portion.

B. For premium time rates paid by a subcontractor, an amount equal to the premium time portion of the salaries and wages which the employer is required to pay and actually pays to its employees pursuant to the terms of its applicable collective bargaining agreement for the overtime period or periods described above, plus a proper proportion, if any, computed upon the basis of premium time salaries and wages of (1) taxes actually paid by the employer pursuant to law, (2) vacation allowances, other fringe benefits and union dues and assessments which the employer actually pays pursuant to contractual obligations, and (3) increased premiums paid by a subcontractor, specifically allocable to the insurance required by this Contract, plus five per cent (5%) of such premium portion, plus two per cent (2%) of the foregoing cost.

All additions to the Contractor's compensation provided for in this clause require the prior written approval of the Engineer and are conditioned on the Contractor's verifiable by the Authority payment of such amounts to his subcontractor.

The additions to the Contractor's compensation provided in this clause shall not apply where the Engineer directs the Contractor to perform work at times other than those specified elsewhere in the Contract and also determines that such work is required to mitigate previous delays in the Contractor's performance of Work.

29. COMPENSATION FOR EMERGENCY DELAYS

If the Contractor is specifically directed by the Engineer to suspend his operations as stipulated in the Section of Division 1 of the Specifications entitled "Airport Operations And Conditions" or if the Contractor is specifically directed not to start his operations at a time when operations are permitted to start as stipulated in such Section, and if solely because of such suspension or direction not to start any of the Contractor's or subcontractor's employees or equipment then engaged in or about to start such Work are necessarily kept idle at the construction site, during the hours when they would otherwise be engaged in the performance of the Work, then the Contractor's compensation shall be increased by an amount equal to the salaries and wages in amounts approved by the Engineer which the employer is required to pay and actually pays to such employees for the period or periods of such idleness, plus a proper proportion of (a) taxes actually paid by the employer pursuant to law upon the basis of such salaries and wages, and (b) vacation allowances and union dues and assessments which the employer actually pays pursuant to contractual obligations upon the basis of such salaries and wages, and in addition thereto such rental as the Engineer deems reasonable for such equipment during the period or periods of such idleness. The rental for idle equipment shall be computed by the Engineer in accordance with the provisions of the clause of the Form of Contract entitled "Idle Salaried Men and Equipment".

In the event that the Contractor deems that any payment should be made pursuant to this numbered clause, he shall give prompt written notice to the Engineer stating the reasons why he believes such payments should be made and shall moreover, furnish to the Engineer at the end of each day, a memorandum showing the name, payroll title, salary rate and employer of each of the workingmen, and description, owner and claimed rental rate for each item of equipment claimed to have been kept idle. Said notice and memorandum are for the purpose of enabling the Engineer to verify the Contractor's claim at the time. Accordingly, notwithstanding any other provisions hereof, the failure of the Contractor to furnish such notice and memorandum shall constitute a conclusive binding determination on his part that he is not entitled to compensation as provided herein and shall constitute a waiver by the Contractor of all claims for such payment, such notice and memorandum being conditions precedent to payment under this numbered clause.

30. MONTHLY ADVANCES

On or about the first day of each month, the Engineer shall (upon receipt from the Contractor of such information as he may require, including a certification in writing, in such form as may be required pursuant to the clause hereunder entitled "Prevailing Rate of Wage", that he has paid and caused his subcontractors to pay at least the prevailing rate of wage and supplements required by such clause) estimate and certify to the Authority the approximate amount of Work performed and compensation earned by the Contractor up to that time showing separately:

A. The amount of Work (other than Extra Work) performed by the Contractor up to that time and a sum bearing the same proportion to the Lump Sum as the Work performed (other than Extra Work) bears to the Work performed and to be performed (other than Extra Work).

B. The increases, if any, in the Contractor's compensation for which provision is specifically made elsewhere in this Contract.

As an aid to the Contractor and to facilitate his performance, the Authority shall, within fifteen days after the receipt of each such monthly certificate, advance to the Contractor by check the sums so certified, minus, however, five per cent (5%) of the sum certified pursuant to subparagraph A of this numbered clause, and minus all prior advances and payments to the Contractor or for his account.

Within ten calendar days of receipt of any sum attributable to Work performed by a subcontractor or materialman, the Contractor shall advance to the subcontractor or materialman said sum, less such amount, if any, as the Contractor is authorized to retain under the subcontract or purchase agreement.

Within ten calendar days of the satisfactory completion of Work performed by a subcontractor or materialman, the Contractor shall release the amount, if any, the Contractor was authorized to retain under the subcontract or purchase agreement.

Notwithstanding the above, the Authority shall have the right, at its sole discretion, to directly pay the subcontractors and material suppliers who perform Work for or furnish materials to the Contractor in connection with the Work of this Contract.

Prior to certifying any amount for payment hereunder, the Engineer may require that the Contractor submit a certification accurately and fully setting forth the total amount due and payable to each subcontractor and supplier for Work performed or materials provided by such subcontractor or supplier in connection with the Work of this Contract. Any payment made by the Authority to a subcontractor or supplier pursuant to the provisions of this numbered clause shall be made in reliance upon such certification and all such payments shall be considered as advances to the Contractor of the compensation payable hereunder. No such payment shall relieve the Contractor of any of its obligations hereunder.

Furthermore, within fifteen (15) days of the Contractor's receipt of the Authority acceptance of the Contractor's Proposal, the Contractor shall submit to the Engineer a listing of all subcontract and material supply agreements entered into by the Contractor for the performance of Work required by this Contract. Such listing shall include the names and addresses of each such subcontractor and supplier and the amounts payable under each such agreement. As and when any modifications are made to such agreements or any additional subcontracts or supply agreements are entered into, the Contractor shall inform the Engineer of such and shall indicate the amounts payable thereunder.

Nothing contained herein shall be deemed to create any additional rights in such subcontractors or suppliers or to alter the rights of the Authority as such are set forth in the clause hereof entitled "Withholding of Payments".

31. RELEASE OF MONIES PREVIOUSLY WITHHELD FROM MONTHLY ADVANCES UPON RENDITION OF A CERTIFICATE OF SUBSTANTIAL COMPLETION

After the rendition of the Certificate of Substantial Completion and with the approval of the Engineer, an amount up to 80% of the total amount of monies withheld from the Contractor's monthly advances in accordance with the preceding clause may be released to the Contractor. If, in the Engineer's judgment, no monies, or less than 80% of the total amount of monies withheld should be released it will be based on, but not limited to, the estimated value of the remaining Work, unresolved claims by subcontractors, the estimate of possible audit adjustments and an assessment of the risks to the Authority in making such a release of monies. This clause does not create a right to such a release of monies or to any specific percentage release, all of which shall remain purely the discretionary decision of the Engineer.

Prior to the release of any amount withheld from the Contractor's monthly advances by the Authority, the Contractor shall submit to the Engineer a certification of all unresolved requests for additional compensation including all items in dispute and potential claims which the Contractor had actual knowledge of or by reasonable inspection and inquiry should have known of, to the date of the certification. Any such items not made known to the Authority by inclusion in the certification of additional compensation requests submitted by the Contractor will be deemed to have been released by the Contractor. Notwithstanding the above provisions, before making any release of monies the Engineer may require the Contractor to submit further information for the Engineer's review and analysis, and shall require the Contractor to execute a separate written release of claims as described above in a form acceptable to the Authority.

Nothing contained herein shall be deemed to alter or diminish the rights of the Authority as such are set forth in the clauses hereof entitled "Withholding of Payments", "Final Payment", "Monthly Advances" or under any other clause of this Contract relating to compensation to the Contractor, any release of monies hereunder being purely at the discretion of the Engineer.

32. FINAL PAYMENT

After the rendition of the Certificate of Final Completion and upon receipt from the Contractor of such information as may be required, the Engineer shall certify in writing to the Authority and to the Contractor the total compensation earned by the Contractor.

If so required, the Contractor shall thereupon (i) certify to the Authority in writing, in such form as may be required pursuant to the clause hereunder entitled "Prevailing Rate of Wage", that he has paid and caused his subcontractors to pay at least the prevailing rate of wage and supplements required by such clause and (ii) furnish to the Authority a detailed sworn statement of all claims, just and unjust, of subcontractors, materialmen and other third persons then outstanding and which he has reason to believe may thereafter be made on account of the Work.

Within thirty days after issuance of such certificate of total compensation earned (or within thirty days after receipt of the documents provided for in the immediately preceding paragraph, if required), the Authority shall pay to the Contractor by check the amount stated in said certificate, less all other payments and advances whatsoever to or for the account of the Contractor. All prior estimates and payments shall be subject to correction in this payment, which is throughout this Contract called the Final Payment.

The acceptance by the Contractor, or by anyone claiming by or through him, of Final Payment shall be and shall operate as a release to the Authority of all claims and of all liability to the Contractor for all things done or furnished in connection with the Contract and for every act and neglect of the Authority and others relating to or arising out of the Contract, including claims arising out of breach of contract and claims based on claims of third persons, excepting only his claims for reimbursement for certain sales taxes as hereinbefore provided. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations in connection with this Contract or the Performance and Payment Bond.

The Contractor's agreement as provided in the immediately preceding paragraph above shall be deemed to be based upon the consideration forming part of this Contract as a whole and not to be gratuitous; but in any event even if deemed gratuitous and without consideration, such agreement as provided in the immediately preceding paragraph above shall nevertheless be effective. Such release shall include all claims, whether or not in litigation and even though still under consideration by the Authority or the Engineer. Such release shall be effective notwithstanding any purported reservation of right by the Contractor to preserve such claim. The acceptance of any check designated as "Final Payment" or bearing any similar designation shall be conclusively presumed to demonstrate the intent of the Contractor that such payment was intended to be accepted as final, with the consequences provided in this numbered clause, notwithstanding any purported reservation of rights.

The Contractor agrees that he shall not be entitled to, and hereby waives any right he might otherwise have to, and shall not seek any judgment whether under this Contract or otherwise for any such Final Payment or for an amount equivalent thereto or based thereon, or for any part thereof, if such judgment would have the effect of varying, setting aside, disregarding or making inapplicable the terms of this numbered clause or have the effect in any way of entitling the Contractor to accept such Final Payment or an amount equivalent thereto or based thereon or any part thereof other than in the same fashion as a voluntary acceptance of a Final Payment subject to all the terms of this Contract including this numbered clause, unless and until the Contractor should obtain a judgment on any claim arising out of or in connection with this Contract (including a claim based on breach of contract) for an amount not included in said Final Payment. In any case in which interest is allowable on the amount of the Final Payment, such interest shall be at the rate of 6% per annum for the period, if any, in which such interest is due.

33. WITHHOLDING OF PAYMENTS

If (1) the Contractor fails to perform any of his obligations under this Contract or any other agreement between the Authority and the Contractor (including his obligation to the Authority to pay any claim lawfully made against him by any materialman, subcontractor or workman or other person which arises out of or in connection with the performance of this Contract or any other agreement with the Authority) or (2) any claim (just or unjust) which arises out of or in connection with this Contract or any other agreement between the Authority and the Contractor is made against the Authority or (3) any subcontractor under this Contract or any other agreement between the Authority and the Contractor fails to pay any claims lawfully made against him by any materialman, subcontractor, workman or other third person which arises out of or in connection with this Contract or any other agreement between the Authority and the Contractor or if in the opinion of the Chief Engineer any of the aforesaid contingencies is likely to arise, then the Authority shall have the right, in its discretion, to withhold out of any payment (final or otherwise and even though such payment has already been certified as due) such sums as the Chief Engineer may deem ample to protect it against delay or loss or to assure the payment of just claims of third persons, and to apply such sums in such manner as the Chief Engineer may deem proper to secure such protection or satisfy such claims. All sums so applied shall be deducted from the Contractor's compensation. Omission by the Authority to withhold out of any payment, final or otherwise, a sum for any of the above contingencies, even though such contingency has occurred at the time of such payment, shall not be deemed to indicate that the Authority does not intend to exercise its right with respect to such contingency. Neither the above provisions for rights of the Authority to withhold and apply monies nor any exercise or attempted exercise of, or omission to exercise, such rights by the Authority shall create any obligation of any kind to such materialmen, subcontractors, workmen or other third persons.

Until actual payment to the Contractor, his right to any amount to be paid under this Contract (even though such amount has already been certified as due) shall be subordinate to the rights of the Authority under this numbered clause.

In the event that wages and/or supplements have been paid in an amount less than as required by this Contract, the Authority shall also have the right to withhold from the Contractor out of any payment, final or otherwise, on this, or any other open contract that the Contractor has with the Authority, so much as may be necessary to pay to laborers, mechanics, architects, draftsmen, engineers and technical workers, and others employed on the Work, the difference between the sums such persons should have received as wages and/or supplements and the amounts they actually received, and to pay such sums over to such persons. All such payments shall be deemed to be payments for the Contractor's account. In addition, the Contractor shall be required to pay to the Authority an amount equal to the Authority's cost of any investigation conducted by or on behalf of the Authority, that discovers a failure to pay wages and/or supplements as required by this Contract by the Contractor or its subcontractors, the cost of such investigation to be determined by the Chief Engineer personally. If the Contractor fails or refuses to pay for the cost of any such investigation after demand by the Authority, the Authority may deduct from any amount payable to the Contractor by the Authority, under the Contract or under any other open contract between the Contractor and the Authority, an amount equal to the cost of such investigation.

If, however, the payment of any amount due to the Contractor shall be improperly delayed by the fault of the Authority, the Authority shall pay the Contractor interest thereon at the rate of six percent (6%) per annum for the period of delay, it being agreed that such interest shall be in lieu of and in liquidation of any damages to the Contractor because of such delay.

CHAPTER III

PROVISIONS RELATING TO TIME

34. TIME FOR COMPLETION AND DAMAGES FOR DELAY

The Contractor shall complete the performance of all Work under this Contract within 510 calendar days after receipt by him of the acceptance of his Proposal.

The Contractor shall not commence the performance of the Work until the later of the following dates:

A. If a Performance and Payment Bond is required, the date of receipt by him of notice from the Authority that the Performance and Payment Bond furnished by him is satisfactory;

B. The date of receipt by him of notice from the Authority that the insurance procured by him in accordance with the clause hereof entitled "Insurance Procured by Contractor" is satisfactory, as evidenced by the certificate(s) to be furnished in accordance with said clause.

The time for completion shall not be extended on account of the time required to furnish the documents referred to in subparagraphs A and B above, but the Authority shall give notice to the Contractor within ten days after receipt of the Performance and Payment Bond or certificate of insurance as to whether or not such bond or insurance is satisfactory.

The Contractor's obligations for the performance and completion of the Work within the time or times provided for in this Contract are of the essence of this Contract. The Contractor guarantees that he can and will complete the performance of the Work within the time hereinbefore stipulated or within the time as extended in accordance with the clause hereof entitled "Extensions of Time". Inasmuch as the damage and loss to the Authority which will result from delay in completing the performance of the Work within the time herein stipulated will include items of loss whose amount will be incapable or very difficult of accurate estimation, the damages to the Authority for each calendar day by which the Contractor does not complete performance of the Work within the time or times above stipulated or within such time or times as extended in accordance with the clause hereof entitled "Extensions of Time", shall be liquidated in the sum of Five Thousand Dollars ($5,000) per calendar day.

35. EXTENSIONS OF TIME

The time above provided for completion of any part of the Contract shall be extended (subject, however, to the provisions of this numbered clause) only if in the opinion of the Engineer the Contractor is necessarily delayed in completing such part by such time solely and directly by a cause which meets all the following conditions:

A. Such cause is beyond the Contractor's control and arises without his fault;

B. Such cause comes into existence after the opening of Proposals on this Contract and neither was nor could have been anticipated by investigation before such opening.

Variations in temperature and precipitation shall be conclusively deemed to have been anticipated before opening of such Proposals on this Contract except to the extent that the actual monthly average temperature varies from a temperature which is 10 per cent (10%) above or below the monthly normal temperature and except to the extent that the actual number of days of precipitation (of 0.1 inch or more) per month exceeds a number equal to two plus the normal number of days of precipitation per month.

In any case, the variations in temperature and precipitation described in the immediately preceding sentence will be cause for an extension of time only if occurring between the actual time of commencement of the Work at the construction site and the time for completion stipulated in the clause hereof entitled "Time for Completion and Damages for Delay" (or such time as extended as provided for herein). In the case of portions of months the number of days will be pro-rated by the Engineer. Temperature and precipitation shall be as recorded by the U. S. Weather Bureau in its publications, including that entitled "Local Climatological Data with Comparative Data", which is applicable to the area in which the Work is to be performed, and in the case of precipitation, the normal number of days of precipitation (of 0.1 inch or more) per month as abstracted from the aforementioned publications are as follows:

Month	**Normal number of days per month on which precipitation exceeds 0.1 inch**
January	7
February	7
March	8
April	7
May	6
June	6
July	5
August	7
September	6
October	6
November	7
December	7

In any event, even though a cause of delay meets all the above conditions, an extension shall be granted only to the extent that (i) the performance of the Work is actually and necessarily delayed and (ii) the effect of such cause cannot be anticipated and avoided or mitigated by the exercise of all reasonable precautions, efforts and measures (including planning, scheduling and rescheduling), whether before or after the occurrence of the cause of delay, and an extension shall not be granted for a cause of delay which would not have affected the performance of the Contract were it not for the fault of the Contractor or for other delay for which the Contractor is not entitled to an extension of time.

Any reference herein to the Contractor shall be deemed to include subcontractors and materialmen, whether or not in privity of contract with the Contractor, and employees and others performing any part of the Contract and all the foregoing shall be considered as agents of the Contractor.

The period of any extension of time shall be that necessary to make up the time actually lost, subject to the provisions of this numbered clause, and shall be only for the portion of the Contract actually delayed. The Engineer may defer all or part of his decision on an extension and any extension may be rescinded or shortened if it subsequently is found that the delays can be overcome or reduced by the exercise of reasonable precautions, efforts and measures.

As a condition precedent to an extension of time, the Contractor shall give written notice to the Engineer within 48 hours after the time when he knows or should know of any cause which might under any circumstances result in delay for which he claims or may claim an extension of time (including those causes which the Authority is responsible for or has knowledge of), specifically stating that an extension is or may be claimed, identifying such cause and describing, as fully as practicable at the time, the nature and expected duration of the delay and its effect on the various portions of the Contract. Since the possible necessity for an extension of time may materially alter the scheduling, plans and other actions of the Authority, and since, with sufficient opportunity, the Authority might if it so elects attempt to mitigate the effect of a delay for which an extension of time might be claimed, and since merely oral notice may cause disputes as to the existence or substance thereof, the giving of written notice as above required shall be of the essence of the Contractor's obligations and failure of the Contractor to give written notice as above required shall be a conclusive waiver of an extension of time.

It shall in all cases be presumed that no extension, or further extension, of time is due unless the Contractor shall affirmatively demonstrate to the satisfaction of the Engineer that it is. To this end the Contractor shall maintain adequate records supporting any claim for an extension of time, and in the absence of such records, the foregoing presumption shall be deemed conclusive.

36. IDLE SALARIED MEN AND EQUIPMENT

If any salaried men or equipment of the Contractor or any subcontractor are necessarily kept continuously idle and wholly unoccupied at the construction site for a full day on each of two or more full days on which they would be engaged in the performance of the Work but for causes due solely to acts or omissions of the Authority or the Engineer occurring after the opening of Proposals on this Contract, and if such idleness is not due to any cause within the control of the Contractor or of any of his subcontractors or materialmen or his or their employees, then the Authority shall pay to the Contractor and the Contractor shall accept (in addition to any sums otherwise payable under this Contract, and in full satisfaction of and in liquidation of all claims for damages because of such act or omission of the Authority or the Engineer) an amount equal to that which the employer actually pays such salaried employees during such full days of idleness, plus a proper proportion of vacation allowances and union dues and assessments actually paid by the employer pursuant to contractual obligations on the basis of such salaries, and a proper proportion of the taxes actually paid by the employer pursuant to law upon the basis of such salaries and plus such rental for such idle equipment as the Engineer deems reasonable. The rental for idle equipment shall be computed by the Engineer in accordance with the provisions of the clause of the Form of Contract entitled "Compensation for Extra Work"; provided, however, that the seven per cent (7%) of the rental to be paid in accordance with said clause in the case of equipment utilized by subcontractors shall not be payable in connection with such idle equipment; and provided further that the provisions of subparagraph C of said clause shall not be applicable to such idle equipment.

The Contractor shall give written notice to the Engineer before the end of the second of the above mentioned 2 or more full days (whether or not the Authority is aware of the existence of any circumstances which might constitute a basis for payment under this numbered clause), specifically stating that salaried men or equipment have been kept idle under circumstances which might result in payment under this numbered clause; and he shall furnish with such notice, for all the days that have occurred, and shall in addition furnish at the end of each additional day of the above mentioned 2 or more full days, (a) a memorandum showing the name, payroll title, salary rate and employer of each of the salaried men claimed to have been kept idle at the construction site, and taxes based upon their salaries and the holiday and vacation allowances and union dues and assessments which the employer must actually pay pursuant to contractual obligations based on their salaries, and (b) a memorandum of the equipment claimed to be kept idle, together with the amount claimed as rental therefor. Said notice and memoranda are for the purpose of enabling the Engineer to verify the Contractor's claim at the time, and of enabling him to take such steps as may be necessary to remedy the conditions upon which the claim is based. The furnishing of such notice and memoranda shall be a condition precedent to payment under this numbered clause, so that the day on which notice is given shall be counted as not later than the second of the above mentioned 2 or more full days and no subsequent day shall be counted for which the above memoranda are not furnished at the end of such day.

37. DELAYS TO CONTRACTOR

As between the Contractor and the Authority, the Contractor assumes the risk of all suspensions of or delays in performance of the Contract, regardless of the length thereof, arising from all causes whatsoever, whether or not relating to this Contract, including wrongful acts or omissions of the Authority, its officers, agents, employees and contractors, except only to the extent, if any, that compensation or an extension of time may be due as expressly provided for elsewhere in this Contract for such suspension or delays and except to the extent, if any, that compensation may be agreed to by the Chief Engineer in writing pursuant to the clause hereof entitled "Compensation for Extra Work" for impact costs incurred by the Contractor in connection with the performance of Extra Work. Subject only to such exceptions, the Contractor shall bear the burden of all costs, expenses and liabilities which he may incur in connection with such suspensions or delays, and all such suspensions, delays, costs, expenses and liabilities of any nature whatsoever, whether or not provided for in this Contract, shall conclusively be deemed to have been within the contemplation of the parties.

Notwithstanding any provisions of this Contract, whether relating to time of performance or otherwise, the Authority makes no representation or guaranty as to when the construction site or any part thereof will be available for the performance of the Contract or as to whether conditions at the construction site will be such as to permit the Contract to be performed thereon without interruption or by any particular sequence or method or as to whether the performance of the Contract can be completed by the time required under this Contract or by any other time.

Wherever in connection with this Contract it is required, expressly or otherwise, that the Authority shall perform any act relating to the Contract, including making available or furnishing any real property, materials, or other things, no guaranty is made by the Authority as to the time of such performance and the delay of the Authority in fulfilling such requirement shall not result in liability of any kind on the part of the Authority except only to the extent, if any, that an extension of time or compensation may be due as expressly provided for elsewhere in this Contract.

38. CANCELLATION FOR DELAY

If the performance of the Contract or any portion of it shall, in the opinion of the Chief Engineer, be materially delayed, whether or not through the fault of the Contractor, by any cause which affects the Contractor's ability to perform the Contract without affecting to the same degree the Authority's own ability to perform it, either directly or through others, the Authority shall have the right at any time during the existence of such delay to cancel this Contract as to any portion not yet performed, without prejudice to the rights, liabilities and obligations of the parties under this Contract arising out of portions already performed, provided, however, that such right of cancellation shall not exist if the delay be due to any wrongful act or omission of the Authority. In the event of such cancellation, no allowance shall be made for anticipated profits.

CHAPTER IV

CONDUCT OF CONTRACT

39. AUTHORITY OF DIRECTOR

If at any time it shall be, from the viewpoint of the Authority, impracticable or undesirable in the judgment of the Director to proceed with or continue the performance of the Contract or any part thereof, whether or not for reasons beyond the control of the Authority, he shall have authority to suspend performance of any part or all of the Contract until such time as he may deem it practicable or desirable to proceed. Moreover, if at any time it shall be, from the viewpoint of the Authority impracticable or undesirable in the judgment of the Director to proceed with or continue the performance of the Contract or any part thereof whether or not for reasons beyond the control of the Authority, he shall have authority to cancel this Contract as to any or all portions not yet performed and as to any materials not yet installed even though delivered. Such cancellation shall be without prejudice to the rights and obligations of the parties arising out of portions already performed, but no allowance shall be made for anticipated profits.

40. AUTHORITY OF CHIEF ENGINEER

Inasmuch as the public interest requires that the project to which this Contract relates shall be performed in the manner which the Authority, acting through the Chief Engineer, deems best, the Chief Engineer shall have absolute authority to determine what is or is not necessary or proper for or incidental to the portion thereof specified in the clause hereof entitled "General Agreement" and the Contract Drawings and Specifications shall be deemed merely his present determination on this point. In the exercise of this authority, he shall have power to alter the Contract Drawings and Specifications; to require the performance of Work not required by them in their present form, even though of a totally different character from that now required; and to vary, increase and diminish the character, quantity and quality of, or to countermand, any Work now or hereafter required. Such variation, increase, diminution or countermanding need not be based on necessity but may be based on convenience.

To resolve all disputes and to prevent litigation the parties to this Contract authorize the Chief Engineer to decide all questions of any nature whatsoever arising out of, under, or in connection with, or in any way related to or on account of, this Contract (including claims in the nature of breach of Contract or fraud or misrepresentation before or subsequent to acceptance of the Contractor's Proposal and claims of a type which are barred by the provisions of this Contract) and his decision shall be conclusive, final and binding on the parties. His decision may be based on such assistance as he may find desirable. The effect of his decision shall not be impaired or waived by any negotiations or settlement offers in connection with the question decided, whether or not he participated therein himself, or by any prior decision of the Engineer or others, which prior decisions shall be deemed subject to review, or by any termination or cancellation of this Contract provided, however, that notwithstanding the decision reached by the Chief Engineer in a review of determinations by the Assistant Chief Engineer for Construction or Engineer of Construction or Engineer that a particular item of Work is not Extra Work the Contractor shall be compensated therefor as provided in written orders of the Assistant Chief Engineer for Construction or Engineer of Construction or Engineer expressly and unmistakably indicating his intention to treat Work described therein as Extra Work issued in accordance with the provisions of the clause hereof entitled "Extra Work Orders" for amounts not in excess of $250,000.

All such questions shall be submitted in writing by the Contractor to the Chief Engineer for his decision, together with all evidence and other pertinent information in regard to such questions, in order that a fair and impartial decision may be made. In any action against the Authority relating to any such question the Contractor must allege in his complaint and prove such submission, which shall be a condition precedent to any such action. No evidence or information shall be introduced or relied upon in such an action that has not been so presented to the Chief Engineer.

This numbered clause shall be governed by and construed in accordance with the law of the State of New York, without giving effect to its choice of law provisions.

41. AUTHORITY AND DUTIES OF ENGINEER

In the performance of the Contract, the Contractor shall conform to all orders, directions and requirements of the Engineer and shall perform the Contract to the satisfaction of the Engineer at such times and places, by such methods and in such manner and sequence as he may require, and the Contract shall at all stages be subject to his inspection. The Engineer shall determine the amount, quality, acceptability and fitness of all parts of the Work and shall interpret Contract Drawings, Specifications and any orders for Extra Work. The Contractor shall employ no equipment, materials, methods or men to which the Engineer objects, and shall remove no materials, equipment or other facilities from the construction site without permission. Upon request, the Engineer shall confirm in writing any oral order, direction, requirements or determination.

The Contractor is requested to orally advise the Engineer of questions as they arise. Although such advice will not substitute for the written notice and information for which requirements are set forth elsewhere herein, it is anticipated that it will facilitate prompt decisions on the part of the Engineer and others.

The enumeration herein or in the Specifications of particular instances in which the opinion, judgment, discretion or determination of the Engineer shall control or in which the Contract shall be performed to his satisfaction or subject to his inspection, shall not imply that only the matters of a nature similar to those enumerated shall be so governed and performed, but without exception the entire Contract shall be so governed and so performed.

42. NOTICE REQUIREMENTS

No claim against the Authority shall be made or asserted in any action or proceeding at law or in equity, and the Contractor shall not be entitled to allowance of such claim, unless the Contractor shall have complied with all requirements relating to the giving of written notice of the information with respect to such claim as provided in this numbered clause. The failure of the Contractor to give such written notice and information as to any claim shall be conclusively deemed to be a waiver by the Contractor of such claim, such written notice and information being conditions precedent to such claim. As used herein "claim" shall include any claim arising out of, under, or in connection with, or in any way related to or on account of, this Contract (including claims in the nature of breach of Contract or fraud or misrepresentation before or subsequent to acceptance of the Contractor's Proposal and claims of a type which are barred by the provisions of this Contract) for damages, payment or compensation of any nature or for extension of any time for performance of any part of this Contract.

The requirements as to the giving of written notice and information with respect to claims shall be as follows:

A. In the case of any claims for Extra Work, extension of time for completion, idle salaried men and equipment, or any other matter for which requirements are set forth elsewhere in this Contract as to notice and information, such requirements shall apply.

B. In the case of all other types of claim, notice shall have been given to the Engineer, personally, as soon as practicable, and in any case, within 48 hours, after occurrence of the act, omission, or other circumstance upon which the claim is or will be based, stating as fully as practicable at the time all information relating thereto. Such information shall be supplemented with any further information as soon as practicable after it becomes or should become known to the Contractor, including daily records showing all costs which the Contractor may be incurring or all other circumstances which will affect any claim to be made, which records shall be submitted to the Engineer, personally.

The above requirements for notices and information are for the purpose of enabling the Authority to avoid waste of public funds by affording it promptly the opportunity to cancel or revise any order, change its plans, mitigate or remedy the effects of circumstances giving rise to a claim or take such other action as may seem desirable and to verify any claimed expense or circumstances as they occur, and the requirements herein for such notice and information are essential to this Contract and are in addition to any notice required by statute with respect to suits against the Authority.

The above referred to notices and information are required whether or not the Authority is aware of the existence of any circumstances which might constitute a basis for a claim and whether or not the Authority has indicated it will consider a claim.

No act, omission, or statement of any kind shall be regarded as a waiver of any of the provisions of this numbered clause or may be relied upon as such waiver except only either a written statement signed by the Executive Director of the Authority or a resolution of the Commissioners of the Authority expressly stating that a waiver is intended as to any particular provision of this numbered clause, and more particularly no discussion, negotiations, consideration, correspondence, or requests for information with respect to a claim by any Commissioner, officer, employee or agent of the Authority shall be construed as a waiver of any provision of this numbered clause or as authority or apparent authority to effect such a waiver.

Since merely oral notice or information may cause disputes as to the existence or substance thereof, and since notice, even if written, to other than the Authority representative above designated to receive it may not be sufficient to come to the attention of the representative of the Authority with the knowledge and responsibility of dealing with the situation only notice and information complying with the express provisions of this numbered clause shall be deemed to fulfill the Contractor's obligation under this Contract.

43. EQUAL EMPLOYMENT OPPORTUNITY

During the performance of this Contract, the Contractor agrees as follows:

A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color or national origin, and will take affirmative action to insure that they are afforded equal employment opportunities without discrimination because of race, creed, sex, color or national origin. Such action shall be taken with reference, but not be limited to: recruitment, employment, job assignment, promotion, upgrading, demotion, transfer, layoff or termination, rates of pay or other forms of compensation, and selection for training or retraining, including apprenticeship and on-the-job training.

B. The Contractor shall send to each labor union or representative of workers with which he has or is bound by a collective bargaining or other agreement or understanding, a notice, to be provided by the State Commission for Human Rights, advising such labor union or representative of the Contractor's agreement under A. through H. of this numbered clause (hereinafter called "non-discrimination requirements"). If the Contractor was directed to do so by the Authority as part of the bid or negotiation of this Contract, the Contractor shall request such labor union or representative to furnish him with a written statement that such labor union or representative will not discriminate because of race, creed, sex, color or national origin and that such labor union or representative either will affirmatively cooperate, within the limits of its legal and contractual authority, in the implementation of the policy and provisions of these non-discrimination requirements or that it consents and agrees that recruitment, employment, and the terms and conditions of employment under this Contract, shall be in accordance with the purposes and provisions of these non-discrimination requirements. If such labor union or representative fails or refuses to comply with such a request that it furnish such a statement, the Contractor shall promptly notify the State Commission for Human Rights of such failure or refusal.

C. The Contractor shall post and keep posted in conspicuous places, available to employees and applicants for employment, notices to be provided by the State Commission for Human Rights setting forth the substance of the provisions of A. and B. herein and such provisions of the State's laws against discrimination as the State Commission for Human Rights shall determine.

D. The Contractor shall state, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, that all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, sex, color or national origin.

E. The Contractor shall comply with the provisions of Sections 291-299 of the Executive Law and the Civil Rights Law, shall furnish all information and reports deemed necessary by the State Commission for Human Rights under these non-discrimination requirements and such sections of the Executive Law, and shall permit access to his books, records and accounts by the State Commission for Human Rights, the Attorney General and the Industrial Commissioner for the purposes of investigation to ascertain compliance with these non-discrimination requirements and such sections of the Executive Law and Civil Rights Law.

F. This Contract may be forthwith canceled, terminated or suspended, in whole or in part, by the Authority upon the basis of a finding made by the State Commission for Human Rights that the Contractor has not complied with these non-discrimination requirements, and the Contractor may be declared ineligible for future contracts made by or on behalf of the State, the Authority or other public authority or agency of the State, until he has satisfied the State Commission for Human Rights that he has established and is carrying out a program in conformity with the provisions of these non-discrimination requirements. Such finding shall be made by the State Commission for Human Rights after conciliation efforts by the Commission have failed to achieve compliance with these non-discrimination requirements and after a verified complaint has been filed with the Commission, notice thereof has been given to the Contractor by the Commission and an opportunity has been afforded him to be heard publicly before the State Commissioner of Human Rights or his designee. Such sanctions may be imposed and remedies invoked independently of or in addition to sanctions and remedies otherwise provided by law.

G. The Contractor shall include the provisions of A. through F. above in every subcontract or purchase order in such a manner that such provisions will be binding upon each subcontractor or vendor as to operations to be performed within the State of New York. The Contractor shall take such action in enforcing such provisions of such subcontract or purchase order as the Authority may direct, including sanctions or remedies for non-compliance. If the Contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the Authority, the Contractor shall promptly so notify the General Counsel to the Authority, requesting him to intervene and protect the interests of the Authority.

H. The provisions of this numbered clause which refer to the State Commission for Human Rights, the Attorney General and the Industrial Commissioner are inserted in this Contract for the benefit of such parties, as well as for the benefit of the Authority, and said Commission, Commissioner and the Attorney General shall have a direct right of action against the Contractor to effectuate the intent of this clause.

44. AFFIRMATIVE ACTION REQUIREMENTS - EQUAL EMPLOYMENT OPPORTUNITY

The Contractor shall comply with the provisions set forth hereinafter. These provisions are modeled on the conditions for bidding on federal government contracts adopted by the Office of Federal Contract Compliance in 1978.

The Contractor and each subcontractor must fully comply with the clause entitled "Equal Employment Opportunity" and the requirements in this numbered clause. The Contractor commits himself to the goals for minority and female utilization set forth below and all other requirements, terms and conditions of this numbered clause by submitting a properly signed Proposal.

The Contractor shall appoint a company executive to assume the responsibility for the implementation of the requirements, terms and conditions of this numbered clause.

A. The goals for minority and female participation, expressed in percentage terms, for the Contractor's workforce at the construction site under this Contract are as follows:

Minority, except laborers	30%
Minority, laborers	40%
Female, except laborers	6.9%
Female, laborers	6.9%

These goals are applicable to all construction Work performed at the construction site under the Contract.

The Contractor's compliance with this numbered clause shall be based on his implementation of the clause entitled "Equal Employment Opportunity", and specific affirmative action obligations required herein of minority and female employment and training must be substantially uniform throughout the length of the Contract and in each trade. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the Contract. Compliance with the goals will be measured against the total work hours performed.

B.

1.) The Contractor shall provide written notification to the Director, Office of Business Diversity and Civil Rights of the Port Authority of New York and New Jersey, within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under this Contract. The notification shall list the name, address and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated start and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

2.) The Contractor shall submit a Workforce Projection Schedule, which shall be correlated to the progress schedule, within thirty days after acceptance of the Contractor's Proposal, for the approval of the Engineer. The Contractor shall maintain and periodically update it at intervals as required by the Engineer. The Workforce Projection Schedule shall include the time period in which each trade shall be utilized, the average number of workers required per trade on a weekly basis, the peak period for each trade, and the number of workers required per trade for the peak period on a weekly basis.

C.

1.) As used in this numbered clause:

a. "Director" means Director, Office of Business Diversity and Civil Rights of the Authority;

b. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U. S. Treasury Department Form 941;

c. "Minority" includes:

(i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

(ii) Hispanic persons of Puerto Rican, Mexican, Dominican, Cuban, Central or South American culture or origin, regardless of race;

(iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2.) Whenever the Contractor, or any subcontractor at any tier, subcontracts a portion of the Work involving any construction trade, he shall physically include in each subcontract in excess of $10,000 such provisions as are necessary for the Contractor to achieve the aggregate goals set forth above.

3.) The Contractor shall implement the specific affirmative action standards provided in 6.) a. through p. hereof. The goals set forth above are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in the total workforce at the construction site under the Contract including employees of the Contractor and the subcontractors. The Contractor is expected to make substantially uniform progress toward his goals in each craft during the period specified. These goals may be achieved through utilization of journeyworkers and apprentices. In the event they are not achieved through the utilization of journeyworkers, the maximum number of apprentices provided for in the applicable collective bargaining agreement may be utilized to achieve said goals.

4.) Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations hereunder.

5.) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

6.) The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these provisions shall be based upon his effort to achieve maximum results from his actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or his unions have employment opportunities available, and maintain a record of the organizations' responses.

b. Develop maximum job opportunities for apprentices appropriate to the conditions of the Work and subject to the applicable collective bargaining agreement, in conjunction with training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 6.) a. above.

c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet his obligations.

e. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting his EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations hereunder with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and subcontractors with whom the Contractor does or anticipates doing business.

i. Direct his recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth.

k. Tests and other selection requirements shall comply with 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations hereunder are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

7.) Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (6.) a. through p.). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of his obligations under 6.) a. through p. hereof provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet his individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's non-compliance.

8.) Goals for minorities and for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation hereof if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved his goals for women generally, the Contractor may be in violation hereof if a specific minority group of women is under-utilized).

9.) The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

10.) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

11.) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the clause entitled "Equal Employment Opportunity", including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered by the Authority. Any Contractor who fails to carry out such sanctions and penalties shall be in violation hereof.

12.) The Contractor, in fulfilling his obligations hereunder shall implement specific affirmative action steps, at least as extensive as those standards prescribed in 6.) hereof so as to achieve maximum results from his efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of these provisions, the Authority shall proceed accordingly.

13.) The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports, including the Monthly Employment Utilization Report, relating to the provisions hereof as may be required and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g. mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

14.) Nothing herein provided shall be construed as a limitation upon the application of any laws which establish standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

45. AFFIRMATIVE ACTION PROGRAMS

The Contractor assures that he will undertake an affirmative action program as required by 14 CFR Part 152, Subpart E, to insure that no person shall on the grounds of race, creed, color, national origin, or sex be excluded from participating in any employment activities covered in 14 CFR Part 152, Subpart E. The Contractor assures that no person shall be excluded on these grounds from participating in or receiving the services or benefits of any program or activity covered by this subpart. The Contractor assures that he will require that his covered suborganizations provide assurances to the Contractor that they similarly will undertake affirmative action programs and that they will require assurances from their suborganizations, as required by 14 CFR Part 152, Subpart E, to the same effect.

46. PREVAILING RATE OF WAGE

The Contractor shall pay or provide (and shall cause all subcontractors to pay or provide) to his or their workmen, laborers and mechanics (who are employed by him or them to work on an hourly or daily basis at any trade or occupation at or about the construction site) at least the prevailing rate of wage and supplements for others engaged in the same trade or occupation in the locality in which the Work is being performed as determined by the Engineer and notwithstanding that such rate may be higher than the rate in effect on the date of opening of Proposals.

For purposes of this Contract, the Engineer has determined that the prevailing rates of wage and supplements are those established by the Commissioner of Labor of the State of New York for the locality and for the period of time in which the Work is performed. The currently prevailing rates of wage and supplements are set forth in the Prevailing Rate Schedule annexed hereto and made a part hereof. These rates are subject to annual adjustment effective July 1st of each year and a Prevailing Rate Schedule reflecting all adjustments will be available for the Contractor's inspection on or about July 15th of each year on the 3rd Floor, 3 Gateway Center, Newark, New Jersey 07102 during regular business hours.

The provisions of this numbered clause are inserted in this Contract for the benefit of such workmen, laborers and mechanics as well as for the benefit of the Authority; and if the Contractor or any subcontractor shall pay or provide any such workman, laborer or mechanic less than the rates of wages and supplements above described, such workman, laborer or mechanic shall have a direct right of action against the Contractor or such subcontractor for the difference between the wages and supplements actually paid or provided and those to which he is entitled under this clause. If such workman, laborer or mechanic is employed by any subcontractor whose subcontract does not contain a provision substantially similar to the provisions of this clause (requiring the payment or provision of at least the above minimum, and providing for a cause of action in the event of the subcontractor's failure to pay or provide such wages and supplements) such workman, laborer or mechanic shall have a direct right of action against the Contractor. The Authority shall not be a necessary party to any action brought by any workman, laborer or mechanic to obtain a money judgment against the Contractor or any subcontractor pursuant to this numbered clause.

Nothing herein contained shall be construed to prevent the Contractor or any subcontractor from paying higher rates of wages or providing higher supplements than the minimum hereinbefore prescribed; and nothing herein contained shall be construed to constitute a representation or guarantee that the Contractor or any subcontractor can obtain workmen, laborers and mechanics for the minimum herein before prescribed. All wages actually paid that are in excess of the prevailing wages in the performance of Extra Work and Net Cost Work, if applicable, shall be subject, on each occasion, to the initial and continuing approval of the Engineer in advance of the performance of such Extra Work and Net Cost Work, if applicable.

The Contractor shall post at the Work site, in a place that is prominent, accessible and visible to all employees of the Contractor and his subcontractors during the daily time period that the Contractor and/or subcontractor performs Work at the site, the appropriate prevailing wage and supplement schedules. The Contractor must inform all employees, including those of his subcontractors, that they may obtain a copy of the prevailing wage and supplement schedule from the Contractor.

The Contractor and every subcontractor shall make and maintain weekly payroll records during the course of the Work and for the period set forth in the clause hereof entitled "Authority Access to Records" for all employees employed in the Work. Such records shall contain the name, address and last four digits of the social security number of each such employee (Contractors and subcontractors must maintain the full social security number of each employee and shall provide them upon request to the Port Authority Inspector General), the employee's correct payroll classification, rate of pay and supplements, daily and weekly number of hours worked, deductions made and actual wages and supplements paid. The Contractor shall submit these weekly payroll records to the Authority (on forms furnished by the Authority) of all his payroll records and those of each of his subcontractors as the Authority may require with the Contractor's monthly Payment Application, together with an affidavit by the Contractor and by each subcontractor to the effect that such payroll records are correct and complete, the wage and supplement rates contained therein are not less than those required by the provisions of this Contract, and the classifications set forth for each employee conform with the Work performed. Such copies and summaries and the original payroll records shall be available for inspection by the Authority (including its Inspector General), and the Contractor and his subcontractors shall permit such representatives to interview employees during Work hours at the construction site.

The Engineer may at any time request the Contractor to prepare a daily report on the Authority form entitled *Contractor Daily Sign-In Sheet*, copies of which can be obtained from the Engineer. The *Contractor Daily Sign-In Sheet* shall be completed as follows:

1.) At the beginning of each workday the Contractor shall:

a. fill in the top of the *Contractor Daily Sign-In Sheet*, including the location, date, contractor/subcontractor name and contract number;

b. ensure that each employee, including those of subcontractors, has printed and signed his or her name and indicated his or her work classifications, the last four digits of his or her social security number, and his or her starting time;

2.) At the end of each workday, the Contractor shall:

a. ensure that each employee, including those of subcontractors, has signed out and indicated his or her ending time;

b. sign the Certification Statement at the bottom of the form to indicate that the information contained in the *Contractor Daily Sign-In Sheet* is true and accurate; and

c. submit the original completed form to the Engineer's representative.

The Contractor's failure to comply with any provision of this numbered clause shall be deemed a substantial breach of this Contract.

47. EXTRA WORK ORDERS

No Extra Work of a cost in excess of $250,000 shall be performed except pursuant to written orders of the Chief Engineer expressly and unmistakably indicating his intention to treat the Work described therein as Extra Work; and, no Extra Work of a cost of $250,000 or less shall be performed except pursuant to written orders of the Chief Engineer, Assistant Chief Engineer for Construction, Engineer of Construction or Engineer expressly and unmistakably indicating his intention to treat the Work described therein as Extra Work.

In the absence of such an order signed by the Chief Engineer in the case of Extra Work of a cost in excess of $250,000 and by the Chief Engineer or Assistant Chief Engineer for Construction or Engineer of Construction or Engineer in the case of Extra Work of a cost of $250,000 or less, if the Engineer shall direct, order or require any Work, whether orally or in writing, which the Contractor deems to be Extra Work, the Contractor shall nevertheless comply therewith, but shall within twenty-four (24) hours give written notice thereof to the Chief Engineer and the Engineer, stating why he deems it to be Extra Work, and shall moreover furnish to the Engineer time slips and memoranda as required by the clause hereof entitled "Compensation for Extra Work". Said notice, time slips and memoranda are for the purpose of affording to the Chief Engineer an opportunity to verify the Contractor's claim at the time and (if he desires so to do) to cancel promptly such order, direction or requirement of the Engineer, of affording to the Engineer an opportunity of keeping an accurate record of the materials, labor and other items involved, and generally of affording to the Authority an opportunity to take such action as it may deem desirable in light of the Contractor's claims. Accordingly, the failure of the Contractor to serve such notice or to furnish such time slips and memoranda shall be deemed to be a conclusive and binding determination on his part that the direction, order or requirement of the Engineer does not involve the performance of Extra Work, and shall be deemed to be a waiver by the Contractor of all claims for additional compensation or damages by reason thereof, such written notice, time slips and memoranda being a condition precedent to such claims.

48. PERFORMANCE OF EXTRA WORK

The provisions of this Form of Contract relating generally to Work and its performance shall apply without exception to any Extra Work required and to the performance thereof. Moreover, the provisions of the Specifications relating generally to the Work and its performance shall also apply to any Extra Work required and to the performance thereof, except to the extent that a written order in connection with any particular item of Extra Work may expressly provide otherwise.

49. TITLE TO MATERIALS

All materials to become part of the permanent construction shall be and become the property of the Authority upon delivery at the construction site or upon being especially adapted for use in or as a part of the permanent construction, whichever may first occur, subject however to the Contractor's assumption of risk under the clause hereof entitled "Risks Assumed by the Contractor", subparagraph A.

The Contractor shall promptly furnish to the Authority such bills of sale and other instruments as may be required by it, properly executed, acknowledged and delivered, assuring to it title to such materials, free of encumbrances and shall mark or otherwise identify all such materials as the property of the Authority.

50. ASSIGNMENTS AND SUBCONTRACTS

Any assignment or other transfer by the Contractor of this Contract or any part hereof or of any of his rights hereunder or of any monies due or to become due hereunder and any delegation of any of his duties hereunder without the express consent in writing of the Authority shall be void and of no effect as to the Authority, provided, however, that the Contractor may subcontract portions of the Work to such persons as the Engineer may, from time to time, expressly approve in writing. For each individual, partnership or corporation proposed by the Contractor as a subcontractor, the Contractor shall submit to the Authority a certification or, if a certification cannot be made, a statement by such person, partnership or corporation to the same effect as the certification or statement required from the Contractor pursuant to the clauses of the "Information For Bidders" entitled "Certification of No Investigation (Criminal or Civil Anti-Trust), Indictment, Conviction, Suspension, Debarment, Disqualification, Prequalification Denial or Termination, Etc; Disclosure of Other Required Information", "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee" and "Certification of Participation in a State-Registered Apprenticeship Program". The Certification of Participation in a State-Registered Apprenticeship Program shall only be applicable to each subcontractor whose total amount of subcontract under this Contract is greater than $1 million. All further subcontracting by any subcontractor shall also be subject to such approval of the Engineer. Approval of a subcontractor may be conditioned on (among other things) the furnishing, without expense to the Authority, of a surety bond guaranteeing payment by the subcontractor of claims of materialmen, subcontractors, workmen and other third persons arising out of the subcontractor's performance of any part of the Work. Approval of a subcontractor may be rescinded for, among other things, failure of the Contractor to furnish the subcontractor's certificate of insurance, as required by the Form of Contract clause entitled "Insurance Procured by Contractor", within the time set forth in said clause.

No consent to any assignment or other transfer, and no approval of any subcontractor, shall under any circumstances operate to relieve the Contractor of any of his obligations; no subcontract, no approval of any subcontractor and no act or omission of the Authority or the Engineer shall create any rights in favor of such subcontractor and against the Authority; and as between the Authority and the Contractor, all assignees, subcontractors, and other transferees shall for all purposes be deemed to be agents of the Contractor. Moreover, all subcontracts and all approvals of subcontractors shall be and, regardless of their form, shall be deemed to be conditioned upon performance by the subcontractor in accordance with this Contract; and if any subcontractor shall fail to perform the Contract to the satisfaction of the Engineer, the Engineer shall have the absolute right to rescind his approval forthwith and to require the performance of the Contract by the Contractor personally or through other approved subcontractors.

51. CLAIMS OF THIRD PERSONS

The Contractor undertakes to pay all claims lawfully made against him by subcontractors, materialmen and workmen, and all claims lawfully made against him by other third persons arising out of or in connection with or because of the performance of this Contract and to cause all subcontractors to pay all such claims lawfully made against them.

52. CERTIFICATES OF PARTIAL COMPLETION

If at any time prior to the rendition of the Certificate of Final Completion, any portion of the permanent construction has been satisfactorily completed, and if in the judgment of the Engineer such portion of the permanent construction is not necessary for the operations of the Contractor but will be immediately useful to and is needed by the Authority for other purposes, the Engineer may render to the Authority and to the Contractor a certificate in writing to that effect (herein called a Certificate of Partial Completion), and thereupon or at any time thereafter the Authority may take over and use the portion of the permanent construction described in such Certificate and exclude the Contractor therefrom.

The rendition of a Certificate of Partial Completion shall not be construed to constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates in the event that he has failed to complete the same in accordance with the terms of this Contract. Moreover, the acceptance of a Certificate of Partial Completion by the Authority shall not operate to release the Contractor or his sureties from any obligations under or upon this Contract or the Performance and Payment Bond.

53. CERTIFICATE OF SUBSTANTIAL COMPLETION

Prior to the rendition of the Certificate of Final Completion, the Engineer may deem the entire Work to be substantially completed when, in the judgment of the Engineer, the permanent construction has been satisfactorily completed to the point where the Work is fit for its intended purpose and use. The Engineer may, if such a determination of substantial completion is made and at such time, render to the Authority and to the Contractor a certificate in writing to that effect (herein called the Certificate of Substantial Completion), and thereupon or at any time thereafter the Authority may take over and use the permanent construction described in such Certificate and exclude the Contractor therefrom. Whether to make a determination of a substantial completion as to any portion of the Work, and whether to render such a Certificate, shall be the discretionary determination of the Engineer based upon an examination and appraisal of the completed Work, and no right to such a determination or certification is established in the Contractor by this provision.

The rendition of such Certificate of Substantial Completion shall not relieve the Contractor of his obligation hereunder to complete the Work of this Contract nor shall it be construed to constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates in the event that he has failed to complete the same in accordance with the terms of this Contract. Moreover, the acceptance of a Certificate of Substantial Completion by the Authority shall not operate to release the Contractor or his sureties from any obligations under or upon this Contract or the Performance and Payment Bond.

When the Contractor is of the opinion that the Work is substantially complete as described above, the Contractor may submit to the Engineer a written request that the Engineer inspect the Work so as to determine, in the Engineer's sole opinion, whether substantial completion has been achieved. The Contractor's written request shall list the specific items of Work that are incomplete. Upon such a request, the Engineer will respond within 30 days with a Certificate of Substantial Completion or provide a written explanation of the reasons why the Work is not substantially complete including a list of open items necessary to achieve substantial completion. Nothing contained herein shall be deemed to preclude the Engineer from making a determination of substantial completion in the absence of a request therefor by the Contractor.

54. CERTIFICATE OF FINAL COMPLETION

After the satisfactory completion of all Work whatsoever required and the making of such tests and inspections as may be necessary or desirable, the Engineer shall render to the Authority and to the Contractor a certificate in writing (herein called the Certificate of Final Completion) certifying that in his opinion all Work under this Contract including Extra Work, has been completed in accordance with the Contract Drawings and Specifications and the requirements of the Engineer, and certifying the date as of which it was so completed.

The rendition of the Certificate of Final Completion shall not be construed to constitute an extension of the Contractor's time for performance in the event that he has failed to complete the Work in accordance with the terms of this Contract. Moreover, the acceptance of the Certificate of Final Completion by the Authority shall not operate to release the Contractor or his sureties from any obligations under or upon this Contract or the Performance and Payment Bond.

55. NO GIFTS, GRATUITIES, OFFERS OF EMPLOYMENT, ETC.

During the term of this Contract, the Contractor shall not offer, give or agree to give anything of value either to an Authority employee, agent, job shopper, consultant, construction manager or other person or firm representing the Authority, or to a member of the immediate family (i.e, a spouse, child, parent, brother or sister) of any of the foregoing, in connection with the performance by such employee, agent, job shopper, consultant, construction manager or other person or firm representing the Authority of duties involving transactions with the Contractor on behalf of the Authority, whether or not such duties are related to this Contract or any other Authority contract or matter. Any such conduct shall be deemed a material breach of this Contract.

As used herein "anything of value" shall include but not be limited to any (a) favors, such as meals, entertainment, transportation (other than that contemplated by the Contract or any other Authority contract), etc., which might tend to obligate the Authority employee to the Contractor, and (b) gift, gratuity, money, goods, equipment, services, lodging, discounts not available to the general public, offers or promises of employment, loans or the cancellation thereof, preferential treatment or business opportunity. Such term shall not include compensation contemplated by this Contract or any other Authority contract.

Where used in this clause, the term "Authority" shall be deemed to include all subsidiaries of the Authority. Currently, those subsidiaries are the Port Authority Trans-Hudson Corporation (PATH), the Newark Legal and Communications Center and the New York and New Jersey Railroad Corporation.

In addition, during the term of this Contract, the Contractor shall not make an offer of employment or use confidential information in a manner proscribed by the Code of Ethics and Financial Disclosure dated as of April 11, 1996 (a copy of which is available upon request to the Office of the Secretary of the Authority).

The Contractor shall include the provisions of this clause in each subcontract entered into under this Contract.

CHAPTER V

WARRANTIES MADE AND LIABILITY

ASSUMED BY THE CONTRACTOR

56. CONTRACTOR'S WARRANTIES

The Contractor represents and warrants:

A. That he is financially solvent, that he is experienced in and competent to perform the type of services contemplated by this Contract, that the facts stated or shown in any papers submitted or referred to in connection with his Proposal are true, and, if the Contractor be a corporation, that it is authorized to perform this Contract;

B. That he has carefully examined and analyzed the provisions and requirements of this Contract and inspected the construction site, that from his own investigations he has satisfied himself as to the nature of all things needed for the performance of this Contract, the general and local conditions and all other matters which in any way affect this Contract or its performance, and that the time available to him for such examination, analysis, inspection and investigations was adequate;

C. That the Contract is feasible of performance in accordance with all its provisions and requirements and that he can and will perform it in strict accordance with such provisions and requirements;

D. That no Commissioner, officer, agent or employee of the Authority is personally interested directly or indirectly in this Contract or the compensation to be paid hereunder; and

E. That, except only for those representations, statements or promises expressly contained in this Contract, no representation, statement or promise, oral or in writing, of any kind whatsoever by the Authority, its Commissioners, officers, agents, employees or consultants has induced the Contractor to enter into this Contract or has been relied upon by the Contractor, including any with reference to: (1) the meaning, correctness, suitability, or completeness of any provisions or requirements of this Contract; (2) the nature, existence or location of materials, structures, obstructions, utilities or conditions, surface or subsurface, which may be encountered at the construction site; (3) the nature, quantity, quality or size of the materials, equipment, labor and other facilities needed for the performance of this Contract; (4) the general or local conditions which may in any way affect this Contract or its performance; (5) the price of the Contract; or (6) any other matters, whether similar to or different from those referred to in (1) through (5) immediately above, affecting or having any connection with this Contract, the bidding thereon, any discussions thereof, the performance thereof or those employed therein or connected or concerned therewith.

Moreover, the Contractor accepts the conditions at the construction site as they may eventually be found to exist and warrants and represents that he can and will perform the Contract under such conditions and that all materials, equipment, labor and other facilities required because of any unforeseen conditions (physical or otherwise) shall be wholly at his own cost and expense, unless specifically provided for elsewhere in this Contract.

Nothing in the Contract Drawings or Specifications or any other part of the Contract is intended as or shall constitute a representation by the Authority as to the feasibility of performance of this Contract or any part thereof. Moreover, the Authority does not warrant or represent either by issuance of the Contract Drawings and Specifications or by any provision of this Contract as to time for performance or completion or otherwise that the Contract may be performed or completed by the times required herein or by any other times.

The Contractor further represents and warrants that he was given ample opportunity and time and by means of this paragraph was requested by the Authority to review thoroughly all documents forming this Contract prior to opening of Proposals on this Contract in order that he might request inclusion in this Contract of any statement, representation, promise or provision which he desired or on which he wished to place reliance; that he did so review said documents, that either every such statement, representation, promise or provision has been included in this Contract or else, if omitted, that he expressly relinquishes the benefit of any such omitted statement, representation, promise or provision and is willing to perform this Contract without claiming reliance thereon or making any other claim on account of such omission.

The Contractor further recognizes that the provisions of this numbered clause (though not only such provisions) are essential to the Authority's consent to enter into this Contract and that without such provisions, the Authority would not have entered into this Contract.

57. RISKS ASSUMED BY THE CONTRACTOR

The Contractor assumes the following distinct and several risks, whether they arise from acts or omissions (whether negligent or not) of the Contractor, of the Authority, or of third persons, or from any other cause, and whether such risks are within or beyond the control of the Contractor, excepting only risks which arise solely from affirmative acts done by the Authority subsequent to the opening of Proposals on this Contract with actual and wilful intent to cause the loss, damage and injuries described in subparagraphs A through C below:

A. The risk of loss or damage to the permanent construction prior to the rendition of the Certificate of Final Completion (other than loss or damage to the portions of the permanent construction with respect to which Certificates of Partial Completion have been issued), and the Contractor shall forthwith repair, replace and make good any such loss or damage to the permanent construction without cost to the Authority;

B. The risk of claims, fines or penalties, just or unjust, made by third persons or assessed by courts or governmental agencies or entities against the Contractor or the Authority on account of injuries (including wrongful death), loss, damage or liability of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the Work (whether or not actually caused by or resulting from the performance of the Work) or out of or in connection with the Contractor's operations or presence at or in the vicinity of the construction site or Authority premises, including claims against the Contractor or the Authority for the payment of workers' compensation, whether such claims, fines or penalties are made or assessed and whether such injuries, damage, loss and liability are sustained at any time both before and after the rendition of the Certificate of Final Completion;

C. The risk of loss or damage to any property of the Contractor, and of claims made against the Contractor or the Authority for loss or damage to any property of subcontractors, materialmen, workmen and others performing the Work, occurring at any time prior to completion of removal of such property from the construction site or Authority premises or the vicinity thereof.

The Contractor shall indemnify the Authority against all claims described in subparagraphs B and C above and for all expense incurred by it in the defense, settlement or satisfaction thereof, including expenses of attorneys, except where indemnity would be precluded by New York State General Obligations Law, Section 5-322.1 or by other applicable law. If so directed, the Contractor shall defend against any claim described in subparagraphs B and C above, in which event he shall not without obtaining express advance permission from the General Counsel of the Authority raise any defense involving in any way jurisdiction of the tribunal, immunity of the Authority, governmental nature of the Authority or the provisions of any statutes respecting suits against the Authority . Unless a claim is one which the Contractor is not required to indemnify the Authority against as described in the first sentence of this paragraph, such defense shall be at the Contractor's cost.

The provisions of this numbered clause shall also be for the benefit of the Commissioners, officers, agents and employees of the Authority, so that they shall have all the rights which they would have under this numbered clause if they were named at each place above at which the Authority is named, including a direct right of action against the Contractor to enforce the foregoing indemnity, except, however, that the Authority by action of its Board of Commissioners may at any time in its sole discretion and without liability on its part cancel the benefit conferred on any of them by this numbered clause, whether or not the occasion for invoking such benefit has already arisen at the time of such cancellation.

Neither the issuance of a Certificate of Completion nor the making of Final Payment shall release the Contractor from his obligations under this numbered clause. Moreover, neither the enumeration in this numbered clause nor the enumeration elsewhere in this Contract of particular risks assumed by the Contractor or of particular claims for which he is responsible shall be deemed (a) to limit the effect of the provisions of this numbered clause or of any other clause of this Contract relating to such risks or claims, (b) to imply that he assumes or is responsible for risks or claims only of the type enumerated in this numbered clause or in any other clause of this Contract, or (c) to limit the risks which he would assume or the claims for which he would be responsible in the absence of such enumerations.

Inasmuch as the Authority has agreed to indemnify the City of New York against claims of the types described in subparagraph B above made against said city, the Contractor's obligation under subparagraph B above shall include claims by said city against the Authority for such indemnification, including those arising from acts or omissions (whether negligent or not) of said city.

58. NO THIRD PARTY RIGHTS

Nothing contained in this Contract is intended for the benefit of third persons, except to the extent that the Contract specifically provides otherwise by use of the words "benefit" or "direct right of action".

59. INSURANCE PROCURED BY THE AUTHORITY

In order to reduce the cost of this Contract, the Authority will procure and will maintain in force and pay the premiums on:

A. A policy of public liability (Comprehensive - Commercial General Liability, including Contractual) insurance on which the Contractor and the subcontractors will be insureds issued by an insurance company satisfactory to the Authority, with current coverage limits of $50 million per occurrence for bodily injury and property damage liability.

B. A policy of workers' compensation and employer's liability insurance fulfilling the Contractor's and the subcontractor's obligations under the applicable State Workers' Compensation Law for those employees of the Contractor and the subcontractors employed pursuant to this Contract in operations conducted at the site of the Work hereunder. Coverage under this policy may, as appropriate, include one or more of the following endorsements:

1.) Longshore and Harbor Workers' Compensation Act Coverage Endorsement. (Applies when performing work on or around navigable waters).

2.) Maritime Coverage Endorsement (Applies to masters or members of the crews of vessels, if vessels are used).

3.) Federal Employer's Liability Act Coverage Endorsement. (May apply to railroad related Work).

Determination in any instance as to the appropriateness of the included coverage described in B.1, 2 and 3 above will be made based upon information to be provided by the Contractor relating to the mode of performance of Work to be done under the Contract.

The policy described in B above will not provide coverage for any workers' compensation for the Contractor and/or subcontractors who perform any asbestos work. In such cases, the Contractor or subcontractors shall procure and maintain, at their own expense, the workers' compensation insurance in accordance with the requirements of law in the state(s) where the Work will take place, including employer's liability insurance (in limits of not less than $1 million per occurrence).

Should the Contractor and/or subcontractors be required to procure the workers' compensation insurance, within ten days after the acceptance of his Proposal the Contractor shall deliver to the General Manager, Risk Financing, The Port Authority of NY & NJ, Treasury Department, 225 Park Avenue South, 12th Floor, New York, N.Y. 10003 (Attn: Contract Insurance Review), an original certificate, stating the Contract number, from the insurer. A duplicate certificate evidencing the above insurance shall also be delivered to the Engineer. With regard to insurance required to be procured by a subcontractor, the Contractor shall deliver the certificate described above at least ten days before the subcontractor commences Work.

The requirements for insurance procured by the Contractor or subcontractors shall not in any way be construed as a limitation on the nature or extent of the obligations of the Contractor or subcontractors.

C. A policy of builder's risk insurance, covering the improvements or other Work to be effectuated by the Contractor and the subcontractors, with coverage limits of $50 million per occurrence for all locations combined (subject to a $50 million annual aggregate for flood and earthquake damage and a limit of $10 million per occurrence for damage to off-site storage and property in-transit). The deductible is $10,000 per occurrence for all losses except those caused by flood and earthquake, where a $50,000 deductible per occurrence with respect to flood, and a $25,000 deductible per occurrence with respect to earthquake are in effect. The policy form contains various exclusions, including but not limited to the following property exclusions: automobiles; aircraft; and Contractor's and subcontractors' machinery, tools, and equipment and property of a similar nature, including forms, shoring, scaffolding, temporary structures, rental property/equipment and similar property, not intended to become a permanent part of a building or structure. The Contractor and the subcontractors must refer to the policy form to determine all properties and perils included and excluded and to determine their rights and responsibilities as insureds under the policy form. The Contractor and the subcontractors are responsible for payment for all losses within the deductibles and losses not covered by the builder's risk policies.

The current policies described in A, B and C of this numbered clause are available for examination by appointment in the office of the General Manager, Risk Financing, The Port Authority of NY & NJ, Treasury Department, 225 Park Avenue South, 12th Floor, New York, N.Y. 10003. The policies under A above are subject to certain liability coverage exclusions, which include, but are not limited to, exclusions from liability from claims arising from pollution and exposure to asbestos.

The Contractor and subcontractors shall comply with all obligations of the insured under or in connection with all of the policies described in A, B and C above.

The Authority shall have the right at any time and from time to time at its option to procure insurance substituting in whole or in part for any or all of the policies described in A, B and C above or to require that the Contractor and the subcontractors themselves obtain insurance substituting in whole or part for that above referred to, provided always, however, that the Contractor and the subcontractors shall be afforded coverage as stipulated by the Authority and the Authority shall either pay the premiums on such substitute insurance or reimburse the Contractor and the subcontractors therefor.

Neither the procurement of the above insurance or any substitute insurance nor the extent of the coverage or the limits of liability thereunder shall be construed to be a limitation on the nature or extent of the Contractor's obligations, or to relieve the Contractor of any such obligations, and the procurement of the above insurance is only for the purpose of reducing the cost of the Contract without constituting any representation by the Authority as to the adequacy of the insurance to protect the Contractor against the obligations imposed on the Contractor by law (except the applicable State Workers' Compensation Law) or by this or any other contract.

Notwithstanding any provision of this clause, however, no subcontractor shall be or have the right to be covered under the policies of insurance above referred to until the subcontractor has been expressly approved in writing by the Engineer, as required under this Contract, and such approval may be withheld, among other reasons, until execution by the subcontractor of agreements affirming his obligations provided in this clause with respect to the above insurance.

The provisions of this numbered clause are not intended to create any rights for the Contractor other than rights which may be available to the Contractor under said policies themselves, whatever such rights may be. Moreover, the Authority makes no representation or guaranty, either by the provisions of this numbered clause or otherwise, as to the effect of or the coverage under said policies, and no employee or agent of the Authority is authorized to make any such representation or guaranty, either by the provisions of this numbered clause or otherwise, as to the effect of or the coverage under said policies, and no employee or agent of the Authority is authorized to make any such representation or guaranty or to offer any interpretation of or information on said policies. The Contractor warrants and represents that he has examined and is familiar with the above stated coverages and that in submitting his Proposal he has relied solely on his own interpretation thereof and not on any representations or statements, oral or written, of the Authority, its Commissioners, officers, agents, employees, consultants or contractors.

All negotiations and adjustments with any insurer concerning payment for any loss, the risk of which is borne by the Contractor under this Contract, shall be the responsibility of and shall be conducted by the Contractor unless the applicable policy provides otherwise. The Contractor shall, however, inform the Engineer of the progress of all such negotiations and notify the Engineer sufficiently in advance of all meetings thereon so that the Engineer or designated representatives may attend said negotiations if they so desire.

The Authority shall be entitled to all returned premiums, dividends and credits which may become payable at any time for any reason whatsoever in connection with the aforementioned insurance. The Contractor hereby assigns to the Authority all such returned premiums, dividends and credits and the subcontractors shall be deemed to have assigned to the Authority all such returned premiums, dividends and credits by becoming subcontractors under this Contract. The Contractor shall execute and cause the subcontractors to execute any instrument necessary or convenient to evidence the Authority's right to such returned premiums, dividends and credits.

Notwithstanding any payment by the Authority of any insurance premiums, the Authority shall not be deemed the employer of any employees hired by the Contractor or any subcontractor covered by such insurance nor shall it be liable for any of the obligations of such employer.

The Contractor and the subcontractors shall cooperate to the fullest extent with the Authority in all matters relating to the aforementioned insurance and shall comply with all requirements of all insurance policies procured by the Authority. They shall also at their own expense furnish the Engineer or a duly authorized representative with copies of all payrolls, correspondence, papers, records and other things necessary or convenient for dealing with or defending against any claims and for procuring or administering the aforementioned insurance including furnishing the name of any of their employees, officers, or agents whose presence or testimony is necessary or convenient in any negotiations or proceedings involving such insurance.

60. INSURANCE PROCURED BY CONTRACTOR

The Contractor, and all subcontractors, shall maintain and pay the premiums on the policy or policies of insurance for coverage(s) as hereinafter described, which shall cover their operations hereunder, shall be effective throughout the effective period of this Contract, and shall afford coverage(s) in not less than the amounts set forth below:

A. Commercial Automobile Liability Insurance: covering "any" vehicles on the broadest commercially available form:

1.) Vehicles operating in the Air Operations Area without an authorized escort require a Combined single limit for bodily injury and property damage liability – $25 million per each accident.

2.) Vehicles operating in the Air Operations Area with an authorized escort require a Combined single limit for bodily injury and property damage liability - $5 million per each accident.

3.) Vehicles operating outside of the Air Operations Area require a Combined single limit for bodily injury and property damage liability - $2 million per each accident.

The Port Authority of New York and New Jersey and its related entities shall be named as an additional insured in the liability policy or policies and evidenced by the certificate(s) of insurance set forth above. The liability policy(ies) and the certificate(s) of insurance shall show coverage for cross-liability/severability of interests as provided under the standard ISO "separation of insureds" condition.

The Contractor shall deliver certified copies of the policy(ies) described above or certificate(s) of insurance evidencing the existence thereof to the Engineer at the location where the Work will be performed, within ten (10) days after the acceptance of his Proposal. Such policy(ies) or certificate(s) shall state the Contract number and shall contain a valid provision or endorsement that the policy(ies) may not be canceled, terminated, changed or modified without giving thirty (30) days written advance notice thereof to the Authority.

Such policy(ies) and certificate(s) of insurance shall contain an additional endorsement providing that "the insurance carrier shall not, without obtaining express advance permission from the General Counsel of the Authority, raise any defense involving in any way the jurisdiction of the Tribunal over the person of the Authority, the immunity of the Authority, its Commissioners, officers, agents or employees, the governmental nature of the Authority or the provisions of any statutes respecting suits against the Authority".

Certified copies of all renewal policies or certificates evidencing their existence shall be delivered to the Engineer at the location where the Work will be performed at least ten (10) days prior to the expiration date of each expiring policy. If at any time any of the certificates or policies shall be or become unsatisfactory to the Authority as to form or substance, or if the carrier issuing any such certificate or policy shall be or become unsatisfactory to the Authority, the Contractor shall promptly obtain a new and satisfactory certificate and policy. Upon request of the General Manager, Risk Financing, the Contractor shall furnish the Authority with a certified copy of each policy stated above.

The requirements for insurance procured by the Contractor shall not in any way be construed as a limitation on the nature or extent of the contractual obligations assumed by the Contractor under this Contract. The insurance requirements are not a representation by the Authority as to the adequacy of the insurance to protect the Contractor against the obligations imposed on him by law or by this or any other contract.

CHAPTER VI

RIGHTS AND REMEDIES

61. RIGHTS AND REMEDIES OF AUTHORITY

The Authority shall have the following rights in the event the Chief Engineer shall deem the Contractor guilty of a breach of any term whatsoever of this Contract:

A. The right to take over and complete the Work or any part thereof as agent for and at the expense of the Contractor, either directly or through other contractors.

B. The right to cancel this Contract as to any or all of the Work yet to be performed.

C. The right to specific performance, an injunction or any other appropriate equitable remedy.

D. The right to money damages.

For the purpose of this Contract, breach shall include but not be limited to the Contractor's failure to procure insurance satisfactory to the Authority within the time limit specified in the Clause hereof entitled "Insurance Procured by Contractor" and the following, whether or not the time has yet arrived for performance of an obligation under this Contract: a statement by the Contractor to any representative of the Authority indicating that he cannot or will not perform any one or more of his obligations under this Contract; any act or omission of the Contractor or any other occurrence which makes it improbable at the time that he will be able to perform any one or more of his obligations under this Contract; any suspension of or failure to proceed with any part of the Work by the Contractor which makes it improbable at the time that he will be able to perform any one or more of his obligations under this Contract; any false certification at any time by the Contractor as to any material item certified pursuant to the clauses of the Information For Bidders entitled "Certification of No Investigation (Criminal or Civil Anti-Trust), Indictment, Conviction, Suspension, Debarment, Disqualification, Prequalification Denial or Termination, Etc; Disclosure of Other Required Information", "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent Fee or Other Fee", and "Certification of Participation in a State-Registered Apprenticeship Program", any false certification at any time by the Contractor or a subcontractor pursuant to the clause "Prevailing Rate of Wage Certification" set forth in the Information for Bidders, or the willful or fraudulent submission of any signed statement pursuant to such clauses which is false in any material respect; or the Contractor's incomplete or inaccurate representation of its status with respect to the circumstances provided for in such clauses.

The enumeration in this numbered clause or elsewhere in this Contract of specific rights and remedies of the Authority shall not be deemed to limit any other rights or remedies which the Authority would have in the absence of such enumeration; and no exercise by the Authority of any right or remedy shall operate as a waiver of any other of its rights or remedies not inconsistent therewith or to estop it from exercising such other rights or remedies.

62. RIGHTS AND REMEDIES OF CONTRACTOR

Inasmuch as the Contractor can be adequately compensated by money damages for any breach of this Contract which may be committed by the Authority, the Contractor expressly agrees that no default, act or omission of the Authority shall constitute a material breach of this Contract, entitling him to cancel or rescind it or (unless the Engineer shall so direct) to suspend or abandon performance.

63. PERFORMANCE OF WORK AS AGENT FOR CONTRACTOR

In the exercise of its right to take over and complete Work as agent for the Contractor, for which provision is made in the clause hereof entitled "Rights and Remedies of Authority", the Authority shall have the right to take possession of and use or permit the use of any and all plant, materials, equipment and other facilities provided by the Contractor for the purpose of the Work and the Contractor shall not remove any of the same from the site of the Work without express permission. Unless expressly directed to discontinue the performance of all Work, the Contractor shall continue to perform the remainder thereof in such manner as in no way will hinder or interfere with the portions taken over by the Authority.

In the certificate of total compensation earned, for which provision is made in the clause hereof entitled "Final Payment", the Engineer will separately state the amount of Work performed by the Authority as agent for the Contractor, credit to the Authority the cost thereof, and credit to the Contractor the compensation earned thereby; and the difference between them shall be payable by the Contractor to the Authority, or vice versa as the case may be. If such difference is in its favor, the Authority may deduct it from any moneys due the Contractor, and if such moneys be insufficient, the balance thereof shall be payable to it on demand; if in the Contractor's favor, it shall constitute part of the Final Payment.

The exercise by the Authority of its right to take over the Work shall not release the Contractor or his sureties from any of his or their obligations or liabilities under this Contract or the Performance and Payment Bond.

64. NO ESTOPPEL OR WAIVER

The Authority shall not be precluded or estopped by any acceptance, certificate or payment, final or otherwise, issued or made under this Contract or otherwise issued or made by it, the Engineer, or any officer, agent or employee of the Authority, from showing at any time the true amount and character of Work performed, or from showing that any such acceptance, certificate or payment is incorrect or was improperly issued or made; and the Authority shall not be precluded or estopped, notwithstanding any such acceptance, certificate or payment, from recovering from the Contractor any damages which it may sustain by reason of any failure on his part to comply strictly with this Contract, and any moneys which may be paid to him or for his account in excess of those to which he is lawfully entitled.

Neither the acceptance of the Work or any part thereof, nor any payment therefor, nor any order or certificate issued under this Contract or otherwise issued by the Authority, the Engineer, or any officer, agent or employee of the Authority, nor any permission or direction to continue with the performance of Work, nor any performance by the Authority of any of the Contractor's duties or obligations, nor any aid lent to the Contractor by the Authority in his performance of such duties or obligations, nor any other thing done or omitted to be done by the Authority, its Commissioners , officers, agents or employees shall be deemed to be a waiver of any provision of this Contract or of any rights or remedies to which the Authority may be entitled because of any breach thereof, excepting only a resolution of its Commissioners, providing expressly for such waiver. No cancellation, rescission or annulment hereof, in whole or as to any part of the Work, because of any breach hereof, shall be deemed a waiver of any money damages to which the Authority may be entitled because of such breach. Moreover, no waiver by the Authority of any breach of this Contract shall be deemed to be a waiver of any other or any subsequent breach.

CHAPTER VIII

MISCELLANEOUS

65. SUBMISSION TO JURISDICTION

The Contractor hereby irrevocably submits himself to the jurisdiction of the Courts of the State of New York and to the jurisdiction of the Courts of the State of New Jersey in regard to any controversy arising out of, connected with, or in any way concerning the Proposal or this Contract. The Contractor agrees that service of process on the Contractor in relation to such jurisdiction may be made, at the option of the Authority, either by registered or certified mail addressed to the applicable office as provided for in the clause hereof entitled "Service of Notices on the Contractor", by registered or certified mail addressed to any office actually maintained by the Contractor or by actual personal delivery to the Contractor if the Contractor be an individual, to any partner if the Contractor be a partnership or to an officer, director or managing or general agent if the Contractor be a corporation.

Such service shall be deemed to be sufficient when jurisdiction would not lie because of the lack of basis to serve process in the manner otherwise provided by law. In any case, however, process may be served as stated above whether or not it might otherwise have been served in a different manner.

66. PROVISIONS OF LAW DEEMED INSERTED

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein and the Contract shall be read and enforced as though it were included therein, and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

67. INVALID CLAUSES

If any provision of this Contract shall be such as to destroy its mutuality or to render it invalid or illegal, then, if it shall not appear to have been so material that without it the Contract would not have been made by the parties, it shall not be deemed to form part thereof but the balance of the Contract shall remain in full force and effect.

68. NON-LIABILITY OF THE AUTHORITY REPRESENTATIVES

Neither the Commissioners of the Authority nor any officer, agent, or employee thereof shall be charged personally by the Contractor with any liability or held liable to him under any term or provision of this Contract, or because of its execution or attempted execution, or because of any breach hereof.

69. SERVICE OF NOTICES ON THE CONTRACTOR

Whenever provision is made in this Contract for the giving of any notice to the Contractor, its deposit in any post office or post office box, enclosed in a postpaid wrapper addressed to the Contractor at his office, or its delivery to his office, shall be sufficient service thereof as of the date of such deposit or delivery, except to the extent, if any, otherwise provided in the clause entitled "Submission to Jurisdiction". Until further notice to the Authority the Contractor's office will be that stated in his Proposal. Notices may also be served personally upon the Contractor; or if a corporation, upon any officer, director, or managing or general agent; or if a partnership upon any partner.

70. MODIFICATION OF CONTRACT

No change in or modification, termination or discharge of this Contract, in any form whatsoever, shall be valid or enforceable unless it is in writing and signed by the party to be charged therewith or his duly authorized representative, provided, however, that any change in or modification, termination or discharge of this Contract expressly provided for in this Contract shall be effective as so provided.

The authority of any person to order Extra Work or to alter the Contract Drawings and Specifications does not include the power to cancel, modify or waive any provision of the Form of Contract, and no officer or other representative of the Authority shall have the power so to do unless and until hereafter so authorized by or pursuant to a resolution of the Commissioners of the Authority or by or pursuant to a resolution of their appropriate Committee.

71. PUBLIC RELEASE OF INFORMATION

The Contractor and all his subcontractors shall not issue or permit to be issued any press release, advertisement, or literature of any kind, which refers to the Authority or the services performed in connection with this Contract, without first obtaining the written approval of the Chief Engineer. Such approval may be withheld if for any reason the Chief Engineer believes that the publication of such information would be harmful to the public interest or is in any way undesirable. This provision shall survive termination or expiration of this Contract.

PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS that we, the undersigned[21] Contractor and surety company (or companies), as principal and surety (or sureties), respectively,

Contractor	Surety

[21] Insert names of the Contractor and surety company (or companies) in the appropriate columns. If space is insufficient add rider.

If the Contractor is a corporation, give the state of incorporation, using also the phrase "a corporation organized under the laws of _____".

If the Contractor is a partnership, give full names of partners, using the phrase "co-partners doing business under the firm name of _____".

If the Contractor is an individual using a trade name, give individual name, using also the phrase "an individual doing business under the trade name of _____.".

are hereby held and firmly bound unto The Port Authority of New York and New Jersey (herein called the "Authority") in the penal sum of _____ Dollars

and _____ Cents ($ _____.), for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, representatives, executors, administrators, successors and assigns. Each surety, however, if there is more than one, shall be jointly and severally liable for said penal sum.

Signed this _____ day of _____ 20

The condition of the above obligation is that

WHEREAS, the above named principal has entered into a Contract in writing with the Authority, a copy of which is hereby made a part of this bond as though herein set forth in full and which is designated Contract LGA-124.201 - "LaGuardia Airport – Design and Construction of the East Parking Garage", and

WHEREAS, the Authority has required this bond for the faithful performance of all obligations imposed by said Contract and also for the payment of all lawful claims of subcontractors, materialmen and workmen arising out of the performance of said Contract;

NOW, if the said principal shall well and faithfully do and perform the things agreed by him to be done and performed according to the terms and true intent and meaning of said Contract and if all lawful claims of subcontractors, materialmen and workmen arising out of the performance of said Contract are paid, then this obligation shall be void, otherwise the same shall remain in full force and effect; it being expressly understood and agreed that, provided the sureties shall comply with the provisions hereof, the aggregate liability of all sureties for any and all claims hereunder shall in no event exceed the penal amount of this obligation as hereinbefore stated.

This undertaking is for the benefit of the Authority and all subcontractors, materialmen and workmen having lawful claims arising out of the performance of said Contract, and all such subcontractors, materialmen and workmen (as well as the Authority itself) shall have a direct right of action upon this bond; but the rights and equities of such subcontractors, materialmen and workmen shall be subject and subordinate to those of the Authority.

The sureties, for value received, hereby stipulate and agree that the obligations of said sureties and their bond shall be in no way impaired or affected by any extensions of time, modification, omission, addition or change in or to the said Contract or the construction to be performed thereunder, or by any supervision or inspection or omission to supervise or inspect the construction, or by any payment thereunder before the time required therein, or by any waiver of any provision or condition thereof (whether precedent or subsequent), or by any assignment, subletting or other transfer thereof or of any part thereof or of any construction to be performed or any moneys due or to become due thereunder; and said sureties do hereby waive notice of any and all of such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers, and hereby expressly stipulate and agree that any and all things done and omitted to be done by and in relation to assignees, subcontractors and other transferees shall have the same effect as to said sureties as though done by or in relation to said principal.

The sureties shall give the General Counsel of the Authority the following notices:

A. Written notice of an intent to pay any claim of a subcontractor, materialman or workman hereunder;

B. Written notice within five days of the institution of an action by a subcontractor, materialman or workman hereunder.

The sureties shall not pay the claim of any subcontractor, materialman or workman hereunder until the expiration of thirty days after receipt by said General Counsel of notice under either subparagraph A or B above, describing the claim to be paid.

IN WITNESS WHEREOF, the principal and the sureties have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____

Principal

(Seal) By [22] _____

_____

Surety

By[23] _____

APPROVED AS TO ACCEPTABILITY OF SURETIES:

_____

Credit Manager

_____ 20

---

22 If bond is signed by an officer or agent, give title; if signed by a corporation, affix corporate seal.

23 Add signatures of additional sureties, if any.

ACKNOWLEDGMENT OF PRINCIPAL, IF A CORPORATION

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known, who being by me duly sworn, did depose and say that he resides at _____; that he is the _____. of _____ the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation, and that he signed his name thereto by like order.

(Notary Seal) _____

(Notary Signature)

ACKNOWLEDGMENT OF PRINCIPAL, IF A PARTNERSHIP

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me

personally came and appeared _____, to me known, and known to me to be one of the members of the firm of _____ _____ described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(Notary Seal) _____

(Notary Signature)

ACKNOWLEDGMENT OF PRINCIPAL, IF AN INDIVIDUAL

State of _____

_____ SS:

County of _____

On this _____ day of _____, 20 , before me personally came and appeared _____, to me known and known to me to be the person described in and who executed the foregoing instrument and he acknowledged to me that he executed the same.

(Notary Seal) _____

(Notary Signature)

AFFIX ACKNOWLEDGMENT AND JUSTIFICATION OF SURETY

BASIC SPECIFICATIONS

DIVISION 1

GENERAL PROVISIONS

72. CONSTRUCTION REQUIRED BY THE SPECIFICATIONS

These Basic Specifications relate generally to performing the design and construction of a multi-level parking garage and related Work at the Westerly end of existing Parking Lot 4 and the vicinities thereof at LaGuardia Airport.

These Basic Specifications require the doing of all things necessary or proper for or incidental to the matter referred to in the immediately preceding paragraph, as shown on the Basic Contract Drawings in their present form. In addition, all things shown on the Basic Contract Drawings even though not expressly mentioned in these Basic Specifications, all things mentioned in these Basic Specifications even though not shown on the Basic Contract Drawings, and all things not specified either on the Basic Contract Drawings, or in the Basic Specifications but involved in carrying out their intent and in the complete and proper execution of the matter referred to in the immediately preceding paragraph are required by these Basic Specifications; and the Contractor shall perform the same as though they were specifically delineated, described and mentioned.

In case of a conflict between a requirement of the Basic Contract Drawings and a requirement in Division 1 of the Basic Specifications, the requirement of Division 1 shall control. In case of a conflict between a requirement contained in other Divisions of the Basic Specifications and a requirement of the Basic Contract Drawings, the requirement of the Basic Contract Drawings shall control.

Some Sections of the Basic Specifications make cross references to construction specified in other Sections of the Basic Specifications, including cross references intended to avoid duplication by the bidders in quoting prices and to point out some of the necessity for coordination. Such cross references are not intended to be complete or all inclusive, and the Contractor shall ascertain for himself both the nature and the extent of all construction which may be related to that under each Section of the Basic Specifications whether or not expressly referred to.

Some Sections of the Basic Specifications contain a general description of the construction under such Sections. Such description is merely a very general one and is not intended to outline the construction required by the Basic Specifications and Basic Contract Drawings. Accordingly, such description shall be construed as in aid of and supplemental to, but in no case limiting, impairing or decreasing, the requirements elsewhere set forth with respect to the construction to be performed.

The Contractor's compensation for all construction whatsoever referred to in the Basic Specifications and Basic Contract Drawings in their present form, even though the need for certain items of such construction may be contingent upon future occurrences or determinations or upon other circumstances, shall be deemed to be included in the price(s) quoted by the Contractor in the Form of Contract unless the Basic Specifications or Basic Contract Drawings expressly state that compensation in addition to such price shall be payable for such items of construction. The express statement in some cases to the effect that certain construction shall be without additional cost to the Authority shall not impair the application of this paragraph in other cases.

The distribution of various parts of the construction among the Divisions and Sections of the Basic Specifications or among the Basic Contract Drawings is not intended as a representation of the most effective or logical method of organizing, scheduling, or subcontracting the construction, and the Contractor shall ascertain for himself how to do so unless otherwise expressly prescribed in this Contract.

In all cases the provisions of the second paragraph of this numbered Section shall control.

73. AVAILABLE PROPERTY

Subject to the conditions elsewhere stated herein, those areas to be occupied by the permanent construction will be made available to the Contractor upon commencement of his first operations at the construction site.

Any additional property which the Contractor desires for his operations shall be obtained by him at his own expense.

The Contractor will be permitted to use only so much of the aforesaid areas as is necessary for the performance of the Contract, and he must at all times so conduct his operations as not to encroach upon or block the portions used by others. The Engineer may at any time make joint or exclusive assignments of particular portions thereof, either to the Contractor or to others, and may take over and use for other purposes any portions which, in the opinion of Engineer, are not required for the performance of the Contract.

The Contractor shall daily clean up the areas made available to him so that they are free at all times of refuse, rubbish, scrap material or debris.

74. CONSTRUCTION SITE SECURITY REQUIREMENTS

The Port Authority of New York and New Jersey operates facilities and systems at which terrorism or other criminal acts may have a significant impact on life safety and key infrastructures. The Authority reserves the right to impose multiple layers of security requirements on the performance of the Work of the Contract, including on the Contractor, subcontractors and materialmen, depending upon the level of security required, as determined by the Authority. The Contractor shall comply, and shall ensure that his subcontractors and materialmen comply, with the following security requirements:

A. Identity Checks, Background Screening and Issuance of Photo Identification Cards

No person will be permitted on or about the construction site without a Facility Photo ID issued by the Authority. Facility Photo IDs are required for employees of the Contractor, subcontractors and materialmen. All employees of the Contractor, subcontractors and materialmen shall wear Facility Photo IDs in a conspicuous and clearly visible position whenever they are working at the construction site.

As part of the requirement for the issuance of Facility Photo IDs, the Contractor shall perform background checks through the Secure Worker Access Consortium (SWAC) and obtain SWAC ID cards with a "HIGH" SWAC approval level for all workmen and materialmen on this Contract. Information on the SWAC process, including office locations and hours of operation, is available on the following website: http://www.secureworker.com/ .

The Contractor shall coordinate with the Engineer at least 5 business days in advance to obtain Facility Photo IDs. The SWAC ID card, a state issued driver's license and an additional form of identification shall be presented by each workman and materialman in order to be issued a Facility Photo ID by the Authority. Facility Photo IDs will be issued at no cost to the Contractor.

The Contractor shall ensure that all workmen and materialmen renew their SWAC ID and Facility Photo ID prior to the respective ID cards' expiration dates. Any workman or materialman with an expired SWAC ID or expired Facility Photo ID shall not be permitted access to the construction site.

B. Construction Site Access Control:

1.) The Authority may provide for construction site access control, inspection and monitoring by security guards retained by the Authority. However, this provision shall not relieve the Contractor of his responsibility to secure equipment and Work at the construction site at his own expense.

2.) At the beginning of each work period or work shift, the Contractor shall furnish to the security guards, if any, or to the Engineer a memorandum showing for that work period or work shift:

a. The name and company affiliation of each employee of the Contractor or of a subcontractor who is expected to enter the construction site and,

b. The name of each firm expected to deliver materials, service equipment or perform other services and a description of such materials or services.

C. High Security Areas:

1.) If Work under this Contract is required in high security areas, as may be designated as such by the Authority, the Contractor shall comply with certain security procedures while performing Work in such areas. The security procedures may require that the Contractor, subcontractors or materialmen performing Work in such areas be escorted to and from these areas by security personnel designated by the Authority. Further, the Contractor, subcontractors or materialmen may be required to be monitored by security personnel designated by the Authority while performing Work in certain high security areas.

2.) Prior to the start of Work at the construction site, the Contractor will be provided with a description of the high security areas from the Authority, which will be in effect on the date that Work commences. The description of high security areas may be changed at any time by the Authority during the duration of this Contract. The Contractor shall notify the Authority no less than twenty-four hours prior to the performance of any Work in a high security area. The Contractor shall conform to the security procedures as may be established by the Authority and the escorting and monitoring of workmen and materialmen hereunder.

The Authority may impose, increase, and/or upgrade security requirements for the Contractor, subcontractors and materialmen during the duration of this Contract to address changing security conditions and/or new governmental regulations. The Contractor will be compensated for changes to the security requirements as directed by the Engineer at the Net Cost of such Work. "Net Cost" shall be computed in the same manner as is compensation for extra work, including any percentage addition to cost, as set forth in the clause of the Form of Contract entitled "Compensation for Extra Work". Performance of such Net Cost Work shall be as directed by the Engineer and shall be subject to all provisions of the Contract relating to performance of extra work. Compensation for said Net Cost Work shall not be charged against the total amount of compensation authorized for extra work.

75. OPERATIONS OF OTHERS

During the time that the Contractor is performing the Contract, other persons will be engaged in other operations on or about the construction site including performing runway and taxiway pavement rehabilitation, peforming structural rehabilitation of existing runway decks and peforming utilitiy upgrade and maintenance work. all of which shall remain uninterrupted.
The Contractor shall so plan and conduct his operations as to work in harmony with others engaged at the construction site and not to delay, endanger or interfere with the operations of others (whether or not specifically mentioned above), all to the best interests of the Authority and the public and as may be directed by the Engineer.

76. LABOR ACTIONS

Whenever any labor strike, slowdown, work stoppage, picketing or other labor action which might interfere with the performance of the Contract, or of other Authority or PATH contracts or the operation of any Authority or PATH facility occurs at the construction site or at any other Authority or PATH facility as a result of the Contractor's (or its subcontractor's) utilization of particular means, methods or manpower to perform the Work required by the Contract, the Contractor shall pursue all remedies which are appropriate and available to him to avoid such interference.

77. CONTRACTOR'S MEETINGS

The Contractor shall conduct job progress and coordination meetings with subcontractors in his field office every two weeks, or as frequently as job conditions require or the Engineer may request. The Engineer shall be notified and, at his option, may attend these meetings. The Contractor shall prepare and distribute minutes to the Engineer and the subcontractors within forty-eight (48) hours of the day following the meetings.

The Contractor shall attend separate job progress and coordination meetings with the Engineer every two weeks, or at times otherwise requested by the Engineer.

78. BASIC CONTRACT DRAWINGS

The Basic Contract Drawings which accompany and form a part of these Specifications bear the general title "The Port Authority of NY & NJ - LaGuardia Airport – Design and Construction of the East Parking Garage - Contract LGA-124.201" and are separately numbered and entitled as follows:

Drawing No.	Title	
G001	TITLE SHEET	General
G002	DRAWING INDEX	General
G003	GENERAL NOTES	General
G004	GENERAL NOTES (CONTINUED)	General
G005	NOTES AND ABBREVIATIONS	General
G006	REGIONAL AND FACILITY PLANS	General
G007	PROJECT LOCATION PLAN	General
C001	CIVIL NOTES, LEGEND AND ABBREVIATIONS	Civil
C002	ALIGNMENT PLAN	Civil
C003	REMOVAL PLAN	Civil
C004	PAVING PLAN	Civil
C005	GRADING PLAN	Civil
C006	UTILITY PLAN	Civil
C007	SECTIONS	Civil
C008	DETAILS -1-	Civil
C009	DETAILS -2-	Civil
C010	DETAILS -3-	Civil
C011	DETAILS -4-	Civil
C012	DETAILS -5-	Civil
A011	EAST END SITE PLAN	Architectural
A012	AXONOMETRIC VIEW	Architectural
A101	LEVEL 1 FLOOR PLAN	Architectural
A103	LEVEL 2, LEVEL 3 AND LEVEL 4 FLOOR PLANS	Architectural
A105	LEVEL 5 FLOOR PLAN	Architectural
A106	LEVEL 6 FLOOR PLAN	Architectural
A201	NORTH AND SOUTH ELEVATION	Architectural
A202	EAST AND WEST ELEVATION	Architectural
A251	BUILDING SECTIONS	Architectural

A311	ENLARGED ELEVATOR PLANS AND AXONOMETRIC VIEW	Architectural
A313	ELEVATOR CAB PLANS AND SECTIONS	Architectural
A321	STAIR PLANS AND SECTION	Architectural
A501	EXTERIOR METAL PANEL SCREEN DIAGRAM	Architectural
A502	ENLARGED SECTION AND ELEVATION TYPICAL	Architectural
A504	ENLARGED SECTION AND ELEVATION	Architectural
A511	FACADE DETAILS – SECTIONS AND PLANS	Architectural
A521	FACADE PANELS – TYPE 1	Architectural
A522	FACADE PANELS – TYPE 2 AND 2'	Architectural
A523	FACADE PANESL – TYPE 3	Architectural
A751	STAIR DETAILS	Architectural
S101	LEVEL 1 SLAB PLAN	Structural
S102	TYPICAL LEVEL (LEVELS 2-4) FRAMING PLAN	Structural
S103	LEVEL 5 FRAMING PLAN	Structural
S104	LEVEL 6 FRAMING PLAN	Structural
S201	STRUCTURAL NORTH & SOUTH ELEVATIONS	Structural
S202	STRUCTURAL EAST & WEST ELEVATIONS	Structural
S701	DETAILS	Structural
VT501	EAST GARAGE GENERAL DATA	Vertical Transportation
VT502	EAST GARAGE PASSENGER ELEVATORS 1-3_4000_350	Vertical Transportation
M001	NOTES, ABBREVIATIONS AND SYMBOLS	Mechanical
M501	HVAC RISER DIAGRAM	Mechanical
M505	FUEL OIL PIPING FLOW DIAGRAM	Mechanical
FP001	FIRE PROTECTION NOTES, ABBREVIATION AND SYMBOLS	Fire Protection
FP501	STANDPIPE RISER DIAGRAM	Fire Protection
P001	PLUMBING NOTES, ABBREVIATION AND SYMBOLS	Plumbing
P501	SANITARY RISER DIAGRAM	Plumbing
P502	STORM RISER DIAGRAM	Plumbing
P503	WATER RISER DIAGRAM	Plumbing

E001	ELECTRICAL GENERAL NOTES AND SYMBOL LIST	Electrical
E101	SINGLE LINE DIAGRAM 1	Electrical
E102	SINGLE LINE DIAGRAM 2	Electrical
E103	SINGLE LINE DIAGRAM 3	Electrical
E104	SINGLE LINE DIAGRAM 4	Electrical
E105	POWER RISER DIAGRAM	Electrical
E106	FIRE ALARM RISER DIAGRAM	Electrical
E200	ELECTRICAL AND ELECTRONIC CONDUITS	Electrical
E211	LEVEL 1 LIGHTING PLAN	Electrical
E212	LEVEL 2-5 TYPICAL LIGHTING PLAN	Electrical
E216	LEVEL 6 LIGHTING PLAN	Electrical
E302	LIGHTING FIXTURE SCHEDULE -1	Electrical
E303	LIGHTING FIXTURE SCHEDULE -2	Electrical
E304	LIGHTING FIXTURE SCHEDULE -3	Electrical
E309	SUBSTATION ARRANGEMENT	Electrical
ES001	ELECTRONICS DRAWING LIST, ABBREVIATIONS, SYMBOLS, AND NOTES	Electronics
ES002	ELECTRONICS NOTES AND SYMBOLS	Electronics
ES101	ELECTRONICS LEVEL 1 PLAN	Electronics
ES102	ELECTRONICS LEVEL 2 PLAN	Electronics
ES103	ELECTRONICS LEVELS 3-5 PLAN	Electronics
ES106	ELECTRONICS LEVEL 6 PLAN	Electronics
ES201	ELECTRONICS OSP CABLE RISER DIAGRAM	Electronics
ES202	ELECTRONICS OSP CONDUIT RISER DIAGRAM	Electronics
ES203	ELECTRONICS LOGIC DIAGRAM	Electronics
ES204	ELECTRONICS VOICE AND DATA LOGIC PROGRAM	Electronics
ES301	ELECTRONICS CONTROL CLOSETS	Electronics
ES302	ELECTRONICS CONTROL ROOM	Electronics
ES501	ELECTRONICS DETAILS	Electronics
ES502	ELECTRONICS DETAILS	Electronics
ES503	ELECTRONICS DETAILS	Electronics
ES504	ELECTRONICS DETAILS	Electronics

ES505	ELECTRONICS DETAILS	Electronics
ES506	ELECTRONICS DETAILS	Electronics
ES507	ELECTRONICS DETAILS	Electronics
ES508	ELECTRONICS DETAILS	Electronics
ES509	ELECTRONICS DETAILS	Electronics
ES510	ELECTRONICS DETAILS	Electronics
MT001	MAINTENANCE OF TRAFFIC – WORK AREA PROTECTION PLAN	Traffic
T001	SITE PAVEMENT MARKING, GUIDE RAIL, AND CONCRETE BARRIER LOCATION PLAN	Traffic
T007	PAVEMENT MARKING AND SIGN LOCATION PLAN LEVEL P-1	Traffic
T008	PAVEMENT MARKING AND SIGN LOCATION PLAN LEVEL P-2	Traffic
T009	PAVEMENT MARKING AND SIGN LOCATION PLAN LEVEL P-3	Traffic
T010	PAVEMENT MARKING AND SIGN LOCATION PLAN LEVEL P-4	Traffic
T011	PAVEMENT MARKING AND SIGN LOCATION PLAN LEVEL P-5	Traffic
T012	PAVEMENT MARKING AND SIGN LOCATION PLAN LEVEL P-6	Traffic
T024	SIGN DATA SHEET -12	Traffic
T025	STANDARD DETAILS -1-	Traffic

The Basic Contract Drawings do not show all of the details of the Work and are intended only to illustrate the character and extent of the Work to be performed. Accordingly, they may be supplemented during the performance of the Work by the Engineer or by the Contractor subject to the approval of the Engineer, to the extent necessary to further illustrate the Work.

An indication on the Basic Contract Drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials does not constitute a representation as to the conclusions to be drawn therefrom nor a representation that no others exist in addition to those shown, even in the same location; nor does the absence of any indication on said drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials constitute a representation that none exist.

After the Contract has been executed, the Contractor will be furnished six (6) copies of the Basic Specifications and Basic Contract Drawings without charge.

79. REFERENCE DRAWINGS

The following drawings, called Reference Drawings, were not prepared by the Authority or by others for use in connection with this Contract, but they were prepared for other purposes, such as for other contracts or for design purposes for this or other contracts, and are furnished to the Contractor to give him such information as may be in the possession of the Authority. Said drawings are as follows:

A. Drawings bearing the general title "Building System Reference Drawings for contract LGA-124.201" and separately numbered and entitled as follows:

G001	TITLE SHEET	General
G002	DRAWING INDEX	Architectural
S105	LEVEL 1 STRIPING PLAN	Structural
S106	TYPICAL LEVEL STRIPING PLAN	Structural
S107	LEVEL 5 STRIPING PLAN	Structural
S108	LEVEL 6 STRIPING PLAN	Structural
S251	STRUCTURAL BUILDING SECTIONS	Structural
S252	STRUCTURAL BUILDING SECTIONS	Structural
S253	STRUCTURAL BUILDING SECTIONS	Structural
S254	STRUCTURAL BUILDING SECTIONS	Structural
S301	TYPICAL STAIR PLANS & SECTIONS	Structural
M101	LEVEL 1 FLOOR PLAN	Mechanical
M102	LEVEL 2 FLOOR PLAN	Mechanical
M103	LEVEL 3 AND LEVEL 4 FLOOR PLAN	Mechanical
M104	LEVEL 5 FLOOR PLAN	Mechanical
M105	LEVEL 6 FLOOR PLAN	Mechanical
M106	ROOF LEVEL PLAN	Mechanical
M503	HVAC DETAILS 2	Mechanical
M504	HVAC SCHEDULES	Mechanical
M506	DIESEL TANK ROOM LEVEL 1 PART PLAN	Mechanical
FP101	LEVEL 1 FLOOR PLAN	Fire Protection
FP102	LEVEL 2 FLOOR PLAN	Fire Protection
FP103	LEVEL 3 AND LEVEL 4 FLOOR PLAN	Fire Protection
FP104	LEVEL 5 FLOOR PLAN	Fire Protection
FP105	LEVEL 6 FLOOR PLAN	Fire Protection
FP301	WATER SERVICE SUMP PUMP & JANITOR CLOSET LEVEL 1 PART. PLAN	Fire Protection
FP502	FIRE PROTECTION DETAILS	Fire Protection

P101	LEVEL 1 FLOOR PLAN	Plumbing
P102	LEVEL 2 FLOOR PLAN	Plumbing
P103	LEVEL 3 AND 4 FLOOR PLAN	Plumbing
P104	LEVEL5 FLOOR PLAN	Plumbing
P105	LEVEL 6 FLOOR PLAN	Plumbing
P106	LEVEL 7 ROOF PLAN	Plumbing
P151	UNDER SLAB PIPES LEVEL 1 FLOOR PLAN	Plumbing
P301	JANITOR CLOSET LEVEL 2, LEVEL 3, LEVEL 4 AND LEVEL 5 PART PLAN	Plumbing
P302	WATER SERVICE SUMP PUMP & JANITOR CLOSET LEVEL 1 PART PLAN	Plumbing
P505	PLUMBING SCHEDULES	Plumbing
E201	LEVEL 1 POWER PLAN	Electrical
E202	LEVEL 2 POWER PLAN	Electrical
E203	LEVEL 3 POWER PLAN	Electrical
E204	LEVEL 4 POWER PLAN	Electrical
E205	LEVEL 5 POWER PLAN	Electrical
E206	LEVEL 6 POWER PLAN	Electrical
E217	TYPICAL LIGHTING PLANS	Electrical
E301	FEEDER SCHEDULE	Electrical
E305	MANHOLE DETAILS	Electrical
E306	HANDHOLE DETAILS	Electrical
E307	DUCTBANK DETAILS	Electrical
E308	5KV CABLE PULL CHAMBER DETAIL	Electrical
MT002	MAINTENANCE OF TRAFFIC STANDARD DETAILS -1-	Traffic
MT003	MAINTENANCE OF TRAFFIC STANDARD DETAILS -2-	Traffic
MT004	MAINTENANCE OF TRAFFIC STANDARD DETAILS -3-	Traffic
MT005	MAINTENANCE OF TRAFFIC STANDARD DETAILS -4-	Traffic
T013	SIGN DATA SHEET -1-	Traffic
T014	SIGN DATA SHEET -2-	Traffic
T015	SIGN DATA SHEET -3-	Traffic
T016	SIGN DATA SHEET -4-	Traffic

T018	SIGN DATA SHEET -6-	Traffic
T019	SIGN DATA SHEET -7-	Traffic
T020	SIGN DATA SHEET -8-	Traffic
T021	SIGN DATA SHEET -9-	Traffic
T022	SIGN DATA SHEET -10-	Traffic
T023	SIGN DATA SHEET -11-	Traffic
T026	STANDARD DETAILS -2-	Traffic
T027	STANDARD DETAILS -3-	Traffic
T028	STANDARD DETAILS -4-	Traffic
T029	STANDARD DETAILS -5-	Traffic
T030	STANDARD DETAILS -6-	Traffic
T031	STANDARD DETAILS -7-	Traffic

B. LaGuardia Airport East Garage Code analysis dated March, 2013

C. PA Standard Signage Submission for JFK Terminal 4 Headhouse Expansion

D. LaGuardia Airport Redevelopment Program Protective Design Narrative, pages 34 to 38, dated 3/29/2013.

An indication on the Reference Drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials does not constitute a representation as to the conclusions to be drawn there from nor a representation that no others exist in addition to those shown, even in the same location; nor does the absence of any indication on said drawings of the existence, nature or location of any utilities, structures, obstructions, conditions or materials constitute a representation that none exist.

80. SHOP DRAWINGS, CATALOG CUTS AND SAMPLES

The Contractor shall specifically prepare for this Contract all Shop Drawings which may be required in addition to the Detailed Contract Drawings or in addition to any other drawings which the Engineer may issue in supplementing the Contract Drawings.

The specific requirements elsewhere set forth in the Specifications for furnishing Shop Drawings, Catalog Cuts and samples for any particular portion of the Contract shall not limit the obligation of the Contractor to furnish Shop Drawings, Catalog Cuts and samples for any other portion when so required by the Engineer.

The Contractor shall submit a general "Submittal Schedule" for the Engineer's review and approval listing the planned transmittal date and estimated number in each specification section category of Shop Drawings, Catalog Cuts, pages of calculations and samples within 30 days after receipt by the Contractor of the acceptance of the Proposal. A more detailed schedule shall be submitted no less than 30 calendar days prior to the actual date of any submittal.

After checking and verifying all field measurements and after complying with applicable procedures specified hereunder, the Contractor shall submit to the Engineer for review and approval, in accordance with the approved schedule of Shop Drawing submissions, or for other action if so indicated by the Engineer, six copies, unless otherwise requested, of all Shop Drawings which will bear a specific written indication that the Contractor has reviewed the submission for conformance to the requirements of the Contract Drawings and Specifications.

The Port Authority uses Oracle Primavera Contract Management (formerly known as Expedition) software to track the status of Submittals provided by the Contractor. In order to facilitate this electronic tracking, the Contractor shall use the transmittal form that is provided at the pre-construction meeting, and shall forward it to the Engineer via a MAPI compliant e-mail system (e.g. Microsoft Outlook, CC mail, Lotus notes, etc.).

The Contractor's transmittals of Submittal data shall fully comply with the numbering and naming conventions and other procedures that will be provided by the Engineer to the Contractor at the pre-construction meeting.

All submissions shall contain specific reference to the contract drawing and technical specification section to which they apply, as indicated below or as otherwise identified, as the Engineer may require. In general, submissions shall specifically reference Contract Drawing numbers or Specification section numbers for which the item pertains. The data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, conformance to the specified performance and design criteria, materials, test results and similar information to enable the Engineer to review the submittal as required.

The Contractor shall also submit six copies to the Engineer for review and approval pursuant to the approved submittal schedule, of all Catalog Cuts and samples for conformance to the requirements of the Contract Drawings and Specifications. All Catalog Cuts and samples shall have been reviewed by the Contractor and shall be accompanied by a specific written indication that the Contractor has reviewed the submittal for conformance with the Contract Drawings and Specifications and shall be identified clearly as to material, supplier, manufacturer's procedures and pertinent data such as catalog numbers and the use for which intended.

Before submission of each Shop Drawing, Catalog Cut and sample, the Contractor shall have determined and verified all quantities, dimensions, conformance to the specified performance and design criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed and coordinated each Shop Drawing or Catalog Cut with other Shop Drawings and Catalog Cuts and with other requirements of the Work.

At the time of each submission, the Contractor shall give the Engineer specific written notice of each variation in any Shop Drawing, Catalog Cut and sample from the requirements of the Contract Drawings or Specifications and, in addition, shall cause a specific notation of each such variation to be made on each submittal to the Engineer, for review and approval of each such variation.

The Engineer's review and approval of Shop Drawings, Catalog Cuts or samples shall not relieve the Contractor from responsibility for any variation from the requirements of the Contract Drawings or Specifications unless the Contractor has in writing called the Engineer's attention to each such variation at the time of submission as required hereunder and the Chief Engineer has given written approval of each by an express specific written notation thereof incorporated in or accompanying the Shop Drawing, Catalog Cut or sample approval. Approval of Shop Drawings, Catalog Cuts and samples which are inconsistent with the requirements of the Contract Drawings and Specifications shall not be deemed to waive or change such requirements or to relieve the Contractor of his obligations to perform such requirements unless the Chief Engineer shall expressly and specifically state that he is waiving or changing such requirements, as stated above.

Where a Shop Drawing, Catalog Cut or sample is required no related Work shall be performed prior to the Engineer's review and approval of the submission.

The format for Shop Drawings prepared by the Contractor shall be as follows: Standard "D" size drawings with outside cut line dimensions of 22 inches by 34 inches and showing in detail all dimensions and description of materials. Two borders shall be drawn. The first shall be drawn one-half inch from the outside edges (top, bottom, left and right). The second shall be drawn inward to the drawing, one-half inch from the top, bottom and right border lines and one and one-half inch from the left border line. The inside borders on these drawings shall be 20 inches by 31 inches. A title block shall be shown on the right side of the drawing adjacent to the inside border identifying the Contractor's Name, Contract Title, Contract Number, cross-referenced Contract drawing number, Specification reference number and related paragraph and applicable signatures. These drawings shall be arranged in systematic order and numbered consecutively.

Upon receipt of the submittal, the Engineer will review the Shop Drawing, Catalog Cut or sample for conformance to the design information and materials shown on the Contract Drawings and contained in the Specifications. Approval by the Engineer shall not constitute a complete review or approval of the means, methods, techniques, sequences or procedures of construction, except where a specific means, method, technique, sequence or procedure of construction is specifically delineated in or required by the Contract Drawings or Specifications, and the approval shall not constitute a review and approval in regard to safety precautions or programs incident thereto. The review and approval of a separate item will not in itself indicate approval of the assembly in which the item functions. Any design shown on the Shop Drawings and prepared by the Contractor, his subcontractors, their detailers, or their professional engineers is the complete responsibility of the Contractor.

Within the number of working days hereinafter specified after receipt of the Shop Drawing prints, the Engineer shall approve or not approve the same or require corrections or additions to be made thereon. When a shop drawing is not approved or if additions or corrections are required, the Engineer shall return within this period one of the six copies submitted and the Contractor shall make the revisions, corrections or additions shown thereon to be made. The Contractor shall resubmit six prints showing the drawing corrected as required. The Contractor shall direct specific attention in writing to revisions other than the corrections called for by the Engineer on the previous submittal. Each drawing shall be corrected as required until the approval of the Engineer is obtained. After each resubmission, the Engineer shall have the number of working days hereinafter specified in which to approve revisions or corrections.

The number of working days within which the Engineer will advise the Contractor as to whether the Shop Drawings are approved, not approved, or require corrections or additions to be made thereto shall be as follows, except that 20 working days shall be required for the Engineer to review shop drawings submitted with design calculations.

No. of Dwgs. Submitted Within 5 Consecutive Working Days for Each Discipline(*)	No. of Working Days for Engineer To Review Shop Drawings
Up to 50	10
51 to 75	15
More than 75	20
* Disciplines shall be defined as follows: Structural, Architectural, Civil, Geotechnical, Mechanical, Electrical, Traffic and Environmental.	

Failure of the Contractor to provide 30 calendar days advance notice to the Engineer of any submittal shall result in a five (5) working day extension of the number of working days stated in the chart above. In no event shall an extension of the Engineer's review time provided for in this section relieve the Contractor from its duty to meet all contractual Milestone dates.

After approval has been given to any Shop Drawing or Catalog Cut no change will be permitted thereon unless approved in writing by the Engineer.

Before final payment for the Work is made, the Contractor shall submit to the Engineer only those previously approved or approved as noted Shop Drawings, which have been revised by field changes.

The Contractor shall mark-up the approved and approved as noted Shop Drawings directing specific attention to revisions reflecting the permanent construction as actually made. In accordance with the requirements specified in this numbered Section, the Contractor shall submit one original print of these drawings, marked "FINAL SHOP DRAWING – NOT FOR REVIEW", dated, and signed by the Contractor to the Engineer for verification. By signature, the Contractor is verifying that the drawing reflects the as-constructed condition.

All drawings, data, calculations and other papers of any type whatsoever, whether in the form of writing, figures or delineations, which are prepared in connection with this Contract and submitted to the Authority shall become the property of the Authority. The Authority shall have the non-exclusive right to use or permit the use of all such drawings, data and other papers and any ideas or methods represented thereby for any purpose and at any time without additional compensation. No such papers shall be deemed to have been given in confidence. Any statement or legend to the contrary in connection with such drawings, data or other papers and in conflict with the provisions of this paragraph shall be void and of no effect.

81. SUBSTITUTION

Where a proprietary item or make is specified or mentioned herein or called for or mentioned on the Contract Drawings and the phrases "similar and equal to" or "approved equal" are used in connection therewith, the utilization of any other item or make will be deemed a substitution. Substitution for the proprietary item or make specifically named may be made only in accordance with the Section hereof entitled "Workmanship and Materials" and in accordance with the following.

Whenever materials or equipment are specified or described in the Contract Drawings or Specifications by using the name of a proprietary item or the name of a particular supplier, the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of another supplier or manufacturer may be accepted by the Engineer if sufficient information and proof is submitted by the Contractor to permit the Engineer to determine that the material or equipment proposed is equivalent or equal to that named and the Engineer approves the substitution. The procedure for review by the Engineer will include the following. Requests for review of substitute items of material and equipment will not be accepted by the Engineer from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall make a timely written application to the Engineer for approval thereof, certifying that the proposed substitution will perform at least the identical functions and achieve at least the identical results called for by the specified product and otherwise be equal to the specified product with regard to, but not limited to, durability, maintenance, strength, energy costs and record of proven performance. The application shall state that the evaluation and approval of the proposed substitution shall not delay the Contractor's completion of the Work as required by the Contract, whether or not approval of the substitution will require a change in the construction and, in no event will the Contractor be granted an extension of time for completion of any portion of the Work for reasons related directly or indirectly to the evaluation of the proposed substitution or to the proposed substitution itself. Any variations of the proposed substitution from that specified shall be identified in the application, and maintenance, repair and replacement services for the substitution shall be indicated. The Engineer may require the Contractor to furnish at the Contractor's expense additional laboratory test data concerning the proposed substitution.

Such submission to the Engineer shall be made only by including the requested substitution in the list of materials required to be submitted to the Engineer in accordance with the Section hereof entitled "Inspections and Rejections" within forty-five calendar days after the receipt of the acceptance of the Contractor's Proposal. After the approval of said list, no substitutions will be permitted, except that a brand or make named in the Specifications may be submitted for approval in lieu of a brand or make on said list. Any such submission shall not imply, or impose on the Engineer, any obligation whatsoever to discuss, disclose or justify the reasons for his opinion, approval, acceptance or rejection.

The Engineer shall be the sole judge of as to whether a proposed substitution will be approved, and no substitution shall be ordered or utilized without the Engineer's prior written approval. The Engineer may require Contractor to furnish at Contractor's expense a special performance guarantee or other assurance with respect to any approved substitution. Furthermore, the approval of any substitute proprietary item or make shall not in any way entitle the Contractor to additional compensation therefor.

Notwithstanding such approval, however, the Contractor assumes the risk that such approved substitute item or make is not equal to that shown or specified and if at any time the substitution shall appear not to be so equal he shall replace the substitution with that originally shown on the Contract Drawings or called for in the Specifications at his own cost and reimburse the Authority for any loss occurring on account of the substitution failing to be equal, notwithstanding that it had been previously approved for use by the Engineer.

The construction called for by the Contract Drawings and Specifications may be adapted for a particular proprietary item or make of material or equipment. Therefore, if any construction not required by the Contract Drawings or Specifications in their present form is necessary or desirable because of the use of substitute item or make of material or equipment (even though such other item or make is approved by the Engineer), such construction shall be furnished or performed by the Contractor at his expense and subject to the approval of the Engineer.

82. WORKMANSHIP AND MATERIALS

Workmanship and materials shall in every respect be free from defects of any kind and shall be in accordance with the best modern practice and whenever the Contract Drawings, Specifications or directions of the Engineer admit of a doubt as to what is permissible or fail to note the quality of any construction the interpretation which calls for the best quality is to be followed. Workmanship shall conform to applicable Specifications, manufacturer's instructions and recommendations for installation of products for the applications shown on the Contract Drawings, all of which shall be subject to the provisions of the Section of Division 1 GENERAL PROVISIONS entitled "Inspections and Rejections".

Materials and Equipment incorporated into the Work shall be new except as may be otherwise herein specifically required, and shall comply with make, size, type and quality specified, or as specifically approved in writing by the Chief Engineer in accordance with the Section of Division 1 GENERAL PROVISIONS entitled "Substitution".

Reference to standards of any society, institution, association, or governmental authority in the Specifications or on the Contract Drawings, whether specific or by implication, shall mean for such standards which are part of the building code in effect for Work of this Contract, the edition date published in such code; and such references which are not part of the building code, shall mean the latest edition date in effect at the time of opening of Proposals upon the present Contract unless specifically stated otherwise.

In addition, various paragraphs of these Specifications may contain references to certain standard or tentative specifications or requirements of various organizations. Unless otherwise stated, these references are to be construed as referring to the specifications and requirements in effect on the date set for opening Proposals upon the present Contract.

If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment to be employed by the Contractor in performing the Work. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the approved instructions of the applicable supplier except as otherwise provided in the Contract Drawings or Specifications.

In case of a discrepancy between a description or requirement in the Contract Drawings and Specifications for any material or equipment and a catalog number or other designation for the same material or equipment (even though stated to be acceptable), the description or requirements shall control.

All inventions, ideas, designs and methods contained in the Specifications and Contract Drawings in which the Authority has or may acquire patent, copyright or other property rights are hereby expressly reserved for the exclusive use of the Authority. The Specifications and Contract Drawings contain confidential information which is disclosed only to enable this Contract to be performed. Said Specifications and Drawings must not be used for any purpose detrimental to the interest of the Authority and must not be produced or copied in whole or in part or used for furnishing information to others without the written consent of the Authority, provided, however, that the Contractor may, when the performance of the Contract so requires, furnish said information to others for the purpose of engaging or informing subcontractors and materialmen.

If, in accordance with this Contract, the Contractor furnishes research, development or consultative services in connection with the performance of the Contract and if in the course of such research, development or consultation patentable subject matter is produced by the Contractor, its officers, agents, employees, subcontractors or materialmen, the Authority shall have, without cost or expense to it, an irrevocable, non-exclusive, royalty-free license to make, have made, and use, either itself or by anyone on its behalf, such subject matter in connection with any activity now or hereafter engaged in or permitted by the Authority. Promptly upon request by the Authority, the Contractor shall furnish or obtain from the appropriate person a form of license satisfactory to the Authority, but as between the Contractor and the Authority the license herein provided for shall nevertheless arise for the benefit of the Authority immediately upon the production of said subject matter and shall not await formal exemplification in a written license agreement as provided for above. Such license may be transferred by the Authority to its successors, immediate or otherwise, in the operation or ownership of any real or personal property now or hereafter owned or operated by the Authority, but such license shall not be otherwise transferable.

The right to use all material, software, firmware, compositions of matter, manufactures, apparatus, appliances, processes of manufacture or types of construction required in connection with this Contract and to which a patent, copyright or other intellectual property right applies or may apply shall be obtained by the Contractor without separate or additional compensation whether the same is patented, copyrighted or otherwise protected as an intellectual property right before, during or after the performance of the Contract.

The Contractor shall indemnify the Authority against and save it harmless from all loss and expense incurred in the defense, settlement or satisfaction of any claims in the nature of patent, copyright or other intellectual property right infringement arising out of or in connection with the Authority use, in accordance with the preceding two paragraphs of this numbered Section, of such subject matter or material, software, firmware, compositions of matter, manufactures, apparatus, appliances, processes of manufacture or types of construction to which a patent, copyright or other intellectual property right applies or may apply. If requested by the Authority and if notified promptly in writing of any such claim, the Contractor shall conduct all negotiations with respect to and defend such claim without expense to the Authority. If the Authority be enjoined from using any of the facilities which form the subject matter of this Contract and as to which the Contractor is to indemnify the Authority against patent, copyright or other intellectual property right claims, the Authority may, at its option and without thereby limiting any other right it may have hereunder or at law or in equity, require the Contractor to supply, temporarily or permanently, facilities not subject to such injunction and not infringing any patent, copyright or other intellectual property right or to remove all such facilities and refund the cost thereof to the Authority or to take such steps as may be necessary to ensure compliance by the Authority with such injunction, all to the satisfaction of the Authority and all without cost or expense to the Authority.

83. INSPECTIONS AND REJECTIONS

All Work and all construction, processes of manufacture and methods of construction involved in or related to the performance of the Work shall be at all times and places subject to the inspection of the Engineer, acting personally or through his Inspectors, and the enumeration in these Specifications of particular portions of such Work, construction, processes of manufacture or methods of construction which will or may be inspected by the Engineer or such Inspectors shall not be deemed to imply that only such Work, construction, processes of manufacture and methods of construction will or may be so inspected. The Engineer shall be the judge of the quality and suitability of the Work, construction, processes of manufacture and methods of construction for the purposes for which they are used or to be used. Should they fail to meet his approval they shall be forthwith reconstructed, made good, replaced or corrected, as the case may be, by the Contractor at his own expense. Rejected material shall be removed immediately from the site. The fact that the Inspectors have approved the materials and workmanship shall not relieve the Contractor from his obligation to supply other material and workmanship when so ordered by the Engineer.

The Contractor, at his own expense, shall furnish such facilities and give such assistance for inspection as the Engineer may direct. In the case of materials required by the Specifications to be inspected in the factory or plant, and in the case of any other items which the Engineer may designate, the Contractor shall secure for the Engineer and his Inspectors free access to all parts of such factories or plants and shall furnish to the Engineer three copies of purchase orders, two copies of mill shipping statements and four copies of shipping statements. Moreover, in the case of such materials to be factory or plant inspected, the Contractor shall give at least ten days' notice to the Engineer of his intention to commence the manufacture or preparation of such materials.

Other than the materials and equipment specifically required to be inspected at the manufacturer's factory or plant, all materials will be inspected at the construction site and any portions thereof which are rejected by the Engineer shall be immediately removed from the construction site by the Contractor and shall be replaced with new materials by the Contractor at his own expense.

In the case of materials to be inspected at the construction site, the Contractor shall submit a list of all such materials in triplicate to the Engineer for his approval prior to ordering same. The list shall be submitted within forty-five calendar days after receipt of the notice of acceptance and shall contain the following information:

A. Classification of submittal in accordance with the following:

Class I - A submittal for record of an expressly specified item.

Class II - A submittal of an item which conforms to an express generic specification or a submittal which is deemed by the Contractor to be identical to an expressly specified item.

Class III - A submittal which is deemed by the Contractor to be functionally equivalent but not identical to a specified item.

B. In the case of Class II and Class III, the Contractor shall supply adequate information to the Engineer to enable the Engineer to compare the specified item and the proposed substitution. Information shall include, but need not be limited to, technical specifications, Catalog Cuts, drawings, references to existing installations and test data, or any other data required by the Engineer.

C. In the case of fabricated materials for which Shop Drawings are to be prepared, a brief description of the material and the statement "see Shop Drawings".

D. In the case of materials or equipment listed in manufacturer's catalogs, the list shall contain the vendor's name, the manufacturer's name, brand name, style designation, catalog number and, where the Specifications require catalog cuts, the statement "see catalog cut".

E. In the case of materials or equipment for which Shop Drawings are not to be prepared, and which are not listed in any catalog, the list shall contain a complete description of the material or equipment, which shall be in sufficient detail to describe completely the materials or equipment and quality therefor.

The Engineer shall advise the Contractor whether said list is approved or requires corrections or additions within the number of working days indicated in the chart below:

Type of Submittal	No. of Working Days for Engineer to Approve/Disapprove Items
Class I Material submittals	10
Portland Cement mix designs that require confirmation of the 28-day properties	35
Changes in asphalt mix designs that need to be confirmed with a batch mix at the plant	35
Class II Material submittals	20
Class III Material submittals	30

Failure of the Contractor to provide 30 calendar days advance notice to the Engineer of any submittal shall result in a five (5) working day extension of the number of days stated in the chart above. In no event shall an extension of the Engineer's review time provided for in this section relieve the Contractor from its duty to meet all contractual Milestone dates.

Within ten working days after receipt of said list, the Engineer shall notify the Contractor of which items are approved and which disapproved. Within two working days thereafter, the Contractor shall resubmit a new list covering those items which were disapproved. After each such re-submission the Engineer shall have a similar period of ten days in which to approve or disapprove.

Should materials or equipment be delivered to the construction site without having been placed on the aforementioned list and approved, it shall be immediately removed from the construction site by the Contractor at his own expense.

84. MANUFACTURERS' CERTIFICATION

Where materials and equipment are required by these Specifications to conform to certain standard or tentative specifications or requirements of any organizations, including American Society for Testing and Materials, American National Standards Institute, Association Rules for Grading Lumber, Federal Specifications, National Electrical Manufacturers Association, American Association of State Highway and Transportation Officials, American Water Works Association and the International Municipal Signal Association, the Contractor shall furnish to the Engineer the manufacturer's written certification that each of the materials or equipment conforms to the foregoing standard or tentative specifications. The certification shall be delivered to the Engineer prior to installation of the materials to which it refers. Such certifications shall not be binding or conclusive on the Authority and may be rejected at any time by the Engineer if incorrect, improper or otherwise unsatisfactory in his opinion.

85. NO RELEASE OF CONTRACTOR

Any provision of this Contract for testing, inspection or approval, and any actual testing, inspection or approval, of any materials, workmanship, plant, equipment, drawings, program, methods of procedure, or of any other thing done or furnished or proposed by the Contractor to be done or furnished in connection with the Contract is for the benefit of the Authority not the Contractor. Any approval of such things shall be construed merely to mean that at that time the Engineer knows of no good reason for objecting thereto. No such provision for testing or inspection, no omission of testing or inspection, and no such approval shall release the Contractor from his full responsibility for the accurate and complete performance of the Contract in accordance with the Contract Drawings and Specifications or from any duty, obligation or liability imposed upon him by the Contract or from responsibility for injuries to persons or damage to property.

86. ERRORS AND DISCREPANCIES

If, in the performance of the Contract, the Contractor discovers any errors or omissions in the Contract Drawings or Specifications, or in the marks, lines and elevations furnished by the Authority in the construction undertaken and executed by him, he shall immediately notify the Engineer and the Engineer shall promptly verify the same.

If with the knowledge of such error or omission and prior to the correction thereof, the Contractor proceeds with any construction affected thereby, he shall do so at his own risk and the construction so done shall not be considered as construction done under and in performance of this Contract unless and until approved and accepted.

87. DIFFERING SUBSURFACE CONDITIONS

If during the performance of Work, the Contractor becomes aware of any unanticipated subsurface conditions or has cause to suspect the presence of such condition, then the Contractor shall immediately notify the Engineer, or designee thereof verbally, to be followed immediately by written notification. The Contractor shall specify the nature, location, and impact on the Work of such conditions. The Contractor shall immediately stop Work in and secure the area against injury to persons or damage to property pending further instructions from the Engineer.

The Contractor shall then conduct all necessary investigations and testing of the subsurface conditions as directed by the Engineer to identify the character and extent of the unanticipated subsurface conditions and/or to satisfy applicable Federal, State and local laws, codes and ordinances and regulations and shall notify the Engineer accordingly. The investigation program shall be submitted to the Engineer for review and approval.

In the event the Contractor discovers such subsurface conditions during the performance of the Work and (i) special handling of such condition is necessary and required for the performance of the Work as determined by the Engineer; (ii) such special handling cannot be avoided or mitigated by the exercise of reasonable measures by the Contractor; and (iii) the Contractor actually incurs increased costs caused by such condition that could not have been reasonably anticipated from the Contract Drawings, Reference Drawings and Specifications and inspection of the construction site; then in such event, as approved by the Engineer, the Contractor shall, notwithstanding any provision in this Contract to the contrary, be compensated for such costs for special handling, including the necessary investigations and testing of subsurface conditions, in accordance with the provisions of the Form of Contract clause entitled "Compensation For Extra Work".

88. ACCIDENTS AND FIRST AID PROVISIONS

The Contractor shall promptly report in writing to the Engineer and to the Authority Manager, Claims Administration all accidents whatsoever arising out of or in connection with the performance of the Contract, whether on or adjacent to the construction site, which result in death, injuries or property damage, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damage is caused, the accident shall be reported immediately by telephone to both of the said representatives of the Authority.

The Contractor shall provide at the construction site such equipment and medical facilities as are necessary to supply first aid service, in case of accident, to any who may be injured in the progress of the Contract. He shall have standing arrangements for the removal and hospital treatment of any person who may be injured while engaged in the performance of the Contract.

If any claim is made by any third person against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the fact in writing to the aforementioned representatives of the Authority, giving full details of the claim.

89. SAFETY PROVISIONS

In the performance of the Contract, the Contractor shall exercise every precaution to prevent injury to workers and the public or damage to property.

He shall, at his own expense, provide temporary structures, place such watchmen, design and erect such barricades, fences and railings, give such warnings, display such lights, signals and signs, exercise such precaution against fire, adopt and enforce such rules and regulations, and take such other precautions as may be necessary, desirable or proper, or as may be directed.

The Contractor shall employ for Work of the Contract a competent person conforming to the requirements of the Code of Federal Regulations 29 CFR 1926.32(f) who shall be designated by the Contractor as authorized to perform the duties required by 29 CFR 1926 et seq. as applicable for Work of this Contract.

Obtain and submit to the Engineer one copy of material safety data sheet (MSDS) conforming to the requirements of 29 CFR 1910.1200(g) for each hazardous chemical utilized for permanent and consumable materials employed for Work of this Contract.

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss, including but not limited to:

A. All employees on the Work, the public, and other persons and entities who may be affected thereby;

B. All the Work, materials and equipment to be incorporated therein, whether in storage on or off the site; and

C. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement in the course of construction.

The Contractor's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and the Contractor has removed all workers, material and equipment from the construction site, or the issuance of the Certificate of Final Completion, whichever shall occur last.

Until fire protection needs are supplied by permanent facilities under this Contract, install and maintain temporary fire protection facilities. Comply with requirements of National Fire Protection Association NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alteration and Demolition Operations".

The Contractor shall employ only such men as are physically fit and are free from contagious or communicable diseases.

The Contractor shall use only machinery and equipment adapted to operate with the least possible noise, and shall so conduct his operations that annoyance to occupants of nearby property and the general public will be reduced to a minimum.

The bringing of intoxicating substances onto the construction site and the use or consumption of intoxicating substances at the construction site are prohibited. It shall be the responsibility of the Contractor to insure that all employees of the Contractor and of all subcontractors, materialmen and any other persons under contract to or under the control of the Contractor shall comply with the provisions of this paragraph.

The Contractor shall daily clean up all refuse, rubbish, scrap materials and debris caused by his operations, to the end that at all times the construction site shall present a neat, orderly and workmanlike appearance. Before the Certificate of Final Completion of Work will be issued, the Contractor shall remove all surplus materials, falsework, temporary fences and other temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations and shall put the construction site in a neat, orderly condition.

In the event the Contractor encounters at the construction site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB) or any other hazardous material not shown on the Contract Drawings or mentioned in the Specifications, the Contractor shall immediately stop Work in the area affected and report the condition in writing to the Engineer. Work in the affected area shall not thereafter be resumed by the Contractor except upon the issuance of a written order to that effect from the Engineer.

Within 15 days of submission to the Engineer of the Detailed Contract Drawings and the Detailed Specifications which are marked by the Engineer "No Further Comments", the Contractor shall submit to the Engineer for review, the Contractor's Site Safety Program, which shall be specific for the construction site and include a description of the Work to be performed, a hazard assessment of the Work to be performed and the means by which such hazards shall be mitigated. The Contractor's Site Safety Program shall comply with all applicable federal, state, municipal and local and departmental laws and shall include, among other things, the designation by the Contractor of a qualified individual to administer such Site Safety Program.

90. RECYCLING OF CONSTRUCTION DEBRIS MATERIAL

The Contractor shall remove from Authority property all construction debris, demolition debris and other debris material generated from the performance of the Work of this Contract unless the material is deemed acceptable by the Engineer for on-site re-use or recycling in accordance with the technical requirements of this Contract and remains at the Work site. The Contractor shall transport to recycling facilities or re-use and recycle on-site for this Contract, as applicable, no less than 75% by weight of the following types of designated debris material, to the extent arising from the Work of this Contract:

Asphalt Concrete

Portland Cement Concrete

Steel

Excess Unrestricted Soil

During the process of removal of all such designated debris material from Authority property, the Contractor shall submit to the Engineer on a monthly basis a Designated Debris Material Assessment Summary indicating the actual types and quantities by weight of the designated debris material removed for this Contract up to that point in time. In addition, the Designated Debris Material Assessment Summary shall also include types and quantities by weight of designated debris material actually re-used or recycled on-site in this Contract or, if shown on the Contract Drawings, are stockpiled for future use by the Authority. The Designated Debris Material Assessment Summary shall be accompanied by written verification from recycling and landfill destinations identifying the originating Work site, quantity of material delivered and type of debris material for all designated debris material removed from the Work site.

Within 15 days of submission to the Engineer of the Detailed Contract Drawings and the Detailed Specifications which are marked by the Engineer "No Further Comments", the Contractor shall submit to the Engineer for review the Contractor's Designated Debris Material Assessment Plan indicating the anticipated types and anticipated quantities by weight and the intended destinations for all such designated debris material to be removed from the Work site. The Designated Debris Material Assessment Plan shall also indicate anticipated types and anticipated quantities by weight of all such designated debris material to remain at the Work site for re-use or recycling in this Contract as applicable.

All removals shall be completed promptly upon the completion of construction under this Contract.

91. DIESEL-POWERED EQUIPMENT

A. The Contractor and its subcontractors shall minimize all air-borne pollutants generated by diesel-powered equipment and vehicles at all times during the performance of this Contract in accordance with this numbered Section. The requirements herein apply to all land-based and barge-mounted diesel-powered construction equipment. Marine propulsion engines, marine auxiliary engines, and dredges used in construction activity are exempt from these requirements.

B. No diesel-powered equipment shall be brought on the construction site without meeting the following requirements unless a waiver has been granted as specified in D. below. In addition, all such equipment and engines shall comply with all Federal, state and local regulations applicable to exhaust emission controls and safety.

1.) Ultra Low Sulfur Diesel (ULSD) Fuel

All diesel-powered equipment to be used in the performance of the Work of this Contract shall use ULSD fuel with an average sulfur content of no more than 15 parts per million (ppm). This requirement applies to on-road and non-road diesel engines. The Engineer may collect samples of the ULSD fuel directly from the fuel tanks of the diesel-powered equipment used on the construction site in order to verify that sulfur concentrations do not exceed 15 ppm. Diesel-powered equipment not using ULSD shall be removed from the construction site or shall immediately comply with the ULSD fuel requirements in this Section as directed by the Engineer and at no additional cost to the Authority.

2.) Emissions Control Devices – Best Available Technology (BAT)

All non-road diesel-powered equipment with a rated horsepower of 50 horse power (hp) or greater and active on the construction site for any portion of a 24-hour workday for more than 20 total consecutive and non-consecutive days shall be retrofitted with Emissions Control Devices (Devices) utilizing the best available technology (BAT). The Devices shall consist of Diesel Particulate Filters (DPFs) or other measures with equivalent particulate matter (PM) removal efficiency, wherever the implementation of such a Device is feasible in the opinion of the Engineer. For non-road diesel-powered equipment rated between 50 hp and 75 hp, Diesel Oxidation Catalysts (DOCs) may be used in place of DPFs.

Both active and passive filter regeneration mechanisms shall be considered for DPFs. In cases where DPFs are not feasible for safety considerations, mechanical reasons, or where the technology would not function properly, the Contractor shall submit a request for a waiver to the Engineer for review and approval prior to the use of such diesel-powered equipment. If the Engineer grants a waiver under these circumstances, then the Contractor shall retrofit the diesel-powered equipment with Flow Through Filters (FTF) if feasible in the opinion of the Engineer. DOCs shall be used in place of DPFs or FTFs unless it is proven to the Engineer by the Contractor that the application of this type of technology is also technically infeasible.

The use of diesel-powered engines greater than 50 hp without tailpipe reduction measures will be permitted pursuant to the Engineer's approval of a written request for a waiver submitted by the Contractor in accordance with D. below.

The use of Devices shall be targeted primarily toward the reduction of PM and secondarily to the reduction of nitrogen oxides (NOX), and shall in no event result in an increase in the emissions of either pollutant. The Devices of best available technology shall be defined as those that are contained in the U.S. Environmental Protection Agency (EPA) Verified Retrofit Technology List, the list of California Air Resources Board (CARB), Verifications, Europe's Verified Technology List (VERT), or as otherwise approved by the Engineer to provide the maximal level of pollutant reductions intended by this Section. For more information, refer to the following websites:

U.S. Environmental Protection Agency Verified Technology List:
http://www.epa.gov/otaq/retrofit/nonroad-list.htm

California Air Resources Board Verified Technology List:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Europe's Verified Technology List:
http://www.akpf.org/pub/vert_filterliste.pdf

3.) Diesel Construction Equipment Age Requirements

To facilitate the application of verified Emission Control Devices, as well as provide lower baseline emissions, Tier 0 engines shall not be used in the performance of this Contract unless they have been upgraded to Tier 1 and then retrofitted with best available technology devices. As determined by the Engineer, exceptions will be made only for specific engines that are not readily upgraded to Tier 1, and where the Work of this Contract cannot reasonably be performed using alternative engines that comply with this Section. In such cases, the Contractor shall submit a written request for a waiver to the Engineer for review and approval prior to bringing such equipment onto the construction site.

4.) Diesel Engine Idling Policy

The idling time of non-road and on-road vehicles shall be limited to three (3) consecutive minutes as determined by the Engineer with the following exceptions:

a. An on-road or non-road vehicle is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control, or is in queue when engaged in an active operation with other equipment.

b. It is necessary to operate defrosting, heating, or cooling equipment to ensure the safety or health of the driver or passengers.

c. To ensure the safe and proper operation of auxiliary equipment that is located in or on the vehicle, to accomplish the intended use of the vehicle or equipment, but only to the extent so necessary (for example - cranes and concrete mixers).

d. To bring the vehicle to the manufacturer's recommended operating temperature, but only to the extent so necessary.

e. The outdoor ambient temperature is below twenty (20) degrees Fahrenheit.

f. A vehicle is being actively worked on for repairs or maintenance and engine idling is necessary to effectuate such repairs or maintenance.

5.) Electrification

Where electric power is distributed to and available throughout a construction site, electrically powered equipment shall be preferred over diesel-powered versions of that equipment.

C. Submittals:

The Contractor shall submit to the Engineer for review and approval an inventory list for all non-road diesel equipment and engines, and verified Emissions Control Devices. No Work shall commence utilizing diesel-powered non-road equipment rated at 50 hp or greater until the Contractor submits a comprehensive and complete inventory list inclusive of all such equipment, including the specifics of each as detailed below, and same is approved by the Engineer.

1.) The inventory list shall be provided in an electronic format (e.g., Microsoft Word, Access or Excel), and shall include the following:

a. Contract number and title.

b. Owner of equipment's name, address, telephone number and contact person familiar with the operation and maintenance of the equipment and the emission control technologies; whether owner is the Contractor, subcontractor or rental firm.

c. Dates that equipment is anticipated to arrive at and depart from the site.

d. Number, type, make, year of manufacture, manufacturer and serial number.

e. Engine type, tier level, make, horsepower rating, year of manufacture, and serial number.

f. Approximate fuel consumption rate per shift.

g. Anticipated function, duration of use, and days and hours of operation.

h. Retrofit type, make, model, manufacturer, installation date, EPA, VERT or CARB verification number or supporting documentation related to emission control devices.

i. Previous acceptance or waivers granted by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards.

2.) On-Going Equipment Updates:

Whenever a new or additional piece of diesel-powered non-road equipment is required to complete the Work of this Contract, the Contractor shall submit to the Engineer an update of the equipment inventory list. These updates shall include the actual dates the equipment arrives and departs from the site.

D. Waivers:

The Contractor shall submit a written request for a waiver to the Engineer for review and approval prior to bringing equipment that does not conform to the above requirements onto the construction site. The Contractor shall demonstrate due diligence by providing written documentation of efforts to comply with this Section. For waivers based upon the unavailability of retrofit devices for certain equipment, the Contractor will generally be required to provide written documentation from more than one vendor or supplier of retrofit devices to satisfy this requirement. Waiver requests related to the use of DPFs shall take into consideration actively regenerating filters for equipment with low temperature profiles that typically preclude the application of passively regenerating filtration systems.

Equipment retrofitted with an approved device in connection with another construction contract of the Authority, or the City of New York, or the Metropolitan Transportation Authority is exempt from further retrofitting for three (3) years from the date the retrofit was approved, even if new BAT retrofit devices are available. The Contractor shall submit to the Engineer documentation of approval of a retrofit device by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards for the equipment in question. In addition, if the Authority, or the City of New York, or the Metropolitan Transportation Authority, another public agency that issued a waiver under the same or substantially the same standards previously waived a requirement contained in this Section for a particular piece of equipment, that equipment shall be exempt from the requirement for three (3) years from the date the initial waiver was granted.

1.) In responding to waiver requests, the following conditions will be taken into consideration with applicable documentation:

a. A BAT retrofit device would pose a safety hazard or impair operator visibility; or

b. A BAT retrofit device would void the engine warranty; or

c. A BAT retrofit device cannot be used for mechanical reasons; or

d. A BAT retrofit device or the engine would not function properly if the BAT retrofit device were installed; or

e. A Tier 0 engine is not readily upgraded to Tier 1, and where the task cannot be reasonably accomplished using alternative engines that do comply with this Section; or

f. The furnishing and installation of a BAT retrofit is more than 30 percent of the fair market value of the construction equipment; or

g. The Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards previously approved a BAT retrofit device for the equipment in question. Such approval is valid for three years from the date it was issued; or

h. The Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards previously granted a waiver for the equipment in question. Such waiver is valid for three years from the date it was issued.

In addition, the Engineer may, in his or her discretion, grant a waiver based upon excessive costs to satisfy the requirements of this Section, undue burden on the Contractor, marginal benefits, or other relevant factors, provided adequate supporting documentation is submitted by the Contractor.

2.) Waiver requests shall include the following:

a. Name of contractor applying for the waiver.

b. Contract number and title.

c. Owner of equipment's name, address, telephone number and contact person familiar with the operation and maintenance of the equipment and the emission control technologies, whether owner is the Contractor, subcontractor or rental firm.

d. Number, type, make, year of manufacture, manufacturer and serial number.

e. Engine type, make, horsepower rating, year of manufacture, and serial number.

f. Approximate fuel consumption rate per shift.

g. Anticipated function, duration of use, and days and hours of operation.

h. Technical explanation of safety hazard, mechanical constraint, warranty, limited availability, or functionality issues cited as basis for waiver.

i. Written documentation from retrofit device manufacturers, engine manufacturers, or rental companies, as appropriate, supporting the stated reasons for the waiver; for waivers based upon the unavailability of a retrofit device for specified equipment, the Contractor shall provide documents from more than one supplier.

j. If applicable, documentation of previous BAT retrofit approvals granted by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards for the equipment in question.

k. If applicable, documentation of previous waivers granted by the Authority, or the City of New York, or the Metropolitan Transportation Authority, or another public agency that issued a waiver under the same or substantially the same standards for the equipment in question.

3.) Review of Waiver Application

The Engineer will make a determination whether to approve the Waiver Request no later than 10 days after its receipt.

92. DAILY PROGRESS, EQUIPMENT AND LABOR REPORTS

The Contractor shall furnish to the Engineer at the end of each day Work is performed at the construction site, a memorandum showing for that day (a) the construction performed, (b) the type of equipment used identifying each piece of equipment as owned by the Contractor or rented from others; (c) a statement of any unusual happening that occurred, and (d) the names and number of workers in each trade classification that were employed. Such memorandum shall not be deemed to be a substitute for the notices, time slips, memoranda or other data required under the clauses of the Form of Contract relating to compensation for Extra Work.

93. LAWS AND ORDINANCES

In order to effectuate the policy of the Authority, the Contractor shall comply with all provisions of federal, state, municipal, local and departmental laws, ordinances, rules, regulations and orders which would affect the Contract and the performance thereof and those engaged therein if said Contract were being performed for a private corporation, except where stricter requirements are contained in the Specifications or Contract Drawings, in which event the latter requirements shall apply. However, the Contractor shall not apply for any permits, licenses or variances in the name of or on behalf of the Authority, but shall do so in his own name where required by law, regulation or order or by the immediately preceding sentence. Nor shall the Contractor apply for any variance in his own name without first obtaining the approval of the Authority.

The Contractor shall verify that employees performing Work under this Contract in the United States are legally present in the United States and authorized to work by means of the federally required I-9 program.

94. NOT USED

95. SIGNS

No advertisement or sign, other than the name and address of the Contractor, will be permitted on any fences, temporary structures or elsewhere on the construction site and such advertisement will be permitted only upon the condition that it is first approved by the Engineer. In any event, the advertisement shall not exceed six feet by eight feet in overall dimensions.

96. CONTRACTOR'S FIELD OFFICE AND REPRESENTATIVE

At a readily accessible point on or near the construction site, the Contractor shall maintain a field office provided with a telephone.

During the performance of any Work at the construction site, the Contractor shall have a representative thereat who shall be authorized by the Contractor to receive and put into effect promptly all orders, directions and instructions from the Engineer. The Contractor's representative shall be provided, at all times, with a conformed copy of this Contract and a set of the Contract Drawings.

Orders and directions may be given orally by the Engineer and shall be received and promptly obeyed by the Contractor or his representative or any superintendent, foreman or other employee of the Contractor who may have charge of the particular part of the Work in relation to which the orders or directions are given. A confirmation in writing of such orders or directions will be given by the Engineer when so requested by the Contractor.

97. SURVEYS

The Engineer will establish a bench mark and a base line at or adjacent to the location of the Contractor's operations. The Contractor shall perform all surveys which may be required for the performance of the Contract. He shall carefully preserve any base line and bench mark which may be established by the Engineer.

The Contractor shall, in addition, furnish to the Engineer, without additional compensation therefor, any or all information and data regarding points, lines, grades, elevations and other survey information established by the Contractor during the performance of the Contract.

Surveys and measurements of quantities for purposes of computing Contractor's compensation shall be made by the Contractor as directed by and in the presence of, or jointly with, the Engineer, at the Engineer's option. Computations of quantities for payment shall be made by the Contractor and shall be subject to the approval of the Engineer.

98. TEMPORARY STRUCTURES

Unless otherwise provided in this Contract, the Contractor shall determine the need for and shall design, furnish and construct all barricades, fences, staging, falsework, formwork, shoring, scaffolding and other temporary structures required in the performance of the Contract, whether or not of the type enumerated in the Specifications or on the Contract Drawings, including those which would be required by law or regulation if this Contract were being performed for a private corporation. All such temporary structures shall be of adequate strength for the purposes for which they are constructed and shall be provided with graphics, warning signs and warning lights as required to inform personnel and the public of the hazards being protected against, and the Contractor shall maintain them in satisfactory condition. The design and drawings for such structures shall be prepared by the Contractor utilizing a professional engineer licensed in the state where the structure will be constructed, and when requested by the Engineer they shall be submitted for his review before being used.

The Contractor shall ensure that each temporary structure is inspected by the professional engineer who designed the temporary structure prior to initial use and submit a schedule of periodic inspections to be performed by such professional engineer to the Engineer for review. The number of periodic inspections of temporary structures to be performed by the professional engineer shall be the minimum required by law or regulation if this Contract were being performed for a private corporation. The Contractor shall also submit a signed and sealed statement of inspection from the professional engineer performing the inspection of the temporary structure, including a statement of fitness for use for the intended purpose of the temporary structure, to the Engineer for review.

Neither such approval, however, nor any requirements of the Engineer, the Specifications or the Contract Drawings shall relieve the Contractor of his responsibility for the design, construction and use of the temporary structures or from any obligations and risks imposed on him under this Contract, and any such approval or requirements shall be deemed merely to relate to minimum standards and not to indicate that the temporary structures are adequate or that they meet the Contractor's obligations under this Contract.

Temporary structures shall be painted with an approved dark color paint and shall be repainted whenever necessary during the period that the Contract is being performed. Upon completion of all Work under this Contract, the temporary structures shall be removed from the construction site.

99. PERMIT AND REQUIREMENTS FOR WELDING

Prior to the commencement of any cutting or welding operations at the construction site, the Contractor shall notify the Engineer and obtain an Authority cutting and welding permit. The Authority will issue this permit without payment of a fee, and application forms may be obtained from any Resident Engineer of the Authority, at his office at the facility. Unless otherwise approved by the Engineer, all cutting and welding operations shall be performed in accordance with the conditions which form a part of said permit. The permit application must be filled out and submitted in duplicate to the Engineer at least forty-eight hours prior to commencing welding or cutting operations at the construction site.

100. FINAL INSPECTION

When, in the opinion of the Contractor, the construction is completed and ready for final inspection, he shall so notify the Engineer in writing and the Engineer will give said construction (including any portions with respect to which Certificates of Partial Completion have been issued) a minute and thorough inspection. Before any Certificate of Final Completion will be issued, any defects or omissions noted on this inspection must be corrected by the Contractor.

101. WARRANTIES

The Specifications may provide for certain warranties of portions of the permanent construction. These warranties are intended for the greater assurance of the Authority and not as a substitute for rights which the Authority might otherwise have. Although such warranties shall be enforceable as provided, neither any requirement of this Contract with respect to warranties by the Contractor nor any guarantee or warranty given to the Contractor or the Authority by any manufacturer shall be deemed to be a limitation upon any rights which the Authority would have, either expressed or implied, in the absence of such guarantees or warranties.

102. UTILITY DATA COLLECTION

In order to assist the Authority with the collection of as-built utility data, notify the Engineer within 48 hours prior to the covering of all underground structures, piping, conduit, cable or duct banks.

Do not build-in, backfill, fill over, around, or in any way cover underground structures, piping, conduit, cable or duct banks until given notice to proceed by the Engineer.

Nothing contained herein shall relieve the Contractor from performing the Work in accordance with the Contract Drawings and Specifications nor release the Contractor from any obligations under or upon this Contract.

103. REQUIREMENTS FOR CRANES AND DERRICKS

During the performance of Work at the construction site, the use by the Contractor or his subcontractors of power operated cranes and derricks for hoisting and/or rigging purposes; or for construction, alteration, demolition, excavation and maintenance purposes, including highways or sewers; or for the installation of piles; or for the hoisting or lowering of any article on the outside of any building or structure shall be subject to the approval of the Engineer in accordance with this Section.

A. Determinations will be made in writing by the Engineer on whether cranes and other such equipment meeting certain criteria shall be exempt from all or part of the requirements herein. Such determinations shall in no way relieve the Contractor from conformance with all applicable requirements of this Section and governing codes including the possession of a valid operator's license subject to verification by the Engineer.

1.) The following equipment will be considered for full exemption, which means exempt from B., C., D., E., F., G., H. and I. below:

a. Excavating or earth-moving equipment, except cranes used with clamshells.

b. Augurs, churn-drills, and other drilling equipment not used for the hoisting of any objects.

c. Mobile cranes, including jibs and any other extensions to the boom, exceeding 50 feet but not exceeding 135 feet in length, and with a manufacturer's rated capacity of 3 tons or less used exclusively as a man-basket.

d. Hoisting machines permanently mounted on the bed of material delivery trucks that are used exclusively for the loading and unloading of such trucks, provided that the length of boom does not exceed the length of the truck bed by more than 5 feet, and any material transported thereon shall not be raised more than 2 feet in the unloading process.

e. Cranes and derricks with a manufacturer's rated capacity of less than 1 ton.

f. Mechanics trucks with a hoisting device used in activities associated with the maintenance and repair of construction related equipment.

g. Articulating boom cranes that do not have an integral hoisting mechanism and that are used exclusively for the loading and unloading of trucks or trailers, provided that the length of boom does not exceed 135 feet, and that any material transported thereon shall not be raised more than 100 feet in the unloading process.

2.) The following equipment will be considered for Partial Exemption – I, which means exempt from B.4.), C.2.), C.4.) and D. below:

a. Cranes with less than 160 feet combined boom/jib length to be used for a period not exceeding 24 hours, operated entirely within Authority property and at a location at least one boom/jib length away from all Authority property.

b. Service cranes and clamshells with a boom length of 110 feet or less, to be operated entirely within Authority property and at a location that does not require the moving of any load over a roadway or sidewalk.

c. Pile drivers or clamshells operated entirely within Authority property with a soil bearing pressure not exceeding 500 pounds per square foot.

d. Mobile cranes, including jibs and any other extensions to the boom, not exceeding 50 feet in length and with a manufacturer's rated capacity of 3 tons or less.

3.) The following equipment will be considered for Partial Exemption – II, which means exempt from B., C. 2.), C. 3.), C. 4.), D., F., G. and I. below:

a. Articulating/knuckle boom cranes used to hold, support or stabilize material to facilitate construction activity.

b. Cranes with a manufacturer's rated capacity of 1 ton or more.

B. For each crane or derrick not considered fully exempt by the Engineer, submit the following forms to the Engineer prior to delivery of the crane or derrick to the construction site: (See F. below for all forms)

1.) A copy of a current and valid Form CD-2, entitled "Crane/Derrick/Mobile Work Platform – Approval and Operation Application/Certificate", Revised 08/15/05, as issued by the New York City Department of Buildings - Cranes & Derricks Division, hereinafter called "NYCDOB-C&D". Form CD-2 shall bear the approval stamp of NYCDOB-C&D as a "Temporary Certificate of Approval/Temporary Certificate of Operation," and shall include an expiration date, a legible CD Number, and an authorized signature from a representative of NYCDOB-C&D. In the event that such approved Form CD-2 is not available, the Contractor shall ensure that the owner of the crane or derrick files a Form CD-2 directly with NYCDOB-C&D. Submit to the Engineer proof of the filing, a copy of the completed Form CD-2, and an "acceptable to operate" inspection report issued by NYCDOB-C&D.

2.) A fully executed Form CD-11, entitled "Equipment Owner Identification Form", Revised 12/03, as issued by NYCDOB-C&D.

3.) A fully executed Form CD-16, Statement of Notification to Community Boards.

4.) A fully executed Form CD-4, entitled "Crane/Derrick/Mobile Work Platform – On-Site Inspection Application/Certificate", Revised 12/03, as issued by NYCDOB-C&D. Form CD-4 shall be accompanied by drawings and calculations, all signed and sealed by a Professional Engineer licensed in the state of New York. The drawings and calculations shall clearly indicate the following:

a. Location of each crane or derrick.

b. All pertinent features of the site.

c. Supporting platforms and structures.

d. Swing and reach of each crane or derrick.

5.) If the crane or derrick location is within two hundred feet (200') of an NYC subway line or facility, approval from New York City Transit ("NYCTA") is required prior to the placement, assembly, or erection of the crane or derrick. In such cases, a Certificate of On-Site Inspection cannot be issued without NYCTA written approval.

Upon the review and acceptance in writing by the Engineer of all of the above submissions, the crane or derrick will be permitted to enter the construction site. Coordinate all such deliveries with the Engineer.

C. Upon delivery to the construction site for cranes or derricks considered for Full Exemption or Partial Exemption – I or Partial Exemption – II by the Engineer, submit the following to the Engineer in accordance with A. above. For all other cranes or derricks, submit all of the following to the Engineer:

1.) Names, classifications, and license numbers of each crane or derrick operator and the master, tower, or climber crane rigger.

2.) For cranes or derricks to be operated solely on Authority property, file Form CD-8, entitled "Technical Report – Statement of Responsibility", Revised 12/03, as issued by the NYCDOB-C&D. Form CD-8 shall be completed in its entirety with the exception of Box #5B, and signed and sealed by a Professional Engineer licensed in the state of New York in Box #5A.

Upon review and acceptance by the Engineer of all submitted drawings and associated documentation specified above, the Contractor will be permitted to place and/or assemble the crane or derrick at the construction site, with the exception of tower or climber cranes. For tower or climber cranes, additional submittals and inspections shall be required as specified in 4.) below.

3.) For cranes or derricks to be operated on other than Authority property, file all forms, drawings and associated documentation directly with NYCDOB-C&D. Upon the submission to the Engineer of a current and valid "Certificate of On-Site Inspection" as issued by NYCDOB-C&D, will the Contractor be permitted to assemble or erect the crane or derrick at the construction site.

4.) For tower or climber cranes, in addition to the documentation in B. and C. above, submit the following to the Engineer:

a. A fully executed Form CD-7, entitled "Notification of Erecting or Dismantling of Climber or Tower Crane", Revised 07/07. Form CD-7 shall be accompanied by a copy of the license of each master or tower rigger designated to supervise the erection of the crane and all associated documentation required to ensure compliance with the manufacturer's recommendations. Form CD-7 shall also be accompanied by signed and sealed drawings by a Professional Engineer licensed in the state of New York for the erection, jumping, climbing and dismantling of the tower or climber crane. Documentation and drawings shall include the following:

(i) Serial number identification of equipment to be used for all rigging and lifting operations including all machines to be used for erection or dismantling.

(ii) Detailed listing of assemblies and components required for erection and dismantling of rigging and lifting equipment, including but not limited to lifting frame, climbing hydraulic cylinders, upper basket, lower basket, outriggers, communication system, tie-downs, dogs, horn, lights and weathervane.

(iii) Location of rigging and lifting equipment, assist cranes, sidewalk sheds, surrounding buildings, protection for their roofs and pick-up points, loads, and radius of swing of all loads. In addition, submit to the Engineer the safe load from the crane manufacturer's approved load radius chart for lift radius.

(iv) Weight list certified by the crane manufacturer listing all assemblies and components to be lifted. All components shall be clearly marked with their weight painted on the assembly, or stamped on metal tags attached to the assembly. In lieu of an equipment manufacturer's certification, submit documentation signed and sealed by a Professional Engineer licensed in the state of New York certifying the weight list and indicating how such weights were determined.

(v) Locations of the centers of gravity for all asymmetrical components.

(vi) Sequence of operation detailing erection, jumping, climbing and dismantling, along with the rigging materials to be used in such operations.

(vii) Written certification by a Professional Engineer licensed in the state of New York that all safety devices on each crane to be used in the erection, jumping, climbing and dismantling operations have been calibrated in accordance with the crane manufacturer's recommendations.

(viii) Names, license numbers (as applicable) and contact information for each licensed rigger, rigger foreman, site safety manager, crane safety coordinator and entity performing the erection, jumping, climbing, and/or dismantling Work.

(ix) Load test procedure signed and sealed by a Professional Engineer licensed in the state of New York identifying the weights to be used and the load moment and line pull testing to be conducted in accordance with b. below.

b. A load test shall be conducted on each tower or climbing crane by a Professional Engineer licensed in the state of New York in accordance with the load test procedure submitted under (x) above. Upon completion of the load test and determination that the results are satisfactory, submit to the Engineer the signed and sealed report certifying acceptance of the results by the Professional Engineer licensed in the state of New York.

c. A fully executed Form CD-12, entitled "Designation of Safety Coordinator" Revised 12/03, as issued by NYCDOB-C&D.

d. A signed and sealed report documenting the results of the field inspection of the crane in the "unassembled state (for cranes delivered in the unassembled state)" performed by a Professional Engineer licensed in the state of New York and certifying that all crane parts are in satisfactory condition, and acceptable for assembly and erection.

e. A copy of the Safety Coordination Meeting Log as stipulated in Section BC 3319 entitled "Cranes and Derricks" of the Building Code for the City of New York (BCCNY) (3319.8.2 through 3319.8.8, and 3319.10.2). Conduct the safety coordination meeting within the week prior to the erection, jumping, climbing, or dismantling of a tower or climber crane in accordance with BCCNY and notify the Engineer one week prior to the meeting.

Upon review and acceptance by the Engineer of all documentation in B. and C. above, the Contractor will be permitted to erect the tower or climber crane at the construction site.

D. Prior to the use and/or operation of each crane or derrick, including tower or climber cranes, at the construction site when the crane or derrick will be operated solely on Authority property, complete the following:

1.) Performance of a field inspection of the crane or derrick in the "assembled state" by a Professional Engineer licensed in the state of New York in accordance with BCCNY Reference Standard RS 19-2 including the verification, inspection, and certification of the following:

a. That the crane or derrick has a current and valid Form CD-2 as issued by NYCDOB-C&D for the configuration to be used at the construction site.

b. That the support, dunnage, configuration and location of the crane or derrick have been constructed and positioned in accordance with the drawings and calculations submitted to the Engineer with Form CD-4.

c. That the crane or derrick is in working order and there is no visible damage including, but not limited to, the following items:

(i) Bent or missing lacings

(ii) Pins are properly installed and have no visible fatigue

(iii) Maladjustment of control mechanisms interfering with proper operation

(iv) Excessive wear of control mechanisms components and contamination by lubricants or other foreign matter

(v) Malfunction of operational aids

(vi) Hydraulic hoses

(vii) Deformation, chemical damage, cracks and wear of hooks and latches

(viii) Rope reeving for compliance with crane manufacturer's specifications

(ix) Malfunction and excessive deterioration of electrical apparatus and accumulation of dirt and moisture

(x) Hydraulic system for proper oil level

(xi) Tires for recommended inflation pressure

Upon the completion of the field inspection and the determination that the crane or derrick is sound and has been assembled and positioned in accordance with the drawings and calculations submitted to the Engineer with Forms CD-4 and CD-7, submit to the Engineer both a signed and sealed inspection report certifying conformance by the Professional Engineer licensed in the state of New York and a fully executed Form CD-8, signed and sealed in Box #5B.

2.) For tower or climber cranes, in addition to the above, procure the services of a New York State Licensed Surveyor to perform a plumbness survey, a licensed testing laboratory to perform anchor bolt pull-out testing, and a licensed rigger to certify compliance with the manufacturers bolt torque values connecting sections. Submit to the Engineer a fully executed Form CD-6, entitled "Crane / Derrick and Work Platform – Plumbness And Torque Notification/Anchor Bolt Pull Out Test" Revised 12/03, as issued by NYCDOB-C&D.

Upon the review and acceptance by the Engineer of a signed and sealed inspection report and Final Form CD-8 (and Form CD-6 for tower and climber cranes), the Contractor will be permitted to use and operate the crane or derrick. Form CD-4 and Final Form CD-8 (and Form CD-6 for tower and climber cranes), as accepted by the Engineer will constitute the "Certificate of On-Site Inspection."

E. Requirements for inspection and operation of cranes at the construction site:

1.) Monthly inspections and reports shall be performed, prepared and signed by a competent person as defined in Federal Register Part II, Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926 Cranes and Derricks in Construction; Final Rule (OSHA), and a copy of each inspection report shall be store in the crane cab for three months.

2.) Pre-lift meetings shall be held as outlined in Federal Register Part II, Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926 Cranes and Derricks in Construction; Final Rule (OSHA). Submit pre-lift meeting minutes to the Engineer.

3.) No crane or derrick operator shall start an operation when the wind speed exceeds 30 miles per hour or the wind speed is forecast to reach 30 miles per hour before the operation can be completed. Tower cranes shall not be raised to new operating levels when the wind speed exceeds 20 miles per hour.

4.) Operating and jumping procedures shall comply with the requirements of Chapter 33/Section BC 3319 and Reference Standard RS 19-2 of the BCCNY.

F. The forms issued by the NYCDOB-C&D listed below can be found on the following website:

www.nyc.gov/html/dob/downloads/pdf/cd

CD-2 - Crane/Derrick/Mobile Work Platform – Approval and Operation Application/ Certificate, Revised 08/15/05

CD-4- Crane/Derrick/Mobile Work Platform – On-Site Inspection Application/ Certificate, Revised 12/03

CD-6- Crane/Derrick and Work Platform – Plumbness And Torque Notification/Anchor Bolt Pull Out Test, Revised 12/03

CD-7- Notification of Erecting or Dismantling of Climber or Tower Crane, Revised 07/07

CD-8- Technical Report – Statement of Responsibility, Revised 12/03

CD-11- Equipment Owner Identification Form, Revised 12/03

CD-12- Designation of Safety Coordinator, Revised 12/03

CD-16- Statement of Notification to Community Boards

CD-22- Inspection Request for Assembled/Unassembled Crane, Derricks, and Mobile Work Platforms revised 10/05

G. If Form CD-2 issued by the NYCDOB-C&D expires while the crane or derrick is in use at the construction site on Authority property, the Contractor shall ensure that the owner of the crane or derrick files all renewals and/or extensions directly with NYCDOB-C&D. Submit proof of the filing along with a copy of the completed Form CD-2 to the Engineer. Upon receipt of any such renewals or extensions issued by NYCDOB-C&D, submit copies to the Engineer.

H. The estimated review time for all crane and derrick submissions to the Engineer is five (5) business days. If the Contractor has not received any reply by the fourth day of the review, contact the Engineer.

I. The NYCDOB-C&D issues a letter of deficiency to the Authority or stop work order to the Contractor while the crane or derrick is on Authority property, the Contractor shall cooperate fully with the NYCDOB-C&D to ensure that all acceptable corrective actions will be taken immediately. Keep the Engineer advised during the performance of all remedial Work.

104. TEMPORARY UTILITY SERVICES

Operate and maintain temporary services and facilities in a safe and efficient manner. Modify as required throughout progress of the Contract, and remove from Authority property when no longer required, or replaced by the use of completed permanent facilities as approved by the Engineer.

Make arrangements for securing, and pay all costs for heat, light, power, water, and other services which may be required for the performance of the Contract.

105. TEMPORARY SANITARY FACILITIES

Make arrangements for securing and pay all costs for temporary toilets, wash facilities and drinking water including toilet tissue, paper towels, paper cups and similar disposable materials for use by the Contractor, subcontractors, materialmen or other persons over whom the Contractor has control. Comply with regulations and health codes, which would be applicable if the Authority were a private corporation, for the type, number, location, operation and maintenance of fixtures and facilities. Install facilities where directed by the Engineer, and remove from Authority property when no longer required.

106. PROGRESS SCHEDULE

A. Schedule Requirements

1.) The Contractor shall, at his own expense, prepare, maintain and update detailed electronic progress schedules for the Engineer's review and approval. All submittals required herein shall be in the form and content stipulated in this Section. Each progress schedule shall bear the signature of the Contractor's authorized representative. The progress schedules/graphics required by this Contract shall be produced using the latest version of Oracle – Primavera P6 scheduling software.

2.) The schedule shall be prepared by a scheduler who is an employee of the Contractor with 3 (three) years minimum experience in the development and updating of Critical Path Method schedule networks for projects of a complexity comparable to this Contract, or by an outside entity with similar experience specializing in project controls. The Contractor's senior management personnel shall actively participate in the development and updating of the schedule.

3.) Progress schedules shall be sufficiently detailed to accurately depict all the Work and milestones (including acquisition of any required permits, design progress, procurement of subcontractors, key submittals and approvals, materials procurement and construction activities performed by the Contractor and his subcontractors) and shall graphically represent the logical sequence and duration of activities, all in accordance with the requirements of the Contract. The information provided in progress schedules shall also include, but not be limited to, the interdependencies between the Contractor's Activities and all other Activities required for the successful completion of the Contract, e.g., those to be performed by utility companies or by other entities. All Milestone dates specified in the Contract shall be represented in the schedule by Milestone activities that are logically interrelated to the Work that must be accomplished in order to achieve the Milestone.

4.) All activities, except the Contract Start Milestone and Contract Completion Milestone shall be linked to predecessor(s) and successor(s).

5.) The Contractor's schedule shall incorporate the Activity Code Structure shown in Attachment A, and such other coding as may be required by the Engineer.

6.) The Contractor shall load construction activities with budget information and shall identify the cost to perform Work for each construction and management activity. The sum of the costs assigned to all activities shall be equal to the Contract value. No activity costs shall be assigned to the preparation and review of submittals and materials fabrication or procurement.

7.) To assist the Contractor in preparing its progress schedule, a sample Network Diagram is shown in Figure 1. The sample is intended merely as an example of a format for the Contractor's guidance. The types of data shown are the types of data expected to be shown on the Contractor's Network Diagram. However, the information presented in the sample Network Diagram shall not be misinterpreted as either representing a plan for the Contractor's Network Diagram or a depiction of the level of detail which will be required in such diagram.

8.) The submittal of Progress Schedules under this Section shall not be deemed to be a substitute for the reporting requirements of the Section of Division 1 entitled "Daily Progress, Equipment and Labor Reports".

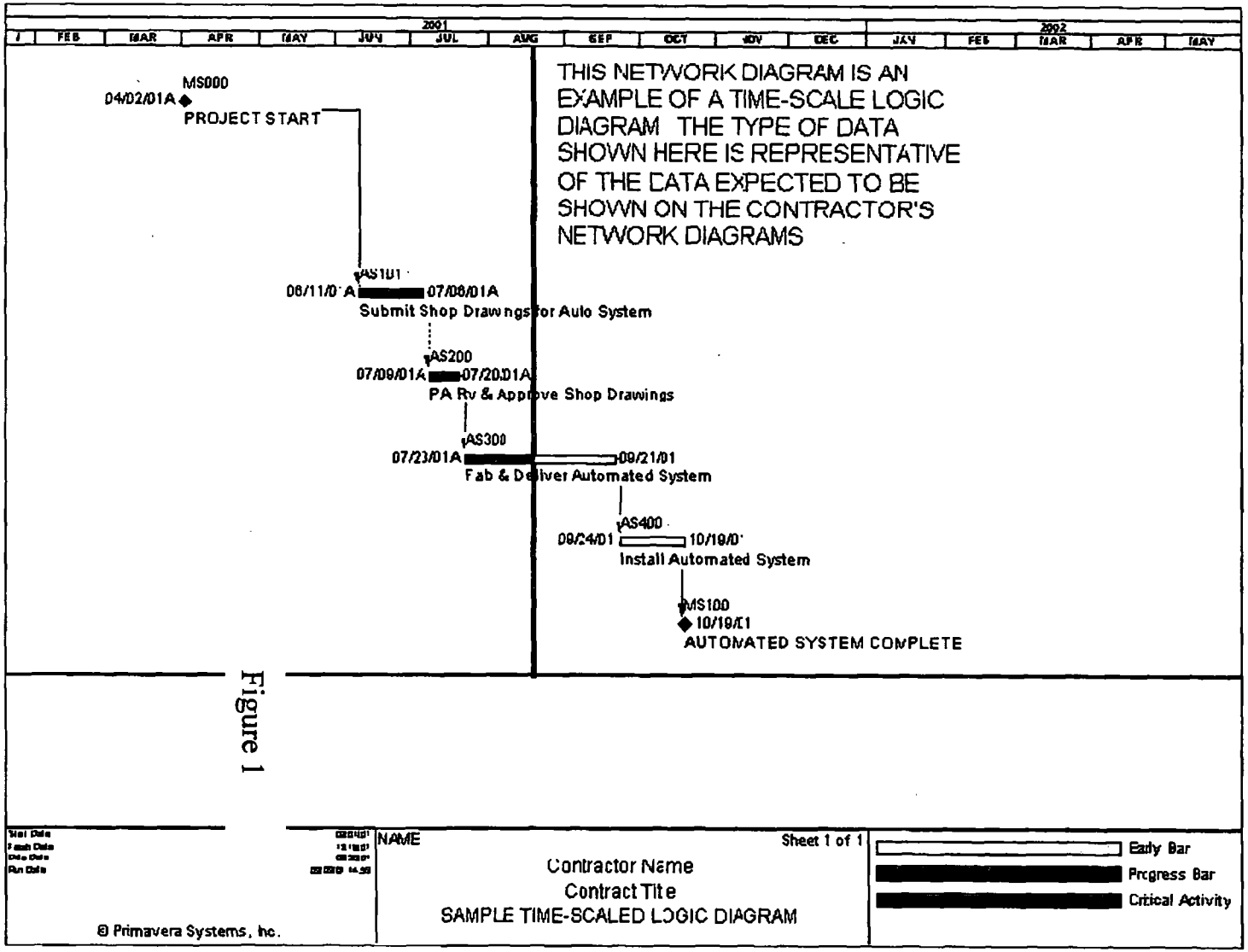
2001
2002
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
THIS NETWORK DIAGRAM IS AN EXAMPLE OF A TIME-SCALE LOGIC DIAGRAM THE TYPE OF DATA SHOWN HERE IS REPRESENTATIVE OF THE DATA EXPECTED TO BE SHOWN ON THE CONTRACTOR'S NETWORK DIAGRAMS
MS000
04/02/01A
PROJECT START
AS101
06/11/01A
07/06/01A
Submit Shop Drawings for Auto System
AS200
07/09/01A
07/20/01A
PA Rv & Approve Shop Drawings
AS300
07/23/01A
09/21/01
Fab & Deliver Automated System
AS400
09/24/01
10/19/01
Install Automated System
MS100
10/19/01
AUTOMATED SYSTEM COMPLETE
NAME
Sheet 1 of 1
Contractor Name
Contract Title
SAMPLE TIME-SCALED LOGIC DIAGRAM
Early Bar
Progress Bar
Critical Activity
© Primavera Systems, Inc.

Figure 1

B. Schedule Terminology

Schedule terminology used in this Contract shall have the meaning described below:

1.) Activity: A discrete item of Work with a Duration that can be clearly defined; a synonym for task. Unless otherwise permitted in writing by the Engineer, an activity's duration shall be not more than 14 calendar days or 10 working days except for non-construction activities, such as procurement cycles, material delivery, soil consolidation, etc. Each activity (task) description shall clearly identify the Work to be performed. No two or more activities in the schedule shall have exactly the same description.

2.) Activity Codes: Activity Codes allow each activity to be grouped into specific classifications such as area, responsibility, phase, system, or location. The codes consist of specific values and descriptive titles that are entered into the data dictionary of the scheduling software. Activities shall be assigned specific Activity Codes as appropriate.

3.) Alternative Solutions: Analyses of various options for dealing with encountered or anticipated Contract problems. Alternative solutions shall be developed to assist in determining the best method(s) of preventing or correcting any impediments to the progress of the Work. Alternative Solutions analysis shall indicate impacts on scheduling and resources.

4.) Analysis Report: A report that displays the impacts of all variances reported in the Current Progress Schedule. The Analysis Report focuses attention on the impacts of variances between planned and actual performance, so as to support an assessment of such impacts. The Analysis Report shall include Alternative Solutions.

5.) Bar Chart: A schedule display designed to complement the Network Diagram. The Bar Chart is a traditional Gantt chart to which the Early Start Dates, Early Finish Dates, Late Start Dates, Late Finish Dates and Critical Path have been added.

6.) Calendar: A calendar defines when Work on an activity can occur (i.e. Mon – Fri for a standard Work week). Activities shall be assigned to a calendar that represents the planned Work days. The calendar shall incorporate the Authority holidays listed below. The use of multiple calendars will be permitted.

New Year's Day
Martin Luther King, Jr. Day
Presidents' Day
Memorial Day
Independence Day
Labor Day
Columbus Day
Veterans Day
Thanksgiving Day
Day After Thanksgiving
Christmas Day

7.) Constraint: A constraint is a restriction imposed on the start or finish of an activity or the Contract. An example of the use of constraints is the imposition of a "finish no later than" constraint[24] on the Contract Completion Milestone that is equal to the Contract completion date. This constraint facilitates the identification of activities that control or do not support the completion date. Constraints shall be limited to start and finish constraints on milestone activities that represent critical Contract dates, unless otherwise approved by the Engineer in writing.

8.) Critical Path: The longest path through the network in estimated total elapsed time from the start of the first Activity through the completion of the last Activity. The Critical Path consists of a series of Activities which must be completed on their scheduled completion dates in order for the Contract to be completed on schedule.

9.) Current Progress Schedule: The most recent progress schedule which has been approved by the Engineer. The Original Baseline Schedule shall be referred to as "Revision 0". Each time a different Current Progress Schedule is accepted by the Engineer, the revision number shall be increased by 1 and the old schedule shall be electronically archived so as to permit an audit trail.

10.) Duration: The estimated and/or actual length of time required to fully perform a specific Activity. The Duration for construction activities shall be expressed in Work days.

11.) Early Finish Date: The date upon which an Activity can be completed if it is begun on the Early Start Date.

12.) Early Start Date: The earliest date upon which an Activity can begin.

13.) Hammock: A hammock activity summarizing the early and late dates of a set of activities is used for reporting durations of groups of important activities. An activity shall be designated as a hammock by selecting Hammock as the activity type in the Primavera activity form.

14.) Lag: The interval between the completion of a Predecessor Activity and the start of a Successor Activity. For example, ten days of positive Lag will cause the Successor Activity to begin ten days after the Predecessor Activity has been completed. Negative Lag will cause the Activities to overlap. The amount of Lag between each Activity shall be clearly represented on the Network Diagram.

15.) Late Finish Date: The latest date by which an Activity shall be completed if the succeeding Activity is to be started on schedule.

16.) Late Start Date: The latest date by which an Activity shall be started to allow completion by the Late Finish Date.

17.) Milestone: A significant point in the performance of the Work. A milestone has no Duration, and represents the start of a portion of the Work or the completion of a portion of the Work. A milestone may also represent either the beginning or the completion of a task or action being performed by entities other than the Contractor (e.g., obtaining a permit, notification to proceed with certain Work, etc.).

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24 A late finish or "finish no later than" constraint limits the latest time an activity can complete

18.) Negative Float: The amount of time that the planned completion date of an Activity is later than its required (Late Finish) date. An Activity with Negative Float must be completed ahead of schedule if the Work is to be completed on time. Negative Float usually indicates the need for corrective and/or preventive action to complete the Work on schedule.

19.) Network Diagram: A logic diagram prepared according to the Precedence Diagram Method, which displays each Activity required for the performance of the Contract in the sequence in which it is to be performed with appropriate logic ties between activities displayed.

20.) Original Baseline Schedule: The detailed progress schedule first approved by the Engineer as specified herein. All performance of Work will be measured against the Original Baseline Schedule.

21.) Precedence Diagram Method (PDM): A particular type of graphic representation of all Activities and Constraints. The Activities are represented by nodes; the Constraints are represented by lines between nodes. A sample PDM Network Diagram is shown in Figure 1 of this Section.

22.) Predecessor Activity: The partial or full completion of an Activity which is a prerequisite to commencement of another Activity.

23.) Relationship: A logic tie between two activities representing restrictions on the start or completion of the subsequent activity. Relationships may cause either positive or negative lag. The four basic types of relationships are finish to start, start to start, finish to finish and start to finish.

24.) Successor Activity: An Activity which cannot be started or completed without the prior partial or full completion of a Predecessor Activity.

25.) Total Float: The amount of time by which an Activity or series of Activities may be delayed without affecting the date of completion of the Work. Total Float is not for exclusive use or benefit of either the Contractor or the Authority but shall be used for the benefit of the Work in such manner as the Engineer may in his discretion decide. Use of float suppression and manipulation techniques, such as preferential sequencing, lag logic restraints, inflated activity duration and/or constrained dates, other than as may be required by the Contract, shall be cause for rejection of the Original Baseline Schedule and any subsequent schedule revisions and updates.

C. Schedule Submittal, Review & Approval Process

1.) Baseline Schedule

a. Within forty five (45) calendar days of the acceptance of the Contractor's Proposal, the Contractor shall submit a proposed Baseline Schedule containing the Contractor's projected plan and schedule to complete all Work required by the Contract within the time(s) for completion required by the Contract. A schedule showing time(s) for completion later than those required by the Contract will not be accepted.

b. The Engineer will review the Baseline Schedule and return it to the Contractor with comments, or accept it as the Original Baseline Schedule, within fifteen (15) calendar days. The Contractor shall participate in any meetings called to resolve issues with the schedule.

c. If it is not accepted, the Contractor shall revise the Baseline Schedule in accordance with the Engineer's comments and resubmit it for the Engineer's approval within fifteen (15) calendar days of the receipt by the Contractor of the Engineer's comments. Until such time as acceptance of the Baseline Schedule by the Engineer, the Contractor shall continue to resubmit the Baseline Schedule as directed by the Engineer within the same time frame and in the same format as the initial resubmission.

d. After the approval of the Original Baseline Schedule, no changes shall be made therein without the written approval of the Engineer. No other act or omission on the part of the Engineer shall be deemed to constitute such approval. The Contractor shall not be entitled to any damages by reason of the failure of the Engineer to give timely approval or comments on any progress schedule submitted hereunder.

2.) Progress Schedule Updates

a. The Contractor shall submit to the Engineer not less frequently than once a month, on a date specified by the Engineer, an updated Current Progress Schedule. The Engineer may require that the Contractor also include scheduling updates with his monthly payment request. Schedule updates shall status the actual performance and progress of the Work and depict any changes. Schedule updates where early start or early finish of any activity is positioned on the data line but not actualized will not be approved.

b. If directed by the Engineer, within seven (7) calendar days after receipt by the Engineer of a updated progress schedule, the Contractor shall meet with the Engineer for the purpose of reviewing and obtaining the Engineer's approval of it.

c. The Engineer may require the Contractor to furnish a revised update which shall include any other information he may request to assist him in evaluating the Contractor's progress, including but not limited to manpower loading charts and equipment schedules; "what-if" analysis performed in a copy of the current progress schedule, etc.

d. In the event that the Engineer requests the Contractor to revise the updated schedule submitted, and/or to submit such additional information, the Contractor shall make the requested revisions and/or submit the updated schedule to the Engineer for approval along with the additional information requested within seven (7) calendar days of the Engineer's request.

D. Schedule Reporting Requirements

1.) The Original Baseline Schedule submittal shall include the following:

a. One PDF printout file and one Primavera file submitted electronically.

b. Six copies of the following output reports:

(i) A Schedule narrative in writing that provides a general description of the Contractor's approach to meeting the Contract goals and the Critical Path.

(ii) Explanation for any constrained dates.

(iii) A time-scale logic diagram in PDM format containing all activities displaying Activity ID, Activity Description, Calendar, original and remaining durations, percent complete, Early Dates and Total Float, and sorted by:

(a.) Early Start, Total Float

(b.) Total Float, Early Start (Critical Path report)

c. Supporting data showing all activities with their associated cost, budgets or estimates.

d. The Contractor shall electronically archive all accepted schedules.

2.) In addition to the reports required for the Baseline Schedule submittal, all Progress Schedule Update Reports shall include the following:

a. A narrative comparing the current Dates to the respective Milestone Dates, describing the physical progress during the current report period, explaining plans for continuing the Work during the next report period and describing and explaining changes in crewing and construction equipment. The narrative shall also explain changes in Activity durations, logic ties and Activity Values and the reason why the changes were made.

b. Whenever there is any delay or negative float prediction in the schedule, the Contractor shall submit an alternative solutions report that describes the delay, explains when it started and finished or is expected to finish and the basis for those dates and lists the affected schedule activities by activity ID, and he shall present reasons for the delay. Any revisions to durations or the logical sequence of Activities made to reflect these delays shall be explained. The report shall include proposed schedule recovery efforts such as multiple shifts or overtime to mitigate any potential delay to the overall Contract completion date, or request an extension of time, as appropriate.

c. Critical Path Analysis.

d. An Analysis Report indicating Activities and/or Milestones which are behind schedule by at least 30 calendar days (commonly evidenced by Negative Float).

e. A report that compares the Current Progress Schedule update with the Original Baseline Schedule and prior month's accepted schedule update and lists all changes made to the schedule.

E. General Schedule Provisions

1.) Should the Contractor fail to comply with any provision of this Section, The Engineer shall have the right in his discretion to withhold out of any payment (final or otherwise and even though such payment has already been certified as due) such sums as he deems necessary or desirable, all as more fully provided in the clause of the Form of Contract entitled "Withholding of Payments".

2.) Neither the acceptance, review or approval of any progress schedule or other data submitted by the Contractor pursuant to this Section, nor any other action on the part of the Engineer under this Section shall in any way be deemed to be a representation by the Engineer that the Contractor may or will be permitted to follow a particular schedule or sequence of operations or that by following any such schedule or sequence he may or will complete the Work by the time(s) required by the Contract or by any other time(s). Nor shall the approval of any progress schedule or other such data relieve the Contractor of his obligation to complete the Contract by the time(s) required in the Contract, even though the schedule may be inconsistent with such completion.

3.) Any approval under this Section shall be construed merely to mean that the Engineer knew of no good reason at that time to object thereto. No acceptance, review or approval or any other action under this Section shall limit, affect or impair the Contractor's obligation to perform all Work by time(s) required by the Contract and in accordance with all other provisions of the Contract.

4.) The performance of the Work by the time(s) required in the Contract, after taking into account extensions to which the Contractor may be entitled under the clause of the Form of Contract entitled "Extensions of Time", may require the Contractor to perform the Work using overtime labor, additional shifts or additional plant and equipment and/or other measures at no additional cost to the Authority. The Contractor shall anticipate, avoid and mitigate the effects of all delays.

5.) The Engineer shall have the right at any time when in his judgment the Work is not proceeding in accordance with the approved progress schedule or at any time when it is likely that the Work might not be completed by the time(s) required in the Form of Contract even though the Contractor is proceeding in accordance with the approved progress schedule, to order the Contractor without additional compensation to employ additional shifts to increase the number of men employed, to use additional plant or equipment, or to take such other steps as may be necessary or required to assure the completion within the time(s) shown in the accepted schedule.

6.) No action on the part of the Contractor pursuant to this Section shall be construed as a request by him for an extension of the time(s) for completion required by the Contract. A request for an extension of time shall be deemed made only if it complies with the requirements of the clause of the Form of Contract entitled "Extensions of Time". No extension of the time(s) for completion shall be inferred because of any action, omission to act, or statement on behalf of the Engineer pursuant to this Section. Extension of time, if any, shall be granted only pursuant to the clause of the Form of Contract entitled "Extensions of Time".

7.) The Contractor acknowledges and agrees that he is not entitled to an extension of time for impacts that do not extend the contractual end date of the Contract.

ATTACHMENT A

MANDATORY ACTIVITY CODE STRUCTURE

1.) Responsibility (Authority, Contractor)

2.) Area (building, floor or area)

3.) Trade/CSI code (concrete, steel, etc as required)

4.) Location (3rd Fl, etc)

5.) Phase of Work, if applicable

6.) Change Order work, if applicable

7.) Other, as required by the Engineer

PRIMAVERA PROJECT PLANNER

Date 01/02/0 -----ACTIVITY CODES DICTIONARY----- Page 1

NAME - Project Title

CODE	VALUE	TITLE	SEQUENCE
Activity Codes:			
RESP	Responsibility		
	AE	Architect/Engineer	
	C	Contractor	
	O	Port Authority	
AREA	Area		
	G	General Area	1
	CTL	Air Traffic Control Tower	2
MILE	Milestone		
CSI	Trade/CSI Code		
	03000	Concrete	
	04000	Masonry	
	07000	Thermal & Moisture Protection	
	15000	Mechanical	
	16000	Electrical	
LOCN	Location		
PHAS	Phase		
	D	Design	1
	P	Procurement	2
	C	Construction	3
CO	Change Order Wor		
OTH	As Req'd by Engr		

107. ANALYSIS OF BID

Within fifteen calendar days after acceptance of the Proposal, the Contractor shall prepare a detailed analysis of bid on forms furnished by the Authority with all of the spaces filled in without exception, and containing such information as the Engineer may require for each of the items enumerated in such form.

108. AIRPORT OPERATIONS AND CONDITIONS

A. General:

1.) Place "Water" identification signs on all water vehicles or water tanks, which are to be used for the transportation or storage of water during the course of the Work at the airport.

2.) At least 7 days but not more than 10 days prior to performing excavation, call 1-800-272-4480 and provide the information required for excavation(s).

3.) Do not place temporary structures or store materials or equipment required in the performance of the Work within any of the buildings on the airport without specific prior approval of the Engineer.

4.) Do not store petroleum or combustible products, or any other flammable materials, within any buildings or in any part of the airport except as designated by the Engineer.

5.) Do not burn or bury debris of any type on Authority property, or wash waste materials down sewers or into waterways.

6.) Maintain haul routes in a satisfactory condition, and repair damage to such routes, resulting from the Contractor's operations. Unless otherwise approved by the Engineer, clean haul routes each work period and remove earth or other materials, which fall or are otherwise placed on such routes during the performance of Work.

7.) Do not park vehicles on any grass or unauthorized area. Free parking of vehicles in any of the airport parking lots will not be permitted.

8.) Protect against damaging existing lights, pavement, curbs and other fixed items that are to remain. Such items, which are damaged, either directly or indirectly, by the Contractor during the performance of the Contract, whether negligently or not, shall be restored to the condition that existed prior to such damage.

9.) Take all precautions necessary for protection of persons, traffic and property during dust or fragment generating operations, concrete mixing or placing, or other operations which may stain, soil or damage property or injure persons.

10.) Provide sound suppression devices on gasoline and diesel powered construction equipment and pneumatic tools as required to maintain noise exposures below the limits specified in the Code of Federal Regulations (CFR) 29 CFR 1926 U.S. Occupational Health and Safety Administration (OSHA). Maintain such sound suppression devices in proper operating condition throughout the time of their use, and adjust and repair as required to maintain noise within exposure levels stipulated in 29 CFR 1926.52, Table D-2.

11.) Remove on an on-going basis, and before the end of each work period, all paving materials left in the grass shoulder areas, in manholes, catch basins or handholes as a result of the cleaning of the Contractor's equipment.

12.) Food or food related debris shall not to be left on or disposed of on the construction site.

13.) Equipment, vehicles and materials, not being utilized in the current work period shall be removed and stored in the area designated by the Engineer for such purpose, or if there is no such area designated then such items shall be removed from the airport.

B. Not Used

C. Construction Site Conditions Outside Airport Operations Areas:

1.) During the time the Contractor is performing the Work, it may at times be necessary because of emergency or abnormal traffic conditions to suspend the Contractor's operations, or to postpone the time at which traffic lanes, parking or other areas become available for performance of Work. Should the Contractor be specifically directed to suspend operations in traffic lanes, parking or other areas, and remove personnel, and obstructing plant, equipment and materials from such lanes or areas, or should such lanes or areas not be available by the times specified, and if solely because of such suspension of operations or late availability of traffic lanes, parking, or other areas the Contractor is necessarily kept idle at the construction site, the Contractor will be compensated as stipulated in the provisions of the Contract concerning compensation for emergency delays.

2.) Limit the maximum height of construction equipment to 25-feet unless otherwise shown on the Contract Drawings or expressly approved by the Engineer, obstruction light in accordance with the paragraph herein entitled "Obstruction Marking and Lighting" and obstruction mark and light that portion of equipment which exceeds 25-feet in height in accordance with FAA Advisory Circular 70/7460-1K Current Revision.

3.) Perform such duties as the Engineer may direct and as may be necessary in the opinion of the Engineer for the rerouting of traffic in the performance of the Work.

4.) Restrict smoking to areas designated by the Engineer for this purpose.

D. Obstruction Marking and Lighting:

1.) Material, temporary construction and facilities for obstruction marking and lighting constitute temporary facilities that are and shall remain the property of the Contractor unless otherwise shown on the Contract Drawings or specifically directed by the Engineer to be turned over to the Authority.

2.) Provide new materials, or undamaged previously used materials in serviceable condition conforming to the requirements specified herein.

3.) In Air Operations Areas or airport areas where obstructions occur within navigable airspace provide obstruction lights, Model UF-60-7-75A-PE-BI as manufactured by Julian A. McDermott Corp., Ridgewood, N.Y., or approved equal.

a. Unless otherwise shown on the Contract Drawings, mount an obstruction light on the highest point of construction equipment or obstruction.

b. Ensure that obstruction lights are maintained in proper operating condition throughout Work of this Contract, and operate at night seven (7) days a week and during IFR weather conditions.

(i) "Night" means the time between the end of evening civil twilight, and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

E. Not Used.

F. Not Used.

G. Not Used.

H. Subsurface Structures:

1.) Attention is called to the fact that some of the manholes, chambers or other subsurface structures, in which Work is to be performed under this Contract, contain energized high and low voltage cables, and that various insects, snakes, spiders and rodents may be present.

2.) Apply to the Engineer in writing at least 24-hours in advance of the time of: a. entry into existing manholes, handholes, or other subsurface structure or, b. interruption or disruption of utility services. Perform interruptions of electrical services, and entry into subsurface structures in accordance with the provisions of the Section hereof entitled "PERMIT AND REQUIREMENTS FOR ELECTRICAL DISTRIBUTION WORK". Service shall not be cut off on existing installations until all operations have been completed except for connections or reconnections to power source of wiring to be installed under this Contract. Notice to the Engineer shall specifically state which utilities will be affected and the time and the duration of such interruption. Keep all such interruptions to a minimum. No interruption of utility services shall be made without approval of the Engineer whose decision in all cases shall be final.

3.) Test each subsurface structure for combustible, toxic or otherwise harmful, gases or vapors in accordance with NFPA No. 328 "Recommended Practice for the Control of Flammable and Combustible Liquids and Gases in Manholes, Sewers and Similar Underground Structures" before permitting personnel to enter. If such gases or vapors are detected, ventilate the subsurface structure until the gases have dissipated to an acceptable level as determined by the OSHA Air Quality regulations prior to entry.

4.) Manholes and other subsurface structures in which Work is to be performed under this Contract may contain water. Remove water encountered in such locations and keep the floors of such locations free of standing water at all times workers are in such locations.

5.) Verify the exact locations of underground utilities and subsurface structures in the field, and assume all risks of whatever nature, if any, as to the locations of such utilities and structures.

I. No requirement of or omission to require any precautions under this Contract shall be deemed to limit or impair any responsibility or obligation assumed by the Contractor under or in connection with this Contract and the Contractor shall at all times maintain adequate protection to safeguard the public and all persons engaged in the Work and shall take such precautions as will accomplish such end, without undue interference with the public or the operations of the Authority.

109. PERMIT AND REQUIREMENTS FOR ELECTRICAL DISTRIBUTION WORK

A. Notify the Engineer at least 24 hours prior to the commencement of operations at the construction site which in any way may affect existing electrical circuits or require entry into any electrical manhole at the airport, and obtain from the Engineer, Authority Form PA 2497A entitled, "Electrical Work Permit". Execute such form in triplicate each morning prior to commencement of Work on existing electrical circuits or entry into manholes. The Authority will issue this form to the Contractor without payment of a fee.

B. Allow sufficient time for loads to be transferred to other circuits from the circuits upon which Work is to be performed and for lock out of circuits which are within existing load centers. Comply with other requirements contained on the back of the "Electrical Work Permit" insofar as they are applicable to the Work to be performed under this Contract. In any event, reconnect and place back in operation electrical circuits activating parking field, roadway, runway operations, apron and taxiway lights prior to the close of operations on each day, and in any event before sunset of each day. Overtime operations or premium time required to be paid by the Contractor for or in connection with this numbered Section shall be borne by the Contractor without separate or additional compensation therefor.

110. PERMIT AND REQUIREMENTS FOR HOT OPERATIONS

A. Definition: Hot Operations shall mean welding or cutting operations; use of spark-producing power tools; chipping or other spark-producing operations; or use of internal combustion engines without Underwriters Laboratories (UL) approved spark and flame arrestors on portions of Authority property where flammable and combustible liquids are present.

B. Work of this numbered Section shall conform to requirements herein and the following:

1.) Port Authority Form PA 2847 "Special Hot Work Permit", a sample copy of which is attached at the end of this Section.

2.) American National Standards Institute (ANSI):

a.	B31.8	Gas Transmission and Distribution Piping Systems
b.	Z117.1	Safety Requirements for Working in Tanks and Other Confined Spaces

3.) American Petroleum Institute (API) Publication 2201 "Procedure for Welding or Hot Tapping on Equipment Containing Flammables".

4.) American Welding Society (AWS) F4.1 "Recommended Safety Practices for Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances".

5.) National Fire Protection Association (NFPA):

a.	No. 10	Standard for: Portable Fire Extinguishers
b.	No. 51B	Standard for Fire Prevention in Use of Cutting and Welding Processes
c.	No. 328	Recommended Practice for the Control of Flammable and combustible Liquids and Gases in Manholes, Sewers and Similar Underground Structures

C. Special Hot Work Permit Requirements:

1.) Notify the Engineer at least 48 hours prior to initial commencement of hot operations, and obtain from the Engineer Form PA 2847 "Special Hot Work Permit". The Authority will issue such form without payment of a fee. Fill out the form in duplicate and submit to the Engineer prior to commencement of any hot operation each day.

2.) Each Special Hot Work Permit shall be valid only between the hours of 7:00 A.M. to 5:00 P.M. on the day of issue.

D. Preparation: Provide the following equipment and perform the following operations prior to commencement of Work.

1.) In addition to the requirements of the Section of Division 1 GENERAL PROVISIONS entitled "Safety Provisions", provide and maintain the following at areas of Hot Operations:

a. Not less than one 62 x 82 inch fire blanket in portable canvas bag.

b. Two 30 lb. dry chemical fire extinguishers UL rated 60 BC, positioned within 25 feet of hot operation.

c. Sand and water buckets, or treated or aluminized welding curtains to shield welding sparks.

2.) Seal sewer, duct bank, handholes, manholes and other openings located within 100 foot radius of hot operations with a water filled plastic seal. Remove such seals at the completion of each day of Hot Operations.

3.) Test for combustible, toxic or otherwise harmful gases or vapors within 100 foot radius of hot operations in accordance with Chapter 2 of NFPA Standard No. 328 using approved portable combustible gas indicator. Test prior to commencement of hot operations and perform periodic survey throughout performance of hot operations.

a. Use experienced personnel approved by the Engineer.

b. Perform calibration check of instrument each day before use.

4.) For operations in confined spaces, conform to requirements of ANSI Z117.1.

5.) When piping is associated with Hot Operations, valve isolate, drain, clean and force ventilate equipment and piping. Conform to requirements of ANSI B31.8, API 2201 and AWS F4.1 and the following:

a. Part and isolate piping and equipment not associated with but located within 50 feet of Hot Operations. Blank off and seal vapor tight open ends of such adjacent piping and equipment.

b. At welded pipe which cannot be blanked off or otherwise parted or isolated within 50 feet of Hot Operations, perform the following:

(i) If there exists any doubt as to the required non-existence of pressure within the line after shut off, drill a pilot hole to determine whether pressure exists.

(ii) After it has been determined that there is no pressure within the line and said determination approved by the Engineer, cold cut the line.

(iii) After cold cutting and removal of the Hot Operation pipe section, drain, clean, force ventilate remaining in-place piping and blank off or otherwise seal open ends vapor tight.

E. Hot Operations:

1.) Commence Hot Operations upon submission of permit form and completion of preparations stipulated in "D" herein.

a. Provide a worker to solely stand fire watch in accordance with NFPA No. 51B.

2.) For Hot Operation welding operations, firmly make welding ground connections as close as possible to weld area. Protect welders from shock when surrounding area is wet. Verify ground connections with the Engineer before welding.

3.) When Hot Operation is suspended or interrupted, take precautions to ensure that hazardous conditions are eliminated, including but not limited to:

a. Removal of electrodes from welding equipment.

b. Complete electrical disconnection of welding equipment at the power source.

4.) For replacement of cold cut welded pipe, if any, conform to requirements of E.1., and the following:

a. Install 6-foot long dry ice plugs into pipe. Locate plugs not less than 5 feet beyond area of weld.

b. Install vents in pipe at least 20 feet beyond dry ice plug to prevent pressure build up

111. AIRPORT CONSTRUCTION SAFETY REQUIREMENTS

A. General Safety Requirements:

1.) The Contractor shall adhere to all safety precautions described in the current edition of the U. S. Department, Federal Aviation Administration Advisory Circular AC 150/5370-2, current edition, Operational Safety on Airports During Construction. The Contractor is to strictly conduct all activities as not to violate safety standards contained in said Advisory Circular.

2.) Throughout the construction period, the following safety and operational practices shall be followed:

a. Operational safety shall be a standing agenda item during work progress meetings throughout the duration of the Contract.

b. The Contractor shall perform onsite inspections of the construction site throughout the duration of the Contract, with immediate remedy of any safety deficiencies.

c. The Contractor, employees of the Contractor, subcontractors, materialmen or any other support workers over whom the Contractor has control, who are required to enter the Aircraft Operations Area will be required to wear a reflective safety vest, day or night.

d. Construction that is within the safety area of an active runway, taxiway, or apron must be performed when the runway, taxiway, or apron is closed or use-restricted and initiated only with prior permission from the Engineer.

e. The Engineer may order the Contractor to suspend operations and move personnel, equipment, and materials to a safe location at any time he deems it necessary.

B. Maintenance of Construction Site:

1.) Inspect all construction and storage areas as often as necessary to be aware of conditions.

2.) Promptly take all actions necessary to prevent or remedy any unsafe or potentially unsafe conditions as soon as they are discovered.

3.) Provide continuous clean-up operations including a mechanical sweeper for all haul operations or other related traffic to and from the construction site.

4.) The Contractor, at the direction of the Engineer, may be required to provide and maintain an emergency response route through the work area, for Airport Emergency Vehicles. Construction vehicles accessing this road will give way to emergency vehicles at all times. Parking or staging of any construction equipment or stockpiling of materials blocking the road or access to the road will not be permitted.

112. HOURS OF WORK

A. Hours of Work

1.) The Contractor will be permitted to perform the Work of this Contract without restrictions as to Work hours, except as follows:

a. Perform Pile Driving only between the hours of 8:00 AM to 7:00 PM Monday to Friday and 9:00 AM to 6:00 PM Saturday.

b. Tractor Trailer, Extended Length Flatbed Trailers and Lowboy Trailer deliveries shall only be permitted between the hours of 12:01 AM to 6:00 AM each day, seven days a week.

2.) The Contractor shall submit to the Engineer, at least one week in advance, his scheduled hours of Work for each week.

3.) Do not perform Work at the construction site on a Federal legal holiday or a holiday of the state(s) in which Work is being performed, unless otherwise permitted by the Engineer.

113. MAINTENANCE OF TRAFFIC AND WORK AREA PROTECTION

A. Definitions

As used in this numbered Section, and this Section only, the terms used herein shall have the following meaning:

1.) The terms "Traffic Lane", "Lane", "Active Roadway", "Street", and "Roadway" shall mean, in addition to the normally traveled pavement areas, other areas including but not limited to ramp terminal gore areas, roadway shoulders and all other areas that may foreseeably be occupied by moving vehicles.

2.) "Flashing Arrow Sign Unit" (FASU) shall mean an engine/generator-, solar- or battery-powered flashing light sign with lights displayed in the shape of an arrow.

3.) "Variable Message Sign Unit" (VMSU) shall mean an engine/generator-, solar- or battery-powered variable text sign using a matrix composed of elements such as fluorescent flip-disc, fiber optic, light-emitting diode (LED) or incandescent bulb elements.

4.) "Nighttime " shall mean the local time period between 1/2 hour after sunset to 1/2 hour before sunrise.

5.) "Slow-Moving Vehicles" shall mean vehicles or equipment that travel at or under a speed corresponding to 15 mph less than the posted speed limit.

6.) "Work Area" shall mean the area immediately surrounding the Work in progress, typically where workers are afoot, and/or the space within a Roadway where Work on the Roadway is being done by the Contractor.

B. General Requirements

Conform to requirements of this numbered Section, the Contract Drawings and the following:

1.) Portions of the latest editions, including all amendments thereto, of the Federal Highway Administration (FHWA): "Manual on Uniform Traffic Control Devices" (MUTCD) Part VI as hereinafter specified and applicable portions of the companion "Traffic Control Devices Handbook" (TCDH); "Standard Highway Signs"; "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects"; and the "Standard Color Tolerance Charts".

2.) American Association of State Highway and Transportation Officials (AASHTO): "Roadside Design Guide", Chapter 9: Safety Appurtenances for Work Zones; and "Standard Specifications for Highway Bridges", as hereinafter specified.

3.) The requirements of the Americans with Disabilities Act (ADA) laws in all respects as specified in the "ADA Accessibility Guidelines for Buildings and Facilities" (ADAAG).

4.) American Traffic Safety Service Associations (ATSSA): "Guidelines for the Use of Portable Changeable Message Signs".

5.) Maintenance of traffic and Work Area protection features specified herein and as shown on Contract Drawings and/or sketches to be furnished to the Contractor.

6.) In the event of a technical conflict between a requirement in the publications referenced herein and the Specifications and Contract Drawings, the requirements of the Specifications and Contract Drawings shall control.

7.) There may be more than one Work Area within the confines of a closed Roadway or Traffic Lane. Each Work Area shall be individually protected as specified herein.

C. Contractor-Furnished Materials and Equipment

1.) Provide and maintain in good working order all materials, equipment, temporary construction signs and facilities required for proper maintenance of traffic and Work Area protection, as specified herein and/or shown on the Contract Drawings. All said equipment/devices shall remain the property of the Contractor, unless otherwise shown on the Contract Drawings.

2.) All items provided under paragraph C.1 shall be new or undamaged previously used materials in serviceable condition conforming to requirements specified herein.

3.) Provide and maintain in serviceable condition the following, as shown on the Contract Drawings:

a. Portable Changeable Message Signs: Trailer mounted FASU or VMSU.

b. Traffic Cones.

c. Traffic Guide Posts.

d. Plastic Delineator Drums.

e. Type III Barricades.

f. Vehicle-strong Barriers.

(i) Precast Concrete Barrier

(a.) Type 1.

(b.) Type 4.

(ii) Water-filled Barrier Sections: As manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

g. Temporary Signs: Conform to requirements of Specification Section 02850 "Plywood Sign Panels and Wood Sign Posts" and/or Specification Section 02851 "Aluminum Sign Panels" hereof. Plywood signs shall be Type 1, unless otherwise shown on the Contract Drawings.

(i) Temporary Sign Supports: Wood conforming to requirements of Specification Section 02850.

(ii) Portable Sign Supports: "Windmaster" as manufactured by Marketing Displays, Inc., Farmington Hills, MI.; or approved equal;

h. Portable Impact Attenuator, Structural Type: "G-R-E-A-T System" as manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

i. Portable Impact Attenuator, Inertial Sand Barrel Type: "Energite System" as manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

j. Temporary Timber Curbs and Concrete Barriers: Conform to the Contract Drawings and Specification Section 02842 "Temporary Traffic Barriers";

k. Back-Up Trucks: Nominal actual weight of 15,000 lbs. with nominal 24,000 lbs. gross vehicle weight registration and rear-most wheels situated close to rear of truck body. Standard "ICC" type rear bumpers are not an acceptable substitute for the required rear wheel location. Actual vehicle weight may vary depending on recommendations of the manufacturer of the vehicle-mounted impact attenuator selected. In addition, equip truck(s) with:

(i) Standard 4-lamp flashing hazard signal lights (parking and tail lights);

(ii) Four-lamp sealed beam rotating yellow warning light providing 35,000 candle power per lamp with an apparent flash rate of 120 flashes per minute. Truck mount such lights 7 to 10 feet above the Roadway and located so as to be visually unobstructed by any part of truck body, load or equipment.

(iii) Vehicle-Mounted Impact Attenuator: "TMA" units as manufactured by Energy Absorption Systems, Inc., Chicago, IL; or approved equal;

l. Temporary Roadway Plates: Steel Plates, sized to cover Roadway excavations with thickness and edge support adequate to accommodate HS-20-44 loading per Figure 3.7.6B and 3.7.7A in the AASHTO "Standard Specifications for Highway Bridges".

m. Temporary Reflectorized Pavement Marking

(i) On Finished Wearing Surfaces: New, unused removable temporary marking tape conforming to the requirements of Specifications Section 02582 "Preformed Removable Retro-Reflective Pavement Marking Tape" shall be furnished, applied and maintained. For removal see paragraph E.3.d.

(ii) On Roadway Surfaces to be Subsequently Resurfaced or Replaced Under This Contract: An approved traffic paint with glass beads applied at the rate of 1.5 pounds per 100 linear feet per 4-inch wide line, unless otherwise shown on the Contract Drawings. For removal see paragraph E.3.d.

n. When required by paragraph E.6 or utilized by the Contractor in paragraph E.7 herein, provide bituminous premixed asphalt concrete cold patch material.

4.) Submit the following to the Engineer in accordance with Division 1 - GENERAL PROVISIONS entitled "Shop Drawings, Catalog Cuts and Samples":

a. Catalog Cuts and Data Sheets: Complete manufacturer's data for all equipment and materials.

D. Spare Materials and Equipment

1.) Initially furnish and subsequently maintain the quantities of spare materials and equipment, as scheduled on the Contract Drawings, at the construction site or at another nearby location approved by the Engineer.

2.) Totally relamp Flashing Arrow Sign Unit after each single bulb failure.

E. General Work Area Protection

1.) Contractor shall establish a Traffic Maintenance Crew, properly trained, supplied, staffed and equipped to deploy and remove the maintenance of traffic and Work Area protection elements required for each of the Contractor's construction activities, as described on the Contract Drawings and/or paragraph E.3 herein. The Contractor shall identify and maintain one individual, per work period, as the central or key contact for the Traffic Maintenance Crew and their associated activities.

2.) Contractor's Traffic Maintenance training shall be specifically developed from this Section. The contents of Contractor's Training programs shall specifically include the Contract Drawings Traffic Standard Details and all other requirements included on the Contract Drawings.

3.) Prior to commencement of each day's Work, furnish and install, and periodically inspect, maintain, relocate, replace, cover, remove or reconstruct the traffic control delineations, guiding devices, signals, signs and pedestrian protection, Roadway plates, barricades, and barriers, if any, as required throughout the progress of construction operations. Maintain safe control of traffic flow and demarcate areas of Work at all times.

a. Ensure that construction material and equipment not removed from areas of Work during non-working periods are protected in such a manner that they shall not constitute a traffic hazard.

b. Do not park any vehicles other than construction vehicles required for construction operations within the demarcated protected areas of Work.

c. Promptly remove traffic control delineations, guiding devices, signals, signs, pedestrian protection, Roadway plates, barricades and barriers and whenever operations under this Contract no longer require said Work Area protection.

d. All existing permanent and temporary pavement markings and traffic guides that conflict with markings and traffic guides to be installed shall be concurrently removed prior to placement of new pavement markings and traffic guides as follows:

(i) On wearing surfaces that will be subsequently replaced, resurfaced or abandoned during the Work of this Contract, remove obsolete temporary marking tape and remove or obliterate obsolete thermoplastic or paint markings in a manner approved by the Engineer so as to completely obscure all obsolete markings for the duration of the Work.

(ii) On finished wearing surfaces, completely remove temporary marking tape and completely remove obsolete permanent markings in a manner approved by the Engineer. Use of blackout paint or other coating material on any finished wearing surface is prohibited.

(iii) Grind or chip off all adhesive residue resulting from removed or relocated traffic guides.

e. Prior to the end of each work period and not less than twice a day on non-work days, the Contractor's Traffic Maintenance crew shall visually inspect and maintain all elements of the maintenance of traffic and Work Area protection installations.

4.) Throughout Progress of Work of This Numbered Section

a. Maintain visual and physical accessibility to fire hydrants. Provide 24-hour advance notice to the Engineer in the event of hydrant obstruction.

b. Conduct Work Area protection operations so that Traffic Lane ingress and egress to intersecting Roadways, adjacent structures or property, and bus and taxi stops, if any, can be maintained. Obtain the approval of the Engineer and provide 24-hour advance notice to the Engineer in the event that Work Area protection operations obstruct access to Work Areas.

5.) Placement and Removal of Temporary Signs and Traffic Control Devices

a. Do not locate signs or other traffic delineations, guiding devices and signs in a manner that would: obstruct or interfere with motorists view of approaching, merging or intersecting traffic; obstruct other permanent signs or route markers; or mislead or misdirect the motorist.

b. Do not place traffic control signs under an overpass or elevated building, or within overpass or building shadow areas, unless otherwise shown on the Contract Drawings.

c. On Roadways passing below an overpass or elevated building, do not begin or end traffic cone or other delineation and guiding devices under or less than 100 feet from an overpass or building. Extend delineation and guiding devices as required to comply with this requirement.

d. Unless otherwise shown on the Contract Drawings, the Work of installing and removing temporary signs, traffic control devices and pavement marking shall be protected, as a minimum, in accordance with Contract Drawing Standard Traffic Details and/or the MUTCD Part 6, as applicable.

6.) At excavations within Traffic Lanes which will be open to Roadway traffic prior to completion of construction, provide and maintain temporary Roadway plates supported on all edges, and maintain the surface condition of the Active Roadway and Roadway plates so that it is consistent with the posted speed limit. Secure plates against displacement by use of suitable steel pins.

a. Secure plate against displacement and bed in well-tamped pre-mixed cold patch material ramped 1:24 at exposed edges, or

b. Cut a recess in the Roadway surface sized to snugly fit the plate and evenly support the plate around its perimeter. Locate the top of the plate flush with or less than one inch below the adjacent Roadway surface. Secure the plate in the recess in a manner approved by the Engineer.

7.) At excavations within pedestrian walkways including Traffic Lane crosswalks which will be open to walkway pedestrian traffic prior to completion of construction, provide appropriate pedestrian railings and steel plate, wood plank or plywood covers surfaced with an approved heavy duty non-skid paint coating containing a grit additive. Temporary walkway covers over excavations shall be a minimum of 4-feet wide, designed and constructed to carry a minimum of 150 psf. Railings shall be approximately 3 feet 6 inches above the walkway cover and consist of a 2-inch by 4-inch wood top rail, 1-inch by 4-inch intermediate rail and a toe board 5-1/2 inches high all securely fastened to 2-inch by 4-inch wood posts spaced not more than 8 feet apart. Securely fasten wood walkway covers and posts to wood sleepers spanning excavation trench. Chamfer or asphalt ramp exposed edges and secure against displacement. Contractor's installations shall meet the requirements of the ADA laws in all respects.

8.) Use temporary Vehicle-strong Barriers at all times when the Work Area contains open excavations or when materials and/or equipment are left in the Work Area without the presence of workers, unless otherwise shown on the Contract Drawings. Flare exposed ends of the barriers away from the Active Roadway by extending the barriers beyond the roadside recovery area and terminate the barriers with a tapered end section. Where proper flaring of the barriers cannot be obtained, protect the barrier end with Inertial Sand-Filled Barriers or Portable Impact Attenuators. Where Inertial Sand-Filled Barriers or Portable Impact Attenuators are used, do not install tapered barrier end section.

9.) Each Work Area not protected by Vehicle-strong Barriers shall be protected by a back-up truck when workers are present, unless otherwise shown on the Contract Drawings.

10.) Vehicles used by the Contractor during performance of Work shall be considered as equipment vehicles and when not protected by a Vehicle-strong Barrier, said vehicle shall be protected by a back-up truck, unless otherwise shown on the Contract Drawings.

11.) Slow-Moving Vehicles traveling on a Roadway outside of demarcated protected Work Areas shall be followed (approximately 50 feet behind) by a vehicle displaying the same flashing hazard signal lights and sealed beam rotating yellow warning light as required for back-up trucks.

F. Notwithstanding provisions herein requiring or permitting the Authority to approve or disapprove of any traffic control or delineation and guiding device provided by the

Contractor, the Contractor shall ensure the suitability and performance of all such traffic control devices such that inconvenience to the traveling public is held to an absolute minimum.

(END OF SECTION)

PART 1 - GENERAL

1. Introduction

A. The design Work shall be performed in accordance with the Contract requirements, including these Basic Specifications and Basic Contract Drawings.

B. The design of this facility includes related site improvements as described in the Basic Specifications and Basic Contract Drawings.

C. All Work under this Contract shall comply with:

1) Building Code of New York City and the Mechanical Code of New York City (MCNYS), Plumbing Code of New York City (PCNYS), Fuel Gas Code of New York City (PCNYS), and the Fire Code of New York City (FCNYS).

2) The Americans with Disabilities Act Accessibility Guidelines (ADAAG) for Buildings and Facilities.

3) Federal Occupational Safety and Health Administration (OSHA) regulations.

4) All Federal, State, Local and Authority Statutes, Laws, Codes, and Standards applicable to the Work of this Contract.

5) All Codes and Standards in the Basic Specifications.

D. The design Work shall incorporate the protective design strategies as outlined in pages 34 to 38 of the LaGuardia Airport Redevelopment Program's Protective Design Narrative (PDN), dated March 29, 2013. No deviation from the strategies provided by the PDN will be allowed.

2. Required Design Submittals

A. Submit a specific Quality Control/ Quality Assurance Program for the professional services to be performed in connection with this Contract. Upon completion of the Detailed Design documents required hereunder, submit a letter to the Engineer certifying that the Quality Control/Quality Assurance Program has been performed as submitted.

B. Design Submittals required as part of the Detailed Specifications and Detailed Contract Drawings are listed in Parts 4 through 16 of these Basic Specifications. Submit all Design Submittals for review by the Engineer. Comments and decisions made by the Engineer shall be incorporated into Detailed Specifications and Detailed Contract Drawings prior to making any subsequent design submittals to the Engineer.

C. Upload electronic files of all required Design Submittals and those used to produce the required Design Submittals at each submission to the Authority's Project Website.

D. The Design Submittals schedule milestones are as follows:

1) The Preliminary Submission is due no later than 60 calendar days after receipt by the Contractor of the acceptance of his Proposal.

2) The Interim Submission is due no later than 90 calendar days after receipt by the Contractor of the acceptance of his Proposal.

3) The Final Submission is due no later than 150 calendar days after receipt by the Contractor of the acceptance of his Proposal.

E. Design submittal review comments by the Engineer will be provided within 14 calendar days after each submission is received by the Authority, and shall be incorporated into final Detailed Contract Drawings and Detailed Specifications.

F. See Parts 4 through 16 below for specific submittal content.

G. At the Preliminary, Intermediate and Final Submissions submit the number of copies of the required Design Submittals to the Engineer as follows:

1) Thirty-five sets of Detailed Contract Drawings and/or Presentation Drawings

2) Ten copies of the Detailed Specifications

3) Five copies of calculations

H. Detailed Contract Drawings will be reviewed for compliance with the Authority's CAD (Computer Aided Drafting) and BIM (Building Information Modeling) Standards at the Intermediate and Final Submissions by the Engineer. The Detailed Contract Drawings must pass the CAD and BIM review at the Final Submission in accordance with 3. A. below.

3. Design Submittal Formats

A. Detailed Contract Drawings Format

1) Prepare, organize and present Detailed Contract Drawings that are complete, accurate and explicit enough to show compliance with the Basic Contract Drawings and Basic Specifications and as follows:

a. For Environmental, Landscape and Traffic Detailed Contract Drawings, prepare computer aided design (CAD) drawings in AutoCAD "DWG" and "DWF" file format. Use AutoCAD Civil 3D for Civil and Geotechnical Detailed Contract Drawings. All other Detailed Contract Drawings shall be prepared in "DWF" file format generated directly from an Autodesk Revit model in accordance with 4. below.

b. Detailed Contract Drawings shall be "D" size (22" x 34") using inch-pound dimensioning on Authority Standard Contract sheets. Scales shall be graphical rather than numerical. Drawing requirements shall comply with the Authority CAD and BIM Standards, latest version at time of contract award. The Authority CAD and BIM Standards are available on the web at http://www.panynj-cadstandards.com.

c. The drawing numbers series shall be as follows:

General (Title sheet, Index of Drawings, etc.)	G#
Environmental	N#
Civil	C#
Landscape Architecture	LS#
Architectural	A#
Structural	S#
Mechanical HVAC	M#
Vertical Transportation	VT#
Fire Protection	FP#
Plumbing	P#
Electrical	E#
Electronics	ES#
Traffic	T#
Maintenance of Traffic and Work Area Protection	MT#

2) Each drawing shall bear the seal and signature of the Registered Architect or Professional Engineer licensed in the State of New York who prepared the design

for the specific technical field. In addition, the following shall be placed below the seal (in compliance with the CAD and BIM Standards):

NYRA CONSULTING FIRM
NYRA CONSULTING FIRM
NYRA SUB-CONSULTING FIRM
NYRA SUB-CONSULTING FIRM

ORIGINAL SEALED AND SIGNED BY

ORIGINAL SIGNEE

NYRA Professional's Name

NY Registered Architect # NYRA Number

B. Detailed Specifications Format

1) Detailed Specifications shall be prepared by the Contractor following the CSI 3-part format used in the Basic Specifications.

C. Calculations Format

1) Calculations for each design category (Parts 4 through 16 below) shall include a cover page, a table of contents, a summary of criteria, the Contract title and location and Contract number. Cite criteria for which calculations, rationale and formulas are extracted by publication number, title, edition and page number.

2) All engineering calculation sheets shall be numbered, dated, and indexed. The index sheets shall define the total number of the sheets submitted and shall bear the seal and signature of an experienced engineer holding a Professional Engineer's license in the State of New York and who is familiar with and responsible for the design.

3) The cover page of calculations shall include the names of the persons originating and checking the calculations. The person checking the calculations shall be a registered Professional Engineer (or other registered professional engineer other than the originator). In addition, the signature and professional seal of the designer responsible for the work shall be placed on the cover page of the calculations for each respective design discipline.

D. Rendering Format

Refer to Part 8 - Architecture for rendering submittal format.

4. BIM Model

A. Format

BIM Model shall be prepared using the Revit version currently in use by the Authority as identified in the BIM Standards referenced in 3.A.1.)b. above.

B. Quality

BIM Model shall comply with the BIM Standards and all Detailed Contract Drawings shall be prepared directly from the Model.

C. Level of Development

The level of development (LOD) as defined in the AIA Document E202-2008 shall mean the level of completeness to which a Model is developed along with its minimum requirements. Detailed Contract Drawings shall be developed to LOD 300, and Shop Drawings shall be developed to LOD 400. The BIM Implementation Plan in D. below shall include the level of development for each submission stage once reviewed and approved by the Engineer.

All updates or revisions to the Detailed Contract Drawings during the performance of Work for this Contract shall coincide with updates or revisions incorporated into the BIM Model.

D. BIM Implementation Plan

Develop and submit to the Engineer an Implementation Plan which shall include the following items:

- Name and Contact Information for BIM Coordinator
- BIM expectations and goals
- LOD for Model elements (components, systems or assemblies within BIM)
- Coordination Process
- File Naming and Versioning
- Name and Contact Information for each subcontractor's BIM Coordinator
- Coordination/Clash Detection Process
- Coordination/Clash Detection Schedule and Reporting
- 4D modeling Linking Construction Schedule with the Revit Model
- Matrix template of Clashes to be Run

5. Basic Specifications

A. The heading "Basic Specifications" in each of the following Parts (4 through 16) contains the written technical requirements established for this Contract. This information shall be used in combination with the Basic Specifications and the Basic Contract Drawings to fully prepare, organize, and present the design requirements for this Contract. The Professional Engineer(s) and Architect licensed in the State of New York (herein "The Contractor's Entity performing the design for the Contractor") shall use this information to design the required facility. This information compliments the Basic Specifications.

B. Use of the Basic Specifications

1) The Contractor shall produce the Detailed Specifications for approval by the Engineer. Basic Specification cited in Parts 4 through16 shall be used without technical change to the products or procedures contained therein unless approval of the Engineer is obtained. Each Basic Specification shall be edited by the Contractor to suit this Contract by deletion of inappropriate material and addition of new material, as required. All deletions and additions shall be highlighted. Any corrections or modifications required by the Engineer shall be final.

2) Where Basic Specifications are not cited in Parts 4 through 16, the Contractor may use an Authority Standard Basic Specification to aid in the preparation of the Detailed Specifications.

C. Use of the Basic Contract Drawings

1) The Contractor shall produce the Detailed Contract Drawings for approval by the Engineer. The Basic Contract Drawings do not contain sufficient detail required to be produced in the preparation of the Detailed Contract Drawings. The Contractor is free to design all the details required or requested by the Engineer so long as they comply with good engineering practice and are compatible with the Basic and Detailed Specifications and meet the approval of the Engineer. Any corrections or modifications required by the Engineer shall be final.

D. Release of Detailed Contract Drawings and Detailed Specifications for Construction

1.) When the Contractor submits Detailed Contract Drawings and Detailed Specifications which are marked by the Engineer, "No Further Comments", and are signed and sealed by the "Contractor's Entity performing the Design for the Contractor", the Contractor shall furnish to the Authority thirty-five sets of prints and one set of mylar reproducibles of the Detailed Contract Drawings and thirty-five copies of the Detailed Specifications.

a. When the Contractor submits the copies of the final Engineer approved Detailed Specifications and Detailed Contract Drawings, the legal responsibility for the content, completeness and compatibility of the all these documents shall become the sole responsibility of the Contractor.

b. Upon receipt of "Record Sets" by the Engineer, the Contractor shall submit a letter signed and dated by the "Contractor's Entity performing the design for the Contractor" stating the following:

"I have supervised the preparation of drawings and specifications for the entire work represented herein and hereby certify that they conform to all applicable requirements of the respective enactments, ordinances, resolutions and regulations of the City, town or municipality in regard to construction and maintenance of buildings and structures and in regard to health and fire protection."

2.) Upon receiving a "Notice to Proceed" from the Engineer, the Detailed Contract Drawings and Detailed Specifications shall be released, and the Contractor may commence the preparation of shop drawings, catalog cuts, samples and all other materials required for the construction of that portion of Work.

6. Fast Track Construction Based on Approved Design Submittals

A. The Contractor may propose portions of Work for construction for approval by the Engineer. Construction may be authorized to proceed upon the Engineer's approval of the Detailed Contract Drawings, Detailed Specifications, and calculations for that portion of the Work.

7. Completion and Approval of Construction

A. Upon completion of construction, the Contractor shall submit a letter signed and dated by the "Contractor's Entity performing the design for the Contractor" stating the following:

"I have supervised the preparation of drawings and specifications for the entire work represented herein and hereby certify based on the inspections performed by all responsible parties and based on the attached certifications that all Special Inspections, materials, equipment and installations under the subject contract comply with the

approved Drawings and Specifications, the Building Code of New York City and all other applicable codes and regulations. I further certify that all applicable fire protection systems and devices have been properly installed and tested, and their associated alarms have been successfully transmitted to the Central Monitoring Station."

B. Construction Record Drawings

1) Upon completion of construction, the Contractor shall revise the electronic CAD and BIM files used to produce the final Engineer approved Detailed Contract Drawings and Detailed Specifications to reflect all changes made during the construction.

2) Submit 22" x 34" mylar prints of these drawings produced from the revised CAD and BIM files to the Engineer for verification, check of the accuracy, and for approval. Make indicated corrections and additions to the drawings, until the approval of the Engineer has been obtained. After these drawings have been approved by the Engineer, each of the original corrected mylar sheets shall be marked "RECORD DRAWING - NOT FOR REVIEW", dated and signed by the Contractor and turned over to the Engineer before issuance of the Certificate of Final Completion, and such original drawings shall become the property of the Authority. By signature, the Contractor is verifying that the drawing reflects the as-constructed condition.

END OF PART 1

PART 2 - SUSTAINABILITY

A. General Requirements

1.) Conform to the requirements of this numbered Clause, the Basic Contract Drawings, Division 1 and the basic specifications sections 2 through 16 for the following sustainability elements:

a. Materials with recycled-content

b. Locally manufactured materials

c. Forest Stewardship Council (FSC)-Certified wood materials

d. Rapidly renewable (agricultural) materials

e. Low-emitting materials

f. Site Environmental Plan

g. Indoor Air Quality Management Plan

2) Applicable Codes, Guidelines and Standards

a. Port Authority of New York and New Jersey Engineering Department - Sustainable Building Guidelines, August 15, 2007. http://www.panynj.gov/about/pdf/sustainable-building-guidelines.pdf

B. Design Criteria

1.) The Guidelines listed below are the applicable Guidelines from the PANYNJ Sustainable Building Guidelines. The Contractor shall comply with the requirements of the following Guidelines.

a. SEQ-1: Site Selection

b. SEQ-2 Support Urban Development

c. SEQ-4 Expanded Public Transit

d. SEQ-5: Bicycle Access

e. SEQ-6: Alternative Fuel Vehicles

f. SEQ-7: Reduced Parking Disturbance

g. SEQ-10: Storm Water Use

h. SEQ-11: Heat Island Effect Mitigation Site

i. SEQ-12: Heat Island Effect Mitigation Roof

j. SEQ-13: Light Pollution Reduction

k. WEQ-4: Landscape Hydrology

l. MEQ-1: Material Management Plan and Recycling

m. MEQ-4: Materials with Recycled Content

n. MEQ-5: Material Proximity

o. MEQ-7: Wood Certification

p. MEQ-8: Maintenance and Durability

q. MEQ-9: Wood Preservatives

r. EEQ-1: Comprehensive Energy Management Plan

s. EEQ-2: Building Systems Commissioning

t. EEQ-3: Optimize Energy Performance

u. EEQ-4: Ozone Layer Protection and Green House Gas Reduction

v. EEQ-5: Renewable Energy Transition Plan

w. EEQ-6: Energy Systems Control and Maintenance

x. EEQ-7: End Use Metering

y. CEQ-1: Construction Environment

z. CEQ-2: Construction Storm Water Runoff and Pollution Prevention

aa. CEQ-3: Construction Waste Management

bb. CEQ-4: Construction IAQ Management Plan

cc. IEQ-1: IAQ Performance Review

dd. IEQ-5: Reduce Contaminants from Materials

ee. IEQ-6: Chemical & Particulate Control

ff. IEQ-8: Pest Control

gg. IEQ-11: Lighting Quality

C. Sustainability Professional

The Contractor shall designate *a Sustainability Professional with a demonstrated knowledge of green building* for the preparation and submittal of all sustainability submittals to the Engineer and for the coordination of all sustainability requirements as specified herein.

D. Sustainability Submittals

For all materials requiring Sustainability Submittals, submit the following information to the Engineer:

1.) The Sustainable Materials Certification Form (SMCF) on the form bound herewith, with all spaces filled in as applicable. Such form shall include costs associated with the Work computed in accordance with the stipulations of the clauses contained in Chapter II of the Form of Contract.

2.) Documentation to validate the information provided on the SMCF. Where published product literature is submitted, clearly encircle or flag the relevant sustainability information. Such documentation shall be as follows:

a. Recycled Content: Submit published product literature or letter of certification on the manufacturer's letterhead certifying the amounts of post-consumer and/or post-industrial content.

b. Regional Manufacturing (within 500 miles of the construction site): Submit published product literature or letter of certification on the manufacturer's letterhead indicating the city/state where the manufacturing plant is located and the distance in miles from the construction site.

c. Regional Raw Materials (within 500 miles of the construction site)

(i) Submit published product literature or letter of certification on the manufacturer's letterhead indicating the city/state from which each of the raw materials in the product were extracted, harvested or recovered, and the distance in miles from the construction site.

(ii) If only portions of the raw materials for a particular product or assembly originate within 500 miles of the construction site, submit the percentages (by weight) of these materials incorporated in the complete product or assembly.

d. Certified Wood

(i) Submit vendor invoices for each wood product that has been harvested in accordance with the "FSC Principles and Criteria" for well-managed forests developed by the Forest Stewardship Council (FSC). Invoices shall include chain-of-custody (COC) certificate numbers and itemized costs for all certified products.

(ii) For assemblies, submit the percentage (by cost and by weight) of the assembly that is FSC-certified wood.

e. VOC Content: Submit Material Safety Data Sheets (MSDS) certifying the Volatile Organic Compound (VOC) content of adhesive, sealant, paint, and coating products. VOC content shall be reported in grams/liter or lbs./gallon. If the MSDS does not show the product's VOC content, submit this information through other published product literature from the manufacturer, or stated in a letter of certification from the product manufacturer on the manufacturer's letterhead.

f. Rapidly Renewable (Agricultural) Materials: For all products made from raw materials harvested within a ten-year cycle or less, submit vendor invoices, Letters of Certification (where applicable) and product literature detailing specifics of rapidly renewable (agricultural) materials.

3.) Other Product Documentation:

a. Product cut sheets: Submit product cut sheets with written confirmation that the submitted products are the products that were furnished and installed for the Contract.

b. Carpet and Rug Institute (CRI) Green Label Certification: For carpets, carpet tiles and carpet cushions, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products comply with the "Green Label" IAQ testing program of the Carpet and Rug Institute of Dalton, GA.

c. Carpet Component Identification: For all synthetic carpets, submit documentation from the manufacturer (on the manufacturer's letterhead) of the specific carpet component identification code that is printed on or attached to the carpet supplied for the Contract. The code shall identify the carpet face fiber and

its primary backing, secondary backing, adhesive, adhesive filler, and dyes if applicable.

d. Certification of Composite Wood or Agrifiber Resins: For all composite wood, engineered wood and agrifiber products, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that that the products do not contain added urea-formaldehyde or phenol-formaldehyde resins.

e. Certification of Composite Wood or Agrifiber Laminating Adhesives: For all laminating adhesives used with composite wood, engineered wood and agrifiber products (e.g., adhesives used to laminate wood veneers to an engineered wood substrate), submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that that the adhesive products do not contain urea-formaldehyde.

f. Green Seal Compliance: Submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the following product types comply with the VOC limits and chemical component restrictions developed by the Green Seal organization:

(i) Topcoat Paints: Refer to Green Seal Standard GS-11 (1st edition, May 1993).

(ii) Anti-corrosive and Anti-rust Paints: Refer to Green Seal Standard GC-03 (2nd Edition, January 1997).

(iii) Aerosol Adhesives: Refer to Green Seal Standard GS-36 (1st Edition, October 2000).

g. Energy Star Label Certification: For office equipment and electronics, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products are rated under the US EPA/DOE Energy Star program.

h. Low Mercury Fluorescent Lamps: For all fluorescent lamps installed as Work of this Contract, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the lamps contain less than 10 milligrams of mercury, and can be disposed of as non-hazardous waste, as defined by the US EPA.

i. GreenGuard Certification: For systems furniture and seating, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products are certified by the GreenGuard Environmental Institute.

j. Alternative Transportation: Low Emitting and Fuel Efficient Vehicles. Designate a minimum of five (5) percent of the total vehicle parking capacity as preferred parking for low-emitting and fuel-efficient vehicles. Preferred parking refers to the parking spots that are closest to the main entrance of the project (exclusive of

handicapped persons). Of these spaces, provide five with electrical charging capability. In addition, provide electrical charging capacity for 10 spaces.

k. Heat Island Effect Mitigation Roof: Use ENERGY STAR® compliant AND "high emissivity", (emissivity of at least 0.9 when tested in accordance with ASTM E408-71) roofing for a minimum of 75% of the roof area.

4.) Tabulate all values (e.g., distance from construction site for resource harvest, cost of rapidly renewable materials, VOC content of products, etc.) from approved SMCFs and submittals per Division once every month and submit to the Engineer for progress review.

5.) The Contractor shall provide the submittals as required by each PANYNJ Sustainable Design Guideline prior to issuance of Certificate of Final Completion.

E. Recycled Content

1.) In the performance of the Work of this Contract, use building materials with recycled content such that post-consumer recycled content plus one-half of post-industrial recycled content constitutes a minimum of 20 percent of the cost of materials (specified in Divisions 2 through 10) used for the Contract. Calculate the Percent Recycled Content and Recycled Content Value in accordance with the following:

a. Percent Recycled Content (%) = Total Recycled Content Value / Total material cost

b. Recycled Content Value ($) = (% post-consumer recycled content x material cost) + 0.5 x (% post-industrial recycled content x material cost)

c. Recycled content of materials shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims," 16 CFR 260.7 (e), Washington: USFTC, 1992.

d. Report the Percent Recycled Content on the SMCF and submit to the Engineer on a monthly basis.

F. Material Proximity

1.) In the performance of the Work of this Contract, use a minimum of 20 percent (by cost) of all building materials (specified in Divisions 2 through 10) that are regionally manufactured and harvested within 500 miles from the construction site. Calculate the Percent Local Materials in accordance with the following:

a. Percent Local Materials = Total Cost of Local Materials ($) / Total Materials Cost ($)

b. Report the Percent Local Materials on the SMCF and submit to the Engineer on a monthly basis.

G. FSC-Certified Wood Materials

1.) In the performance of the Work of this Contract, use a minimum of 50 percent of all wood building materials (by cost, and whether permanently-installed or temporary) that are harvested in accordance with the "FSC Principles and Criteria" for well-managed forests developed by the Forest Stewardship Council (FSC). Calculate the Percent of FSC-Certified Wood in accordance with the following:

a. Percent of FSC-Certified Wood = FSC-Certified Wood Material Value ($) / Total New Wood Material Value ($)

b. Report the Percent FSC-Certified Wood on the SMCF and submit to the Engineer on a monthly basis.

H. Rapidly Renewable (Agricultural) Materials

1.) In the performance of the Work of this Contract, use 5% of all building materials (by cost) that are "Rapidly Renewable Materials" made from plants typically harvested within a ten-year cycle or less. Calculate the Percent of Rapidly Renewable Materials in accordance with the following:

a. Percent of Rapidly Renewable Materials = Total Cost of Rapidly Renewable Materials ($) / Total Materials Cost ($)

b. Report the Percent of Rapidly Renewable Materials on the SMCF and submit to the Engineer on a monthly basis.

I. Site Environmental Plan

1.) Implement and submit to the Engineer a Site Environmental Plan with measures to reduce the impact of pollution, noise and vibration from construction activities and vehicles on adjoining areas. Such Plan shall address the following:

a. Location of areas for materials delivery and construction access routes to create minimum disruption to the facility and surrounds.

b. Compliance with the Division 1 clause entitled "Diesel-Powered Equipment" for diesel fuel requirements.

c. Consideration of bio-diesel fuel as an alternative to pure diesel fuel.

d. Location of fixed diesel powered exhausts away from fresh air intakes.

e. Reduction of noise and vibration impacts through scheduling and coordination with adjacent construction activities. Utilization of noise barriers where practicable.

f. Coordination of construction activities in adjacent and nearby locations to avoid or minimize impacts on surrounding buildings, structures, infrastructure and utilities where appropriate.

J. Indoor Air Quality Management Plan

1.) General

a. Implement and submit to the Engineer an Indoor Air Quality (IAQ) Management Plan in accordance with NYS Executive Order 111, Article 19.638.7(d)(1).

b. Conduct indoor air quality testing in accordance with NYS Executive Order 111, Article 19.638.7(d)(1) and submit test results to the Engineer.

c. Designate one Sustainability Professional with a demonstrated knowledge of green building from the Contractor's staff to be the IAQ representative. Such representative shall report IAQ Management Plan progress to the Engineer on a regular basis and assemble required IAQ submittals.

2.) Definitions

a. Type 1 Materials: Materials and finishes that act as sources of VOC or particulate contamination. Type 1 materials can include "wet" products, such as paints, sealants, adhesives, sealers and fireproofing materials as well as "dry" products such as flooring coverings with plasticizers, and engineered wood with formaldehyde.

b. Type 2 Materials: Materials and finishes which are woven, fibrous, or porous in nature and which tend to absorb chemicals or particulates released by Type 1 materials. Examples include textiles, carpeting, acoustical ceiling tiles and gypsum board. Type 2 materials can become "sinks" for deleterious substances which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth.

3.) References

a. "IAQ Guidelines for Occupied Buildings under Construction", First Edition, November 1995: Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), www.smacna.org

b. ANSI/ASHRAE 52.2-1999, "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size", www.ashrae.org

4.) The IAQ Management Plan shall meet the following minimum requirements:

a. Plan and perform construction activities to meet or exceed the standards included in Chapter 3 of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) "IAQ Guidelines for Occupied Buildings under Construction," First Edition, 1995. The five major categories of IAQ measures from Chapter 3 are listed below. Organize the IAQ Management Plan in accordance with the SMACNA format, and address measures to be implemented by the Contractor and/or subcontractors in each of the five categories (including subsections). Items not applicable to this Contract should be indicated as such.

HVAC Protection:

• Return Side • Central Filtration • Supply Side • Duct Cleaning
Source Control: Product Substitution: • Modifying Equipment Operation • Changing Work Practices • Local Exhaust • Air Cleaning • Cover or Seal
Pathway Interruption: • Depressurize the Work Area • Pressurize Occupied Space • Erect Barriers to Contain Construction Areas • Relocate Pollutant Sources • Temporarily Seal the Building
Housekeeping: • Routine Jobsite Cleaning • Protection of Stored Materials • Protection of Materials During and After Installation
Scheduling: • Airing-out of New Materials • Sequencing of Finish Applications • Proper Curing of Concrete before Covering • Installation during Unoccupied Periods

b. Protection of Materials from Moisture Damage: Under the Housekeeping category of the IAQ Management Plan, describe measures to protect stored or installed absorptive materials (Type 2) from moisture damage. Also describe measures to be taken if moisture damage does occur to absorptive materials during the performance of the Work.

c. Installation and Replacement of Filtration Media: Under the HVAC Protection category of the IAQ Management Plan, describe the filtration media in ventilation equipment, including replacement criteria for filtration media during construction and confirmation of filtration media replacement for equipment, immediately prior to completion of Work. Filtration media shall meet the requirements of 5.) below.

d. Sequence of Finish Applications for Materials: Furnish and install absorptive materials (referred to herein as "Type 2 Materials") after the installation of materials or finishes which have high short-term emissions of VOC's, formaldehyde, particulates, or other air-borne compounds (referred to herein as "Type 1 Materials"). Absorptive materials include, but are not limited to: carpets; acoustical ceiling panels; fabric wall coverings; insulation (exposed to the air stream); upholstered furnishings; and other woven, fibrous or porous materials. Materials with high short-term emissions include, but are not limited to: adhesives, sealants and glazing compounds (specifically those with petrochemical vehicles or carriers); paints, wood preservatives and finishes;

control and expansion joint fillers; hard finishes requiring adhesive installation; gypsum board (with associated finish processes and products); and composite or engineered wood products with formaldehyde binders.

e. Ventilation during installation of materials and finishes: Supply 100 percent outside air during the installation of materials and finishes, beginning after the building or applicable portion of Work is substantially enclosed. If building HVAC systems are used to supply the ventilation air, furnish and install filtration media in accordance with 5.) below.

f. Flush-out /Air Purging: Conduct flush-out on every floor (or applicable portion of Work) immediately prior to completion of all Work, based on the following parameters:

(i) Air-flow rate: Supply minimum air-flow for the duration of the flush-out period as follows:

a.) When outside air temperatures are between 55 and 85 degrees F., and the relative humidity between 30 and 60 percent, supply 100 percent outside air at a minimum of 50 percent of the full airflow rate of the fan during typical operating conditions.

b.) When outside air temperatures and relative humidity are outside the ranges specified in the paragraph directly above, supply 100 percent outside air at a minimum of 25 percent of the full airflow rate of the fan during typical operating conditions.

(ii) Duration: The minimum duration of the flush-out period shall be the greater of the following:

a.) Time required for delivery of a total air volume of 14,000 cu. ft. per sq. ft. of floor area, or

b.) Seven consecutive days

(iii) The ventilation system shall be capable of replacing 100 percent of the air on any floor, on a minimum of two floors at a time, or as applicable to the portion of the Work.

(iv) Scheduling: Coordinate the scheduling and sequencing of the building flush-out with the Engineer.

a.) Incorporate scheduling and sequencing into the IAQ Management Plan.

b.) Regardless of the duration as determined above, schedule the flush-out so that it concludes within two weeks after issuance of the Certificate of Substantial Completion.

g. Perform Indoor Air Quality (IAQ) Testing in accordance with the requirements of the New York State Green Building Tax Credit (GBTC), section 638.7(d) "Indoor Air Quality", sub-section (1) "Indoor Air Quality Testing". A copy of

the applicable GBTC section is available from
http://www.dec.state.ny.us/website/ppu/grnbldg/index.html

(i) Perform IAQ Testing no later than 30 days after issuance of the Certificate of Substantial Completion.

(ii) Coordinate all IAQ testing and flush-outs required by the GBTC with the Engineer.

h. Confirm that all air filters, casings, coils, fans, and ducts are clean before testing-adjusting-balancing (TAB) and air quality testing. Inspect and/or clean permanent air supply ducts to comply with the minimum requirements of "General Specifications for the Cleaning of HVAC Systems" published by the National Air Duct Cleaning Association.

i. Include provisions in the IAQ Management Plan for addressing construction site conditions that do not adhere to the Plan and remedies for stopping Work, notification of the Engineer and rectifying non-compliant conditions.

5.) Filtration Media

a. If air handlers are used during construction, furnish and install filtration media at each return grill or return duct opening and achieve a Minimum Efficiency Reporting Value (MERV) of at least 8, as determined by ASHRAE 52.2-1999.

b. Replace all filtration media immediately prior to completion of Work and achieve a Minimum Efficiency Reporting Value (MERV) of 13, as determined by ASHRAE 52.2-1999.

6.) Oversee, coordinate, document, and enforce the performance of all IAQ Management Plan control measures and maintenance activities at the construction site. Develop the sequence of major construction activities to include the identification, coordination, start-up date and expected duration of the control measures for each major construction activity. Review the sequence of major construction activities with each subcontractor prior to commencement of the respective subcontract Work.

7.) Assemble all drawings or other documentation related to the control measures implemented and photograph applicable control measures at regular intervals throughout the duration of the Contract for documentation purposes. Examples are photographs of ductwork sealing and protection, temporary ventilation measures and conditions of on-site materials storage (to prevent moisture damage). Photographs shall be integral date stamped and accompanied by brief descriptions, or shall reference specific meeting minutes or similar documents. Maintain a log of all ongoing maintenance activities.

8.) Submit the following to the Engineer in accordance with this clause:

a. A draft and final version of the IAQ Management Plan.

b. The sequence of major construction activities of all IAQ Management Plan control measures.

c. A Monthly IAQ Management Report, containing the following information:

(i) Contract number and title, name of company completing report and dates of period covered by the report.

(ii) Photographs that document the implementation of the IAQ Management Plan.

(iii) Meeting minutes, checklists, worksheets, notifications of deficiencies and resolution logs, etc. related to the IAQ Management Plan.

(iv) Documentation and log of duct inspection and cleaning where required.

d. Product Cut Sheets for all filtration media used during construction and furnished and installed immediately prior to completion of Work, with Minimum Efficiency Reporting Value (MERV) values highlighted. Verify on the product cut sheets that the submitted products have been installed in the completed Work.

K. Low Emitting Materials

1.) Interior Adhesives and Sealants

a. All adhesives and sealants used for interior Work of this Contract shall comply with the following standards:

(i) Adhesives (VOC Limits & Chemical Restrictions): Rule 1168 – "Adhesive and Sealant Applications," amended 1 January 2005): South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.

(ii) Sealants (VOC Limits & Chemical Restrictions):

a.) Regulation 8 (Organic Compounds), Rule 51 (Adhesive and Sealant Products), amended 17 July 2002: Bay Area Air Quality Management District (BAAQMD), State of California, www.baaqmd.gov.

b.) Rule 1168 – "Adhesive and Sealant Applications," amended January 1, 2005): South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.

b. VOC Limits for Interior Adhesives (SCAQMD, Rule 1168):

(i) The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

a.) General: Unless otherwise specified below, the VOC content of all adhesives, adhesive bonding primers, or adhesive primers shall not be in excess of 250 grams per liter.

b.) For specified building construction related applications, the allowable VOC content is as follows:

APPLICATION	VOC LIMIT (g/L)
Architectural Applications	
Indoor carpet adhesive	50
Carpet pad adhesive	50
Ceramic tile adhesive	65
Drywall and panel adhesive	50
Cove base adhesive	50
Multipurpose construction adhesive	70
Structural glazing adhesive	100
Specialty Applications	
PVC welding	510
CPVC welding	490
ABS welding	400
Plastic cement welding	250
Adhesive primer for plastic	250
Contact Adhesive	80
Special Purpose Contact Adhesive	250
Sheet Applied Rubber Lining Operations	850
Substrate Specific Applications	
Metal to metal	30
Plastic foams	50
Porous material (except wood)	50

c. VOC Limits for Interior Sealants (SCAQMD, Rule 1168 and BAAQMD Reg. 8, Rule 51):

(i) The VOC limits defined by SCAQMD and BAAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

APPLICATION	VOC LIMIT (g/L)
Sealants	
Architectural	250
Sealant Primer	
Architectural - Nonporous	250
Architectural - Porous	775

d. Chemical Restrictions on Adhesive and Sealants (SCAQMD, Rule 1168):

(i) Chloroform

(ii) Ethylene dichloride

(iii) Methylene chloride

(iv) Perchloroethylene

(v) Trichloroethylene

2.) Interior Paints and Coatings

a. All paints, primers, and coatings used for interior Work of this Contract shall comply with the following standards:

(i) Green Seal Environmental Standard for Paints (GS-11 for opaque topcoats, GC-03 for anti-corrosive paints), Green Seal, 1001 Connecticut Avenue, NW, Suite 827, Washington, DC, 20036; http://www.greenseal.org/certification/environmental.cfm

(ii) Rule 1113 – "Architectural Coatings," amended 7/9/04: South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov

b. Paints and Primers (Non-Specialized and Anti-Corrosive): Paints and primers used in non-specialized interior applications (e.g., for gypsum board, plaster, wood, metal doors and frames), and as anti-corrosive paints, shall meet the VOC and chemical component limitations of the Green Seal Paint Standards GS-11 and GC-03 respectively. Product-specific environmental requirements are as follows:

(i) Volatile Organic Compounds: The VOC concentrations (in grams per liter) of the product shall not exceed those listed below as determined by US Environmental Protection Agency (EPA) Reference Test Method 24. Calculation of VOC shall exclude water and tinting color added at the point of sale.

a.) Interior Coatings:

Non-flat	150 g/L
Flat	50 g/L

b.) Anti-Corrosive:

Gloss	250 g/L
Semi-gloss	250 g/L
Flat	250 g/L

c. Chemical Component Limits

(i) Aromatic Compounds: The product shall contain no more than 1.0 percent by weight of the sum total of aromatic compounds. Testing for the

concentration of these compounds will be performed by the Engineer if they are determined to be present in the product during a materials audit.

(ii) Other Chemicals: The following chemical compounds shall not be used as ingredients in the manufacture of the product:

a.) Halomethanes: methylene chloride

b.) Chlorinated ethanes: 1,1,1-trichloroethane

c.) Aromatic solvents: benzene, toluene (methylbenzene), ethylbenzene

d.) Chlorinated ethylenes: vinyl chloride

e.) Polynuclear aromatics: naphthalene

f.) Chlorobenzenes: 1,2-dichlorobenzene

g.) Phthalate esters: di (2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate, diethyl phthalate, dimethyl phthalate

h.) Miscellaneous semi-volatile organics: isophorone

i.) Metals and their compounds: antimony, cadmium, hexavalent chromium, lead, mercury

j.) Preservatives (antifouling agents): formaldehyde

k.) Ketones: methyl ethyl ketone, methyl isobutyl ketone

l.) Miscellaneous volatile organics: acrolein, acrylonitrile

3.) Paints and other Architectural Coatings (Specialized Applications): Paints and other architectural coatings used in specialized interior applications (as defined below) shall meet the VOC limitations defined in Rule 1113, "Architectural Coatings" of SCAQMD, of the State of California. The VOC limits defined by SCAQMD, based on 7/9/04 amendments, are as follows. VOC limits are defined in grams per liter, less water and less exempt compounds.

COMPOUND	VOC LIMIT (g/L)
Bond Breakers	350
Concrete-Curing Compounds	350
Fire-Retardant Coatings - Pigmented	 350
Floor Coatings	50
Graphic Arts (Sign) Coatings	500
Industrial Maintenance (IM) Coatings - High Temperature IM Coatings - Zinc-Rich IM Primers	100 420 100

Low-solids Coatings	120
Magnesite Cement Coatings	450
Mastic Coatings	300
Metallic Pigmented Coatings	500
Multi-Color Coatings	250
Pre-Treatment Wash Primers	420
Primers, Sealers and Undercoaters	100
Quick-Dry Enamels	50
Quick-Dry Primers, Sealers and Undercoaters	100
Recycled Coatings	250
Specialty Primers	100
Waterproofing Sealers	100
Waterproofing Concrete/Masonry - Sealers	100
Other Coating Types (not included in above)	250

4.) Carpeting: Carpeting, carpet tiles and carpet cushion shall meet or surpass all criteria of the "Green Label Plus" Indoor Air Quality Test Program established by the Carpet and Rug Institute (CRI). For carpet adhesives refer to E. 1. Interior Adhesives and Sealants above.

5.) Urea-formaldehyde Free Composite Wood: All composite wood, engineered wood, or agrifiber products used for interior applications (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI).

SU .INABLE MATERIALS CERTIFICATION FORM (SMCF)	PAGE OF
CONTRACT NUMBER AND TITLE:	SPECIFICATION SECTION:
CONTRACTOR:	SUBMITTAL NO:
DATE:	

PRODUCT	VENDOR OR MANUFACTURER	REQUIRED FOR ALL PRODUCTS IDENTIFIED IN SPECIFICATIONS (EXCEPT MEP)		RECYCLED CONTENT		% REGIONAL CONTENT MANUFACTURED[3] & EXTRACTED WITHIN 500 MILE RADIUS OF SITE (% BY WEIGHT)[4]	WOOD PRODUCTS: % FSC CERTIFIED[6]	VOC CONTENT[7] (FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS)	% RAPIDLY RENEWABLE CONTENT[5]
		TOTAL INSTALLED COST	MATERIAL COST (EXCLUDING LABOR & EQUIPMENT)	% POST CONSUMER CONTENT[1]	% POST INDUSTRIAL CONTENT[2]				
1.									
2.									
3.									
4.									
5.									
6.									

1 POST-CONSUMER RECYCLED CONTENT: Portion of material or product originating from discarded consumer waste that has been recovered for use as a raw material (e.g., plastic bottles, newspaper)

2 POST-INDUSTRIAL RECYCLED CONTENT: Portion of material or product originating from recovered industrial and manufacturing materials that has been diverted from municipal solid waste for use in a different manufacturing process, prior to use by a consumer (e.g., fly-ash in concrete or synthetic gypsum board, both being by-products of coal-burning power plants). Note that spills and scraps from the original manufacturing process combined with other constituents after a minimal amount of reprocessing for use in further production of the same product do not qualify.

3 REGIONAL EXTRACTION/MANUFACTURE: Extraction: Extraction, harvesting or recovery of materials that are used for manufacturing of products to be installed in the building. Manufacture: Final assembly of components into a finished product that is furnished and installed as part of the Contract. For example, if the lumber is from Missoula, MT, and the joist (the finished product in this case) is assembled in Kent, WA; then the location of final assembly is Kent, WA). Since Missoula, MT is within a 500 mile radius of Kent, WA the answer for this example would be '100%'

4 PARTIAL EXTRACTION/MANUFACTURE: If a product is 100% manufactured regionally, but only a fraction of the material is extracted/harvested/recovered within a 500 mile radius then (only) that percentage (by weight) contributes to the regional value.

5 RAPIDLY RENEWABLE: Materials and products made from raw materials that are harvested within a 10-year cycle (e.g., bamboo, cork, linoleum, fast-growing poplar, wheatboard, wool carpet).

6 FSC CERTIFIED: Wood-based products certified by the Forest Stewardship Council and carrying a Chain-of-Custody certificate number from the vendor or manufacturer.

7 VOC CONTENT: The quantity of volatile organic compounds contained in products such as adhesives, sealants and architectural coatings. Report VOC content in grams/liter or lbs/gallon.

PART 3 - PROGRAM

1. Room Data Sheets

   A. The Room Data Sheets included herein define requirements for each Room.

   B. The Contractor shall comply with the requirements on each Room Data Sheet.

   C. Refer to the Basic Contract Drawings and Parts 3-16 for additional requirements.

   D. The Contractor shall establish and incorporate into the design entries labeled with a "C".

Room Data Sheet

Phase: I | Room Name: **Stair A** | Room No: **101**

General Information

Location: East Parking Garage - Level 1
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 9' - 6"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation
Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:
Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:
HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Electrical Distribution Room** | Room No: **102**

General Information

Location: East Parking Garage - Level 1
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 86 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I — Room Name: **Electronic Distribution Room** — Room No: **103**

General Information

Location: East Parking Garage - Level 1
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 9"
Req'd Mins:
Width: 11' - 3"
Ceiling AFF: 10' - 0"
FloorArea: 54 SF
☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU
Floor Finish: Sealed Conc.
Wall Base Finish: None
Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0,
Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

- ☑ Heat Req'd
- ☑ A/C Req'd
- ☐ Redundant HVAC
- ☐ 24 Hr A/C Req'd
- ☐ CO2 Monitor / Occupancy Sensor
- ☐ Direct Exhaust Req'd
- ☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

- ☐ Fire Protection System
- ☐ Wet FPS
- ☐ Dry FPS
- ☐ Pre-Action FPS
- ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W
Uniformity:
FootCandles:
Required: fc
Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
- ☐ EM Power Req'd
- ☐ Power System
- ☑ Generator
- ☑ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
- ☐ Fire Alarm
- ☐ Public Address System
- ☑ Intercom
- ☑ CCTV
- ☐ CATV
- ☑ Fiber Optic - Facility
- ☐ Fiber Optic - non-Facility
- ☑ Data - Facility
- ☐ Data - non-Facility
- ☐ Radio - Facility
- ☐ Radio - non-Facility
- ☐ 800Mhz IB Trunked
- ☐ 800Mhz Campus Trunked
- ☐ 800MHz Mutual Aid
- ☐ FDNY&EMS
- ☐ ChannelX
- ☐ Master Clock
- ☐ Wireless Carriers
- ☐ Electronic Messaging System
- ☐ Media Display
- ☐ Way Finding Display

Other

Telephone
- ☐ GeneralPhone
- ☐ House Phone
- ☐ Pay Phone
- ☐ Passenger Assistance Phone

Security
- ☑ Intrusion Detection
- ☑ Card Access
- ☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair B** Room No: **104**

General Information

Location: East Parking Garage - Level 1 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 24' - 4" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 9' - 6"
FloorArea: 339 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) :
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electrical Distribution Room** Room No: **106**

General Information

Location: East Parking Garage - Level 1
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 70 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I — Room Name: **Electronic Distribution Room** — Room No: **107**

General Information

Location: East Parking Garage - Level 1
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 10" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 44 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

- ☑ Heat Req'd
- ☑ A/C Req'd
- ☐ Redundant HVAC
- ☐ 24 Hr A/C Req'd
- ☐ CO2 Monitor / Occupancy Sensor
- ☐ Direct Exhaust Req'd
- ☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

- ☐ Fire Protection System
- ☐ Wet FPS
- ☐ Dry FPS
- ☐ Pre-Action FPS
- ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
- ☐ Occupancy Sensor Control
- ☐ Light Dimming Controls

Power
- ☐ EM Power Req'd
- ☐ Power System
- ☑ Generator
- ☑ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
- ☐ Fire Alarm
- ☐ Public Address System
- ☑ Intercom
- ☑ CCTV
- ☐ CATV
- ☑ Fiber Optic - Facility
- ☐ Fiber Optic - non-Facility
- ☑ Data - Facility
- ☐ Data - non-Facility
- ☐ Radio - Facility
- ☐ Radio - non-Facility
- ☐ 800Mhz IB Trunked
- ☐ 800Mhz Campus Trunked
- ☐ 800MHz Mutual Aid
- ☐ FDNY&EMS
- ☐ ChannelX
- ☐ Master Clock
- ☐ Wireless Carriers
- ☐ Electronic Messaging System
- ☐ Media Display
- ☐ Way Finding Display

Other

Telephone
- ☐ GeneralPhone
- ☐ House Phone
- ☐ Pay Phone
- ☐ Passenger Assistance Phone

Security
- ☑ Intrusion Detection
- ☑ Card Access
- ☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair C** Room No: **108**

General Information

Location: East Parking Garage - Level 1 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 9' - 6"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Janitor Closet** Room No: **109**

General Information

Location: East Parking Garage - Level 1 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 6' - 0" Req'd Mins:
Width: 5' - 5" Ceiling AFF: 10' - 0"
FloorArea: 33 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 50 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures: Mop Sink Stern & Williams Terrazzo, Model HL-1910
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type B
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: 1 NEMA 5-20R GFI Receptacle

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Water Service Room** Room No: **110**

General Information

Location: East Parking Garage - Level 1 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 19' - 3" Req'd Mins:
Width: 19' - 4" Ceiling AFF: 10' - 0"
FloorArea: 373 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type A
Lighting Load: 256 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Sewage Ejector Room** Room No: **111**

General Information

Location: East Parking Garage - Level 1
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 22' - 0" Req'd Mins:
Width: 19' - 4" Ceiling AFF: 10' - 0"
FloorArea: 425 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☐ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: Provide Duplex Sewage Ejector with SCADA compatible panel under plumbing fixture

Lighting and Power

Lighting
Lighting Type: 4 Type A
Lighting Load: 256 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R GFI Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Diesel Tank Room** Room No: **112**

General Information

Location: East Parking Garage - Level 1
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 19' - 4" Req'd Mins:
Width: 10' - 9" Ceiling AFF: 10' - 0"
FloorArea: 208 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0 Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System
☐ Wet FPS
☐ Dry FPS
☐ Pre-Action FPS
☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Stair A** | Room No: **201**

General Information

Location: East Parking Garage - Level 2
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Electrical Distribution Room** | Room No: **202**

General Information

Location: East Parking Garage - Level 2
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 86 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) : 100 CFM
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I — Room Name: **Electronic Distribution Room** — Room No: **203**

General Information

Location: East Parking Garage - Level 2
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 9" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 54 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

- ☑ Heat Req'd
- ☑ A/C Req'd
- ☐ Redundant HVAC
- ☐ 24 Hr A/C Req'd
- ☐ CO2 Monitor / Occupancy Sensor
- ☐ Direct Exhaust Req'd
- ☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

- ☐ Fire Protection System
- ☐ Wet FPS
- ☑ Dry FPS
- ☐ Pre-Action FPS
- ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
- ☐ Occupancy Sensor Control
- ☐ Light Dimming Controls

Power
- ☐ EM Power Req'd
- ☐ Power System
- ☑ Generator
- ☑ UPS

Communications and Systems

Systems
- ☐ Fire Alarm
- ☐ Public Address System
- ☑ Intercom
- ☑ CCTV
- ☐ CATV
- ☑ Fiber Optic - Facility
- ☐ Fiber Optic - non-Facility
- ☑ Data - Facility
- ☐ Data - non-Facility
- ☐ Radio - Facility
- ☐ Radio - non-Facility
- ☐ 800Mhz IB Trunked
- ☐ 800Mhz Campus Trunked
- ☐ 800MHz Mutual Aid
- ☐ FDNY&EMS
- ☐ ChannelX
- ☐ Master Clock
- ☐ Wireless Carriers
- ☐ Electronic Messaging System
- ☐ Media Display
- ☐ Way Finding Display

Other

Telephone
- ☐ GeneralPhone
- ☐ House Phone
- ☐ Pay Phone
- ☐ Passenger Assistance Phone

Security
- ☑ Intrusion Detection
- ☑ Card Access
- ☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair B** Room No: **204**

General Information

Location: East Parking Garage - Level 2
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 24' - 4" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 337 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes: None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Electrical Distribution Room** | Room No: **206**

General Information

Location: East Parking Garage - Level 2
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 70 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☐ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I — Room Name: **Main Electronic Distribution Room** — Room No: **207**

General Information

Location: East Parking Garage - Level 2
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 13' - 9" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 0 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

- ☑ Heat Req'd
- ☑ A/C Req'd
- ☐ Redundant HVAC
- ☐ 24 Hr A/C Req'd
- ☐ CO2 Monitor / Occupancy Sensor
- ☐ Direct Exhaust Req'd
- ☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

- ☐ Fire Protection System
- ☐ Wet FPS
- ☐ Dry FPS
- ☐ Pre-Action FPS
- ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
- ☐ Occupancy Sensor Control
- ☐ Light Dimming Controls

Power
- ☐ EM Power Req'd
- ☑ Power System
- ☑ Generator
- ☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
- ☐ Fire Alarm
- ☐ Public Address System
- ☑ Intercom
- ☑ CCTV
- ☐ CATV
- ☑ Fiber Optic - Facility
- ☐ Fiber Optic - non-Facility
- ☑ Data - Facility
- ☐ Data - non-Facility
- ☐ Radio - Facility
- ☐ Radio - non-Facility
- ☐ 800Mhz IB Trunked
- ☐ 800Mhz Campus Trunked
- ☐ 800MHz Mutual Aid
- ☐ FDNY&EMS
- ☐ ChannelX
- ☐ Master Clock
- ☐ Wireless Carriers
- ☐ Electronic Messaging System
- ☐ Media Display
- ☐ Way Finding Display

Other

Telephone
- ☐ GeneralPhone
- ☐ House Phone
- ☐ Pay Phone
- ☐ Passenger Assistance Phone

Security
- ☑ Intrusion Detection
- ☑ Card Access
- ☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair C** Room No: **208**

General Information

Location: East Parking Garage - Level 2 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Janitor Closet** Room No: **209**

General Information

Location: East Parking Garage - Level 2 Room Occupancy Type:
Group: Utilities Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 4" Ceiling AFF: 10' - 0"
FloorArea: 87 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware: Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd ☐ CO2 Monitor / Occupancy Sensor
☐ A/C Req'd
☐ Redundant HVAC ☐ Direct Exhaust Req'd
☐ 24 Hr A/C Req'd ☐ Natural Ventilation

Ventilation Exhaust (ACH): 50 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☐ Dry FPS ☐ FM200

Plumbing Fixtures: Mop sink Stern & Williams Terrazzo, Model HL-1910

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type B
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 1 NEMA 5-20R GFI Receptacle

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Stair A** | Room No: **301**

General Information

Location: East Parking Garage - Level 3
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9"
Req'd Mins:
Width: 13' - 11"
Ceiling AFF: 8' - 0"
FloorArea: 331 SF
☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU
Floor Finish: Sealed Conc.
Wall Base Finish: None
Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0,
Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W
Uniformity:
FootCandles:
Required: fc
Provided: fc

Lighting Power Density:
Required: W/sf W/sf
Provided: W/sf W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Electrical Distribution Room** | Room No: **302**

General Information

Location: East Parking Garage - Level 3
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8"
Req'd Mins:
Width: 11' - 3"
Ceiling AFF: 10' - 0"
FloorArea: 86 SF
☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU
Floor Finish: Sealed Conc.
Wall Base Finish: None
Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0,
Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☐ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W
Uniformity:
FootCandles:
Required: fc
Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: 1 Room Name: **Electronic Distribution Room** Room No: **303**

General Information

Location: East Parking Garage - Level 3 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 9" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 54 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware: Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

- ☑ Heat Req'd
- ☑ A/C Req'd
- ☐ Redundant HVAC
- ☐ 24 Hr A/C Req'd
- ☐ CO2 Monitor / Occupancy Sensor
- ☐ Direct Exhaust Req'd
- ☐ Natural Ventilation

Ventilation Exhaust (ACH) :
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

- ☐ Fire Protection System
- ☐ Wet FPS
- ☑ Dry FPS
- ☐ Pre-Action FPS
- ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
- ☐ EM Power Req'd
- ☑ Power System
- ☑ Generator
- ☐ UPS

Communications and Systems

Systems
- ☐ Fire Alarm
- ☐ Public Address System
- ☑ Intercom
- ☑ CCTV
- ☐ CATV
- ☑ Fiber Optic - Facility
- ☐ Fiber Optic - non-Facility
- ☑ Data - Facility
- ☐ Data - non-Facility
- ☐ Radio - Facility
- ☐ Radio - non-Facility
- ☐ 800Mhz IB Trunked
- ☐ 800Mhz Campus Trunked
- ☐ 800MHz Mutual Aid
- ☐ FDNY&EMS
- ☐ ChannelX
- ☐ Master Clock
- ☐ Wireless Carriers
- ☐ Electronic Messaging System
- ☐ Media Display
- ☐ Way Finding Display

Other

Telephone
- ☐ GeneralPhone
- ☐ House Phone
- ☐ Pay Phone
- ☐ Passenger Assistance Phone

Security
- ☑ Intrusion Detection
- ☑ Card Access
- ☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair B** Room No: **304**

General Information

Location: East Parking Garage - Level 3 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 24' - 4" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 339 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electrical Distribution Room** Room No: **306**

General Information

Location: East Parking Garage - Level 3
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 71 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0 Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☐ Dry FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electronic Distribution Room** Room No: **307**

General Information

Location: East Parking Garage - Level 3
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 10" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 44 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☑ Heat Req'd
☑ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☑ Power System
☑ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☑ Intercom
☑ CCTV
☐ CATV
☑ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☑ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair C** Room No: **308**

General Information

Location: East Parking Garage - Level 3 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:
Sustainable Criteria

Doors , Windows, and Casework
Door and Frame: None, None Hardware:
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) :
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Janitor Closet** Room No: **309**

General Information

Location: East Parking Garage - Level 3
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 4" Ceiling AFF: 10' - 0"
FloorArea: 87 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 50 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200

Plumbing Fixtures: Mop sink Stern & Williams Terrazzo, Model HL-1910

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type B
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: 1 NEMA 5-20R GFI Receptacle

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Stair A** | Room No: **401**

General Information

Location: East Parking Garage - Level 4
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9"
Req'd Mins:
Width: 13' - 11"
Ceiling AFF: 8' - 0"
FloorArea: 331 SF
☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU
Floor Finish: Sealed Conc.
Wall Base Finish: None
Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None
Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W
Uniformity:
FootCandles:
Required: fc
Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electrical Distribution Room** Room No: **402**

General Information

Location: East Parking Garage - Level 4
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 86 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Electronic Distribution Room** | Room No: **403**

General Information

Location: East Parking Garage - Level 4
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 9"
Req'd Mins:
Width: 11' - 3"
Ceiling AFF: 10' - 0"
FloorArea: 54 SF
☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU
Floor Finish: Sealed Conc.
Wall Base Finish: None
Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0,
Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

- ☑ Heat Req'd
- ☑ A/C Req'd
- ☐ Redundant HVAC
- ☐ 24 Hr A/C Req'd
- ☐ CO2 Monitor / Occupancy Sensor
- ☐ Direct Exhaust Req'd
- ☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

- ☐ Fire Protection System
- ☐ Wet FPS
- ☐ Dry FPS
- ☐ Pre-Action FPS
- ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W
Uniformity:
FootCandles:
Required: fc
Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
- ☐ EM Power Req'd
- ☐ Power System
- ☐ Generator
- ☐ UPS

Communications and Systems

Systems
- ☐ Fire Alarm
- ☐ Public Address System
- ☑ Intercom
- ☑ CCTV
- ☐ CATV
- ☑ Fiber Optic - Facility
- ☐ Fiber Optic - non-Facility
- ☑ Data - Facility
- ☐ Data - non-Facility
- ☐ Radio - Facility
- ☐ Radio - non-Facility
- ☐ 800Mhz IB Trunked
- ☐ 800Mhz Campus Trunked
- ☐ 800MHz Mutual Aid
- ☐ FDNY&EMS
- ☐ ChannelX
- ☐ Master Clock
- ☐ Wireless Carriers
- ☐ Electronic Messaging System
- ☐ Media Display
- ☐ Way Finding Display
- Other

Telephone
- ☐ GeneralPhone
- ☐ House Phone
- ☐ Pay Phone
- ☐ Passenger Assistance Phone

Security
- ☑ Intrusion Detection
- ☑ Card Access
- ☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair B** Room No: **404**

General Information

Location: East Parking Garage - Level 4 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 24' - 4" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 339 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electrical Distribution Room** Room No: **406**

General Information

Location: East Parking Garage - Level 4
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 70 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) : 100 CFM
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☐ Dry FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electronic Distribution Room** Room No: **407**

General Information

Location: East Parking Garage - Level 4
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 10" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 44 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

☑ Heat Req'd
☑ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) :
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☑ Generator
☑ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☑ Intercom
☑ CCTV
☐ CATV
☑ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☑ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair C** Room No: **408**

General Information

Location: East Parking Garage - Level 4 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Janitor Closet** Room No: **409**

General Information

Location: East Parking Garage - Level 4 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 4" Ceiling AFF: 10' - 0"
FloorArea: 87 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 50 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures: Mop sink Stem & Williams Terrazzo, Model HL-1910
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type B
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 1 NEMA 5-20R GFI Receptacle

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I
Room Name: **Stair A**
Room No: **501**

General Information

Location: East Parking Garage - Level 5
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load:
Temporary Load:
General Notes: None

Architectural

Dimension

Length: 23' - 9"
Req'd Mins:
Width: 13' - 11"
Ceiling AFF: 10' - 0"
FloorArea: 331 SF
☐ Maximized Daylight

Adjacencies

Proximity To:
InterRelationships:

Finishes

Wall Finish: Plaster CMU
Floor Finish: Sealed Conc.
Wall Base Finish: None
Ceiling Finish: Sealed Conc.

Amenities

Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework

Door and Frame: None, None
Hardware:
Sustainable Criteria

Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes: None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting

Lighting Type: 4 Type XDE-2
Lighting Load: 36 W
Uniformity:
FootCandles:
Required: fc
Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power

☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems

☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone

☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security

☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electrical Distribution Room** Room No: **502**

General Information

Location: East Parking Garage - Level 5
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0 "
FloorArea: 86 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electronic Distribution Room** Room No: **503**

General Information

Location: East Parking Garage - Level 5 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 9" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 54 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware: Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☑ Heat Req'd
☑ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) :
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☐ Dry FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☑ Generator
☑ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☑ Intercom
☑ CCTV
☐ CATV
☑ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☑ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair B** Room No: **504**

General Information

Location: East Parking Garage - Level 5 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 24' - 4" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 339 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Electrical Distribution Room** | Room No: **506**

General Information

Location: East Parking Garage - Level 5
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 70 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0. Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electronic Distribution Room** Room No: **507**

General Information

Location: East Parking Garage - Level 5
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 10" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 44 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☑ Heat Req'd
☑ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation
Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:
Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:
HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☑ Generator
☑ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☑ Intercom
☑ CCTV
☐ CATV
☑ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☑ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Stair C** | Room No: **508**

General Information

Location: East Parking Garage - Level 5
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Janitor Closet** Room No: **509**

General Information

Location: East Parking Garage - Level 5 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 4" Ceiling AFF: 10' - 0"
FloorArea: 87 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 50 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures: Mop sink Stern & Williams Terrazzo, Model HL-1910
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type B
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 1 NEMA 5-20R GFI Receptacle

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I | Room Name: **Stair A** | Room No: **601**

General Information

Location: East Parking Garage - Level 6
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Main Electrical Distribution Room** Room No: **602**

General Information

Location: East Parking Garage - Level 6 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 86 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) : 100 CFM
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 3 Type B
Lighting Load: 192 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I — Room Name: **Back-up power Distribution Room** — Room No: **603**

General Information

Location: East Parking Garage - Level 6
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 9" Req'd Mins:
Width: 11' - 3" Ceiling AFF: 10' - 0"
FloorArea: 54 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes: None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 3 Type B
Lighting Load: 192 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair B** Room No: **604**

General Information

Location: East Parking Garage - Level 6 Room Occupancy Type:
Group: Open Stair Occupancy Load:
Fire Rating: Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 24' - 4" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 0 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH) :
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☑ Dry FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting and Power Notes: None

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I — Room Name: **Electrical Distribution Room** — Room No: **606**

General Information

Location: East Parking Garage - Level 6
Room Occupancy Type: 0
Group: Utilities
Occupancy Load:
Fire Rating: 0
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 7' - 8" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 70 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH): 100 CFM
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System ☐ Wet FPS ☐ Pre-Action FPS
☐ Dry FPS ☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 1 Type A
Lighting Load: 64 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☑ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☑ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: 4 NEMA 5-20R Receptacles

Communications and Systems

Systems
☑ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Electronic Distribution Room** Room No: **607**

General Information

Location: East Parking Garage - Level 6 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 4' - 10" Req'd Mins:
Width: 9' - 2" Ceiling AFF: 10' - 0"
FloorArea: 44 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors , Windows, and Casework
Door and Frame: 0, Hardware: Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☑ Heat Req'd
☑ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation
Ventilation Exhaust (ACH) :
Ventilation (O.A.) :
Cooling Load:
Heating Load:
or maintain:
Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:
HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☑ Intercom
☑ CCTV
☐ CATV
☑ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☑ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☑ Intrusion Detection
☑ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Stair C** Room No: **608**

General Information

Location: East Parking Garage - Level 6
Room Occupancy Type:
Group: Open Stair
Occupancy Load:
Fire Rating:
Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 23' - 9" Req'd Mins:
Width: 13' - 11" Ceiling AFF: 8' - 0"
FloorArea: 331 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Plaster CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Sealed Conc.

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: None, None Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC

☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection

☐ Fire Protection System
☐ Wet FPS
☑ Dry FPS
☐ Pre-Action FPS
☐ FM200

Plumbing Fixtures:

Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 4 Type XDE-2
Lighting Load: 36 W Uniformity:
FootCandles:
Required: fc Provided: fc

Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

Room Data Sheet

Phase: I Room Name: **Elevator Control Room** Room No: **612**

General Information

Location: East Parking Garage - Level 6 Room Occupancy Type: 0
Group: Utilities Occupancy Load:
Fire Rating: 0 Permanent Load: Temporary Load:
General Notes: None

Architectural

Dimension
Length: 9' - 2" Req'd Mins:
Width: 12' - 0" Ceiling AFF: 10' - 0"
FloorArea: 110 SF ☐ Maximized Daylight

Adjacencies
Proximity To:
InterRelationships:

Finishes
Wall Finish: Ptd. CMU Floor Finish: Sealed Conc.
Wall Base Finish: None Ceiling Finish: Exposed Mtl. Deck

Amenities
Furniture and Equipment:
Passenger Amenities:

Doors, Windows, and Casework
Door and Frame: 0, Hardware:
Sustainable Criteria
Architectural Notes: None

Mechanical

HVAC
☐ Heat Req'd
☐ A/C Req'd
☐ Redundant HVAC
☐ 24 Hr A/C Req'd
☐ CO2 Monitor / Occupancy Sensor
☐ Direct Exhaust Req'd
☐ Natural Ventilation

Ventilation Exhaust (ACH):
Ventilation (O.A.):
Cooling Load:
Heating Load:
or maintain:

Summer Design Temp:
Winter Design Temp:
Heat Load From Equipment:

HVAC Notes None

Plumbing and Fire Protection
☐ Fire Protection System ☐ Wet FPS ☐ Dry FPS ☐ Pre-Action FPS ☐ FM200
Plumbing Fixtures:
Plumbing and Fire Protection Notes: None

Lighting and Power

Lighting
Lighting Type: 0
Lighting Load: W Uniformity:
FootCandles:
Required: fc Provided: fc
Lighting Power Density:
Required: W/sf
Provided: W/sf
☐ Occupancy Sensor Control
☐ Light Dimming Controls

Power
☐ EM Power Req'd
☐ Power System
☐ Generator
☐ UPS

Lighting and Power Notes: None

Communications and Systems

Systems
☐ Fire Alarm
☐ Public Address System
☐ Intercom
☐ CCTV
☐ CATV
☐ Fiber Optic - Facility
☐ Fiber Optic - non-Facility
☐ Data - Facility
☐ Data - non-Facility
☐ Radio - Facility
☐ Radio - non-Facility
☐ 800Mhz IB Trunked
☐ 800Mhz Campus Trunked
☐ 800MHz Mutual Aid
☐ FDNY&EMS
☐ ChannelX
☐ Master Clock
☐ Wireless Carriers
☐ Electronic Messaging System
☐ Media Display
☐ Way Finding Display
Other

Telephone
☐ GeneralPhone
☐ House Phone
☐ Pay Phone
☐ Passenger Assistance Phone

Security
☐ Intrusion Detection
☐ Card Access
☐ Key Lock

Communications and Systems Notes: None, None

PART 4 – ENVIRONMENTAL

1. General

   A. This Part sets forth the assumptions, regulatory references, design criteria, permitting process requirements and recommendations for the environmental work associated with construction of the new multi-level East End Parking Garage.

   B. Existing Conditions

      1) The site selected for the Garage is at west end of a paved parking area designated as "Parking Lot 4", located across from US Airways Terminal "C".

2. Assumptions

   A. An environmental study to determine the presence of contamination shall not be conducted as part of this effort. Contamination that is encountered during work shall be addressed according to the environmental management plan provided by the Contractor.

   B. The Contractor shall meet the requirements of the LGA State Pollution Discharge Elimination System (SPDES) Permit, including applicable sections of the Best Management Practices Plan (BMPP) developed for LGA.

   C. The construction of the Garage and associated facilities at Parking Lot 4 will disturb more than one acre of soil; therefore, a Stormwater Pollution Prevention Plan (SWPPP) shall be prepared and a Notice of Intent (NOI) shall be submitted to the NYSDEC, with copies to the Port Authority.

   D. Milling and overlay (paving) shall not be included in the calculations to determine the total area of soil disturbance for the project.

   E. Soils that are excavated as part of this project may be reused in the same excavation provided that the soil does not exhibit signs of gross petroleum contamination (e.g. odor, staining, saturated with free product).

   F. Any excavated soils that are generated as a part of this project that meet environmental requirements but cannot be reused for another reason shall be characterized as excess and disposed of as solid waste or beneficially reused.

   G. Any excavated soil that exhibits signs of petroleum contamination (e.g. odor, staining, saturated with free product) shall not be reused and shall be properly disposed of.

   H. It is assumed that the groundwater from dewatering will not meet the 100 mg/L Total Suspended Solids (TSS) limit in the LGA SPDES permit; therefore, treatment of TSS in the dewatering discharge will be necessary.

   I. Contractor shall test suspect underground utilities (e.g.: piping, ductbanks) for asbestos and submit laboratory analysis results for review prior to disturbance of tested items. If

asbestos is encountered on any underground utilities during excavation, abate and/or dispose of the asbestos according to specifications section 02081. Existing ductbanks have been known to contain asbestos conduits. If existing asbestos ductbanks are to be reused and the asbestos conduits are confirmed, then Contractor shall submit an asbestos dust control plan for review and implementation during all cable pulling operations. If the utilities are to be abandoned in-place, then asbestos abatement and/or disposal will not be required.

J. The Health and Safety Plan (HASP) developed for the project by the Contractor shall address encountering hazardous contamination.

3. Design Criteria

A. Since the project will disturb one or more acres of soil, a SWPPP shall be prepared. The SWPPP, at a minimum, shall describe the soil erosion and sediment control measures that shall be undertaken during construction activities. The SWPPP need not describe post construction water quality since there will be no increase in impervious area. The implementation of a SWPPP will require both a trained Contractor and a qualified inspector who shall conduct weekly inspections.

B. Submit to the Engineer an environmental management plan for the management of excavated and/or excess soil, disposal of waste, management of any water generated from dewatering activities, and include an action plan to be implemented in the event that petroleum contamination is encountered.

C. Stockpile excess soils until completion of the project to maximize the use of excavated soil and minimize the soils that are disposed of as solid waste. Excess soils are any soils that cannot be reused at the site either because the excavation will not require the soils or the soils are deemed unsuitable for a reason other than an environmental reason.

4. Applicable Codes, Standards and References

A. Environmental work shall be performed in accordance with Federal and State environmental standards and requirements. These include, but are not limited to:

B. New York State Department of Environmental Conservation (NYSDEC) SPDES Permit for Stormwater Discharges for LGA – Permit Number NY-0008133 DEC Number 2-6301-00106/00023
C. NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity Permit No. GP-0-10-001
D. New York State Petroleum Contaminated Soil Guidance Policy STARS Memo #1
E. 6 NYCRR Part 360 – Solid Waste Management Facilities
F. 6 NYCRR Chapter III, 364-373 – Hazardous Waste Management Regulations
G. 12 NYCRR Part 56 – Asbestos
H. New York State Standards and Specifications for Erosion and Sediment Control
I. New York State Stormwater Management Design Manual
J. NYSDEC DER-10 – Technical Guidance for Site Investigation and Remediation
K. 29 CFR 1910.120 – Hazardous Waste Operations and Emergency Response

L. 29 CFR 1910.134 – Respiratory Protection
M. 29 CFR 1926 – Safety and Health Regulations for Construction
N. 29 CFR 1926.51 – Sanitation
O. 29 CFR 1926.62 – Lead
P. 29CFR 1926.1101- Asbestos
Q. 29 CFR 1926.62 - Lead
R. 40 CFR 50 – National Primary and Secondary Ambient Air Quality Standards
S. 40 CFR 261-264 – Hazardous Waste Standards
T. 40 CFR 265.13 – General Waste Analysis
U. 40 CFR 268 – Land Disposal Restrictions
V. 49 CFR 171-179 – Transportation Regulations
W. Society for Protective Coatings (SSPC) Technology Guide 6 – Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
X. SSPC Guide 7 – Guide to the Disposal of Lead-Contaminated Surface Preparation Debris

5. Permitting Process

A. A SWPPP shall be developed for the project by the Contractor and a Notice of Intent (NOI) will be submitted by PANYNJ to NYSDEC at least 30 days prior to construction.

B. If the project requires dewatering from well points that will exceed 45 gallons per minute (gpm), the Contractor shall obtain a Long Island Well Permit prior to the initiation of dewatering from well points. If the dewatering is accomplished through a sump pump or any method that does use well points that do not exceed 45 gpm, a Long Island Well Permit will not be required.

C. If the disposal of excess soils is required, verify that the disposal facility is properly permitted to receive the excess soils as solid waste. Also, verify that the transporter of the soil is properly permitted as well.

D. Dewatering effluent must either be treated on site in order for it to meet the requirement of the SPDES Permit if it is to be discharged into any of the storm drains; or if the Contractor does not wish to treat the water on site the effluent must be disposed of at a permitted facility and transported by a properly permitted transporter. Permit shall be prepared by the Contractor and provided to the Engineer for review and submittal to the NYSDEC by the PANYNJ.

6. Recommendations

A. A SWPPP shall be developed for this project, as the work will disturb more than one acre of soil. If the area of disturbed soil is decreased below one acre, a soil erosion and sediment control plan shall be developed and implemented.

B. The environmental management plan is to be approved by Environmental Engineering and the implementation of the plan shall be audited during construction by both the Resident Engineer's Office and the Environmental Engineering Unit.

C. If possible, dewatering should be minimized. If a Long Island Well Permit is required, apply for the permit as early in the process as possible in order to minimize delays.

END OF PART 4

PART 5 - GEOTECHNICAL

1. General

   A. The Contractor shall perform foundation design in accordance with the latest provisions of Building Code of New York State and the Basic Specifications. The design, at minimum, shall include:

      1) Deep foundation design

      2) Downdrag calculations

      3) Settlement calculations

      4) Site-specific seismic analysis*.

      *The Baseline Site Specific Seismic Response Spectrum is provided in the Geotechnical Report

2. Basic Specifications

   The following list contains the Basic Specifications for use on the Geotechnical portion of this Contract. The standard specifications shall be modified as per contract requirements. Submit the proposed modifications to the Engineer for review and approval.

Section No.	Title
02221	Excavation, Backfilling and Filling
02355	Pile Load Test – Static Axial Compressive
02356	Dynamic Pile Testing
02363	Steel Pipe Piles
02379	Caissons (Drilled Shafts)
02391	Protective Coating for Steel Piling
03364	Placement of Portland Cement Concrete Underwater

3. Required Design Submittals

   Submit to the Engineer the following information:

   A. Preliminary – (Design)

      1) The qualifications of the Professional Engineer(s) licensed in the State of New York performing the geotechnical design.

      2) Summary of geotechnical design criteria.

      3) Preliminary foundation design computations and Detailed Contract Drawings.

      4) List of Technical Specifications.

   B. Final – (Design)

1) Final foundation design computations, Detailed Contract Drawings and Detailed Technical Specifications.

END OF PART 5

PART 6 - CIVIL

1. General

   A. This part specifies the assumptions, references and design criteria for the Civil Design including site work and site utilities.

   B. The Contractor shall take precautions to ensure that the existing utilities that are to remain in use are not damaged during construction activities. Existing utilities shall be relocated as needed and/or proposed utilities installed such that all applicable codes are adhered to, including separation standards.

2. Applicable Codes, Guidelines, and Standards

   This design shall address in part, building site identification, site clearing and development, utilities and access roadway on the construction site. Site design including pavement construction, drainage and site utilities, including but not limited to storm, sanitary, and water shall be performed in accordance with the following standards and requirements:

   A. PANYNJ - Design Guidelines, Civil.

   B. PANYNJ - Civil Standard Details.

   C. NYS - Stormwater Management Design Manual.

3. Criteria

   A. Requirements

      1) Storm Drainage runoff and treatment design shall address current storm water practices in accordance with NYS Storm Management Design Manual.

      2) Parking lot and Garage shall be drained in to existing Storm System.

   B. Design Approach

      1) Data Collection

         (1) Soil Condition:

            (a) The Contractor shall perform In-Situ testing to determine appropriate California Bearing Ratio (CBR) Values for pavement Subgrade, Infiltration rate and Ground water elevation.

      2) Survey and Mapping

         (1) See Basic Contract Drawing C005 for Grading. Any additional Survey required to complete the Work shall be performed by the Contractor.

      3) Existing Utilities

(1) See Basic Contract Drawing C006 for Existing Facility Utility Management System (UMS) data. Any additional Survey required to complete the Work shall be performed by the Contractor.

C. Design Criteria

The following design criteria and/or assumptions shall be utilized:

1) Vehicle Classification and Geometry

(1) Basic layout shall conform to Contract Drawings. Layout shall comply with roadway and parking geometry requirements based on the Design vehicles (see Part 14 - Traffic for vehicle types).

2) Roadway Grading

(1) Longitudinal grade and cross slope shall conform to requirements in Civil Engineering Design Guidelines.

(a) Longitudinal Grade - shall not be more than 5.0 percent.

(b) Cross Slope - shall not be less than 0.5 percent and no more than 2.0 percent.

3) Parking Lot Grading

(1) Longitudinal grade and cross slope shall conform to requirements in Civil Engineering Design Guidelines.

(a) Longitudinal Grade - shall not be less than 0.5 percent and no more than 3.0 percent.

(b) Cross Slope - shall not be less than 0.5 percent and no more than 2.0 percent.

4) Earthwork

(1) The earthwork, including but not limited to excavation, placement and compaction, and field test, shall be performed in accordance with the Basic Specifications.

5) Pavement

(1) The Parking full depth flexible pavement section for restoration shall be:

(a) 3-in of Asphalt Top Course Mix (PA-5),

(b) 6-in of Stone Base Course (DGABC).

(2) The Sidewalk full depth rigid pavement section for installations and restoration of existing shall be:

(a) 4-in of Portland Cement Concrete,

(b) 4-in of Stone Base Course (DGABC).

6) Storm Drainage

(1) The design of the systems shall be based on a minimum level of protection (LOP) of 10 years. The design runoff shall be assumed to be produced by the corresponding frequency rainfall (i.e., a 10-year rainfall produces a 10-year runoff).

(2) Connect drainage pipes to the existing drainage system as indicated on the Basic Contract Drawings.

(3) Roof drainage shall be drained to the existing drainage system.

(4) Site grading shall be such that storm runoff shall drain away from the garage.

(5) Relocate existing 12-18 in. Storm drainage line from footprint of the garage, see Basic Contract Drawing C006.

7) Flood Plain

(1) Stillwater flood elevations from current Flood Insurance Rate Maps (FIRM) prepared by the Federal Emergency Management Agency (FEMA) – 11.92-ft (NAVD88 datum).

(2) Designs shall consider an 18" increase over the current FEMA 100-year flood level plus 12" criteria (current FEMA 100 year flood level plus 2.5 ft.). Where prohibiting factors preclude the application of these design criteria to all Contract elements, focus should be centered on critical project elements, those for which disruption of service would result in significant impacts to facility operations.

8) Water Supply

(1) Fire Hydrant and Fire protection System water lines shall be Ductile-Iron Pipe (DIP).

(2) Water distribution system pipes shall have at least 4-ft cover, 5-ft desirable.

(3) Provide fire service water line to the garage. Pipe material shall be Ductile-Iron (DIP).

(4) Provide curb/street valves for each service line.

(5) Provide additional hydrant along the East side of the garage with curb/street valve.

(6) All pipe joints shall be restrained.

9) Miscellaneous Work

(1) Concrete curb shall be non-mountable type with 6-in reveal.

(2) Concrete Sidewalk and curbing shall be white concrete as specified in Basic Specification Section 03301.

(3) All temporary construction chain link fences and gates shall be eight feet in height, metallic coated, and new upon installation.

Basic Specifications

The following lists contains the Basic Specifications for use on the Civil portion of this Contract.

Section No.	Title
02073	CUTTING, PATCHING AND REMOVAL
02221	EXCAVATION BACKFILLING AND FILLING
02231	AGGREGATE BASE COURSE
02272	SOIL EROSION AND SEDIMENT CONTROL
02274	GEOTEXTILES
02510	PLACEMENT OF PORTLAND CEMENT CONCRETE PAVING
02553	ASPHALT CONCRETE PAVING
02575	PAVEMENT MILLING
02610	EXTERIOR SANITARY SEWER SYSTEM
02665	EXTERIOR WATER SUPPLY SYSTEM - DUCTILE IRON PIPE FOR NEW YORK FACILITIES
02720	MANHOLES AND DRAINAGE STRUCTURES
02722	STORM DRAINAGE SYSTEM (INFILTRATION/EXFILTRATION TESTING NOT REQUIRED)
02730	EXTERIOR SANITARY SEWER PRESSURE SYSTEM
02832	METALLIC-COATED STEEL CHAIN LINK FENCE AND GATES
03100	CONCRETE FORMWORK
03200	CONCRETE REINFORCEMENT
03301	PORTLAND CEMENT CONCRETE, LONG FORM

4. Required Design Submittals

A. Intermediate - (Design)

1) Drawings / Documents

(1) The Contractor shall submit drawings/documents for review by the Engineer according to the schedule specified in the Division 1 Clause entitled "Design Criteria Part 1." The Civil Design Presentation drawings, unless otherwise noted, shall measure 22" x 34". The scale of the drawings -shall be adequate to clearly present the design intent and in accordance with the Basic Specifications. The scale of all drawings shall be at a scale no greater than 1:40 with larger scale details as appropriate to adequately describe the detail.

(2) Contractor shall submit Survey Control Plan indicating the area of Work, construction baselines, and survey control points.

(3) Alignment Plan indicating East Garage location, curbing.

(4) Contractor shall submit Removal Plan indicating the limits of removal.

(5) Contractor shall submit a Paving Plan indicating the delineation of all different pavement types, and indicating pavement restoration.

(6) Contractor shall submit a Grading Plan indicating two-tenth of the foot contours.

(7) Contractor shall submit a Utility Plan indicating utilities (including, but not limited to, drainage line, sanitary sewer line (including lift station), water line, electrical power and communications lines with locations (by coordinates or station offsets) and invert and centerline elevations, as appropriate. The drainage indicates pipe size, pipe material, pipe connections, inverts and rim elevations, manholes and catchbasins.

(8) Contractor shall submit Details.

(9) Contractor shall submit List of Specifications.

2) Design Calculations

The Contractor shall submit all calculations for the following designs, sealed by a Professional Engineer licensed in State of New York:

(1) Storm Drainage Design, including Roof drainage.

(2) Sanitary Sewer System Design.

B. Final - (Design)

1) Detailed Contract Drawings.

(1) Contractor shall submit all the Final Detailed Contract Drawings that are identified in Required Design Submittals Section and all associated details, addressing all the Engineer's comments from the Preliminary and Intermediate submittals. The scale of all details shall be sufficient to clearly show all relationships and materials.

2) Detailed Specifications.

(1) Contractor shall submit final Detailed Specifications conforming to the Basic Specifications.

3) Final Complete Design Calculations.
The Contractor shall submit all final calculations for the following designs, sealed by a Professional Engineer licensed in State of New York:

(1) Storm Drainage Design, including Roof drainage.

(2) Sanitary Sewer System Design.

Code compliance shall be provided by submission of documentation.

END OF PART 6

PART 7 - LANDSCAPE ARCHITECTURE

1. Background

   A. The existing site is comprised of an at-grade asphalt parking lot with concrete sidewalk, curbs, medians, ornamental fence and guiderail at the peripheral edges.

2. General Scope

   The new parking garage structure shall occupy a site of approximately 72,000 square feet. The Landscape Architectural work for this Contract will be limited to steel ornamental picket fence.

3. Criteria

   A. Assumptions

      1) Garage construction will result in the disturbance of 140,000 square feet of the existing site. Proposed asphalt paved parking areas immediately adjacent to the garage, shall serve as a construction and lay-down area not only for the garage but also for the future roadways and utility infrastructure contracts. Steel ornamental picket fence, 8'-0" height, will tie into the garage structure and extend to meet existing fence along the southwestern edge of the site in order to establish continuous enclosure of the existing parking lots.

   B. Steel Ornamental Picket Fence

      1.) Steel ornamental picket fence shall be installed adjacent to garage at parking lot edges to restrict pedestrian movement and prevent fare evaders.

         (1) Steel ornamental picket fence shall be as located on the Basic Contract Drawing C002

         (2) Steel ornamental picket fence shall conform to the Montage II – Fusion Welded Heavy Duty Ornamental Steel fence, Invincible design, extended picket bottom rail treatment, 2-Rail style fence, as manufactured by Ameristar Fence Products, Tulsa, OK or approved equal. Color: Black.

4..) Required Design Submittals

A. Intermediate - Design

1.) Provide detailed Contract Drawing designating limits of Steel Ornamental Picket Fence in plan as it applies to the final agreed upon design. Fence shall appear on Civil Alignment Plan Drawings at a scale no greater than 1:30 scale.

2.) Develop and include the necessary Sections and Details on the Contract Drawings and properly cross-reference details with the appropriate plan.

3.) Include detailed technical specifications sections for review.

B. Final - Design

1) Incorporate comments from Intermediate Design Review into the Contract Documents for final review.

2) Submit Detailed Contract Drawings for final review.

3) Submit Detailed Specification Sections for final review.

END OF PART 7

PART 8 - ARCHITECTURE

1. General

   A. This Part specifies the design criteria for the Architectural Work. The Basic Contract Drawings section summarizes the design requirements for the East Parking Garage.

2. Applicable Codes, Standards and Guidelines

   Facility must comply with all applicable codes, standards and guidelines including:

   A. 2008 New York City Building Code

   B. 2008 New York City Fire Code

3. Criteria

   A. General Criteria

      1) Vertical Clearance - The required vertical clearance at the Level 1 at grade is 9'-6" to accommodate ambulance and ADA van loading and unloading vehicles. The required vertical clearance at all levels above the Level 1 is 8'-0".

      2) Right of Way - No bracing of any type may be located at the drive isles, pedestrian paths or at the exterior building face.

      3) Fireproofing (Structural Steel) - Only intumescent paint is to be used to maintain fire ratings at exposed structural steel. No spray-on fireproofing is to be used on the project.

      4) Parking Requirements – Minimum number of 1100 vehicle parking spaces to be maintained in the garage parking layout. All vehicle parking spaces contributing to this space count shall be located within the garage superstructure and footprint.

      5) Natural Ventilation – A 50% open façade and 20% open walls are required for natural ventilation in open garages. Refer to 2008 New York City Building Code Section 406.3.3.1.

      6) Parking Requirements – Refer to Part 16 –TRAFFIC

      7) Future Connector Bridge – A connection bridge to Terminal C will be constructed post the start of the construction of the East Garage. To accommodate the connection of the bridge to the garage, the contractor must attach the curtain wall system at the connector bridge location in a way that will allow for ease of removal.

      8) Conduit Routing – All conduit, piping, exposed ductwork shall be installed in an orderly manner, parallel to structure, where possible. All conduit, piping, exposed ductwork shall be grouped and run tight to the structural grid. No conduit, piping, exposed ductwork may drop below the bottom of the structural tee. Minimize the visual presence of conduit, piping and exposed ductwork is minimized.

      9) All critical equipment to garage operation to be kept at minimum 2 feet above the 100 year flood plain. (electrical substation, , ect.)

10) Exterior Conduit - All exposed conduits at or outside of the exterior screen to be painted. Color to match steel support frame for exterior screen.

11) Bollard Finish – For bidding purposes, presume all bollards to be painted "Silver Shadow" to match steel frame color. Final color selection to be provided by the Engineer.

12) Wayfinding -

a) Pedestrian pathways are to be unobstructed and marked throughout garage.

b) To encourage movement to vertical transportation throughout the garage, provide increased illumination and bold signage at the point of entry to the vertical transportation.

c) Elevator enclosures, cabs, and any windscreens to be constructed primarily of clear glass for visual connectivity.

d) All stairwells to be visually open.

13) Alternative Transportation -

a) Low Emitting and Fuel Efficient Vehicles. Designate a minimum of five percent of the total vehicle parking capacity as preferred parking for low-emitting and fuel-efficient vehicles. Preferred parking refers to the parking spots that are closest to the main entrance of the project (exclusive of spots for handicapped persons). Of these spaces, provide (5) with electrical charging capability. In addition, provide electrical charging capacity for (10) spaces.

14) Elevator Enclosure and Cab -

a) Elevator enclosure and cab provided to be constructed of laminated glass.

b) Laminated glass must conform to ANSI 297.1, 16 CFR Part 1201, or CANKGSB-12.1, whichever is applicable (see Part 91. Markings as specified in the applicable standard must be on each separate piece of glass and must remain visible after installation.

c) Cleaning and maintance of the exterior and interior of the elevator enclosure and cab must be provided for.

15) Lighting

a) Lighting design must provide a sufficient light level to allow the utilized security camera to operate as specified.

b) The point source of lighting must be shielded in a way that the source is not visible at the exterior of the garage.

c) Provide evenly distributed, diffuse natural and artificial light throughout the garage. Refer to Part 14 – LIGHTING.

16) Exit and Safety Signage

a) Provide all signage required for egress, life safety, accessibility, et cetera, which must be in accordance with all applicable codes and standards, including NFPA, OSHA 1910.450 and ADAAG. Refer to Part 16 – TRAFFIC for further information.

17) Finishes

a) All finishes used must be durable and appropriate for high traffic public space.

b) Ease of maintenance is required in all finishes and materials use in project.

c) Galvanic protection to be provided between dissimilar metals.

18) Façade Constructability

a) The façade screen must be designed and constructed in a manner that is repeatable throughout the future buildings on the LaGuardia Airport campus.

B. Program Summary

The following are the program requirements for elements and spaces that supplement requirements specified elsewhere in these Basic Specifications and Room Data Sheets.

1) Electrical Distribution Room

2) Electronics Distribution Room

3) Janitor Closet

a. Provide a service sink

b. Provide infrastructure for storage shelving and mop rack (provided by others)

c. Each Janitor's closet will have a hose bib on the outside of the room in the Garage.

4) Water Service Room

5) Sump Pump Room

6) Elevator Control Room

C. Materials and Finishes

1) General Materials and Finishes. See Basic Technical Specifications for detailed information and for all other elements not specifically mentioned herein.

a) Aluminum screen will clad three facades. Each metal panel will consist of a continuous frame with varying profiled fins. The spacing of the fins is to be consistent to create an undifferentiated surface pattern. Included with the Aluminum screen the following parts are to be painted to match: fins, anchors, stiffeners, and aluminum screen frame. See drawing A511 for reference. For bidding purposes, presume the paint finish is to be PPG UC7059 Duranar XL Bright Silver, a three coat, baked on process. Final color selection to be provided by the Engineer.

b) Aluminum screen frame, steel outriggers, exposed conduits, metal doors and any exposed embed plates to match. See drawing A511 for reference. For bidding purposes, presume the paint finish is to be PPG UC 106707XL Duranar Silver Shadow any intumesent paint used in the project is to match Silver Shadow. Final color selection to be provided by the Engineer.

c) All CMU block to be plastered at surfaces exposed to the public. Plaster to be used must be durable exterior plaster with all edges reinforced. Plaster color to match surrounding precast concrete. Interior CMU block to be painted with color selection to be provided by the Engineer.

Include all mock ups per the Basic Technical Specifications. Including, but not limited to:

1. Stair handrail and guardrail condition
2. Exterior metal screen – mock-up to include support frame, connections, and fins, painted with the specified paint. See A202 for extent.
3. Elevator enclosure
4. Glass Fiber Reinforced Precast Concrete panel
5. Vehicular Barrier at a Structural Column, See A741 for extent

4. Basic Technical Specifications

The following list contains the Basic Technical Specifications for use in the Architecture portion of this Contract.

Section No.	Title
03420	PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION
07410	METAL PANEL SYSTEMS

5. Required Design Submittals

A. Preliminary-(Design)

1) Drawings/Documents

The Contractor must prepare and submit an Architectural Design Presentation for review and approval by the Engineer. The Architectural Design Presentation drawings, unless otherwise directed by the Engineer, must measure 22"x 34". The number of drawings and their scale must be adequate to clearly present the design intent and meet the Basic Specifications. The Architectural Design Presentation must include, but not be limited to, the following items:

a) Site Plan, indicating all vehicular and pedestrian routes, landscaping and site developments.

b) Building Floor Plans at a minimum scale of 1/16"=1'-0" of the Ground Floor level.

c) Roof Plan at a minimum scale of 1/16"=1'-0" which must indicate locations and sizes of all roof penetrations and mechanical intakes.

d) Longitudinal and Transverse Building Sections at a minimum scale of 1/16"=1'-0". Indicate all height relationships and clearances. Indicate all basic materials used in the composition of each type of exterior and interior wall.

e) Overall Building Exterior Elevations at a minimum scale of 1/16"=1'-0" indicating material selection and finishes with their relationships to each other for all elevations. Provide also enlarged elevations 1/8"=1'-0".

f) Two Perspective Color Renderings, both on 22"x 34" boards. One drawing must be a ground level view showing the south façade. The second drawing must be a complete aerial view from Terminal C.

g) Sample Boards (22" x 34") indicating all materials and color selections available for each material for both interior and exterior surfaces Visible to the public.

2) Building Code

a) Submit a complete Building Code Analysis indicating how each code requirement for the building will be met. Include any information required by any of the Sub-codes listed in the Building Code of New York City, in cases of conflicting requirements the most stringent requirements will be followed.

B. Intermediate-(Design)

1) Drawings/Documents

Architectural Graphics as stipulated herein must be detailed sufficiently to clearly illustrate the design intent with mounting details and must include a preliminary sign schedule. All signage required by authorities having jurisdiction must be included. Contractor must submit Detailed Contract Drawings on Authority Standard 22"x34" contract sheets. These drawings must include as a minimum, but not be limited to, the following information:

a) Floor plans (all levels) to fully describe the scope of work required in the Basic Specifications at a minimum scale of 1/16"=1'-0".

b) Roof plan must indicate drainage, all roof penetrations and all other roof elements.

c) Enlarged floor plans of all the occupied program areas at a minimum scale of 1/8"=1'-0".

d) Exterior elevations at a minimum scale of 1/16"=1'-0"to clarify materials, finishes, proportions and other design elements.

e) Building sections at a minimum scale of 1/16"=1'-0".

f) Wall sections and details for all exterior and interior wall types and conditions at a large enough scale to clearly illustrate the details of construction. Minimum scale must be 3/4"=1'-0".

g) Large-scale detail drawings of all building elements.

h) Typical door and window details at a minimum scale of 1-1/2"=1'-0".

i) Preliminary Door Schedule, Hardware Schedule and Finish Schedule.

j) Preliminary Keying System.

k) List of Detailed Specifications Sections.

2) Building Code Analysis

a) Submit Progress Building Code review.

C. Final-(Design)

1) Detailed Contract Drawings

Contractor must submit all the final Detailed Contract Drawings that are identified in previous design submittals including all associated details addressing all the Engineer's comments from the preliminary and intermediate submittals. The scale of all details must be sufficient to clearly show all relationships and materials.

2) Detailed Specifications

Contractor must submit final Detailed Specifications conforming to the Basic Specifications.

3) Submit Final Building Code for review to demonstrate compliance.

END OF PART 8

PART 9 - Structural

1. General

   This Part specifies the design criteria for the Structural Work; The Basic Contract Drawings section summarizes the design requirements for the East Parking Garage.

2. Applicable Codes Standards and Guidelines

   The facility shall comply with all applicable codes, standards and guidelines including, but not limited to the following:

   a. 2008 New York City Building Code, with latest supplement, unless otherwise noted.

   b. ACI 318 "Building Code Requirements for Structural Concrete".

   c. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

   d. Prestressed Concrete Institute MNL 116, Manual for Quality Control for Plants and Production of Precast Concrete Products".

   e. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Fifth Edition, with latest Interim Revisions.

3. Criteria

   a. Design Criteria:

      1. Codes and Specifications:

         1.1. 2008 New York City Building Code, with latest supplement, unless otherwise noted.
         1.2 ACI 318 Building Code Requirements for Reinforced Concrete
         1.3 ASCE 7 Minimum Design Loads for Buildings and Other Structures
         1.4 American Disabilities Act - Accessibility Guidelines
         1.5 AISC Specifications and Design Manuals

      2. Design Loads:

2.1 Dead Loads:

2.2 Structural Occupancy Category for the East Garage
a. Occupancy Category II

2.3 Live Loads:

Exemption (4)

2.4 Wind Loads

Exemption (4)

2.5 Seismic loads:

Minimum Seismic Load Requirements (also see Geotechnical Subsurface Investigation Stage 1 Report dated January 11, 2013):

Exemption (4)

2.6 Minimum Vehicular Impact:

2.7 Minimum Special Loads Requirement:

Exemption (4)

2.8 Flood Load:

Determine if East Garage is located in areas of special flood hazard in accordance with NYC Building Code. Floor load design shall comply with NYC Building Code, Appendix G.

2.9 For all other loads and loading conditions not shown, refer to the NYC Building Code for minimum requirements.

4. Structure

a. Foundation system recommendations from Geotechnical Subsurface Investigation Stage 1 Report dated January 11, 2013 are to utilize deep foundations to support the parking garage. Two deep foundation systems at Contractor's option have been proposed in the Geotechnical Report: drilled concrete piers or concrete filled steel pipe piles. In the concrete filled pipe pile option, structural columns will bear on poured in place concrete pile caps. In both options, the column piers or pile caps will be interconnected with cast in place concrete grade beams. Foundation system shall be designed to accommodate all underground utilities and major equipments at ground level.

b. Slab-on-Grade: The concrete slab-on-grade will consist of a reinforced concrete slab supported on compacted soil.

c. Cast-In-Place Concrete:

1. Concrete shall comply with specification section 03301C.
2. Pipe Pile Fill, Drilled Concrete Piers, Grade Beams, & Pile Caps: Performance Category VI
3. ALL other Structural Elements: Performance Category IV
4. Cast-in-place concrete shall have a minimum compressive strength of 4,000 psi at 28 days.

5. All concrete riding surfaces shall receive a "broom finish".
6. Besides reinforcing bar coupler systems, concrete embedded steel hardware shall be hot-dip galvanized per ASTM A153. Any damaged galvanizing is to be cleaned and touched up with galvanizing paint in the field.

d. Structural Steel:

1. All Structural Steel work shall conform with the NYCBC 2008, the AISC –LRFD 1999, AISC-HSS 2000 and AISC 341-02 per the building Code.
2. All structural steel plates and bars shall conform to ASTM A572 Grade 50. All structural steel shapes (beams, columns, girders, etc.) shall conform to ASTM A572, Grade 50. Hollow structural shapes shall conform to ASTM A500, Grade B. Cold formed tubing shall conform to ASTM A500, Grade B. Pipes shall conform to ASTM A53, Grade B, Type E or S. Anchor bolts shall conform to ASTM F1554, Grade 105.
3. Where stainless structural steel is specified, shape and bars shall conform to ASTM A276, Type 304, Cond. A stainless plate and strip shall conform to ASTM A480, Type 304, Cond. A, stainless steel pipes shall conform to ASTM A312, Grade TP304, Schedule 40S or 80S as indicated, process SML or WLD.
4. All bolts (other than anchor bolts and stainless where indicated) shall conform to ASTM A325 or A490, nuts shall conform to ASTM A563, washers shall conform to ASTM F436. All bolts shall be ¾ inch diameter, minimum. Bolts used in lateral load resisting connections shall be friction type, designed for indicated forces without stress increases.
5. All welding work shall conform to AWS D1.1 "Structural Welding Code – Steel". Minimum fillet weld size shall be ¼ inch.

e. Precast Concrete:

1. Concrete shall comply with specification section 03301C.
2. Precast Concrete Decks and other Structural Elements: Performance Category IV
3. Precast concrete shall have a minimum compressive strength of 5,000 psi at 28 days.
4. All concrete riding surfaces shall receive a "broom finish".
5. All precast double tee to double tee flange connections, hardware, steel connection bolts, nuts, washers, plates, coil rods and coil inserts shall be hot-dipped galvanized steel. Any damaged galvanizing is to be cleaned and touched up with galvanizing paint in the field.

f. Reinforcement:

1. All steel reinforcing bars for East Garage construction shall be either epoxy-coated or hot-dip galvanized at Contractor's option. Steel reinforcing bars shall be in conformance with Specification Section 03200C. Reinforcing bar coupler systems shall be compatible with the selected coating of reinforcing bars.

g. The Lateral Force Resisting System utilized in the East Garage is to be achieved by precast shear walls located on the interior of the structure as indicated on the Basic Contract Drawings. The interior precast shear walls are to include openings for improved visibility and sight lines and to comply with the Building Code requirements for natural ventilation. The Structural Occupancy Category for the East Garage per the NYC Building Code, Section 1604.5 is Category II.

h. The Structural System utilized in the East Garage is to be designed to prevent global/progressive collapse of the building in the event of a structural column being damaged or destroyed. The structural framing is to be designed so that only the bays framing into the affected column will be subject to local collapse and all adjacent bays will remain standing.

i. Perimeter vehicle and pedestrian protection: There shall be a structural steel and cable rail vehicular and pedestrian barrier at the perimeter edge of all parking garage levels. The vehicle barriers shall comply with NYCBC Section 1607.7.3. In addition, designed for a load of 10,000 lbs. ultimate point load at 18" above the finished floor. See the Architectural section and Basic Contract Drawings for additional exterior wall information.

j. Joint Sealants: All floor joints shall be sealed for water tightness. Sealant material shall be one part or two part pourable polyurethane, type ES-4 in conformance with Specification Section 07920C.

k. Expansion Joints: The proposed parking structure is of a size to require a building expansion joint. Expansion Joints system shall be heavy duty, watertight and ADA compliant. Preformed seal with continuous integral rubber seal side flanges shall be secured utilizing metal reinforced rubber anchor blocks. Design connection with concrete embedded hardware on precast double tee that qualified for manufacturer's warranty. Avoid the use of post-installed anchors and field drillings. See project Specifications Section 05810C Prefabricated Expansion Joint Assemblies for additional information and approved expansion joint systems.

l. Stair Construction: The exit stairs of the parking structure shall be constructed of structural precast bearing on precast concrete walls or

beams. The precast stair treads shall be cast with a slip resistant nosing for additional safety.

m. Elevator Shaft: The elevator shaft is designed as a separate structural steel structure with an expansion joint between the shaft and the garage. The structural design of the elevator shaft is to include its own lateral bracing system and foundation.

n. Future Pedestrian Connector Bridge: The East Garage structure is to be designed to accommodate a proposed connector bridge to the Terminal (Not in this Contract). The proposed bridge shall be self-supporting and not bear on the East Garage Structure but shall connect via an expansion joint that shall be part of the bridge design. The foundations for the proposed bridge structure are not in this contract and shall be independent of the East Garage foundations. The East Garage foundation located between column lines I-4 and J-4 may only extend five (5) feet from column line 4 toward the exterior of the garage to accommodate for future connector bridge foundation.

o. Overhead Sign Structure Relocation: An existing overhead sign structure as shown on the Traffic drawings is to be relocated. The Contractor shall include in his Bid the costs associated with designing and installing new foundations, in accordance with AASHTO requirements, for the overhead sign structure and the removal of the existing sign structure foundations as per the provided existing sign structure reference drawings. The replacement sign structure foundations are to be designed to avoid interference with existing underground utilities.

p. Garage Roof Snow Removal: Roof, framing and foundation systems shall be designed to accommodate the stockpiling of snow for an average height of six feet high on roof level. Loading of snow melting equipment/vehicle inside the garage and maximum loading encountered during operation of snow melting shall be accommodated in the design of the garage structure.

q. There are additional items in the project that require structural design by a Professional Engineer licensed in the State of New York. These items include, but are not limited to, electrical and mechanical equipment, ductwork and piping supports, exterior screen facade framing and connections, signs supports, foundations for on-grade equipment, underground manholes and utilities, seismic supports for nonstructural component, etc.

r. Basic Technical Specifications

The following list contains the Basic Technical Specifications for use in the Structural portion of this Contract.

Section No.	Title
03100C	Concrete Formwork
03200C	Concrete Reinforcement
03301C	Portland Cement Concrete, Long Form
03420C	Precast Prestressed Concrete for Building Construction
03602C	Grouting (Non-Metallic)
05120C	Structural Steel
05506C	Miscellaneous Steel
05810C	Prefabricated Expansion Joint Assemblies
07910C	Compression Seals
07920C	Sealants

5. Additional Structural Design Requirements and Guidelines

a. Structural integrity design to prevent progressive collapse, vehicular impact on column in parking garage, etc. shall be in strict conformance with New York City Building Code sections 1624, 1625, 1626 and 1627 on building structural integrity requirements.

b. Contract drawings and design calculation shall include design loads and other data in strict conformance with New York City Building Code section 1603, Construction Documents. In addition to Building Code section 1603.3.1.3, the maximum design wheels configuration and wheels spacing shall be shown on the Contract drawings.

c. Adhesive and friction type anchors are not permitted to be used for overhead application and in condition where anchor is subject to sustained tensile load. Prior to installation of anchor, perform non-destructive testing to ensure proposed drill hole will not damage any embedded structural elements such as rebars or embedded steel plates. Design and installation of anchor shall conform to anchor manufacturer's specification. All adhesive and mechanical anchors should be manufactured by Hilti or approved equal.

d. Exterior signs and luminaries supports shall be designed in accordance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Fifth Edition, with latest Interim Revisions. Interior signs and luminaries supports shall be designed in accordance with New York City Building Code, but not less than a minimum lateral wind gust pressure of 15 psf applied to the surface of signs, luminaries and supports.

e. All signs (exterior or interior) which require routine cleaning or servicing shall be designed for all anticipated additional loads, but not less than a 100 lb concentrated horizontal live load and a 300 lb concentrated vertical live load applied simultaneously at a point, which can develop the most critical effect.

The additional concentrated loads shall be applied in combination with the sign and support dead load only and not concurrent with wind or seismic loads.

6. Required Design Submittals

a. Intermediate Submission

The Contractor shall submit detailed Structural Contract Drawings, Technical Specification and Design Calculations for review by the Engineer. All submitted Structural Contract Drawings and Design Calculations shall be prepared by a Professional Engineer licensed in the state of New York. Contractor shall submit detailed Technical Specifications conforming to the Basic Technical Specifications. In addition, Contractor shall submit the Response Spectrum in accordance with the Geotechnical Report. Contractor also shall submit the selection of snow melting equipment/vehicle specifically for the garage and procedure of snow melting at roof level.

The submitted Structural Contract Drawings shall clearly present the design intent and meet all the required design criteria. The submitted Structural Design Calculations should include analysis and design for all required design loads with the use seismic design parameters from the Response Spectrum. Indicate the type of Lateral Force Resisting System for the garage structure and elevator shaft structure. Clearly present all horizontal and lateral load paths down to the foundation system. Include column and wall design base reactions. Provide design on deep the foundation system, include design capacity of deep foundation, allowable soil pressure and design to accommodate all underground utilities.

b. Final Submission

The Contractor shall submit all the Final Structural Contract Drawings, Technical Specifications and Design Calculations that are identified in the Contract Design Criteria, Basic Contract Drawings and Technical Specifications. Include all associated details addressing all of the Engineer's comments from the Intermediate Submission. All submitted Final Structural Contract Drawings and Design Calculations shall be signed and sealed by a Professional Engineer licensed in the state of New York.

Contractor shall submit documentation on the final garage roof snow melting operation procedure, including garage allowable loadings for snow melting equipment/vehicle and garage allowable operational loadings of snow melting at roof level, signed and sealed by a Professional Engineer licensed in the state of New York.

END OF PART 9

PART 10 – MECHANICAL HVAC

1. General

   A. This section provides current mechanical planning and design information for the new LaGuardia Airport (LGA) East Parking Garage D/B Project. The information in this section includes design objectives, concepts and criteria which meet the requirements of the new NYC Building Code 2008, Port Authority design guidelines and the present and future operational mechanical requirements of the East Parking Garage.

   B. The main focus of the design for all HVAC systems shall be the safety, convenience, reliability, and comfort of the airport patrons and employees. Secondary focus of design is the fuel oil requirement of the rooftop emergency generator.

2. Applicable Codes and Guides
   HVAC and Fuel Systems shall be designed to be in accordance with the latest applicable codes, standards, Port Authority standards, as well as current and best engineering practices.

   A. Air Movement and Control Association, Inc. (AMCA)

   B. Associated Air Balancing Bureau (NEBB) Standards

   C. American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE)

      1) ASHRAE Standard 90.1-2007-Energy Standard for Buildings Except Low-Rise Residential Buildings

      2) ASHRAE Standard 62.1-2004-Ventilation for Acceptable Indoor Air Quality

      3) ASHRAE Standard 55-2004-Themal Environmental Conditions for Human Occupancy

      4) ASHRAE Standard 52.2-2007- Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Practical Size

   D. American Society for Testing & Materials (ASTM) Standards

   E. American Petroleum Institute (API) Standards

   F. American Society of Mechanical Engineers (ASME)

   G. American National Standards Institute (ANSI) Standards

   H. Occupational Safety and Health Administration (OSHA)

   I. National Fire Protection Association (NFPA)

   J. National Association of Corrosion Engineers (NACE)

K. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

L. Underwriters Laboratories, Inc. (UL)

M. Air Conditioning and Refrigeration Institute (ARI)

N. Federal Aviation Administration (FAA) Requirements

O. Environmental Protection Agency (EPA) Regulations

P. New York City Energy Conservation Code (NYCECC)

Q. New York City Construction code

R. New York City Mechanical Code

S. New York City Fuel Oil Gas Code

T. National Fire Protection Association (NFPA)

- NFPA-30 Standard for the Installation of Oil-burning Equipment
- NFPA-31 Flammable and combustible liquid Code
- NFPA-37 Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2008 Edition
- NFPA 90A – Standard for the installation of Air Conditioning and Ventilation Systems
- NFPA-780 Standard for the installation of lightning protection system

U. International Fire Code (IFC)

V. National Institute for Occupational Safety & Health (NIOSH) Guidelines

W. The Port Authority of NY & NJ Sustainable Design Guidelines

X. Leadership in Energy & Environmental Design (LEED) of the US Green Building Council

Y. American Welding Society (AWS) Structural Welding Code Steel AWS D1.1 – Latest Edition

3. HVAC Design Conditions

A. Outdoor Conditions

Summer: 89 deg F DB
73 deg F WB

Winter: 13 deg F DB

(Outside design conditions as per NYC Code and NYC Energy Conservation Code.)

B. Indoor Conditions

Area Designation	Summer		Winter	Relative Humidity
	Temperature deg (DB)	Relative Humidity (+/-10%)	Temperature Deg F (DB)	
Telecommunication Room & Specialty room	72	50%	72	40%
Elevator Machine Room	80	-	70 (Min.)	-
Electrical Closets	95	-	55	-
Data Closets	80	-		-
Security Closets	75	50%		
Oil Pump Room	Natural Ventilation will be provided through a fixed louver. Louver shall be sized to achieve minimum 5 Air Changes per Hour.			
Water Service room	-	-	55	-
Sump Pump Room	-	-	55	-
Janitor Closets	-	-	55	-

4. Air conditioning

A. System Type

1) Mini split type air conditioning system shall be considered for Elevator machine rooms and Electronic rooms. The units must be capable of maintaining temperature. In addition the elevator machine room shall be vented as per NYC Mechanical Code.

B. Duct Systems and Accessories

1) Duct system shall be constructed and installed per the latest edition of the ASHRAE guidelines and Sheet Metal and Air Conditioning Contractors National Association (SMACNA) manuals. All duct systems shall be acoustically treated to meet acceptable noise levels recommended by the acoustic consultant. All ductwork shall be insulated except where ducts are provided with the equivalent thickness of acoustical sound lining or where return air ductwork is in ceilings that are used as return air plenums.

5. Ventilation

A. The project goal is to achieve natural ventilation of the parking garage per NYCBC. It is the intent to achieve a minimum 50% wall openings so that no mechanical ventilation is required.

B. Mechanical exhaust and an under cut shall be provide for the Electrical rooms to maintain the temperature.

C. Janitor closet Exhaust: Effective exhaust systems shall be provided in accordance with the NYC Mechanical Code 2008. All janitor closet areas shall be under negative pressure to control odor.

6. Custom Technical Specifications

Section No.	Title
15505	Aboveground Fuel Storage Tank, Fuel Transfer System and Associated Appurtenances (C-spec)

7. Energy Conservation and Management

A. Automatic Control System

Local intelligent control panels shall be provided for exhaust fans and mini split a/c systems. The local intelligent panels shall have stand-alone capability, and shall contain all programs necessary for equipment operation and shall be able to be monitored thru the BMS system in the CHRP.

B. HVAC Controls

1) Mini-split a/c systems: the mini-split a/c systems if provided shall have their own factory supplied controller and also have the capability to be monitored through the BMS system in the CHRP.

8. HVAC insulation shall be provided on all refrigerant piping and tubing.

9. All equipment and components shall be designed and meet performance requirements that comply with all applicable laws, ordinances, regulations and codes, and the latest industry standards.

10. All systems shall be tested, adjusted and balanced.

11. Required Design Submittals

A. Intermediate – (Design)

1) Drawings / Documents

Contractor shall submit detailed Contract Drawings on Authority standard 22" x 34" drawing sheets. The minimum drawing scale shall be 1" = 8', but shall be adequate to clearly present the design intent and meet the Written Criteria and specifications.

Determination of the adequacy of the content and scale of the drawings shall be the decision of the Engineer. These drawings shall include, but not be limited to the following:

2) All Floor plans at all Parking Levels showing all rooms and spaces as indicated on the Basic Contract Drawings. Design systems utilizing design performance requirements for heating, cooling, ventilation load calculations; and air changes.

   a) Floor Plans - showing equipment layout (with access areas required), piping, shafts, ductwork, and associated CFM's and GPM's (minimum scale of 1/8" = 1'-0").

   b) Building sections (minimum of four) illustrating the interrelationship of the building components with all HVAC systems and equipment (minimum scale of 1/8" = 1'-0").

   c) All piping and ductwork shafts shall be indicated. Shaft wall fire ratings shall be coordinated with the Architectural discipline. Indicate all fire dampers, smoke dampers and combination fire / smoke dampers as required by Code.

   d) All equipment mounting details, pipe and ductwork support systems, roof penetrations, roof curbs, equipment pads, and all associated details shall be indicated (minimum scale of ¾" = 1'-0").

   e) Air flow diagrams of all HVAC systems.

   f) Control wiring diagrams for system controls and associated sequence of operations shall be illustrated. Illustrate all system diagrams for building automation system to be integrated with all HVAC equipment.

      - Duct pressure loss calculations for exhaust fans (EF-1, EF-S, EF-3, and JEF-1)

      - Heat rejection calculations (for Electronic Distribution Rooms, Electrical Distribution Rooms and Elevator Machine Room)

      - Fuel oil pump head loss calculation

3) Contractor shall submit updated Calculations identified in the above Section "9. A. 2. Calculations a. through f." for the Engineer's review.

B. Final – (Design)

1) Detailed Contract Drawings - Contactor shall submit final detailed Contract Drawings that are identified in previous design submittals, including all associated details, addressing all the Engineer's comments from the Preliminary and Intermediate Submittals. The scale of all details shall be sufficient to clearly show all relationships and materials.

2) Detailed Specifications – Contractor shall submit final detailed Specifications conforming to the Basic Specifications. In addition to the Basic Specification the Contractor shall provide specifications for the follow equipment: Ceiling Mounted Ductless Air-Cooled Split Type Air Conditioning System, Variable Speed Drives, etc.

3) Final complete design calculations shall be submitted based on the requirements in Section "9. A. 2. Calculations a. through f." to show code and program conformance to the Engineer.

PART 11 – MECHANICAL - PLUMBING AND FIRE PROTECTION

1. General

   A. This section provides current plumbing planning and design information for the new LaGuardia Airport East Garage D/B Project. The information in this section includes design objectives, concepts and criteria, to meet the requirements of the new NYC Building Code 2008, Port Authority regulatory requirements and the present and future operational mechanical requirements of the LaGuardia Airport (LGA) East Parking Garage.

   B. The main focus of the design for all plumbing systems shall be the safety, convenience, reliability and comfort of the airport patrons and employees.

2. Applicable Codes, Standards and Guidelines
   Plumbing systems shall be designed to be in accordance with the latest applicable codes, standards, Port Authority Standards, as well as current engineering practices.

   A. American National Standards Institute (ANSI)

   B. American Society for Testing and Materials (ASTM)

   C. American Society of Mechanical Engineers (ASME)

   D. American Society of Sanitary Engineers (ASSE)

   E. American Society of Plumbing Engineers (ASPE)

   F. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

   G. New York City (NYC) Building Code 2008 Edition

   H. NYC Plumbing Code – 2008 Edition

   I. NYC Environmental Protection Agency (EPA) Regulations

   J. NYC Department of Environmental Protection (DEP)

   K. NYC Fire Code – 2008 Edition

   L. National Electrical Manufacturers Association (NEMA)

   M. National Fire Protection Association (NFPA)

   N. NFPA – 415 Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways – 2008 Edition

   O. Occupational Safety and Health Administration (OSHA)

   P. Underwriters Laboratories, Inc. (UL)

Q. Federal Aviation Administration (FAA)

R. The Americans with Disabilities Act

S. National Institute for Occupational Safety & Health (NIOSH) Guidelines

T. Port Authority of NY & NJ Sustainable Design Guidelines

U. Port Authority of NY & NJ Engineering Department's Engineering/Architecture Design Division CAD/BIM Standards

V. Port Authority of NY & NJ Tenant Construction Review Manual

W. Leadership in Energy & Environmental Design (LEED) of the US

X. Green Building Council (USGBC)

Y. American Welding Society (AWS) Structural Welding Code Steel AWS D1.1 – Latest Edition

Z. Factory Mutual (FM)

3. Basic Technical Specification

The following list contains the Basic Technical Specifications for use in the Plumbing and Fire Protection portion of this Contract.

Section No.	Title
15375	Fire Standpipe System Piping & Appurtenances.
15410	Plumbing Piping & Appurtenances.
15453	Submersible Sewage Ejectors.

4. Plumbing Systems Description

A. Plumbing Infrastructure - This shall include complete new Plumbing systems including, but not limited to:

1) Domestic Water Distribution

2) Sanitary Drainage

3) Storm Water Drainage

B. Domestic Cold Water Supply Systems

1) There shall be new domestic water main (for East Garage) extended from 5-feet outside the South side building's foundation wall and the civil drawings shall indicate the extension and connection to the existing airport site water main.

2) Reduce Pressure Zone (RPZ) and Backflow Preventer shall be placed on the incoming

domestic water service line.

3) Verify that the street pressure available from the site water system is adequate to provide pressure at the top most remote plumbing fixture.

4) Domestic cold water shall be distributed throughout the building water main to risers and branches to plumbing fixtures and equipment.

5) All domestic water piping shall be insulated and heated traced.

6) Non-freeze wall hydrants shall be provided around the building for general maintenance. The wall hydrant shall be located a maximum of 200-feet apart.

7) A NYC approved water meter, Reduced Pressure Zone (RPZ / Back Flow Preventer) shall be provided at East Garage domestic water service/dry pipe valve room with NYC approved remote meter reading device.

C. Domestic Hot Water Supply Systems

1) Domestic hot water heater, A.O. Smith Model DEL-6, 6 gallon capacity for Janitor Closet (one per each level of East Parking Garage). Heater shall be rated at 2KW, 208Volts, single phase, 60 cycle AC or approved equal, and listed by Underwriters' Laboratories. Hot water shall be distributed by water type heaters. Hot water shall be distributed to the fixtures at 110 degrees Fahrenheit.

a) Thermostatic mixing valves shall be provided for each water heaters in the janitor closet.

b) Electric water storage heater shall be provided for each one of the mop receptors in the janitor closets.

D. Sanitary Drainage and Vent Systems

1) All plumbing fixtures shall be drained by gravity to building sewage ejector pit. Duplex sewage ejector pumps Flygt model no. NP 3085.183 with TOP-4 fiberglass basin and SCADA compatible control panel or approved equal. The pumps shall then pump the effluent from the pit up to the force main back to the site lift station. All sewage ejector pumps shall be provided with normal and emergency power.

2) Elevator shall be provided with STANCOR "Oil Minder" sump pump Model SE-50 with control panel or approved equal in each of the three elevator pits. The installed pump(s) and control system(s) shall be permanently installed in accordance with ASME Elevator Code A17.1. It shall be capable of automatically pumping waste water from the pit while preventing the discharge of oil. The sump pump pit shall not be less than 18 inches in diameter and 24 inches deep, unless otherwise approved. Provide heat tracing insulation on 2" discharge pipe in unheated open garage area.

E. Storm Water Drainage Systems

1) Roof drains shall be provided on roof. The roof drains shall be drained by gravity through horizontal piping and vertical leaders to the building storm sewer and shall discharge to

site storm drainage.

2) All vertical and horizontal storm piping shall be insulated and heated traced.

3) Parking deck drain and Roof drain shall be Zurn Model Z534 or an approved equal.

4) Trench Drain shall be Zurn Model Z665C with clamp collar or an approved equal.

5) No secondary storm drainage system shall be provided since there is no parapet around the roof parking area.

6) Snow Melting Riser shall be provided for future snow melting hose connection.

7) Stair bulkhead shall be provided with a scupper drain, exposed leader and spill on main roof with splashguard.

F. Plumbing Fixtures

1) Where possible plumbing fixtures shall be of the water conservation type.

a) Mop receptor shall be supplied for Janitor's closet, Terrazzo, 32" x 32"x 12"size Stern-Williams Model Hilow Squer HL-1910 with 6" front drop and stainless steel cap and model no. T-10-VB faucet with vacuum breaker or approved equal.

b) Non-freeze hose bibb shall be Jay R. Smith, model 5609QT with integral vacuum breaker or approved equal provided outside of the Janitor closet on each floor.

5. Plumbing Written Criteria

A. Domestic Water Supply Systems

1) System shall be designed using the Modified Hunter's Curve as published in ASSE and the requirements of NYC Plumbing Code, 2008.

2) System shall be designed to maintain a maximum velocity of 8-feet per second at design flow conditions in mechanical and utility areas and a maximum velocity of 6-feet per second at design flow conditions.

3) Maximum water pressure at plumbing fixtures shall be limited to 85-psi.

4) All domestic water piping shall be insulated with molded fiberglass and a minimum thickness of 0.5 inch of insulation.

5) Pipe and fitting materials.

a) Underground: Class 54 ductile iron cement lined tar coated, seal coated, bell and spigot water pipe with 350 psig ductile iron fittings and flanged connection on service inside building.

b) Interior four (4) inches and smaller: Schedule 5 - 304 stainless steel or hard copper tubing, Type 'L' copper tubing. Joints shall be soldered for copper tubing.

c) Interior six inches and larger: Schedule 10, Type 304 stainless steel tubing with stainless steel and welded joints.

B. Domestic Hot Water Supply Systems

1) System shall be designed using the Modified Hunter's Curve as published in ASSE, the hot water requirements published in ASHRAE and the requirements of the NYC Plumbing Code, 2008.

2) Water heater shall be the storage type.

3) The heating section of the water heater shall be registered for a working pressure of 150-psi and shall be pressure tested at 1.5 times the working pressure.

4) All domestic hot water piping shall be insulated with molded fiberglass and a minimum thickness of 1 inch of insulation.

5) Water temperature shall be as follows:

a) Janitor's Closet: 110°F

C. Sanitary Waste and Vent Systems

1) Systems shall be designed as per NYC Building Code 2008 Edition & NYC Plumbing Code 2008 Edition.

2) Cleanouts shall be provided at all changes in direction and as required by code.

3) Interior piping shall have slopes not less than 1/8-inch per foot.

4) Pipe materials and fittings:

a) Underground: Cast iron hub and spigot soil pipe and fittings, ASTM A-74. Extra Heavy Underground.

b) Above Ground: Cast iron hubless soil pipe and heavy-duty fittings with stainless steel couplings.

c) Ejector Discharge: Galvanized steel schedule 40 piping and galvanized threaded cast iron drainage fittings.

5) Heavy-duty submersible sewage ejector pumps with a quick removal system shall be provided. Motors shall be air filled and designed for continuous duty and have built-in over-load protection. Impellers shall be non-clogging.

D. Storm Water Drainage Systems

1) Systems shall be designed as per NYC Plumbing Code, 2008 and shall be designed based on a rainfall rate of 3-inches per hour based on a storm of one-hour duration and a 100-year return period.

2) Interior piping shall have slopes not less than 1/8-inch per foot.

3) Cleanouts shall be provided at all changes in direction and as required by code.

4) Pipe materials and fittings:

   a) Underground: Cast iron hub and spigot soil pipe and fittings, ASTM A-74. Extra Heavy Underground.

   b) Above Ground: Cast iron hubless soil pipe and heavy-duty fittings with stainless steel couplings.

   c) Elevator sump pump discharge: Galvanized steel schedule 40 piping and galvanized threaded cast iron drainage fittings.

5) Heavy-duty submersible sump pumps with a quick removal system shall be provided. Motors shall be air filled and designed for continuous duty and have built-in over-load protection.

6) All storm water piping shall be insulated with molded fiberglass and a minimum thickness of 0.5 inch of insulation.

6. General Fire Protection

A. This section provides current fire protection planning and design information for modernization options for the new LaGuardia Airport, East Garage D/B Project. The information in this section includes design objectives, concepts and criteria, to meet the requirements of NYC Building Code, 2008, NFPA standards and Port Authority regulatory requirements of the LaGuardia Airport (LGA) East Parking Garage.

B. The main focus of the fire protection system design shall be the safety, convenience, reliability, and comfort of the airport patrons and employees.

7. Applicable Codes, Standards and Guidelines
Fire Protection systems shall be designed to be in accordance with the latest applicable codes, standards, Port Authority Standards, as well as current engineering practices.

8. Fire Protection System Description

A. Dry Fire Standpipe System

1) The Parking structure shall be provided with Class I manual dry standpipe system with 6 inch fire water supply with curb valve box located outside of the building.

2) The parking structure shall be provided with Fire Department Siamese connections located on the exterior walls and on the columns at grade level, and connected to the fire distribution main inside the building.

3) 2½ Class 1 Fire Hose Valves shall be provided with lien hose and cover bag at each level of each stairwell; and at columns, cabinets shall be mounted to the column.

4) Provide auxiliary fire hose valve(s) on each level where such area cannot be reached within 150 feet of the hose connection.

5) Fire hose valve(s) subject to freezing condition shall be enclosed in a stainless steel fire hose cabinet(s) on the most upper parking level with proper structural supports of the fire hose cabinet(s), fire hose valve(s), etc.

6) Back flow preventer shall be provided at the East Garage for the manual dry fire standpipe system.

B. Fire Extinguishers

1) Fire extinguishers shall be provided in compliance with NYC Building Code, 2008 and NFPA 10. A wheeled 150lb, type B, fire extinguisher shall be provided at each level next to each of the staircases. These wheeled fire extinguishers shall be housed in a wire cage shown on the drawings in accordance with Port Authority Standards.

9. Fire Protection Performance Requirements

A. Comply with NFPA 72 series codes, NFPA 90, NFPA 13 AND NFPA 20.

B. Comply with ASME A17.1 for elevator recall.

C. Comply with BOCA National Building Code.

D. Comply with Port Authority Design Manual.

E. All equipment shall meet UL and Factory Mutual Engineering Corp. (FM) Standards.

1) Fan shutdown.

2) Smoke Control Initiation: Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.

3) Close smoke dampers in air ducts of system serving zone where alarm was initiated.

4) Record events in the system memory.

5) Record events by the system printer.

6) Provide alarm-monitoring outputs to existing Energy Management

7) Control System local Direct Digital Control Panel (DDCP).

G. Supervisory signal initiation shall be by one or more of the following devices or actions:

1) Operations of a fire-protection system valve tamper.

H. All Fire Department Siamese shall be located within max. 100' from any hydrant in compliance with NFPA-14 .

I. Entire Fire Protection System shall be inspected and tested based on NFPA-25.

10. Required Design Submittals

A. Intermediate – (Design) – Plumbing

1) Contractor shall submit Detailed Contract Drawings on Authority standard 22" x 34" drawing sheets. The Engineer shall make all decisions concerning the sufficiency of drawings, their content and scale. These drawings shall include, but not be limited to, the following:

a) All Floor plans at all buildings levels showing all rooms and spaces as indicated on Basic Contract Drawings. Design system utilizing design performance requirements.

b) Floor plans for the ground level, illustrating equipment locations and associated main run sizes for all piping (minimum scale of 1/8" = 1' – 0").

c) Roof level plans showing the location of all roof penetrations (minimum scale of 1/8" = 1' – 0").

d) Building sections (minimum of four) illustrating the interrelationship of the building components with all Plumbing systems and equipment (minimum scale of 1/8" = 1' – 0").

e) All equipment mounting details, pipe support systems (seismic protection), roof penetrations, roof curbs, housekeeping pads, and all associated details are to be indicated using (minimum scale of ¾" = 1'0").

2) Load calculations for all applicable systems including seismic protection. All calculations shall be prepared by a Professional Engineer licensed in the State of NY.

3) Incoming domestic water and fire water service layouts, piping and equipment layout in floor plan showing the location, layout and spacing of all plumbing fixtures, the summation of plumbing loads; the size, location and materials for all building sewers, vent, and water.

4) Part plans of the janitor closets showing the location, layout and spacing of plumbing fixtures and the piping connections to applicable systems.

5) Riser diagrams for all applicable systems with floor heights and all plumbing fixtures with diagrammatic arrangement of their connections to applicable system.

6) Detailed Specifications for all materials, equipment, fixtures, and insulation and installation procedures.

7) List of detailed Specifications.

8) Water services piping layout for Engineer's review and submit signed and sealed backflow preventers layout drawings, sketches and all relevant documents as required by NYC DEP for approval.

9) Written documentation of coordination with Utility company for natural gas service supply.

10) Provide documentation declaring that the project uses 30% less than the baseline fixture performance requirements of the 1992 Energy Policy Act.

B. Intermediate – (Design) – Fire Protection

1) Contractor shall submit Detailed contract Drawings on Authority standard 22" x 34" drawing sheets. The Engineer shall make all decisions concerning the sufficiency of drawings, their content and scale. These drawings shall include, but not be limited to, the following:

a) All Floor plans at all building levels showing all rooms and spaces as indicated on Basic Contract Drawings. Design system utilizing design performance requirements.

b) Floor plans for the ground level, illustrating equipment locations and associated main run sizes for all piping (minimum scale of 1/8" = 1'-0").

c) Building sections (minimum of four) illustrating the interrelationship of the building components with all Fire Protection systems and equipment (minimum scale of 1/8" – 1' 0").

d) All equipment mounting details, pipe support systems (seismic protection), housekeeping pads, and all associated details are to be indicated using (minimum scale of ¾" = 1' 0").

2) Flow rates and pressures from actual hydrant flow test. Hydrant flow test shall be requested from the New York City Department of Environmental Protection (NYCDEP). Test results shall be utilized to perform and provide hydraulic calculations with all pertinent information as required by NFPA 13.

3) Seismic protection calculations prepared by a Professional Engineer licensed in the State of NY.

4) Key plan identifying location of the city main with size, taping point and size, curb valve location and size, distance from hydrant to FDCs and assembly controlling the sprinkler protecting the area in the scope.

5) Proposed piping and equipment plans showing the location and size of water supplies and the location, spacing, number, and type of sprinklers to be used, with approximate location and size of all feed mains, risers, riser control valves, control valves, FDCs and other essential features of the system. Plans shall indicate all column numbers and sizes, room names, ceiling heights and soffit conditions.

6) The location, number, and type of any electrical or automatic devices to be used in the system.

7) The location, number, size of container and type of portable fire extinguishers.

8) Riser diagram with the available water pressure at the outlet of the fire water service Backflow Preventer.

9) Detailed Specifications for all materials, equipment, valves, and detection and installation procedures.

10) Detailed List of specifications.

C. Final – (Design) – Plumbing

1) Detailed Contract Drawings – Contractor shall submit final detailed Contract Drawings that are identified in all associated details, addressing all the Engineer's comments from the preliminary and intermediate submittals. The scale of all details shall be sufficient to clearly show all relations and materials.

2) Final Load calculations for all applicable systems including seismic protection. All calculations shall be prepared, signed and sealed by a Professional Engineer licensed in the State of NY.

3) Final piping and equipment layout in floor plan showing the location, layout and spacing of all plumbing fixtures, the summation of plumbing loads; the size, location and materials for all building sewers, vent, and water.

4) Final Part plans of the janitor closets showing the location, layout and spacing of plumbing fixtures within the room and the piping connections to applicable systems.

5) Final riser diagrams for all applicable systems with floor heights and all plumbing fixtures with diagrammatic arrangement of their connections to applicable system.

6) Final detailed specifications for all materials, equipment, fixtures, insulation and installation procedures.

7) Final detailed list of specifications.

8) Submit piping layout of the water services, backflow preventer assemblies and all relevant documents and sketches to NYCDEP and the Engineer for approval.

9) Final written documentation of coordination with Engineer and LGA Facilities Group for utilities and supply.

D. Final – (Design) – Fire Protection

1) Detailed Contract Drawings – Contractor shall submit final detailed Contract Drawings that are identified in all associated details, addressing all the Engineer's comments from the preliminary and intermediate submittals. The scale of all details shall be sufficient to clearly show all relationships and materials.

2) Final hydraulic calculations with all pertinent information as required by NFPA 13.

3) Final seismic protection calculations prepared by a Professional Engineer licensed in the State of NY.

4) Final Key plan identifying location of the LGA high pressure main with size, tapping point

and size, curb valve location and size, distance from hydrant.

5) Final piping and equipment layout in floor plan showing the location and size of water supplies and the location, spacing, of standpipes to be used, with approximate location and size of all feed mains, risers, riser control valves, control valves, Siamese connections and other essential features of the system. Plans shall indicate all column numbers and sizes, room names, ceiling heights and soffit conditions.

6) Final location, number, and type of any electrical or automatic devices to be used in the fire protection system.

7) Final location, number, size and type of portable fire extinguishers.

8) Final riser diagram with the available water pressure at the outlet of the fire water service.

9) Final detailed specifications for all materials, equipment and installation procedures.

10) Final detailed list of specifications.

E. Contractor to submit the following calculations at each phase, Intermediate, and Final to the Engineer. The Final Calculations shall be signed and sealed by a NYS approved Engineer

1) Domestic Cold Water calculation(s).

2) Sanitary System calculation(s).

3) Storm Drainage calculation(s).

4) Fire protection hydraulic calculation(s).

5) All calculations shall be submitted to the Port Authority for review.

PART 12 - ELEVATORS

1. Basis of Design

   A. The elevator systems shall be designed in compliance with applicable Codes and General Provisions, including Reference Standards criteria outlined herein.

   B. The proposed elevator system shall meet the anticipated demand associated with arriving and departing passengers. The East Garage is a six level parking structure with parking for 1,145 cars. It is anticipated that the majority of the parking spaces (approximately 95%) will be used by drivers picking up or dropping off airline passengers. A small percentage (5%) of the parking spaces will be used by occupants departing for a flight. An additional 100 parking spaces, located near the West end of Lot 4 may also utilize the East Garage elevators. The parking garage will connect via pedestrian bridge at level 5 to the CTB.

2. References

   A. Applicable Codes:

      1) New York City Building Code Chapter 30.

      2) New York City Building Code Appendix K & Appendix K1.

      3) American Society of Mechanical Engineers, Safety Code for Elevators and Escalators (ASME A17.1).

      4) New York City Electrical Code

      5) American Disabilities Act - ADAAG published in 28 CFR Part 36 Federal Register.

      6) ANSI A117.1 (1992): American National Standards for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People.

      7) American Disabilities Act - ADAAG published in 28 CFR Part 36 Federal Register July 1, 1994.

      8) New York City Building Code Chapter 11.

      9) Earthquake provisions as required by New York City Code.

      10) APTA Heavy Duty Transportation System Elevator Design Guidelines.

      11) APTA Mid to High Rise Heavy Duty Transportation System Elevator Design Guidelines.

      12) APTA Heavy Duty Machine Room Less Elevator Design Guidelines.

3. Design Criteria

   A. Elevator performance is judged by basic standards which relate to:

1) Average Interval (AI): Intervals are the average amounts of time, in seconds, between elevators leaving a main terminal during 5-minute peak periods. Interval is not a direct measure of how long prospective passengers wait for service but a theoretical value based on calculated round trip times and the number of elevators in a common group. Average Interval is a theoretical calculation, not an observation, and can be used to establish an expected level of service for a proposed facility. Average interval calculations shall be used as the basis of this report.

2) Handling Capacity (HC): The number of people that the elevators can transport during peak periods. This is usually expressed as a percentage of the population requiring service. For these studies, handling capacity is measured in the number of people served by the vertical transportation system during a peak 5-minute period.

3) Average Waiting Time (AWT): Passenger waiting time is defined as the actual time a prospective passenger waits after registering a hall call (or entering the queue if a call has already been registered) until the responding elevator doors begin to open. If the responding elevator doors are already open when the passenger arrives, the waiting time for this passenger is taken as zero.

4) Capacity Factor: The car loadings for the passenger elevators were not based on nominal car capacities, i.e., 22 passengers for a 4000lb passenger car, because such loadings do not reflect actual conditions and result in average intervals longer than the selected design criteria and excessive group handling capacities. Reducing the individual car loadings, based on expected arrival patterns and demand, results in reduced average intervals and group handling capacities. All studies are predicated upon individual car load rather than selecting the maximum number of persons that can be transported in a given car size.

B. Design Assumptions

1) Parking Spaces = 1,145

2) 15-minute Peak Pedestrian Traffic = 272 . Total Garage Population Impacting Elevator Service During Peak 5-minute Period = 99

3) Average Interval $\leq$ 45 to 50 Seconds

4) 5-minute Handling Capacity = 100%

C. Design Recommendation: Required: Three passenger elevators, 4000 lb at 350 fpm will handle the expected number of passengers (99) with an Average Interval of 37-seconds. Three passenger elevators, with a capacity of the 4000 lb at 350 fpm (traction equipment) will provide the LaGuardia East Parking garage with excellent elevator service. The 4000 lb elevators meet all provisions of ADA and IBC stretcher requirements. Elevator platform size for the recommended 4000 lb elevators is 8'-0" wide by 6'-2" deep with 4'-0" wide center opening doors. The platform width and depth along with the 4'-0" doors will allow Smart Carts to be easily loaded and unloaded without impacting overall elevator service.

D. Type of Elevator required: Machine Room-Less (MRL) type traction equipment is recommended for the East Garage. The benefits associated with MRL equipment as compared to traditional geared traction equipment are significant. MRL Elevators utilize smaller and more efficient

machines resulting in a significant amount of energy savings (up to 20% over traditional traction and up to 50% for hydraulic). Cooling requirements for MRL equipment is significantly reduced as compared to traditional traction and hydraulic equipment. MRL Elevators utilize a gearless traction type hoist machine, resulting in superior performance and ride quality. MRL Elevators utilize permanent magnet synchronous (PMSM) motors and regenerative variable frequency drives providing the ability to return power back to the building grid. MRL Elevators do not require an overhead penthouse machine room, reducing construction cost.

E. Basic Technical Specifications

The following list contains the Basic Technical Specifications for use in the Vertical Transportation portion of this Contract.

Section No.	Title
14210	TRACTION ELEVATOR

4. Required Design Submittals

A. Preliminary - (Design)

1) Drawings / Documents

Contractor shall provide VT Design presentation for review by the Engineer. The VT Design drawings, unless otherwise noted, shall measure 22"x 34". The minimum drawing scale shall be 1"=8' but shall be adequate to clearly present the design intent and meet the Basic Specifications. Determination of the adequacy of the content and scale of the drawings shall be the decision of the Engineer. The VT Design presentation shall include, but not be limited to, the following items.

a) Hoistway Plan – including overhead requirements and pit requirements.

b) Control Room Plan – indicating control equipment layout

2) Calculations

a) Heating, cooling and ventilation requirement calculations.

b) Power requirements.

c) Static and impact loads, reaction points and required clearances.

3) Specification – Provide list of specification

B. Intermediate - (Design)

1) Drawings / Documents

Contractor shall submit Detailed Contract Drawings on Authority Standard 22"x 34" drawings sheets. The Engineer will make all decisions concerning the sufficiency of drawings, their content and scale. These drawings shall include, but not be limited to, the following:

a) All plans showing control room and hoistway spaces as indicated on the Basic Contract Drawings. Design requirements for:

1. Car, guide rails, buffers and other components in hoistway

2. Maximum rail bracket spacing.

3. Maximum loads imposed on guide rails requiring load transfer to the building structure

4. Loads on hoisting beams.

5. Clearances and travel of car and counterweight run-by.

6. Clear inside hoistway and pit dimensions.

7. Location and sizes of access doors, hoistway entrances and frames.

8. Car & Hall signal and operating fixtures.

9. Remote wiring layouts for each elevator.

10. Refuge space on top of car and pit.

11. Control room, machine area, pit and hoistway layout.

12. Cab design, dimensions and layout.

13. Hoistway-door and frame details

(b) Contractor shall submit intermediate calculations for the following:

1. Heating, cooling and ventilation requirement calculations.

2. Power requirements.

3. Static and impact loads, reaction points and required clearances.

C. Final - (Design)

1) Detailed Contract Drawings

Contractor shall submit final detailed Contract Drawings that are identified in previous design submittals including all associated details, addressing all the Engineer's comments from the preliminary and intermediate submittals. The scale of all details shall be sufficient to clearly show all relationships and materials.

2) Detailed Specifications – Contractor shall submit final detailed Specifications conforming to the Basic Specifications.

3) Final complete design calculations shall be submitted addressing all the Engineer's comments from the preliminary and intermediate submittals.

5. Operation Performance

A. The control system shall provide smooth acceleration and deceleration with 1/8" leveling accuracy at all landings, from no load to full rated load in the elevator, under normal or unloading conditions. The self-leveling shall, within its zone, be entirely automatic and independent of the operating device and shall correct for overtravel and under travel. The car shall remain at the landing irrespective of load. Clearance between the car sill and the hoistway landing shall not exceed 1 ¼ inch.

B. The door open and door close time shall be based on the Code requirements with a door delay feature. The door delay is the minimum acceptable time from notification that a car is answering a call (lantern and audible signal) until the doors of the car start to close. Time shall be calculated by the following equation:

T = D/(1.5 ft/s)
T = Total time in seconds.
D = Distance from a point in the lobby 60 inches directly in front of the hall station to the centerline of the door opening.

For cars with in car lanterns, T begins when the lantern is visible from the vicinity of the hall call station and the audible signal is sounded.

C. Car Call: The minimum acceptable time for doors to remain fully open shall not be less than 5 seconds.

D. The speed of the elevator shall not vary +/- 5% under loading conditions.

E. Ride Quality: Provide smooth and quiet ride, free of rumbles, bumps, vibrations, jerk and sway.

F. Prior to final acceptance and prior to the termination of the maintenance period, the elevators shall

be adjusted as required to meet these performance requirements.

6. Manufacturers

   A. Product of individuals, firms or corporations regularly engaged in manufacturing elevators comparable with this contract and in satisfactory operation for a period of not less than five years.

   B. Qualified Manufacturers:

      1) Fujitec Elevator Company.

      2) Hollister-Whitney Elevator Corporation.

      3) KONE Elevator Company

      4) MCE (Motion Control Engineering Company, Inc.).

      5) Otis Elevator Company.

      6) Schindler Elevator Company.

      7) ThyssenKrupp Elevator Company.

      8) Approved Equal.

7. Materials

   A. Aluminum: Extrusions as per ASTM B221.

   B. Plywood: PS-1-83, A-D Interior Grade Douglas fir. Fire treat per AWPA with a suitable water-soluble fire retardant formation; U.L. FR-S fire hazard classification.

   C. Plastic Laminates: As per NEMA LD-3, with suitable backer sheets to minimize warping, fire rated Grade HGF, .062 inch thick.

   D. Stainless Steel – Interior Applications: As per ASTM A167, Type 302/304 series, with finish as specified.

   E. Stainless Steel – Exterior Applications: As per ASTM A167, Type 316 series, with finish as specified.

   F. Patterned Stainless Steel: As per ASTM A167, Type 304, rigidized stainless steel pattern 5WL®, with satin finish as specified.

   G. Bronze: CDA Alloy 280 Muntz Metal.

H. Structural Steel: AS per ASTM A36.

I. Steel Tubing: ASTM A500, Grade B.

J. Glass: Clear laminated safety glass, complying with ANSI Z97.1, nominal 9/16" thickness.

8. Control Equipment

A. Controller: Provide enclosed controller panels with ventilated cabinets and hinged or removable doors. Provide permanently marked symbols or letters identical to those on wiring diagrams adjacent to each component.

9. Operating Systems

A. Provide a closed-loop solid-state microprocessor system to provide operation as indicated.

B. Components: The microprocessor based group dispatcher and communications network shall be designed and installed to meet the following requirements:

1) Provisions shall be made in the dispatch computer so that the elevator system dispatching can be modified at a future time. The system shall be so designed that the modifications to the software shall be all that is required to revise the dispatching. It shall be further designed so that there will be minimum shut down time should changes be required.

2) The latching circuitry (outputs) shall be fail-safe design that turns off all the outputs in the event of a processor malfunction.

3) Power Supplies: All power supplies utilized shall be UL recognized. They shall all have short-circuit protection.

4) Frame: All assemblies, power supplies, chassis, switches, relays, and other items shall be securely mounted on a substantial, self-supporting steel frame. The equipment shall be completely enclosed with covers. No equipment is to be mounted on the covers.

5) Wiring: All factory wiring shall utilize UL labeled copper wires. All wiring interconnections shall be neatly routed. All wiring connections to studs of terminals shall be made by means of solder or solderless lugs.

6) Marking: All components shall be clearly and permanently identified adjacent to each device and shall be identical to the wiring diagram.

7) Provide extender boards when computing devices are used inside a computer chassis so as to have access to the printed circuit cards utilized.

8) Electronic time delay devices shall use stable capacitor or crystals as the time base.

9) Terminals shall be provided for a future connection to a computerized test system. An adequate number of terminals shall be provided so as to monitor all of the various functions of the elevators. These shall include but not be limited to car positions, running functions up and down, door open and close, hall and car calls, door protective devices, safety circuits, elevator recapture, etc.

C. Printed Circuits and Related Hardware:

1) All printed circuit board edge connections shall be gold plated.

2) All solid-state hardware and devices shall have built-in noise suppression devices that provide a high level of noise immunity.

3) Power supplies shall have noise suppression devices provided.

4) All inputs from external devices (such as pushbuttons) and all outputs to external devices (such as indicators, relays) shall be isolated.

5) The use of relays as input/output devices is not acceptable.

6) A separate regulated power supply shall be used for each computer chassis.

7) The control circuits shall be so designed so that one side of the power supply is grounded to provide for testing.

8) Under no circumstances shall the safety circuits be affected by accidental grounding of any part of the system.

9) In the event of a power failure or interruption, the system shall be designed so that it will start properly when power is returned.

10) System memory shall be provided so that data shall not be lost in the event of a power failure or disturbance.

Note: Conduits or other wiring shall not be exposed in the lobby or other occupied parts of the building.

D. Speed Regulation:

1) The rate of acceleration and deceleration of the cars under any condition of load shall be as nearly constant as is possible with the method of control specified and employed and shall be independent of the operating devices in the car.

2) The acceleration, deceleration and velocity shall all be computer controlled. The detection of velocity and position of the car shall be fed into the computer. The computer shall

compare this information with the velocity profile and adjust as necessary to insure a fast and smooth acceleration and deceleration curve. The maximum acceleration/deceleration shall be 4 feet/sec2 and shall change uniformly.

3) Entire elevator equipment including hoisting machines and controllers shall operate without irregularities and quietly by use of high-grade materials, first class workmanship and adjustments.

10. Field Quality Control

A. Tests

1) Perform as required by code, and authorities having jurisdiction.

2) Provide labor, material, equipment and connections.

3) Repair or replace defective work as required.

4) Pay for restoring or replacing damaged work due to tests.

B. Final Inspection: When all work is completed, and tested, notify the Owner in writing that the elevator is ready for final inspection and acceptance test. A testing and inspection date shall then be arranged. The proper operation of every part of the elevator system and compliance with contract requirements of the Code shall be demonstrated to the Owner. Furnish all test instruments, weights, and materials, required at the time of final inspection. The following tests shall be made on each elevator at the time of final inspection:

1) Test Period: The elevator shall be subjected to a test for a period of one hour continuous run, with full specified load in the car. During the test run, the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor.

2) Speed Load Tests: The actual speed of the elevator car shall be determined in both directions of travel with full contract load and with no load in the elevator car. Speed shall be determined by a tachometer. The actual measured speed of elevator car with full load shall be within 5% of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined between the "UP" and the "DOWN" directions shall be checked.

3) Floor-to-floor times with no load in the car, balanced load in the car and full load in the car shall be checked.

4) Car Leveling Tests: Elevator car leveling devices shall be tested for accuracy of landing at all floors with no load in the car, balanced load in; the car and full load in the car, in both directions of travel. Accuracy of floor landing (plus or minus 1/8 inch) shall be determined both before and after the full-load run test.

5) Final System Tests for Smoke Detection/Fire Elevator Recall: After work is completed, conduct a final test of entire system. Submit results on approved test report forms.

6) Reinspection: if any equipment is found to be damaged or defective, or if the performance of the elevator does not conform to the requirements of the contract specifications or the safety code, no approval or acceptance of the elevators will be issued until all defects have been corrected. When the repairs and adjustments have been completed and the discrepancies corrected. The Engineer shall be notified and the elevator shall be reinspected. Rejected elevators shall not be used until they have been reinspected and approved.

11. Adjusting, Cleaning, Lubrication And Painting

A. Perform the following work prior to final testing and acceptance.

1) Adjust all equipment for optimum performance, including controllers, motors, drives, landing systems, hoistway switches, door operating equipment and safety equipment to achieve the required performance levels.

2) Thoroughly clean all equipment and equipment areas free of all dust, dirt, debris and excessive oil and grease.

3) Lubricate all equipment in accordance with manufacturer's guidelines.

4) Patch and paint exposed work soiled or damaged during installation. Repair to match adjoining work prior final acceptance.

5) Clean and paint the following equipment and areas: pit floor and machine room floor.

12. Instructions

A. Upon completion of all work, the schedule an instruction period. Instructions shall be given by competent supervisory personnel and shall apply to actual field conditions. The instructions shall cover, but shall not be limited to the following:

1) Operation of elevators under emergency conditions, maintenance, adjustment, troubleshooting and diagnostic procedures.

2) Operation of elevator fire recall system and tenant security system.

3) Operation of elevator communication, door reversal device, etc.

END OF SECTION

PART 13 – ELECTRICAL AND FIRE ALARM

1. General

   A. This section provides current electrical and fire alarm planning and design information for the new LaGuardia Airport East Garage D/B Project. The information in this section includes design objectives, concepts and criteria which meet the requirements of the new NYC Building Code, Port Authority regulatory requirements and the present and future operational electrical requirements of the LaGuardia Airport (LGA) East Parking Garage.

   B. The main focus of the design for all Electrical and Fire Alarm shall be the safety, convenience, reliability, and comfort of the airport patrons and employees.

2. Applicable Codes and Guidelines
   Electrical Systems will be designed in accordance with the latest applicable codes, standards, Port Authority Standards, as well as current engineering practices.

   A. New York City Building Code 2008

   B. New York City Electrical Code 2011

   C. New York City Energy Conservation Code 2011

   D. Life Safety Code, NFPA 101 2012

   E. PANY&NJ Electrical Design Guidelines

   F. PANY&NJ Engineering Department's Engineering/Architecture Design Division CAD/BIM Standards

   G. PANY&NJ Sustainable Design Guidelines

   H. PANY&NJ Tenant Construction Review Manual

   I. Leadership in Energy & Environmental Design (LEED) of the US Green Building Council (USGBC)

   J. Occupational Safety and Health Administration (OSHA)

   K. National Electrical Safety Code (NESC)

   L. National Fire Protection Association (NFPA)

   M. American National Standards Institute (ANSI)

   N. Institute of Electrical and Electronic Engineers (IEEE)

   O. National Electrical Manufacturers Association (NEMA)

   P. Underwriters Laboratories, Inc. Standards (UL)

Q. Insulated Cable Engineers Association (ICEA)

R. International Electrical Testing Association (INETA)

S. Americans with Disabilities Act (ADA)

T. Architectural & Transportation Barriers Compliance Board (ATBCB)

U. Environmental Protection Agency (EPA)

V. Federal Aviation Administration (FAA) – Federal Aviation Regulations (FARS 14 CFR)

3. Basic Technical Specifications

The following list contains the Basic Technical Specifications for use in the Electric and Fire Alarm portion of this Contract.

Section No.	Title
16000	Electrical General Requirements
16110	Raceways
16115	Underground Conduit Systems
16120	Wires, Cables, Splices, Terminations (600 Volts or Less)
16121	Wires, Cables, Splices, Terminations (Medium Voltage: 601 Volts to 34,500 Volts, Inclusive)
16127	Control/Signal Transmission Media
16128	Arc-proofing
16133	Control Panels, Enclosures/Cabinets, and Terminal Boxes
16135	Boxes and Fittings
16140	Wiring Devices
16150	Motor Power and Control Wiring
16190	Supporting Devices
16250	Transfer Switches
16315	Medium Voltage Load Interrupter Switches
16320	Dry-Type Transformers General Purpose – 600 Volts or Less
16326	Cast Coil, Dry-Type Transformers (Medium Voltage)
16335	Low Voltage Switchgear
16450	Grounding
16470	Panelboards
16475	Overcurrent Protective Devices (600 Volts or Less)
16477	Protective Devices Coordination Study
16510	Lighting Systems
16620	Diesel-Generator Set (with Auxiliaries)
16670	Lightning Protection System
16720	Fire Alarm Systems
16859	Electric Heating Cables (Self-Limiting Type)
16998	Medium Voltage System Commissioning Tests

4. Electric Service

A. Electric service to the East Parking Garage shall consist of two 4160-volt feeders from the

East Electric Substation to the substation located at the roof level of the East Parking Garage.

5. Temporary Light and Power

   A. Make provision for temporary light and power for the duration of construction.

6. Ductbank and Manhole Systems

   A. Extend two existing concrete-encased underground ductbank systems located under the future Combined Heating and Refrigeration Plant (CHRP). Both existing ductbanks consist of twelve 5-inch reinforced thermosetting conduits arranged in a 2x6 configuration. Provide a manhole at the end of each existing ductbank.

   B. Provide ductbanks extending from these manholes towards the west wall of the East Parking Garage and turn 90 degrees towards the south. Maintain at least 20 ft. separation between the ductbank systems and continue east under the roadway on the south side of the Garage to a location where the concrete-encased riser conduits are to extend upwards to the substation at the roof level. Spacing between manholes in each ductbank system shall be approximately 300 feet.

   C. Both concrete-encased risers shall consist of two 5-inch reinforced thermosetting conduits. One of these conduits in each riser shall be an empty spare.

   D. The remaining conduits in each 5kV ductbank system shall be dead-ended in the last manholes for future extension by another contract.

7. 5kV Class Feeder Cables

   A. Two 4160-volt feeders consisting of 3-conductor 500kcmil 5 kV class flat strap cable as manufactured by Kerite, Okonite, or Pirelli, shall be run from the East Electric Substation to the double-ended secondary unit substation in the East Parking Garage.

8. Service and Distribution Voltages: The following service distribution voltages shall be provided in accordance with general industry practice for electrical equipment and devices.

   A. 4160V – service

   B. 480/277V, 3 phase, 4 wire – power distribution.

   C. 480 volts, 3 phase - motors rated 1/2 horsepower and above.

   D. 120 volts, single phase - motors rated 1/3 horsepower and below.

   E. 277 volts, single phase - LED and fluorescent lighting.

   F. 480 volts, 3 phase - electric heating equipment rated at 3.6 kW or more.

   G. 277 volts, single phase - electric heating equipment rated above 1 kW but less than 3.6 kW.

   H. 120 volts, single phase - electric heating equipment rated 1 kW or less.

I. 120 volts, single phase – receptacle and appliance loads.

9. Equipment

A. The secondary unit substation and the generator shall be provided with weatherproof enclosures and shall be located at the roof level of the parking garage. Other electrical equipment including panelboards and dry-type distribution transformers shall be installed in dedicated electrical distribution rooms at each level. Provide clear space around the equipment. Electrical distribution rooms shall be ventilated to maintain a maximum indoor temperature of 104 deg F. Space shall be provided for future conduits and equipment.

B. Enclosures for outdoor equipment other than the substation and generator shall be rated NEMA 4X stainless steel, and located to be protected against physical damage.

C. Motor controllers shall be located in mechanical equipment rooms.

D. Electrical equipment such as power distribution panels, lighting and appliance panels, and dry-type step-down transformers shall be located in electrical equipment rooms.

10. Voltage Drop

A. Feeders and branch circuits shall be sized to compensate for voltage drop such that the total voltage drop shall not exceed 5% from power source to load served. The voltage drop for feeders shall be limited to 2%.

11. Short Circuit Current and Arc Fault Analysis

A. Perform three phase fault calculations from the substation to the panelboard level to determine the ratings of the electrical distribution system equipment. Electrical equipment shall be fully rated; downstream panelboards shall be coordinated with upstream equipment for the available short circuit current. Perform an arc flash analysis based on the actual equipment provided. Apply labels to equipment indicating appropriate levels of personal protective equipment.

12. Power factor

A. Equipment shall be selected to provide the maximum power factor provided for readily available ballasts and motors. Space shall be provided for future capacitors to be provided if operating system power factor is not within permitted utility limits.

13. Total Harmonic Distortion Design Considerations

A. Equipment that can generate non-linear loads shall be selected to limit the contribution of non-linear loads into the electrical distribution system. The generator shall be sized to handle the anticipated non-linear load on the system.

14. Transient Voltage Surge Suppression Design

A. Provide transient voltage surge suppression at the substation.

B. Panel Protection: Provide transient voltage surge suppression at local panels serving sensitive loads such as electronic equipment.

15. Energy Conservation

A. A lighting control strategy shall be designed that automatically switches off lighting in unoccupied enclosed spaces by means of occupancy sensors operating in vacancy mode (manual ON, automatic OFF). In the parking areas of the garage, lighting shall be controlled by motion sensors integral to the lighting fixtures such that light output decreases to 50% after a delay when no motion is detected. Daylight sensors shall be incorporated where appropriate. Exterior lighting shall be controlled by photocells.

B. Energy efficient motors, transformers and lighting fixtures (lamps and ballasts) shall be specified.

16. Lightning Protection System

A. Provide a lightning protection system complying with the following Codes: Lightning Protection Institute (LPI) 175, NFPA 780, and UL 96A. This shall include all air terminals, conductors, connections, ground rods and ground grid. Incoming electric and communications services shall be provided with surge arresters. The lightning protection system shall be designed by a certified lightning protection designer in order to obtain a UL Lightning Protection Inspection Certificate.

17. Substation

A. Provide an outdoor double-ended secondary unit substation in an integral environmental enclosure. The substation shall consist of the following equipment:

1) Two 5KV Class load interrupter switches (manufactured by S&C - no substitutions)

2) Two 5kV Class grounding switches (manufactured by S&C - no substitutions)

3) Two metering compartments

4) Two 500 KVA, 4.33 KV/ 480 V step-down cast coil type transformers.

5) Two 480 volt main breakers, electrically operated, drawout type

6) One tie breaker, electrically operated, drawout type

7) Digital metering systems (Powerlogic Ion 7330 manufactured by Square-D – no substitutions)

8) Six Feeder breakers, drawout type

9) Two fully equipped spaces

10) One automatic throwover with control power and UPS

11) Two electric meters.

12) One electric totalizer.

18. Power Distribution Panelboards

A. Power Distribution Panelboards shall be provided with a main circuit breaker, copper bus and with molded case, thermal magnetic bolt-on feeder circuit breakers. Breakers 225A and larger shall have interchangeable trips. Enclosures shall be surface mounted, indoor type, made from Code-gauge galvanized steel. Each breaker shall have a dedicated bolt-on steel cover. Provide spare breakers and 25% spaces for future use.

19. Lighting and Appliance Panelboards

A. Lighting and Appliance Panelboards shall be provided with a main circuit breaker, copper bus and with molded case, thermal magnetic bolt-on branch circuit breakers. Enclosures shall be surface mounted, indoor type, made from Code-gauge galvanized steel with door-in-door trim. Provide spare breakers and 40% spaces for future use.

20. Lighting

A. Provide interior lighting throughout the Parking Garage, in public spaces and in non-public spaces. Provide exterior façade lighting.

B. Provide lighting at the roof-mounted substation and the generator sufficient to permit night-time working.

21. Branch Circuits

A. Provide branch circuits to serve lighting, power, security, communications, Smarte Carte vending, heat trace, mechanical equipment, electric vehicle charging stations, and other loads as required.

B. Provide lighting at the roof-mounted substation and the generator sufficient to permit night-time working.

22. Generator

A. Provide a diesel-fueled emergency generator. The packaged engine-generator set shall be UL 2200 listed and housed in an integral weatherproof enclosure. Provide a 270-gallon day tank.

B. The emergency generator shall provide backup power to emergency and optional standby loads of the garage in the event of loss of normal power.

C. The diesel fuel tank shall be located at grade and shall be a UL 2085 listed steel-walled tank with insulation, secondary containment, and monolithic concrete encasement providing vehicle impact and projectile resistance. The tank shall be equipped with integral leak detection. The tank shall be sized for 24 hours running at full load.

23. Emergency and Optional Standby Loads

A. Emergency loads shall be designed with automatic transfer switches to provide emergency power within 10 seconds of normal power loss and to satisfy Code requirements. Emergency loads shall include, but shall not necessarily be limited to:

1) Emergency egress lighting.

2) Fire alarm and rescue systems.

3) Egress signage.

4) Communication systems.

5) Sewage ejector pumps.

6) Sump pumps

7) UPS for communications equipment.

8) Fire suppression systems.

B. Elevators shall be arranged to transfer to emergency power in sequence, return to the designated landing, open the doors, and disconnect from the emergency power source.

C. Optional standby loads shall have a lower priority than emergency loads and shall provide power within 60 seconds.

24. Conduit

A. The minimum conduit size shall be ¾-inch, supported independently of other systems.

B. Use 5-inch reinforced thermosetting resin conduit for 5kV underground feeders in concrete-encased ductbanks and for 5kV concrete-encased risers.

C. Use rigid galvanized steel conduits with threaded fittings for all other above-grade installations.

D. Use Schedule 40 PVC conduits in concrete-encased ductbanks for 600-volt underground feeders and for underground communications.

25. Outlet Boxes and Pull Boxes

A. Outlet boxes for concealed installations in indoor dry locations shall be stamped rigid galvanized steel, 4 inch square or size required by code.

B. Outlet boxes for exposed installations shall be cast metal alloy.

C. Pull boxes shall be galvanized sheet steel with screw on-covers.

26. Receptacles and Electric Vehicle Charging Stations

A. Duplex receptacles shall be industrial specification-grade, grounded, 20A, 125 volts, 2 pole,

3 wire, side wired, copper alloy with screw terminals. Ground fault interrupting type shall be self protecting feed-through.

B. Convenience receptacles shall be located at approximately 30 feet intervals along the perimeter walls of the Parking Garage. Connect up to six receptacles per branch circuit. Provide GFI-type circuit breakers to protect the branch circuits. Provide wet location covers for receptacles, except that receptacles on roof level shall have raintight-in-use covers.

C. Ground fault interrupting type receptacles shall be located within 6 feet of any water source and in the elevator pit. Connect up to six outlets on a branch circuit. The elevator pit receptacle shall be on a dedicated circuit.

D. Each enclosed space shall have duplex receptacles spaced such that no point measured horizontally along the floor line of the wall space is more than 6 feet from a receptacle outlet. Connect up to six receptacles on a branch circuit.

E. Install five charging stations for electric vehicles and the infrastructure to support an additional ten future charging stations. The charging stations will be furnished by Coulomb Technologies or another vendor selected by the Port Authority.

27. Switches and Occupancy Sensors

A. Wall switches shall be specification-grade, 120-277 volt, 20A, single pole toggle type.

B. Wall-mounted occupancy sensors shall be solid state type set to operate in the vacancy mode – manual ON, automatic OFF.

C. Ceiling-mounted occupancy sensors shall be dual technology type.

D. Disconnect switches shall be heavy duty, horsepower rated, 600 volts.

28. Wires and Cables

A. Provide 600-volt wires and cables in accordance with Specification section 16120.

B. Provide medium-voltage flat strap cable in accordance with Specification section 16121.

29. Local Motor Controls

A. Provide motor starters for mechanical equipment.

30. Grounding System

A. Provide a complete ground consisting of a 250 kcmil bare copper wire and driven ground rods with exothermic welds. The ground grid shall be connected to structural steel and to the lightning protection system.

B. For medium-voltage cables the flat strap shall serve as the equipment grounding conductor. For all other feeders and branch circuits provide a separate equipment grounding conductor run in the same raceway as the current-carrying conductors.

C. The electrical system and transformers shall be grounded per code.

D. For additional grounding requirements see selected sections of the Writen Criteria.

31. Heat Tracing

A. Provide heat tracing systems for piping described in Part 11 – MECHANICAL PLUMBING AND FIRE PROTECTION. Heat tracing shall be by means of self-regulating electric heating cables.

32. Flood Water Detection

A. Provide water detectors in the electrical distribution rooms at level 1 of the Parking Garage. Position the water sensor probes 6 inches above the finished floor. Each detector shall have a relay output to a corresponding contactor located at level 2. In the event that water is sensed, the detector shall cause the contactor to de-energize level 1 panelboards (other than the emergency panelboard) and shall sound an alarm.

33. Fire Alarm System Description

A. A complete, integrated and operating fire alarm, detection, control and monitoring system shall be designed and installed throughout the East Parking Garage. The system shall be Cerberus Pyrotronics FireFinder XLS system. No substitutions will be permitted.

B. The fire alarm system in its entirety shall be in compliance with all applicable codes and standards. Accessory and ancillary components as required shall be certified or cataloged by the manufacturer and UL listed to operate with the XLS system.

C. The Fire Alarm Control Panel shall be located inside the electrical room nearest the vehicle entrance at ground level of the East Parking Garage. The FACP shall be interfaced with the existing Siemens's Cerberus Pyrotronics Fire Command Center located at the Airport Rescue and Fire Fighting Building. Provide a dedicated fiber optic connection to the Fire Command Center. Coordinate the work with the Port Authority's Engineers.

34. Applicable Codes, Guidelines, and Standards

Design Fire Alarm System in accordance with the latest applicable codes, standards, Port Authority Standards, as well as current engineering practices.

A. New York City Building Code 2008

B. New York City Electrical Code 2011

C. National Fire Protection Association Standard 13

D. National Fire Protection Association Standard 20

E. National Fire Protection Association Standard 72

F. National Fire Protection Association Standard 90

G. PANY&NJ Tenant Construction Review Manual

E. Applicable UL and FM Standards

35. Fire alarm signal initiation shall be by one or more of the following devices:

A. Manual stations.

B. Heat detectors.

C. Combination smoke/heat detectors.

D. Smoke detectors.

E. Fire extinguishing system operation.

F. Fire standpipe system.

36. A fire alarm signal shall initiate the following actions (as a minimum):

A. Alarm notification appliances shall operate continuously.

B. Identify alarms at the Fire Alarm Control Panel.

C. Identify alarms at the existing master Fire Command Center.

D. Recall elevators.

E. Stop people movers.

F. Transmit an alarm signal to the remote alarm receiving station.

G. Activate voice/alarm communication system.

H. Fan shutdown.

I. Close smoke dampers in air ducts of system serving zone where alarm was initiated.

J. Record events in the system memory.

K. Record events by the system printer.

L. Provide alarm-monitoring outputs to existing Energy Management

M. Control System local Direct Digital Control (DDC) Panel.

37. Fire alarm supervisory signal initiation shall be by the following device or action:

A. Operation of a fire-protection system valve tamper switch.

38. System trouble signal initiation shall be by one or more of the following devices or actions (as a minimum):

    A. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

    B. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.

    C. Loss of primary power at the Fire Alarm Control Panel.

    D. Ground or a single break in Fire Alarm Control Panel internal circuits.

    E. Abnormal ac voltage at the Fire Alarm Control Panel.

    F. A break in standby battery circuitry.

    G. Failure of battery charging.

    H. Abnormal position of any switch at the Fire Alarm Control Panel or annunciator.

    I. Derangement of the emergency power source.

    J. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.

39. System Trouble and Supervisory Signal Actions.

    A. Ring trouble bell and annunciate at the existing Fire Command Center. Record the event on system printer.

40. Return to Normal.

    A. Send a signal to the Fire Command Center to return to normal mode after the system has been reset.

41. Contractor to submit the following calculations:

    A. Load Calculations

    B. Transformer Sizing Calculations

    C. Generator Sizing Calculations

    D. Short Circuit Calculations

    E. Wiring Sizing Calculations

    F. Voltage Drop Calculations

    G. Panelboard Sizing Calculations

    H. Conduit Sizing Calculations

I. All calculations to be submitted at the completion of Design Development to the Port Authority.

END OF PART 13

PART 14 - LIGHTING

1. General

   A. This Part specifies the design criteria for the Architectural Lighting associated with the East Parking Garage and describes the lighting design approach documented in the Basic Contract Drawings.

2. Applicable Codes, Standards and Guidelines

   Comply with all applicable codes, standards and guidelines of all authorities having jurisdiction, including:

   A. The New York State Uniform Fire Prevention and Building Code, consisting of Building Code of New York State (BCNYS), the Fire Code, Mechanical Code, Plumbing Code, and Fuel Gas Code, when referenced by the Building Code; and the standards referenced by the NYS codes.

   B. Lighting Handbook, 10th Edition, The illuminating Engineering Society of North America, 2011.

   C. ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (project design standard).

   D. Energy Conservation Construction Code of New York State, 2010 (project compliance standard).

3. Criteria

   A. Illuminance Standards (Normal Operations)

      1) Interior Parking Decks

         a) Drive Aisles

            - 5 foot-candles minimum average illumination at deck level
            - 1.5 average/minimum ratio not exceeded

         b) Parking Bays

            - 3.5 foot-candles minimum average illumination at deck level
            - 2.0 average/minimum ratio not exceeded

         c) Stairs

            - Landings: 15 foot-candles average, 5:1 average/minimum ratio
            - Stair runs: 5 foot-candles average, 2.5:1 average/minimum ratio

         d) Pedestrian Circulation (raised walkways)

            - Raised Walkways: 10-15 foot-candles average, 2:1 average/minimum ratio

      2) Exterior Parking Deck

         a) Drive Aisles

- 2.5 foot-candles minimum average illumination at deck level
- 1.3 average/minimum ratio not exceeded

b) Parking Bays

- 4 foot-candles minimum average illumination at deck level
- 2.0 average/minimum ratio not exceeded

3) Garage Auto Entrance

a) Entrance-bay Drive Aisle (Normal operation, electric light illumination only)

- Day: 30 foot-candles minimum average illumination at deck level
- Night: 5 foot-candles

B. Illuminance Standards (Emergency Operation)

1) The following are to be lighted as egress paths for emergency egress:

a) Drive Aisles (at least 50% width)

- Average 2.9 foot-candles can be achieved with (1) row of fixtures per aisle (50% parking fixtures per garage level)

b) Pedestrian Circulation walkways

- Average 3 foot-candles can be achieved with (1) row of fixtures per aisle (33% downlights per garage level)

c) Stairs

- Average 8 foot-candles at landings and 2 foot-candles on stair runs can be achieved with (1) fixture per landing aisle (50% downlights per stair)

C. Energy Performance Standards

1) Parking Garage Lighting Power Density (LPD)

a) The lighting design for the garage shall not exceed the allowable lighting power density (Building Area Method) for a parking garage. The design standard, per ASHRAE 90.1-2010, is 0.25 W/sf

b) The Basis of Design lighting system, as currently documented has an LPD not exceeding 0.15 W/sf for all lighting associated with levels 1-6 except MEP spaces.

2) Exterior Screen Lighting

a) The connected load of the architectural uplighting system for the garage's exterior screen shall not exceed 0.2W/sf of lighted screen area, per ASHRAE 90.1-2010 limits for Lighting Zone 4 ("high activity commercial district"). The lighted area of the screen is to be considered as the projected area of the screen from the level of the uplight fixture trough up to the top of the screen at Level 6.

b) The Basis of Design lighting system, as currently documented has a fixture spacing adjusted to result in a connected load that complies with Standard's allowance .

4. Lighting Design Criteria

A. Guiding Criteria

1) The primary users of the East Parking Garage are motorists needing short-term parking for passenger pick-up or because they are late for a day-trip out of town so must park close to their departure terminal. Both groups will generally be unfamiliar with the garage layout and will probably be in a hurry, so a light environment that assists in way-finding and that provides adequate illumination for rapid decision-making is a primary design goal.

2) The following criteria should guide the selection of light fixtures:

- LED source, for good photometric performance, consistent light color with good CRI, and low long-term operating cost.
- Exterior-type construction (UL Wet Location, IP 65). Partially or fully sealed construction improves photometric performance and reduces risk of corrosion or failure due to environmental conditions
- Consistent light color (4000K, 70+ CRI) for all fixtures in facility, to the degree practical, in support of a finished and inviting appearance and to assist motorists in recognizing their vehicles.

B. Parking Deck Lighting

1) LED-based purpose-designed system, Pendant mount (lens level with adjacent tees), Type 5 square distribution.

2) Fixtures adjacent to perimeter (except at auto entrance at Level 1) shall have glare shields configured to limit the direct illumination incident on a vertical surface at the edge of the parking deck to no more than 0.2 foot-candles, in order to reduce the visibility of the lighting system from the outside.

C. Parking Deck Lighting – Level 6

1) LED-based purpose-designed system, Pole mounted (15' pole on 2' concrete base), Type 3 and Type 4 distribution, reduced "house side" distribution.

D. Pedestrian Lighting

1) LED-based surface-mount exterior-type downlights adjacent to stairs and at stair landings

2) LED-based recessed downlights integrated with suspended ceiling panels at elevator and bridge landing circulation.

E. Architectural Screen Lighting

1) LED-based (RGBW color changing) linear narrow-beam façade-grazing uplights, bracket mounted within architectural troughs integrated with perimeter screen system. Fixture

power-data cabling daisy-chained between fixtures for limited home-run circuiting and ease of maintenance.

2) Similar system having wider distribution integrated with projected landings to elevator doors to express screen lighting effect at elevator entrances.

F. Lighting Control

1) Conventional circuit-based control for timeclock/photosensor operation, maintenance use, and, potentially, local daylight harvesting.

2) Parking Deck Lighting: Local motion sensors at each fixture, 30' range, adjustable delay, dual-level switched (100%-50%). Central photo-sensor enables operation of lighting whenever daylight illuminance is less than setpoint, with time delay.

3) Level 6 Deck Lighting: Local motion sensors at each pole, 30'+ range (TBD), adjustable delay, dual-level switched (1/3 or ½ LED modules controlled)

4) Stair Lighting: Daylight harvesting control TBD: Roof photo-sensor (open loop control) operates on-off control at threshold set to ensure lights on whenever daylight illuminance is less than setpoint, with time delay.

5) Level 1 Auto Entrance Parking Bay Lighting: Basic system (XDE-1) operates with similar lighting in parking bays. Daylight only system (XDE-1C): Roof photo-sensor (open loop control) operates on-off control at threshold set to ensure lights OFF whenever daylight illuminance is less than setpoint, with time delay.

END OF PART 14

PART 15 - ELECTRONICS

1. General

   A. This part specifies the assumptions, references and design criteria for the Electronics Design including: structured cabling, IT Consolidated Network, Radio, Wireless, IP Phone System, Security, and the cabling infrastructure to support the Parking Control System, Digital Signage, Smart Cart, and Vehicle Charging Stations.

2. Applicable Codes, Guidelines, and Standards

   A. Port Authority of New York and New Jersey (PANYNJ) - Design Guidelines, Electronics

   B. National Electric Code, (NEC)

   C. National Electric Safety Code (NESC)

   D. National Fire Protection Association (NFPA)

   E. American National Standards Institute (ANSI)

   F. ASTM international (ASTM)

   G. Consumer Electronics Association (CEA)

   H. Electronic Industries Association (EIA)

   I. Institute of Electrical and Electronics Engineers (IEEE)

   J. International Organization for Standardization (ISO)

   K. National Electrical Manufacturers Association (NEMA)

   L. Security Industry Association (SIA)

   M. Telecommunication Industry Association (TIA)

   N. Code of Federal Regulations (CFR)

   O. Underwriters Laboratories (UL)

   P. Federal Communication Commission (FCC)

   Q. Federal Specifications (FS)

R. Federal Information Processing Standards (FIPS)

S. All applicable federal, state, and local codes

3. Criteria

A. Design Criteria

1) General

a) Structured Cabling

i. The Structured Cabling System for the new East End Parking Garage shall consist of the pathways and spaces (the infrastructure) and cabling that will support a number of Technology Systems (i.e. communications and low-voltage systems) required within the facility and communications to the facility through an outside plant communications duct bank. The Structured Cabling System must be designed to support these systems during the infrastructure's working life and shall conform to the Port Authority (PA) communications infrastructure noted in the Standards and Guidelines for Port Authority Technology report.

b) Telecommunication Spaces

i. General:

a. All telecommunications spaces (MDF, IDF, TR,) will be provided with systems to provide air conditioning, backup power and dust mitigation. The minimum requirements for these systems will be:

1. HVAC Requirements: Individual controller, Independent thermostat 24 hrs. per day for 365 Days per year. 55-75 degrees F. 30-55% Relative Humidity. Positive Pressure.
2. Lighting Requirements: All lamps will be installed at a minimum height of 8.5 ft AFF. Uniform lighting levels will be 50 foot candles measured at a height of 3 ft AFF.
3. Electrical Requirements: Generator backup will be provided for room service. UPS in line for cut over. Independent power distribution panel in each room for room equipment use.
4. Architectural Requirements: Finish interior spaces, insulated walls, drop ceilings. No exposed ceilings.
5. Overhead cable runway pathway systems will be provided inside all technology spaces.
6. Plumbing / Fire Protection Requirements: Dry Agent Fire Suppression in the MDF. Avoid wet piping such as fire sprinkler lines, cold or hot water distribution or condensate lines, in or above the MDF space.

ii. Main Distribution Frame (MDF)

a. Provide redundant connections from the Outside Plant (OSP) duct bank to the MDF. The MDF is a space for terminations of backbone cabling into the building from other buildings and service providers. It shall also serve as an electronics room. This room will be located on the second floor due to the high water table. This room shall be: MDF = 16 ft. x 30 ft. (480 sf2)

b. Electrical power requirements for the MDF shall be based on approved equipment lists for the rooms when they are available. However, at this point in the design, provide power that complies with the following minimal requirements:

1. Provide dedicated 120 volt nominal, non-switched, ac double duplex electrical receptacles, each on a separate branch circuit, above each equipment rack and cabinet for equipment power.
2. Provide additional dedicated 120 volt nominal, non-switched, ac double duplex electrical receptacles, each on a separate branch circuit, mounted on each wall to provide power to wall mounted equipment.
3. Provide power convenience duplex receptacles mounted on every wall within the room.
4. There may be a requirement for 30A, 208V circuits or circuits with special twist locks. These potential requirements shall be identified later in the design phase.
5. Provide HVAC cooling systems for the Electronic Control room that comply with the following parameters.
6. HVAC shall be provided on a 24 hours-per-day, 365 days-per-year basis.
7. The temperature and humidity shall be controlled to provide continuous operating ranges a temperature of 70 - 75 degrees and humidity below 65%.

i. Telecommunication Room (TR)

a. Provide connections from the MDF to the TR. The TR is a space for terminations of horizontal cabling. There will be two TR rooms per floor. This room shall be: TR = 6 ft. x 10 ft

b. Electrical power requirements for the TR shall be based on approved equipment lists for the rooms when they are available. However, at this point in the design, provide power that complies with the following minimal requirements:

c. Provide dedicated 120 volt nominal, non-switched, ac double duplex electrical receptacles, each on a separate branch circuit, above each equipment rack and cabinet for equipment power.

d. Provide additional dedicated 120 volt nominal, non-switched, ac double duplex electrical receptacles, each on a separate branch circuit, mounted on each wall to provide power to wall mounted equipment.

e. Provide power convenience duplex receptacles mounted on every wall within the room.

f. There will be a requirement for 30A, 208V circuits or circuits with special twist locks.

ii. Pathways

a. The electronics pathways are those physical building facilities used for installation of communications cables. These pathways typically include cable trays, conduits, junction boxes, pull boxes, conduit sleeves and outside plant electronics raceways.

b. All electronics raceways shall be installed per the latest issue of the TIA/EIA-569-A Standards and shall comply with the National Electrical Code and all other applicable State and local codes and regulations.

c. The pathways required for the new East End Parking Garage includes the following:

1. Outside plant communications duct banks

2. Backbone pathways

3. Horizontal pathways

b) Outside Plant Communications Ductbanks

i. Outside plant communications duct banks will be required for interconnecting to other Terminal buildings and Service Provider facilities. The outside plant communications duct banks shall be designed and installed per the latest issue of the TIA/EIA-758 Customer-Owned Outside Plant Electronics Standard and all other applicable codes and regulations.

ii. These raceways shall comply with the following general requirements:

a. The maximum length of conduit sections between buildings and manholes shall not exceed 350 feet.

b. There shall not be more than the equivalent of two 90 degree bends within conduit sections between buildings and maintenance holes. All bends shall be sweeping bends.

c. The OSP duct banks shall have the proper excavation depth (minimum 48 inches below finished grade), width, route and support of work.

d. The OSP duct banks shall also include an active locating system (either location tags or tape) that can be integrated into a future GIS system.

e. The OSP duct banks shall have a load rating of:

1. AASHTO Extra Heavy Duty Rating for Aircraft apron / Taxiway / Runway Areas

2. AASHTO H-20 Rating for Typical Roadway / Commercial Traffic Areas.

f. The OSP conduits installed between manholes and the East End Substation Facility shall be sloped as specified in ANSI/TIA/EIA-758 to ensure proper drainage of water.

g. All underground conduits entering the Garage shall be plugged to prevent the entrance of water and gases.

c) Pathways

i. Backbone Pathways

a. All 4" and 5" electronics backbone pathways shall have un-twisted and installed with twist prevention mechanism on both ends three 3-cell fabric innerduct with measured pull tape to maximize the capacity of the conduit and add up to 3 times more cables per conduit unless specified.

ii. Horizontal Pathways

a. Horizontal pathways are used for routing cables from outlets and devices to the East End Parking Garage MDF, IDF, and TR's serving those areas.

b. Horizontal pathways shall be designed and constructed as follows:

1. Conduits shall be routed from the outlet boxes, concealed within wall spaces, and extended to cable trays within the accessible ceiling spaces. The cable trays shall continue the pathway to the MDF or TR's.

2. Where cable trays are not available, all electronics cables shall be installed within conduit directly to the MDF or TR's. Cabletrays are not allowed in public areas.

3. Standard outlet boxes shall consist of 4-square, deep gang boxes with single gang mud rings.

4. Conduits used within the horizontal pathways shall be 1-inch (minimum) in size.

5. The cable tray system shall be the primary raceway serving the communications cabling within the MDF, TR's and IDF's.

6. Cable tray shall be aluminum tray, open ladder bottom, center supported, with 4-inch high sides and 24 inches wide.

d) Telecommunications Cabling Requirements

i. Backbone Cabling

a. Backbone cabling will consist of singlemode and multimode fiber optic cables and high-pair count copper cables. The fiber shall be OM4 laser optimized 50 micron multimode fiber optic cable to support the latest 10 Gigabit and 40 Gigabit IEEE standards.

b. The following backbone cables shall be installed within the East End Parking Garage:

1. Backbone Cables from the OSP to the MDF.

a. Provide multiple 96-strand singlemode OSP fiber optic cable or a 96-strand multimode OSP fiber optic cable. Install in 4" conduits as specified above.

b. Provide multiple 200-pair Category 3 UTP OSP copper cable. Install in 4" conduits as specified above.

ii. Horizontal Cabling

a. Horizontal cabling is the portion of the electronics cabling system that extends from the device outlets to the horizontal cross-connects in the MDF and TR's serving the area.

b. The horizontal electronics cables shall not only be capable of supporting Gigabit Ethernet transmission to the desktop but also the more recently ratified 10 Gigabit per second (Gbps) IEEE Standard. Horizontal cables therefore must be TIA/EIA-568B Augmented Category-6A compliant, 4-pair, UTP cables. Additionally, all connecting hardware within the horizontal link, from electronics jacks to the connecting hardware within the electronics rooms shall be Category 6A compliant.

iii. Horizontal Cabling Systems

The following systems have been identified for horizontal cabling drops;

a. Fire Alarm Panels

b. Video Surveillance Systems Cameras

c. Access Control System Panels

d. Data Network Workstations

e. Phone System- Handsets and ring downs

f. SCADA Mechanical and Electrical Stations and equipment

g. Digital Signage

h. Parking Control System

e) Grounding System

i. An Electronics Grounding and Bonding System shall be designed and installed for the new East End Parking Garage. This grounding system shall provide a uniform ground within all electronics spaces, to ensure safe and reliable operation of the communications and low-voltage equipment and systems. Grounding shall meet the requirements and practices of applicable authorities and codes. In addition, the electronics grounding and bonding system shall conform to the ANSI-J-STD-607-A "Commercial Building Grounding (Earthing) and Bonding Requirements for Electronics" standard.

ii. The following guidelines are provided for this system:

a. An electronics main grounding busbar (TMGB) shall be located in the MDF.

b. An electronics bonding backbone (TBB) conductor shall be run between the MDF and the TR's/IDF's and be bonded to the master grounding busbar (MGB) at the electrical entrance facility and the TMGB.

c. TBBs shall be installed in continuous lengths of not less than #3 green insulated AWG cable.

d. Provide IDF, TR's electronics ground busbar hardware at locations indicated on the Drawings.

e. Install a green insulated 16 mm^2 (6 AWG) bonding between the electronics ground busbar and the nearest access to the aluminum pan installed on the cable rack.

f. Use green insulated 16 mm^2 (6 AWG) bonding jumpers across all junctions.

g. Bond ground bars on equipment racks and cabinets with a green insulated16 mm^2 (6 AWG) copper wire bonding jumpers attached at each end with compression-type two hole connector . Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using a green insulated 16 mm^2 (16 AWG) bonding jumper's and mounting bolts.

h. Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the electronics ground busbar, whichever is closer, using green insulated 16 mm^2 (6 AWG) ground wire bonding jumpers.

f) Redundancy

i. The Structured Cabling System section shall have several levels of physical redundancy both with the infrastructure and the cabling.

ii. Redundant Outside Plant Communications Vaults and Entry Points into the East End Parking Garage.

iii. Dual, physically separate, communications duct banks feeding the East End Parking Garage. These duct banks shall enter the facility at different locations.

iv. Service Providers, such as the local telephone company and other competitive carriers can then provide redundant incoming services into the East End Parking Garage and redundant network interfaces within the MDF Room.

v. In the event of a duct bank being damaged, communications to/from the East End Parking Garage shall still remain operational through the secondary duct bank.

g) IT Consolidated Network

i. The Consolidated Network (CN) is comprised of the electronic components located throughout the entire airport campus to provide connectivity to individual end-users. The CN provides the necessary bandwidth for various communications systems to distribute and share data throughout the premises. The network forms the electronic infrastructure allowing different communications systems to effectively share bandwidth using various protocols. Quality of Service (QOS) can be implemented to guarantee service and delivery of data for each system utilizing the CN.

ii. The applications that are currently running on the LGA CN that would be needed for the East End Parking Garage is emergency telephone, security IP cameras, Wi-Fi, Parking Revenue System, data connections.

iii. The electronics infrastructure for the CN shall be configured with a core networking electronics system that will be redundantly connected to the existing Port Authority Wide Area Network (PAWANET) enterprise network. The design shall include full redundancy to eliminate any single point of failure in the system. In the MDF there shall be, "edge-level" electronics to provide connections to end-user devices (IP phones, Access Control Panels, workstations, printers, etc.).

iv. The "edge-level" devices shall be redundantly connected to the core devices in the MDF to provide connectivity to any other device on the network. In order to accommodate the requirements of several independent systems that will utilize the system, the use of Virtual LAN (VLAN) technology shall be employed. This will allow each system to secure its data from other virtual networks on the system.

v. All primary components in the system shall be chassis based. This type of configuration will provide the framework to adequately meet the existing data requirements as well as provides a means for expansion when data requirements increase.

h) Radio / Wireless

i. Trunked radio systems, also known as 800 trunked radios, use a small number of radio channels that are shared among a large number of users. The system consists of repeater channels or talk channels and controller channels.

ii. As the East End Parking Garage progresses design documents for all construction shall be reviewed to ensure adequate coverage within and around the new facility.

iii. The contractor shall perform an empirical radio coverage with at least one test point per 1000 sq ft to document trunking and backup 800 MHz and facility UHF radio coverage levels. Levels less than -90 dBm shall require radio coverage if reliability is less than 97%.

iv. The design shall provide all necessary calculations to mitigate interference, intermodulation's, and link loss budgets. In addition FDNY coverage as measured from the Garage and CTB.

v. First Responder communications within the Garage shall be recorded on the Public Safety Recorder.

vi. The radio design shall comply with Motorola R56 standard inclusive of lightning protection, grounding, etc...

vii. Intelligibility shall be 3.4 DAQ or better.

i) Security

i. Video Surveillance System

The design looks to provide an IP (Internet Protocol) Power over Ethernet supported video surveillance system. The design will be an expansion off an existing centralized Verint / Nextiva video control and distributed recording system. This system will be based off the PANYNJ system standard and will support the program in concordance with PANYNJ and TSD policy as well as meeting any requirements as defined by the authority under a delivered Concept of Operations. Performance requirements shall include but not be limited to:

a. All cameras shall be fixed IP cameras per compatibility documented by Verint.

b. Space planning for the Security VSS shall consist of the following:

1. 1/2 Cabinet in the MDF

2. Integration with the multiple displays and workstations at the site wide security operations center

3. Integration with the existing software and servers

4. Comply with Agency CCTV policy deemed current at the time of Final Design.

5. Comply with the Agency CCTV standards deemed current at the time of final design.

6. The design shall provide for anticipated views of each camera for Agency acceptance prior to final design.

ii. Access Control System

The design shall provide an IP (Internet Protocol) based access control system. The design will be an expansion off an existing centralized Lenel digital access control system. This system will be based off the PANYNJ system standard and will support the program in concordance with PANYNJ and TSD policy as well as meeting any requirements as defined by the authority under a delivered Concept of Operations. Performance requirements shall include but not be limited to:

a. The access control system shall cover doors listed as emergency egress, entrances to telecommunications spaces and other PANYNJ spaces as shown on the plans.

b. All card readers shall be FIPS compliant

c. Space planning for the Security ACS shall consist of the following:

1. 1/2 Cabinets in the MDF

2. Network Equipment in the MDF and TR's

3. Wall space for ACS equipment in the TR's

4. Integration with site wide the security operations center to include reader licensing

iii. Emergency Phones

The design shall provide an IP (Internet Protocol) based digital telephone system. The design will be an expansion off the existing LGA system, which in itself is an expansion of the Port Authority Cisco IP Phone System currently maintained by PANYNJ TSD. This system will have the capacity to provide phone service both internally and to direct outside lines for the purposes of supporting staff needs, elevator call phones, emergency or "Blue Light" stations and public access such as courtesy phones. Connectivity shall be provided by the SCS. Within the footprint of the garage, the IP phone system will support Code Blue emergency phones at all stairwell entrances, all elevator lobbies, and in locations as shown on drawings. The system will also provide for phone connections via the elevator umbilicals to cab phones. Performance requirements shall include but not be ,limited too:

a. Space planning for the Emergency Phones shall consist of the following:

1. Network Equipment in the MDF and TR's
2. Integration with the site wide security operations center

j) Parking Control System (Infrastructure Only)

i. The design will provide each toll plaza with a connection point to an evenly distributed, redundant local area network connection point that provides for high-speed optical connectivity. The plan will provide for a telecommunications demark enclosure with fiber optic connectivity and will ensure that end-of-line connections are within industry standard distance limitations in all locations.

ii. The future Parking Control System shall be located in the MDF. Two 2" conduits per booth shall be provided to support future Parking Booths on the east side of the parking garage.

k) Digital Signage System (Infrastructure Only)

i. The Digital Signage system shall be located in the MDF. The digital signage shall be integrated into the Parking control system for way finding and parking information. Telecommunications outlets shall be added to each of the Digital Displays.

l) Luggage Carts (Infrastructure Only)

i. The Smart Cart racks shall be located on each floor near the elevators. A data jack shall be required at each location and terminated in the nearest IDF for connectivity to the LGA network.

m) Vehicle Charging Stations (Infrastructure Only)

i. The Vehicle Charging Stations shall be located on each floor. A data jack shall be required at each location and terminated in the nearest TR for connectivity to the LGA network.

2. Basic Specifications

The following list contains the Basic Specifications for use on the electrical portion of this Contract.

Section No.	Title
13710	Video Surveillance System – Cameras
16110	Raceways
16114	Cable Trays
16126	Optical Fiber Cable
16127	Control – Signal Transmission Media
16130	Conductor Bars
16133	Control Panels Enclosures – Cabinets and Terminal Boxes
16135	Boxes and Fittings.
16450	Grounding
16729	Access Control System
16784	Telephones and Telephone System Equipment
16785	Data Network Equipment
16790	Emergency Phones
16935	Supervisory Control and Data Acquisition (SCADA)

3. Required Design Submittals

A. Intermediate - (Design)

1) Drawings/Documents

a) Contractor shall submit Contract Drawings on Authority standard 22"x34" contract sheets. These drawings shall include as a minimum, but not be limited to, the following information:

b) Floor plans to describe the scope of work required in the Basic Specifications at a minimum scale of 1/8"=1'-0".

c) Provide heat and power loads for all MDF and IDF locations.

d) Intermediate one line diagram.

e) Intermediate equipment layout plan.

f) Intermediate block diagram and plan.

g) List of Specifications Sections

B. Final - (Design)

1) Drawings/Documents

a) Contractor shall submit Contract Drawings on Authority standard 22"x34" contract sheets. These drawings shall include as a minimum, but not be limited to, the following information:

b) Floor plans to fully describe the scope of work required in the Basic Specifications at a minimum scale of 1/8"=1'-0".

c) Final one line diagram.

d) Final equipment layout drawings.

e) Typical details, sections, and wiring diagrams.

f) Final List of Detailed Specifications Sections.

g) Device Illustrations, including proposed mounting conditions.

h) Fiber optic testing reports.

i) Detailed Specifications for equipment and materials

j) Operations and maintenance manuals for all electronic equipment

END OF PART 15

PART 16 - TRAFFIC

1. General

   A. This part specifies the design criteria for traffic related work, including permanent signing, pavement markings, ITS, and maintenance of traffic and work area protection.

2. Codes and Standards

   A. This material shall be the latest edition of all requirements and shall include but not be limited to the following:

AASHTO: A Policy on Geometric Design of Highways and Streets
AASHTO: Roadside Design Guide
AASHTO: Standard Specifications for Highway Bridges
FHWA: Manual on Uniform Traffic Control Devices (MUTCD)
FHWA: Standard Highway Signs
PANY&NJ "Traffic Engineering Design Guidelines"
PANYNJ Traffic Standard Details
PANYNJ Traffic Signal Design and Drawing Preparation Guidelines
PANYNJ "Civil Engineering Design Guidelines"
Applicable ADA standards
National Fire Protection Association.
    NFPA 70 National Electrical Code
National Electrical Manufacturers Association
    - Standard for Traffic Control Systems (Publication No. TS-1)
    - Standard for Traffic Control Assemblies (Publication No. TS-2)
    - National Transportation Communications for Intelligent Transportation Systems Protocol (NTCIP) Standards: NTCIP 1201 Global Object Definitions, NTCIP 1203 Object Definitions for Dynamic Message Signs, and NTCIP 2001 Class B Profile
    - Standards for Enclosures for Electrical Equipment (Publication No. 250)
    - Standards for Wiring Devices - Dimensional Requirements (Publication No. WD6)
Underwriters Laboratories Inc.
    - UL 467 Grounding and Bonding Equipment
PANYNJ Traffic Engineering CADD Graphic Standards
PANYNJ AIRPORT ROADWAY SIGN DESIGN MANUAL

3. Criteria

   A. General Criteria

1) Overall description: number of levels, estimated parking capacity, basic operation and function (ingress/egress, circulation, etc.)

(1) Estimated Parking Capacity inside the structure: 1,100 +/-

(2) Number of levels: 6 (Ground, plus 5)

(3) Garage configuration: Sloped plate. Parking available on ramps between floors.

(4) Terminal Connections on Level 5 via pedestrian connector bridge to Terminal C.

(5) Vehicle Ingress/Egress: Patrons will use existing Parking Lot P4 entry plaza and future P4 exit plazas for access to/from the airport roadway network. Work for the future exit plaza is not part of this Contract.

(6) Circulation. All drive aisles shall support two-way traffic.

2) Technical Assumptions

(1) The Pedestrian Connector Bridge between the Garage and Terminal C is not expected to be completed when the Garage is opened for use. Pedesrtian circulation will be provided using a temporary walkway connecting to the existing crosswalk near the P4 exit plaza. The Contractor shall provide for detour pedestrian signage that shall be left in place upon completion of the Contract and until the Connector is operational.

B. Design Criteria

1) Geometric Design Criteria for parking spaces, aisles, ramps, etc.

(1) Parking Stalls:

(a) Regular Stalls: 18 feet x 8.5 feet (L x W) minimum.

(b) ADA Parking Stalls: 18 feet x 11 feet, with at least one 5 foot wide aisle parallel to each stall. The pedestrian aisle shall be marked and shall be of equal length to the stall. Refer to the Basic Contract Drawings.

(2) Drive aisles:

(a) Floor drive aisles: 24 feet wide minimum.

(b) Ramp drive aisles: 30 feet wide minimum (with parking)

(3) Minimum Vertical Clearance from Floor to Bottom of Structure

(a) Ground Level: 9'-6"

(b) All other levels: 8'-0"

(4) Minimum Vertical Clearance (Actual)

(a) Ground Level: 9'-2"

(b) All other levels: 7'-6"

(5) Minimum Vertical Clearance (Posted)

(a) Ground Level: 9'-2"

(b) All other levels: 7'-6""

(c)

(6) Design Vehicle

(a) Upper Floors: AASHTO "P" Vehicle

(b) Ground Floor: AASHTO "P" Vehicle; ADA Compliant Van

(7) Vehicle Ramp Grades:

(a) Ramps with Parking 5% Max

(b) Ramps without Parking 8% Max

2) Permanent Signing

(1) All Regulatory signs shall be fabricated and installed in accordance with the Federal Highway Administration (FHWA) "Manual of Uniform Traffic Control Devices (MUTCD) for Streets and Highways", latest edition, except as noted.

(2) Vehicle and pedestrian wayfinding signs shall be designed, fabricated, and installed in accordance with the PANYNJ Airport Roadway Sign Design Manual. Sign mounting details are available in the Basic Contract Documents and in the PANYNJ Traffic Standard Details.

3) Pavement Markings

(1) Pavement marking design, configurations, and materials shall be in accordance with the PANY&NJ Traffic Engineering Design Guidelines, Standard Details, and specifications, except as noted.

(2) All pavement markings shall be installed in accordance with the Federal Highway Administration (FHWA) "Manual of Uniform Traffic Control Devices (MUTCD) for Streets and Highways", latest edition, except as noted.

4) Traffic Related Safety Devices

(1) Devices include vertical clearance detection, bollards, wheel stops, guiderails, and barriers. Design and device installation shall be in accordance with Port Authority Standards.

(a) Vertical Clearance (Overheight) Detection

(i) Overheight protection shall be installed on the ground floor at all entrances to the garage, and at ramp to the upper levels. The detection device shall conform to the Basic Contract Drawings. An equivalently functioning device may be substituted with the approval of the Engineer. Approval must be received prior to equipment purchase and installation.

(b) Roadway Guide Rail and Concrete Barrier

(i) The roadside design shall provide for guide rail or concrete barrier as warranted by the criteria of the AASHTO Roadside Design Guide, the PANYNJ Engineering Guidelines, and the PANYNJ Standard Details to prevent vehicle impacts to obstructions adjacent to the roadway.

(ii) Guide rail and concrete barrier design, placement, and material type for roadways shall be in accordance with the PANY&NJ Traffic Engineering Design Guidelines, the AASHTO Roadside Design Guide, and the PANY&NJ Standard Details. The contractor shall use W-Beam guide rail where guide rail is used, unless otherwise specified by the Engineer.

(iii) For barrier or guide rail, the design shall provide an adequate length of need. The design shall account for the deflection distances allowable based on the obstruction locations.

(iv) The Contractor shall design the guard rail-to-concrete barrier and concrete barrier-to-guide rail connections where required.

(c) Garage Interior Railings and Vehicle Barriers

(i) Interior railings and vehicle barriers shall be a minimum 42" in height. The spacing between horizontal elements of the railings/barriers shall be 4" or less.

(ii) For structural design criteria relating to interior garage railings and vehicle barriers, see PART 9 – STRUCTURAL.

(d) Bollards and Wheel Stops

(i) Bollard placement shall be in accordance with the basic Contract Drawings, PANY&NJ Traffic Engineering Design Guidelines and the PANY&NJ Standard Details. For structural design and installation requirements, see PART 9 – STRUCTURAL.

(ii) Wheel stops placement and installation shall be in accordance with the PANYNJ Standard Details. Wheel stops may be either concrete or plastic. Engineer

approval is required prior to purchase and installation. See PART 9 – STRUCTURAL for embedment requirements.

5) Parking Guidance System

(1) The Intelligent Parking Guidance System (IPGS) shall be used to provide motor vehicle operators an indication parking availability and control the Variable Message Signs being furnished as part of this Contract. The system shall conform to the criteria and requirements of specification Section 11151 – Intelligent Parking Guidance System, as well as the codes and standards referenced in PART 16.2 Codes and Standards.

6) ADA Compliance

(1) The garage shall provide parking spaces, passageways and clearances compliant with ADA Guidelines, latest edition.

7) Designated Parking

(1) Provisions shall be made for Low Emitting/ Fuel Efficient Vehicle (LE/FE) only designated parking. See Part 2 – Sustainability for criteria. Within these designated spaces or in addition to them, provisions shall be made for the inclusion of electric vehicle charging stations. The number and installation requirements shall be determined based on coordination with the engineer.

(2) Five (5) electric vehicle charging stations shall be placed in the garage. Installation requirements shall be determined based on coordination with the engineer. The Garage shall have power provisions to add an additional ten (10) charging stations sometime in the future.

(3) Provisions shall be made for ADA accessible parking spaces, in accordance with the ADAAG, latest edition. Van Accessible parking spaces shall be grouped on the first (ground) level.

8) Maintenance of Traffic (M.O.T.) and Work Area Protection

(1) M.O.T. and work area protection shall be provided to accommodate all work items within the scope of the Project, including but not limited to the following:

(a) M.O.T. required to establish site work zones indicated in the Basic Contract Drawings;

(b) M.O.T. required to perform work relating to the roadway realignment;

(c) M.O.T. required inside the P4 parking lot for the partial closure of the lot;

(d) M.O.T. required to remove and also reinstall the overhead sign structure as indicated in the Basic Contract Drawings;

(e) M.O.T. required for pedestrian detours necessary to provide circulation around the work area during construction, and to and from the Garage after completion.

(f) M.O.T. required for any utility work within the public traveled way.

(2) All temporary traffic control and work area protection devices shall be fabricated and installed in accordance with Part 6 entitled "Temporary Traffic Control" of the Federal Highway Administration (FHWA) "Manual of Uniform Traffic Control Devices (MUTCD) for Streets and Highways", latest edition, except as noted.

(3) See Division 1 clause entitled "Maintenance of Traffic and Work Area Protection" for additional requirements.

4. Basic Specifications

A. The following list contains the Basic Specifications for use on the Basic Traffic portion of this Contract.

Section No.	Titles
Division 1 M.O.T	Maintenance of Traffic and Work Area Protection
02580	Thermoplastic Reflectorized Pavement Markings
02582	Preformed Removable Retro-Reflective Pavement Marking Tape
02588	Traffic Paint Pavement Markings
02841	W Beam and Thrie Beam Guide Rail
02842	Temporary Traffic Barriers
02844	Temporary Concrete Barriers
02846	Temporary Water-Filled Barriers
02850	Plywood Sign Panels and Wood Sign Posts
02851	Aluminum Sign Panels
11151	Parking Guidance System

5. Required Design Submittals

A. Intermediate - (Design)

1) Design/Drawings

The Contractor shall submit drawings/documents for review by the Engineer. The Traffic Design drawings, unless otherwise noted, shall measure 22"x34". The final decisions on issues of adequacy of the drawings and their scale will be by the Engineer The Drawings shall include, but not be limited to, the following items:

(1) Contractor shall submit Maintenance of Traffic and Work Area Protection Plans applicable for the entire duration of the Contract.

(2) Conceptual Maintenance of Traffic and Work Area Protection Plans indicating closures, temporary signs, duration of closures, and detour routes.

(3) Contractor shall submit Sign Layout Plans and Tables for both permanent and temporary traffic signs. The plans shall indicate the locations of all signs and the tables shall indicate the overall sign dimensions, letter dimensions, message on sign, and colors.

(4) Contractor shall submit Striping Plans indicating pavement markings and type of marking.

(5) Contractor shall submit parking management systems drawings. The drawings shall include a plan and details sufficient to show the layout and functionality of the system.

(6) Plans shall be developed in the NAD-83 coordinate system.

2) Specifications

(1) Contractor shall submit a preliminary list of Specifications.

(2) Contractor shall submit a complete list of Specifications, plus copies of any special specifications related to ITS

3) Sole Source Items

(1) The Contractor shall identify all sole source items and submit sole source letter(s) for all of the items.

B. Final - (Design)

1) Detailed Contract Drawings

(1) Contractor shall submit all Final Contract Drawings that are identified in A and B above and all associated details, addressing all the Engineer's comments from preliminary and intermediate submittals. The scale of all details shall be sufficient to show all relationships and materials clearly.

2) Detailed Specifications

(1) Contractor shall submit final Detailed Specifications conforming to the Basic Specifications.

END OF PART 16

DIVISION 2

SECTION 02073

CUTTING, PATCHING AND REMOVAL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for cutting, patching and removal of existing construction.

1.02 QUALITY ASSURANCE

A. Cutting, patching and removal shall be performed by workers skilled in the specific trades involved.

B. Site Conditions

1. Except for portions shown to be relocated or retained by the Authority, remove and transport off Authority property all portions of the existing construction shown on the Basic Contract Drawings to be removed in accordance with Division 1 clause entitled "Recycling of Construction Debris Material".
2. All construction debris shall become the Contractor's property.
3. Prior to start of Work, make an inspection accompanied by the Engineer to determine physical condition of adjacent construction that is to remain.

1.03 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

All materials required for patching shall be new. Patching materials shall match in every respect adjacent portions of the existing construction unless otherwise shown on the Basic Contract Drawings.

PART 3. EXECUTION

3.01 PROTECTION

A. Protect existing adjacent surfaces to remain and finished surfaces at all times and repair or replace, if damaged, at no cost to the Authority and to the satisfaction of the Engineer.

B. Protect all existing and new construction including utilities, finishes and equipment from water, damage, weakening or other disturbance.

3.02 CUTTING, PATCHING AND REMOVAL

A. Perform all cutting, patching and removal as shown on the Basic Contract Drawings. Work shall be performed in accordance with the approved methods using approved materials.

B. Do not cut or remove more than is necessary to accommodate the new construction or alteration.

C. Maintain the integrity of all construction at all times.

D. Do not allow removed materials and debris to accumulate at the construction site; remove them at the end of each work period or daily. All areas adjacent to, and leading to and from the site shall be kept free of removed materials and debris.

E. Do not burn, bury, or dispose of in storm drains, wetlands or waterways on Authority property debris of any type.

F. Dispose of debris resulting from removal operations in accordance with all local laws and regulations that would apply if the Authority were a private corporation.

END OF SECTION

SECTION 02073

CUTTING, PATCHING AND REMOVAL

APPENDIX "A"

SUBMITTALS

A. Product Data

Submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey, 07310-1397, for approval, all product data sheets for the materials to be used for patching.

B. Construction/Installation Procedures

Submit to the Engineer plans, methods, equipment and procedures as applicable for cutting, patching and removal.

C. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one package per Section or trade, and sent to the Engineer of review.

END OF APPENDIX "A

DIVISION 2

SECTION 02221

EXCAVATION, BACKFILLING AND FILLING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for excavation, backfilling and filling.

B. Definitions

1. As used herein, excavation shall mean the removal of existing pavement, concrete foundations and all materials other than bedrock (ledge rock) encountered within the limits of excavation that are not specified to be removed under the Section entitled "CUTTING, PATCHING AND REMOVAL".
2. As used herein, backfilling shall mean the filling of excavations made for construction purposes and shall extend only to existing grades or design grades, whichever are lower.
3. As used herein, filling shall mean the placement of fill material in conformance with requirements of this Section at or above existing grades.

1.02 REFERENCES

American Society for Testing and Materials (ASTM)

ASTM D 422	Standard Test Method for Particle - Size Analysis of Soils
ASTM D 1556	Standard Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

New Jersey Interagency Engineering Committee (NJIEC)

Standard Soil Aggregate Gradations

1.03 JOB CONDITIONS

A. Protect excavations as follows:

1. Prevent water from entering excavated areas and, if it does, remove it immediately to maintain a dry condition at all times.
2. Dispose of water in a manner not to cause injury to the public health or damage to public or private property.
3. If water enters excavated areas and weakens or disturbs underlying soil, remove the weakened or disturbed soil and replace it in conformance with 3.02 A.5.
4. Where shown on the Basic Contract Drawings or where required for protection of adjacent utilities or structures or where required for performance of the Work, secure the sides of excavations against movement as follows:
   a. Install sheet piling or sheeting held in place by waling and bracing members. Top of sheeting shall extend at least six inches above ground.
   b. Do not excavate below the bottom of sheet piling or sheeting except as necessary to install sheeting.
   c. Fill voids behind sheeting immediately with material conforming to I-12 designation defined in 2.01 A.1 or otherwise approved by the Authority.
   d. Comply with all other provisions of the Specifications that may impose additional or stricter requirements.
5. For excavations extending to a depth of 5 feet or more, and where sheeting is not required to conform with provisions of 1.03 A.4 above, excavate slopes to a safe angle of repose, or protect trench excavations by use of a portable trench shield.
6. Restore all areas impacted by excavation to their original condition, matching pavement types and sections to meet original pavement grades.

B. Do not traverse paved areas with tracked vehicles or equipment such as carry-all scrapers which may damage such pavement unless protected to the satisfaction of the Authority.

C. Do not place fill or backfill on frozen subgrade.

D. Do not perform rolling or other compaction at any time when the ground water level is above a plane two feet below the surface to be compacted. When the ground water level is above such plane, lower it by approved methods and maintain it below such level prior to and during the compaction operations.

E. Protect from damage trees and other vegetation that are to remain in place.

1.04 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Fill

1. Unless otherwise shown on the Basic Contract Drawings, fill shall consist of clean sand and gravel containing no organic matter, conforming to the following NJIEC Standard Soil Aggregate Gradations:

	Total Percent Passing by Weight NJIEC Designation		
	I-7	I-10	I-12
Sieve Sizes			
4 inch		100	100
2 inch		80-100	
1 inch	100		
3/4 inch		60-100	70-100
1/2 inch	80-100		
No. 4		40-100	
No. 8	35-100		
No. 16	25-90	20-70	
No. 50	5-50	5-40	0-75
No. 100	0-8	0-30	
No. 200	0-2	0-20	0-5

2. The Basic Contract Drawings show the locations in which each designation of fill is required.

B. Backfill

1. Unless otherwise shown on the Basic Contract Drawings, material shall conform to the requirements for I-12 designation, subject to 2.01 B.2 below.
2. Where the entire backfill is above the water table, material conforming to the requirements for I-10 designation may be used in lieu of I-12 designation, except under foundations, aircraft pavement and utilities.

C. Sources

1. When fill and backfill material are provided by the Authority, the location of the stockpile and NJIEC Designation (if applicable) are shown on the Basic Contract Drawings. Samples of material will not be required for testing.
2. Material excavated at the construction site shall be used for fill or backfill to the extent that it conforms with the requirements specified in 2.01 A.1 and 2.01 B.1 as noted on Basic Contract Drawings. Samples shall be submitted for testing by the Authority for conformance with the requirements of this Section.
3. If sufficient quantities of material are unavailable from sources described in 2.01 C.1 and 2 above, furnish material from sources off site.

PART 3. EXECUTION

3.01 PREPARATION

A. Clearing and Grubbing

Remove trees, clear and grub areas to be excavated or in which construction is to be performed, as follows:

1. Remove trees, stumps, all roots larger than 2 inches in diameter, and all matted root systems.
2. Remove all topsoil, debris, organic matter and any other objectionable material not suitable for use as backfill or fill or for support of structures or pavements.
3. Backfill all holes and other low spots resulting from clearing and grubbing with material conforming with 2.01 B before proceeding with compaction of fill as specified in 3.03 or with other construction in the area.

3.02 EXCAVATION

A. General

1. Excavation shall consist of the removal of materials as defined in 1.01 B.1, and the removed materials shall be segregated as suitable and unsuitable and stockpiled as shown on the Basic Contract Drawings.
2. When excavation of bedrock (ledge rock) is required as shown on the Basic Contract Drawings, the provisions for removal are specified in the Section entitled "ROCK EXCAVATION".
3. Excavate to elevations required for installation of permanent construction in such manner as not to disturb the subgrade below such elevations.
4. Where existing foundations or other existing construction are encountered which may cause hard spots, remove them to a minimum of two feet below subgrade for pavement or structures.
5. Should bottom of excavation be weakened or disturbed or carried below required depth:
   a. Under footings - compact bottom, as specified in 3.03 below and replace over-excavation with concrete of the same Class and Type as that specified for the footing or foundation.
   b. Elsewhere - Compact bottom as approved by the Authority and refill with material conforming to I-12 designation defined in 2.01 A.1.
6. Perform excavation around and adjacent to existing structures, pipes and conduits which are to remain in place, without damage to or movement of existing construction. Use hand excavation to locate and expose near-surface structures, pipes and conduits. When excavation is to be performed under such structures, pipes and conduits, support them in a manner as approved by the Authority to ensure uninterrupted operation of the supported items.

B. Dewatering

1. Where excavations are to extend below the water table, prior to placement of any permanent construction or filling or backfilling any excavated area, lower the water table in such an area to two feet below the elevation of the required subgrade and maintain this condition until the construction or pavement is placed thereon.

2. Dewater in a manner to prevent the loss of ground due to the migration of soil fines into the dewatering system.

C. Trenching for Utilities

1. Shape bottom of trench to uniform invert section.
2. When excavating in soft soils which may be subject to lateral movement or bottom heave conform with requirements shown on the Basic Contract Drawings.

D. Disposal of Excavated Material

All debris and all material either unsuitable for or in excess of that required for backfill or fill, shall be disposed of away from the construction site.

E. Restrictions

1. Do not place backfill until the Authority has inspected and approved the Work and indicated where backfill may be placed.
2. Leave all pipe joints exposed until all tests on such pipe, required by other Sections of the Specifications, have been performed.
3. Remove all temporary structures, sheet piles, sheeting, bracing and forms and all organic materials and debris of every nature, taking care, upon the removal of sheet piling, sheeting and temporary supports, not to cause movement of adjacent ground or structures or create the danger of a slide.

3.03 PLACEMENT AND COMPACTION

A. Equipment

1. Steel vibratory rollers shall have provision for regulation of vibration frequency. The Authority shall be informed of the type and size of equipment to be used before the start of any compaction efforts.
2. Placement and spreading equipment shall be reviewed and approved by the Authority.
3. Unless otherwise shown on the Basic Contract Drawings, pneumatic-tired rollers shall have minimum weight of 20 tons and a tire pressure of between 60 and 150 psi as directed by the Authority. For aircraft pavements, the minimum roller weight shall be 50 tons.
4. When mechanical tampers are to be used, the Authority shall be informed of the type and size for approval before compaction efforts with this equipment can begin.

B. Compaction Requirements

Backfill and fill shall be compacted to achieve a density of 95 percent of the maximum density as determined by Procedure C of ASTM D 1557, except where alternate density requirements are approved by the Authority or shown on the Basic Contract Drawings.

C. Subgrade, Excavated and Existing Surfaces

Compaction of subgrade, excavated and existing surfaces will consist of a proof-rolling operation performed as follows:

1. Compact surface with a minimum of six passes of an approved vibratory steel roller operated at a speed not to exceed three miles per hour and at the optimum operating frequency recommended by the manufacturer.
2. In areas where surface consists of a fine grained soil, compact with a minimum of six passes of an approved pneumatic-tired roller.
3. Overlap passes of roller a minimum of six inches.

4. In areas where use of a roller is impractical, compact surface while at or near optimum moisture content with mechanical tampers.

D. Backfill and Fill

1. Moisture content of backfill and fill material shall be within a range of plus or minus two percent of optimum, as determined by Procedure C of ASTM D 1557.
2. Backfill, conforming with I-12 gradation, and fill, conforming with I-7 and I-12 gradation, shall be placed in 14-inch, loose layers and compacted with a minimum of six passes of an approved vibratory roller operated at a speed not to exceed three miles per hour.
3. Passes shall be overlapped a minimum of six inches.
4. Backfill and fill, conforming with I-10 gradation, shall be placed in 12-inch, loose layers and compacted with a minimum of six passes of an approved pneumatic-tired roller.
5. In areas where a 14-inch layer over existing material is not adequate to support the construction equipment, increase thickness of first lift as approved by the Authority.
6. In areas adjacent to structures and utilities as shown on Basic Contract Drawings, compaction equipment shall be restricted and as directed by the Authority.
7. In areas where use of a roller is impractical, place fill in maximum 8-inch, loose layers and compact with approved mechanical tampers to specified density.
8. Compact backfill as specified in 3.03 D.6 above for fill. In pipe trenches, each layer of backfill shall be not more than eight inches in thickness before compaction. Backfill shall be placed on both sides of the pipe, simultaneously.
9. The surface of filled or backfilled areas, which are to receive pavement or on which a structure is to be placed, shall be within plus or minus 1/2 inch of the elevations shown on the Basic Contract Drawings and shall be free of depressions or projections greater than 1/2 inch when tested with a 16-foot straight edge.
10. The surface of filled areas at other locations shall be within plus or minus one inch of elevations shown on the Basic Contract Drawings unless a closer tolerance is necessary to meet requirements of other Sections of the Specifications or the Basic Contract Drawings.

3.04 FIELD TESTS

A. Inspection and Testing

1. The Authority will perform Quality Assurance testing on delivered field samples of material submitted from each source, for conformance with 2.01. Gradation and maximum density will be determined in accordance with ASTM D 422 and Procedure C of ASTM D 1557, respectively. If deemed appropriate by the Authority, Atterberg Limits will be determined on fine-grained soils in accordance with ASTM D 4318.
2. If the sample from a source is approved and if the Authority requests, conduct the Authority's representative to that source. Additional samples will be selected and tested.
3. The Authority will notify the Contractor of approval of material source within seven days after receiving samples. Approval of a source of backfill or fill material shall be subject to material continuing to meet the requirements of 2.01.

4. When performing Quality Assurance testing, the Authority will determine the density of compacted fill or backfill by in-place density tests or from undisturbed samples cut from the compacted fill or backfill as required. Notify the Authority 24 hours prior to start of filling or backfilling to allow the Authority time to make provisions for such testing.
5. To evaluate whether material has been compacted to specified density the Authority will compare results of in-place density tests with results of control tests on material of the same designation using Procedure C of ASTM D 1557.
6. If fill or backfill have not been sufficiently compacted as determined by in-place density tests, the compaction effort shall be continued and moisture content shall be adjusted as necessary until the specified compaction is obtained.
7. The Authority will check conformance to elevations shown on the Basic Contract Drawings and required tolerance for surface straightness.
8. Provide labor and equipment to take samples as directed and to assist the Authority in other tests.

B. Testing Requirements for Fill and Backfill

1. Control Tests

   Fill and backfill material field samples will be tested in the laboratory by the Authority as part of the Quality Assurance program. These control tests consist of determining maximum density and optimum water content by Procedure C of ASTM D 1557, and gradation by ASTM D 422. When deemed appropriate by the Authority, Atterberg Limits will be determined on fine-grained soils.

2. In-Place Density Tests

   Quality Control consisting of in-place density testing, as a minimum, shall be performed by the Contractor to determine densities achieved after compaction efforts. An in-place Quality Control plan shall be submitted to the Authority for review and approval. This plan should address, as a minimum, items such as in-place test type and frequencies for different materials; equipment type, calibration and maintenance; operator identity and qualifications, etc.

   Quality Assurance testing will be performed by the Authority after compaction operations, at the standard frequencies already established by Port Authority testing bulletins. Test methods may either sand-cone (ASTM D 1556), rubber balloon (ASTM D 2167), or nuclear device (ASTM D 2922), with moisture content for nuclear method determined by ASTM D 3017. Tests will measure the density of the layer immediately below each compacted layer and the density of the uppermost or final layer.

C. Proofrolling in Pavement areas or under footings

1. After excavation has been performed to the elevation of pavement subgrade, proofroll the area shown on the Basic Contract Drawings with two passes of a pneumatic-tired roller in the presence of the Authority.
2. If, in the sole determination of the Authority, the proofrolling produces noticeable weaving of the surface, excavation of unsuitable material may be required below pavement subgrade, within the limits and to the depth ordered by the Authority.
3. In no case will the depth of such removal of unsuitable material exceed three feet below the pavement subgrade.

4. Remove all such unsuitable material and replace it with suitable backfill material in accordance with the requirements of 2.01 B.

5. The Contractor will be reimbursed for any ordered excavation of unsuitable material below the elevation of pavement subgrade or under footings and subsequent backfilling (but not for the proofrolling specified in 3.04 C.1) at the "Net Cost" for such Work. "Net Cost" shall be computed in the same manner as is compensation for Extra Work, including any percentage addition to cost, as set forth in the clause of the Contract providing compensation for Extra Work. Performance of such Net Cost Work shall be subject to all provisions of the Contract relating to performance of Extra Work. Compensation for said Net Cost Work shall not be charged against the total amount of compensation authorized for Extra Work.

END OF SECTION

SECTION 02221

EXCAVATION, BACKFILLING AND FILLING

APPENDIX "A"

SUBMITTALS

A. Submit to the Manager, Materials Engineering Division, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, N.J. 07310-1397, proposed material suppliers and sources for each designation of fill or backfill to be used under this contract. The submittal document must contain, as minimum information, the Contract location, title and number; designation of intended material use; source and supplier of material being submitted. Sample submittal paperwork must be received by the Manager of Materials at least three weeks prior to delivery of material to site. Do not delivery any material until the Authority has checked and approved material supplier and source. Delivered material must receive on-site approval as per Section 3.04, Paragraph A, prior to use.

B. The Contractor shall be responsible for Quality Control procedures. Before the actual start of earth work, the Contractor must submit a Quality Control Plan for review and approval by the Authority.

C. Where sheet piling or sheeting is required as shown on the Basic Contract Drawings, submit detailed Shop Drawings and design calculations of the sheeting and bracing system to the Authority for review in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS. Submit such drawings and calculations three weeks prior to commencement of such excavation. Shop Drawings and calculations shall be prepared by a Professional Engineer, licensed in the State in which the work will be performed, who has a minimum of five years experience in the design of soil retaining structures. The Shop Drawings shall be sealed and signed by the Professional Engineer.

END OF APPENDIX A

DIVISION 2

SECTION 02231

AGGREGATE BASE COURSE

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for dense graded aggregate base course (DGABC) and open graded aggregate base course (OGABC) each where shown on the Basic Contract Drawings including the use of recycled concrete aggregate (RCA) as an alternate for virgin aggregate.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM C 88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Test Method for Material Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregate by Washing
ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1556	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN m/m^3))
ASTM D 1883	Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2167	Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2434	Test Method for Permeability of Granular Soils (Constant Head)
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3665	Practice for Random Sampling of Construction Materials
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. Aggregate Base Course shall not be placed or spread unless subgrade is free of frost and standing water.

2. Do not place aggregate base course, or perform any compaction operations when ground water level is above a plane two feet below the bottom of the base course. This condition would be indicated by existing water level readings, known site conditions or by the results of probes performed by the Contractor before material placement.

3. When necessary, lower and maintain ground water below the required plane by methods approved by the Engineer.

B. Design and Tolerance

1. The compacted base course, shall have a minimum California Bearing Ratio (CBR) of 80 as determined by ASTM D 1883. In the case of open graded aggregate base course the permeability, as tested in accordance with ASTM D 2434, shall be a minimum of 1.0×10^{-3} centimeters per second.

2. Surface of the base course shall be within plus or minus 1/2 inch of elevations shown on the Basic Contract Drawings and free of depressions or projections greater than 3/8 inch when tested with a 16-foot straight edge applied parallel with or at right angles to the centerline.

3. Thickness of base course at any point shall not be deficient by more than 1/2 inch from the required thickness shown on the Basic Contract Drawings.

4. The field density of the base course after compaction shall be at least 95 percent (100 percent for runways, taxiways and aprons) of the maximum density as determined by Procedure "C" of ASTM D 1557, with the exception that base course material passing the 1-1/2-inch sieve shall be used instead of the material passing the 3/4-inch sieve specified.

1.04 QUALITY CONTROL AND ASSURANCE

A. Provide and maintain quality control plans and procedures that shall ensure all base course materials and completed construction conform to this Section. The Engineer shall be afforded access to the Contractor's plant, equipment and field operations at all times for checking compliance with the approved quality control procedures. Provide labor and equipment to take samples as directed and assist the Engineer in other tests. Repair all areas from which samples are taken to meet all requirements of this Section.

B. The quality control plan shall include as a minimum:

1. Assignment of quality control responsibility to specifically-named individuals.

2. Outline of sampling location procedures and in-place density testing methodologies.

3. Performance of regularly scheduled inspections of the material source in the case of RCA.

4. Provisions for the prompt implementation of control and corrective measures.

5. Provisions for liaison with the Engineer at all times

6. Performance of necessary quality control tests, including use of a nuclear gauge.

C. For RCA, Quality Control procedures shall include performing the following tests on dedicated stockpiles being produced for use under this Contract:

1. Gradation tests (ASTM C 117 and C 136) shall be performed at least once per day.

2. Composition tests shall be a continuous visual inspection and shall include removal of any objectionable material to ensure compliance with 2.01B.

3. Soundness of Aggregates (ASTM C 88) and Resistance to Degradation (ASTM C 131) shall be performed a minimum of once every two weeks, unless otherwise directed by the Engineer.

D. For Contracts requiring over 500 cubic yards of aggregate base course, and where otherwise directed by the Engineer, select an area from the first day's production to be called a control strip. The control strip shall be a minimum of 2500 square feet and shall be constructed to meet the requirements of this section and in the same manner as the remainder of the course it represents. The purpose of the control strip is to have the contractor establish the compaction pattern, methods and effort required to achieve the quality requirements and to calibrate the Contractor's nuclear gage. Additional control strips shall be constructed whenever a significant change occurs in the type or source of the material and whenever a significant change occurs in the composition of the material from the same source.

E. Engineer's Sampling and Testing

1. The Engineer may elect to inspect, test, and approve aggregate base course at the source. At least five days prior to delivery of material to site, the Engineer shall be notified.

2. Base course material delivered to the construction site will be sampled and tested by the Engineer for conformance to the requirements specified in 2.01 A copy of the test analyses will be on file with the Engineer. The samples will be taken from stockpiles on site, prior to material placement operations. Minimum testing frequencies will be as follows:

<u>Aggregate Base Course Using Virgin Aggregate</u>

Gradation	1 test per Lot
Moisture-Density	
Proctor Test	1 test per Lot

A Lot shall be defined as one day's production but no more than 400 cubic yards.

<u>Aggregate Base Course Using Recycled Concrete Aggregate</u>

Gradation	4 tests per Lot (one test from each sublot)
Moisture-Density	
Proctor Test	4 tests per Lot
Composition	4 tests per Lot

3. The Engineer will check base course thickness at least once every 2500 sq. ft.

4. The Engineer will determine field density of compacted base course from in-place density tests. Frequency of testing will be at least one test every 2500 square feet per lift. Locations of random sampling shall be determined in accordance with ASTM D 3665. The in-place field density shall be determined in accordance with ASTM D 2922 and ASTM D 3017, or ASTM D 2167, or ASTM D 1556.

5. The Engineer will check conformance to elevations required by the Basic Contract Drawings and required tolerance for surface straightness.

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Virgin aggregate for base course shall be quarry processed, crushed dolomite, limestone, gneiss, or trap rock free from coatings of clay, silt, vegetable matter, and other objectionable materials, and shall contain no clay balls.

B. Recycled concrete aggregate for base course shall be as follows:

1. The RCA shall consist of at least 90 percent, by weight, Portland cement concrete, with the following materials making up the remaining 10 percent:

   Wood-0.1%, maximum
   Brick, Mica schist, or other friable material-4%, maximum
   Asphalt Concrete-10%, maximum

2. Virgin aggregate may be added to meet the 90% minimum concrete requirement.

3. The percentage of asphalt concrete and other deleterious material shall be determined by weighing that material retained on the No. 4 sieve, and dividing by the total weight of RCA material retained on the No. 4 sieve.

C. Gradation for aggregate base course shall be as follows:

1.

	Percentage Passing By Weight	
Sieve Size	DGABC	OGABC
1 1/2"	100	100
3/4"	55-90	60-95
3/8"		40-80

No.4	25-60	15-35
No. 50	5-25	8-20
No. 200	3-12	0-7

2. The portion passing the No. 40 sieve shall be non-plastic when tested in accordance with ASTM D 4318.

3. The aggregate base course shall have not less than 90% by weight with at least two fractured faces and 100% with at least one fractured face, and with a maximum of 7% of flat or elongated pieces. A flat piece is one having a ratio of length to width greater than five.

D. Soundness of Aggregates:

Loss limitation shall not be more than 10% loss by weight, using sodium sulfate for 5-cycle test period, or not more than 15% loss by weight, using magnesium sulfate for a 5-cycle test period as determined by ASTM C 88.

E. Resistance to Degradation:

Percentage loss between the original weight and the final weight of the test sample, shall not exceed 45% as determined by ASTM C 131.

F. Recycled Concrete Aggregate Stockpile Approval:

RCA will be sampled from lots as specified in 1.04 E.2. Each sublot of each lot shall meet all applicable test requirements of this Section. If any one sublot does not meet these requirements, the entire lot will be disapproved and shall not be used for the purposes of this Contract.

The Engineer will approve or disapprove the RCA within 4 days after sampling, unless the Engineer determines that soundness of aggregate or resistance to degradation tests specified in this Section 2.01 are required, in which case 21 days will be required for approval or disapproval. Do not deliver RCA until it has been approved by the Engineer.

After a lot has been approved, no additional material shall be added to the lot stockpile until that stockpile is exhausted. Any new stockpile formed shall be subject to testing and acceptance as described above.

PART 3. EXECUTION

3.01 INSTALLATION

A. Equipment

1. Placing and spreading equipment shall be approved by the Engineer and be capable of spreading material without segregation of aggregate sizes.

2. Steel vibratory rollers to be used for compaction, shall have provision for regulation of vibration frequency. Pneumatic rubber-tired rollers shall have a minimum weight of 20 tons and tire pressure of between 60 and 150 psi, as directed by the Engineer. All compaction equipment, including mechanical tampers when proposed, is subject to review an approval by Engineer.

B. Preparation of Subgrade

1. Verify that job conditions specified in 1.03 A have been met and there are no high points in the subgrade which would interfere with meeting the tolerance requirements specified in 1.03 B.

2. For granular subgrades, compact subgrade with a minimum of 6 passes of an approved vibratory steel roller, operating at the optimum operating frequency as recommended by the manufacturer.

3. For fine-grained soil subgrades, compact subgrade with a minimum of 6 passes of an approved pneumatic rubber-tired roller.

4. Rollers shall be operated at a speed not to exceed 3 miles per hour. Roller passes shall be overlapped a minimum of 6 inches.

5. All subgrade compaction operations shall be performed at or near optimum moisture content. In areas where use of a roller is impractical, compact subgrade with approved mechanical tampers.

6. Provide grade control as follows:

   a. Set grade stakes on a rectangular grid not more than 25 feet on centers.

   b. After firmly driving stakes, offset mark each 6 inches above the top of base course.

   c. Maintain stakes during placement and compaction of base course.

C. Placement and Compaction

1. Place base course materials evenly over the prepared subgrade with approved spreading equipment. In multi-layer construction, the previously constructed layer should be cleaned of loose of foreign material prior to placing the next layer. The surface of the compacted material shall be kept moist until covered by the next layer.

2. When spread, base course materials shall be at or near optimum moisture content and of a thickness such that the maximum depth of a compacted layer shall be 6 inches. In multi-layer construction, the base course shall be placed in approximately equal-depth layers.

3. Compact immediately after spreading, while at or near optimum moisture content, by rolling. The number, type and weight of rollers shall be sufficient to compact the material to the required density.

4. In areas where use of rollers is impractical, compact with manually operated equipment while at or near optimum moisture content.

5. The base course shall be maintained in a condition that will meet all specification requirements until the Work is accepted. Equipment used in the construction of an adjoining section may be routed over completed portions of the base course, provided no damage results and provided that the equipment is routed over the full width of the base course to avoid rutting or uneven compaction.

6. If, in the opinion of the Engineer, the compacted base course softened due to exposure to the elements, drain off all freestanding water and recompact the base course until density requirements are met.

D. Adjustment of Deficiencies

1. Scrape, add or remove material or replace deficient material, and recompact to meet specified density, grade or smoothness criteria.

2. In no case will the addition of thin layers of material be added to the top layer of base course to meet grade. If the elevation of the top layer is 1/2 inch or more below grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material added, and the layer shall be cut back to grade and rerolled.

END OF SECTION

SECTION 02231

AGGREGATE BASE COURSE

APPENDIX "A"

SUBMITTALS

A. Submit to the Engineer of Materials, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397, all of the following:

1. The proposed source of material. Material must come from a source approved by either NYDOT or NJDOT. The Engineer will approve or disapprove within 10 working days after receipt of submittal. Do not deliver material until the Engineer has approved of the source.

2. In the case of RCA, the name of the intended supplier and certified test data demonstrating the supplier's compliance with the material requirements of 2.01, at least 21 days prior to delivery of any RCA to the construction site. The Engineer will approve or disapprove within 10 working days after receipt of submittal. Do not deliver material until the Engineer has approved of the source.

3. In the case of RCA, an actual material submittal from the proposed source may be required as the result of a new, unfamiliar or unsatisfactory supplier submittal. Two 75 pound representative samples from a dedicated stockpile proposed for use under this contract must then be supplied as follows:

   a. Submit RCA samples in clean, sturdy containers or bags that shall not permit loss of any of the material.

   b. Clearly label samples with the Contract location, title, and number; identification of the material supplied; and the location of the source.

   The Engineer will approve or disapprove within 21 days after receipt of sample. When an actual sample is required, do not deliver material to the site until Engineer has approved of the sample.

B. If the source and/or the supplier of the aggregate base course material changes, resubmittals for approval must be made in accordance with 1.05, above.

C. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one package per Section or trade, and sent to the Engineer of review.

DIVISION 2

SECTION 02272

SOIL EROSION AND SEDIMENT CONTROL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the construction and maintenance of various, temporary soil erosion and sediment control measures, including relocation as required for staged construction.

1.02 REFERENCES

American Society for Testing and Materials (ASTM) ASTM C 33 Specification for Concrete Aggregates

1.03 REQUIREMENTS

A. Environmental Requirements

1. Apply dust retardants other than water only when wind velocity is less than 5 mph and drift hazard is negligible.
2. Conform to "Seeding Calendar Limitations" of the Section entitled "SEEDING".
3. Use Dust Retardant or other approved methods for temporary surface stabilization of short duration where establishing grass by seeding is not practical.

B. Construction Requirements

1. The Contractor shall employ soil erosion and sedimentation control measures during the duration of the contract to control erosion and minimize the sedimentation of water courses on the construction site.
2. The Basic Contract Drawing do not include borrow pits or storage areas that the Contractor utilizes or establishes outside of the site in order to perform the Work. If the land disturbance for this Work is five thousand square feet (5,000 SF) or greater, the Contractor shall provide the Engineer with documentation that a soil erosion and sediment control plan has been approved for this Work by the appropriate Soil Conservation District of the New Jersey Department of Environmental Protection.
3. The Contractor shall incorporate all permanent pollution control features into the project at the earliest practicable time. Temporary soil erosion and sediment control measures shall be coordinated with the permanent pollution control features and with the construction of pavement, drainage facilities such as pipes, culverts, headwalls, channels, ditches, etc., to the maximum extent practical to assure economical, effective and continuous erosion control throughout the duration of the Contract, as outlined in the approved progress schedule.

4. Prior to all grubbing operations, soil erosion and sediment control measures shall be installed. When unstabilized areas caused by site development, grading, or other earth disturbing activities exist beyond 14 calendar days, the areas disturbed shall be seeded and mulched. These requirements pertain to perimeter controls, berms, dams, swales, ditches and slopes. Upon completion of the grading or construction, disturbed areas shall be permanently stabilized in accordance with the Basic Contract Drawing within 7 calendar days.

5. When excavation or embankment construction reaches the finished subgrade, those areas on which paving is to be placed are exempt from the above stabilization requirements. Roadways and haul roads actively being used for daily conveyance of equipment as well as areas between temporary berms, except median areas, are also exempt unless otherwise shown on the Basic Contract Drawing.

6. Streams shall be protected from soil erosion and sediment. Streams being diverted shall be protected through the use of silt fences. Temporary diversion channels shall be lined with geotextile and temporary riprap.

7. The turbid discharge from dewatering construction activities shall be contained in a dewatering basin in order to control sediment and provide filtration of water prior to it being released into adjacent streams or other watercourses.

8. Soil being stockpiled shall be placed in well-drained areas no closer than 50 feet from streams, wetlands, floodplains and other watercourses, unless otherwise directed by the Engineer. The stockpiles shall be seeded and mulched in accordance with the Basic Contract Drawing. Temporary soil erosion and sediment controls shall be provided around the stockpiles until such time as vegetation is established on the piles.

9. Temporary soil erosion and sediment control measures shall be used to correct conditions that develop during construction.

10. In the event that temporary soil erosion and sediment control measures are required due to the Contractor's failure, for any reason, to install or maintain soil erosion and sediment controls, either as part of the work or as directed by the Engineer, such Work shall be performed by the Contractor at no additional cost to the Authority.

11. If the Contractor is not in compliance with soil erosion and sediment control provisions, corrective actions shall be taken immediately. The Engineer may suspend the Work, wholly or in part, until such time as the Contractor is fully in compliance. All corrective and remedial work required to bring the Contractor into compliance shall be performed at no additional cost to the Authority.

12. Temporary soil erosion and sediment control measures shall be removed when necessary to allow for the installation of permanent control features or as permanent controls become functional. Before issuance of a Certificate of Final Completion, all items used for temporary soil erosion and sediment control shall be removed unless otherwise shown on the Basic Contract Drawing.

1.04 QUALITY ASSURANCE

A. Progress Schedule

1. The Contractor shall prepare a progress schedule for the Engineer's approval in accordance with Division 1 of the Specifications.

2. The progress schedule shall clearly outline the intended maintenance of traffic, the locations where temporary and permanent soil erosion and sediment control measures shall be installed, and such other information as required. The progress schedule shall give special consideration to sensitive areas such as wetlands, waterways, etc. Appropriate staging and seasonal constraints shall be used to maximize the effectiveness of the soil erosion and sediment controls. The progress schedule shall also indicate when Work is restricted in these sensitive areas as outlined in permits issued by regulatory agencies.

B. Soil Erosion and Sediment Control Manager

1. The Contractor shall assign to the project a supervisory-level employee to serve in the capacity of Soil Erosion and Sediment Control Manager. This employee shall be thoroughly experienced in all aspects of soil erosion and sediment control and construction. The Contractor shall submit the name and experience of this employee to the Engineer for approval at least 10 working days prior to commencing any Work on the project. Replacement of the Soil Erosion and Sediment Control Manager during the Contract shall be made only after approval of a written request for such replacement.

2. The Soil Erosion and Sediment Control Manager shall implement approved soil erosion and sediment control schedules and methods of operations. He shall coordinate his operations with the Engineer and shall oversee and supervise all aspects of soil erosion and sediment control work for the project.

   He will attend all soil erosion and sediment control meetings during the Contract.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

1.06 DELIVERY, HANDLING AND STORAGE

Protect materials against damage prior to installation.

1.07 SPARE MATERIALS

During construction, the Contractor shall have on hand sufficient spare materials and appurtenances as are necessary to repair damage to permanent and temporary installations.

PART 2. PRODUCTS

2.01 MATERIALS

A. Geotextiles shall conform to the Section entitled "Geotextiles". Unless otherwise shown on the Basic Contract Drawing, geotextiles shall have a maximum Apparent Opening Size of 0.6 mm. and minimum permeability of 1×10^{-3} cm/sec.

1. Silt Fences and Inlet Filter Sediment Control shall be "Self Supported".

2. Geotextiles for other Soil Erosion and Sedimentation Control items shall be "Erosion Control - Class A".

B. Wood stakes, posts and boards shall be solid, reasonably knot-free lumber conforming to the nominal size specified on the Basic Contract Drawing.

C. Hay bales shall consist of timothy , red top or native grasses securely bound with wire or baling twine. The twine shall be an ultra-violet light stabilized polypropylene which has a knot strength of 170 pounds and straight break strength of 300 pounds.

D. Rip rap shall be broken stone (argillite, calcite, dolomite, gneiss, granite, quartzite, traprock). Unless otherwise shown on the Basic Contract Drawing, riprap shall have a designated median stone (D50) size in the range of 6 to 9 inches maximum dimension, weighing not more than 150 pounds, with at least 90% weighing more than 25 pounds but not more than 40% exceeding 100 pounds, having the following characteristics:

Characteristic	Max. %
Weathered decomposed stone	5
Other than that classification approved	5
Absorption in cold water	1.8
Sodium sulfate soundness, loss by weight	10

E. Coarse aggregate shall be broken stone or washed crushed gravel meeting the specification for rip rap except for size and weight requirements. Size and gradation shall be as shown on the Basic Contract Drawing.

F. Welded wire fabric shall conform to AASHTO M55 flat sheets or rolls.

G. Pipe for temporary slope drains shall be minimum 8-inch diameter of type shown on the Basic Contract Drawing.

H. Seed and mulch shall be as specified in the Section entitled "SEEDING".

I. Topsoil Stabilization Matting.

Topsoil stabilization matting shall be one of the following:

1. Excelsior mat shall be wood excelsior, 48 $\pm$ 1 inch in width and weighing 0.8 pounds per square yard, $\pm$ 5 percent. The excelsior material shall be covered with a netting to facilitate handling and to increase strength and shall be biodegradable.

2. Jute mat shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 $\pm$ 1 inch width and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of $\pm$ 5 percent, with approximately seventy-eight warp ends per width of cloth and forty-one weft ends per linear yard of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one half its normal diameter.

J. Dust Retardant

1. "Coherex" as manufactured by Golden Bear Division of the Witco Corporation, Chandler, AZ 85244.

2. "Soil-Sement" as manufactured by Midwest Industrial Supply, Inc., Canton, OH 44711.

3. "Soil Seal Concentrate" as manufactured by Soil Seal Corporation, Los Angeles, CA 90017.

4. Or approved equal.

K. Calcium Chloride shall be Grade 2, in the form of loose dry granules or flakes, and shall be fine enough to feed through commonly used spreaders at the specified rates.

2.02 CONSTRUCTION FEATURES

A. Silt Fence

1. Silt fence shall consist of geotextile whose width shall be at least 3 feet to provide for a 2-foot high fence after 1 foot of fabric is buried in the existing soil. Heavy-duty silt fence shall consist of geotextile whose width shall be at least 4 feet to provide for a 3 foot high fence after 1 foot of fabric is buried in the existing soil. Sections of fabric shall be joined in such a manner that, when in operation, the sections work effectively as a continuous fence. Fence posts shall be installed at a slight angle toward the anticipated runoff source.

2. Heavy-duty silt fence shall include a welded wire mesh backing for the geotextile. This welded steel wire mesh shall be galvanized and contain 4 inch square openings. The geotextile shall be secured to the welded wire mesh.

B. Haybale Check Dams with Temporary Stone Outlets

1. Haybales shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale. The temporary stone outlets, consisting of riprap stones conforming to the requirements for temporary riprap, shall be placed in the center of each flow line. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of each stone outlet.

2. The riprap stones and coarse aggregate shall be placed on geotextile, and shall be embedded into the ground. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

C. Temporary Stone Check Dams

1. Temporary stone check dams shall be constructed in ditches to reduce flow velocity.

2. The check dams shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of each check dam.

3. The riprap stones and coarse aggregate shall be placed on geotextile and shall be embedded in the ground. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

D. Temporary Slope Drains

1. Temporary slope drains shall be installed on embankment slopes to intercept surface runoff where concentrated runoff will cause excessive erosion of the slope.

2. The drain pipe shall be staked to the slope or secured with riprap stones to prevent movement or displacement. A flared end section shall be attached at each end of the pipe and elbows shall be installed as required to conform with the existing changes in slopes.

3. A temporary earth berm and haybales shall be constructed at the top of slope in the vicinity of the slope drain to intercept runoff and channel the runoff to the slope drain. The haybales shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale.

4. Riprap stones, conforming to the requirements for temporary riprap, shall be placed loosely at both ends of the pipe to prevent scour. The riprap stones shall be placed on geotextile which, at the top of slope, shall be draped over the earth berm. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

E. Inlet Filters

1. For existing inlet structures, geotextile shall be placed under the grates, over the curb pieces and extend a minimum of 6 inches beyond. Coarse aggregate, size No. 8, shall be placed behind each curb piece and on the geotextile to secure the in place.

2. Openings required in new inlet walls to provide for temporary drainage shall be covered with welded wire mesh, geotextile and coarse aggregate, size No. 8.

3. Inlet filters, consisting of welded steel wire mesh and geotextile shall be installed to control sedimentation at new inlet drainage structures. Inlet filters of geotextile alone shall be installed to control sedimentation at existing inlet drainage structures.

4. For new inlet structures, welded steel wire mesh shall be molded around the inlet frames and grates, or inlet structures, and extend a minimum of 6 inches down each side of the new structures. Geotextile shall then be secured to the welded wire mesh. Coarse aggregate, size No. 8, shall be placed against the inlet structures to hold the inlet filter in place.

5. Inlet filters shall be removed before scheduled paving operations begin.

F. Inlet Protection (Haybale Barrier)

1. Inlet protection (haybale barrier) shall consist of haybales that completely encircle inlet drainage structures. The perimeter length of the haybale barrier shall be at least four times the perimeter length of the inlet structure. Haybales shall not encroach into the traveled way.

2. Haybales placed around inlet structures within earthen areas shall be embedded 4 inches into the ground and anchored in place with 2 wood stakes per bale. Haybales placed around inlet structures within pavement areas shall be placed on top of the pavement, tied together to prevent movement and shall not be anchored in place.

G. Inlet Sediment Traps

1. Inlet sediment traps, consisting of silt fence and temporary stone inlets, shall be constructed to control sedimentation at existing and proposed inlet drainage structures.

2. The silt fence shall consist of geotextile whose width shall be at least 3 feet to provide for a 2-foot high fence after 1 foot of geotextile is buried in the existing soil. Sections of geotextile shall be joined in such a manner that, when in operation, the sections work effectively as a continuous fence. The silt fence shall be installed around the drainage structure and into the stone inlets. Fence posts shall be installed at a slight angle toward the anticipated flow.

3. The temporary stone inlets, consisting of coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed in each flow line upgrade of the inlet structure. The coarse aggregate shall be placed on geotextile that shall be buried in the soil. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

H. Floating Turbidity Barriers

1. Floating turbidity barriers, consisting of 10-mil. thick polyethylene plastic sheets suspended from floats, shall be installed in streams or other watercourses to intercept silt coming from drainage pipes or that caused by construction operations within waterways.

2. Barriers shall be located 50 feet from the point of discharge of drainage pipes or from the area of construction operations affecting waterways. The barriers shall extend across the entire waterway or radially from the shoreline.

I. Temporary Stone Outlet Sediment Traps

1. Temporary, stone outlet sediment traps, consisting of temporary basins and riprap spillways, shall be constructed within existing, proposed and temporary ditches.

2. The spillways shall consist of riprap stones conforming to the requirements for temporary riprap. Coarse aggregate, conforming to ASTM C-33 size No. 2, shall be placed immediately upgrade of the spillways.

3. The riprap stones and coarse aggregate shall be placed on geotextile that shall be buried in the soil. When sections of geotextile need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

J. Dewatering Basin

1. Dewatering basins shall be constructed within the Site and outside any undisturbed wetland area, and areas not affected by roadway construction, as a dewatering containment measure in order to control sediment and provide filtration of water.

2. The dewatering basins shall be sized by the Contractor to entirely contain the expected discharge of water and sediment based on the flow rate of the pump to be used and the volume of water present within the area to be dewatered. The material to be used to form the basin is at the discretion of the Contractor. The outfall of the basin shall be such that the water exiting the basin does not cause erosion to, or scouring of, the area onto which the water is being discharged.

PART 3. EXECUTION

3.01 PREPARATION

A. Clearing and grubbing operations shall be so scheduled and performed that grading, mulching, seeding and other permanent pollution control features can follow immediately thereafter according to the approved progress schedule. Should seasonal limitations make such coordination unattainable, additional temporary soil erosion and sediment control measures shall be performed between successive construction stages, as directed.

B. The amount of surface area of erodable earth material exposed at one time by clearing and grubbing, excavation, borrow or fill operations, without stabilization, shall not exceed 750,000 square feet for clearing and grubbing operations, or 750,000 square feet for grading operations without prior approval. The Engineer may increase or decrease these amounts commensurate with the Contractor's ability to keep the construction on the approved progress schedule.

C. Obtain the Engineer's approval before starting any operations that would require seeding for stabilization when seeding is restricted by the calendar limitations of the Section entitled "SEEDING". Approval will be based on the Contractor's alternate method for stabilizing disturbed areas when seeding is not reasonable due to seasonal constraints. The alternate method shall be approved by the Engineer before implementation and may include use of the Dust Retardant or other methods.

3.02 INSTALLATION

A. Embankment Areas

1. Side ditches shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, before beginning all earth work. Stabilization for the ditches and swales shall consist of seed, mulch, topsoil stabilization matting or temporary riprap, as required to prevent erosion.

2. Embankment greater than 25 feet in height shall be stabilized in stages of equal increments not to exceed 15 feet. Each stage shall be either temporarily seeded and mulched, or permanently stabilized, before proceeding with the next stage. At the completion of the final stage of embankment placement, the entire slope, if not previously done, shall be permanently stabilized.

3. At the end of each workday, temporary stabilized earth berms and slope drains shall be constructed along the top edges of the embankment to intercept surface runoff.

B. Excavation Areas

1. Ditches to be used in a cut section, and side and outlet ditches, shall be excavated and stabilized, and perimeter soil erosion and sediment controls installed, before beginning all earthwork. Stabilization for the ditches shall consist of seed, mulch, topsoil stabilization matting or temporary riprap, as required to prevent erosion.

2. Slopes greater than 25 feet in height shall be excavated and stabilized in stages of equal increments not to exceed 15 feet. Each stage shall be permanently stabilized before proceeding with the next stage, in accordance with the time limitations specified herein.

C. Dust Control

1. Employ construction methods and means that keep flying dust to a minimum. Provide for the laying of water or other dust control materials on the project and on roads, streets and other areas immediately adjacent to the project limits, and wherever traffic or buildings that are occupied or in use are affected by such dust caused by his hauling or other construction operations. The materials and methods used for dust control shall be as specified herein or as directed by the Engineer.

2. Apply Dust Retardant in accordance with the manufacturer's written instructions. Reapply as often as required. Calcium chloride shall not be used in any areas to be seeded or landscaped.

3. Calcium chloride may only be used on pavement subgrades subject to the approval of the Engineer. Care shall be exercised when using calcium chloride on steep slopes to prevent the calcium chloride from washing into streams or accumulating around plants or in landscape areas. Calcium chloride shall not be applied in solution. Apply calcium chloride at a rate of approximately 1.5 pounds per square yard.

D. Dirt Control

1. The Contractor shall provide for prompt removal from existing roadways of all dirt and other materials that have been spilled, washed, tracked or otherwise deposited thereon by his hauling and other operations, whenever the accumulation is sufficient to cause the formation of mud, interfere with drainage, damage pavements or create a traffic hazard.

2. In order to minimize tracking of dirt and other materials onto existing roadways, a stabilized construction driveway shall be constructed at locations where vehicles exit a work site. The construction driveway shall consist of a layer of broken stone, which shall be a minimum 4 inches thick and 100 feet long where practical, and of sufficient width to serve the intended purpose. The broken stone shall be 2 1/2 - inch nominal size conforming to ASTM C-33 size No. 2. The driveway shall be maintained by top dressing with additional stone, as directed, and shall be removed when no longer required.

E. Seeding

Temporary and permanent seeding shall be in accordance with the Section entitled "SEEDING".

3.03 SOIL EROSION AND SEDIMENT CONTROL MAINTENANCE

A. Soil erosion and sediment control measures shall be maintained during the Contract even when the Work is suspended. Controls shall be inspected immediately after each rain, and any required corrective work shall immediately be performed. Riprap stones, coarse aggregate, silt fence, or haybales damaged due to washouts or siltation shall be replaced.

B. Sediment traps and basins shall be cleaned out when they are 50 percent filled. Silt fences, stone outlet structures, dams, and haybales shall have sediment removed when the sediment reaches 50 percent of the height of the soil erosion and sediment control measure. Sediment removed shall be disposed of in accordance with the Basic Contract Drawing.

END OF SECTION

SECTION 02272

SOIL EROSION AND SEDIMENT CONTROL

SUBMITTALS

APPENDIX "A"

A. Submit catalog cuts for the following:

1. Geotextiles
2. Pipe for Slope Drains
3. Topsoil Stabilization Matting
4. Dust Retardant

B. Submit certificate from geotextile manufacturers that geotextiles comply with the requirements specified in this Section.

C. Submit design computations for sizing of Dewatering Basins prepared by a Professional Engineer, licensed in the State in which the Work will be performed.

D. Submit to the Manager, Materials Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07302-1397, certified test data the following:

1. Riprap
2. Coarse Aggregates

E. Submit a Progress Schedule reflecting the requirements of Section 1.04 A.

F. Submit name and applicable experience of Soil Erosion and Sediment Control Manager in accordance with Section 1.04 B.

G. Submit alternate methods for stabilizing disturbed areas when seeding calendar limitations apply.

H. Submit documentation of approval of soil erosion and sediment control plan for offsite land disturbance greater than 5000 square feet.

END OF APPENDIX "A"

DIVISION 2

SECTION 02274

GEOTEXTILES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for geotextiles (fabrics) made of polymers for the following applications:

1. Subsurface Drainage
2. Sediment Control
3. Erosion Control
4. Separation of Dissimilar Materials (including subgrade stabilization)

B. This Section does not specify requirements for geotextiles for the following application:

1. Reinforcement within pavement structures and paving membranes
2. Reinforcement for embankment structures
3. Polymeric liners (geomembranes)

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M288 Standard Specification for Geotextiles

American Society of Testing and Materials (ASTM)

ASTM D 4354 Standard Practice of Sampling of Geosynthetics for Testing

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Unless otherwise shown on the Basic Contract Drawings or Specified herein, the geotextiles shall conform to the applicable requirements of AASHTO M288.

1.04 QUALITY ASSURANCE

A. Geotextile materials will be visually inspected by the Engineer when delivered to the construction site. Damaged materials or materials not meeting the requirements of this Section shall be removed from the construction site and replaced.

B. Engineer's Sampling and Testing

1. The Contractor shall furnish labor, equipment and materials to take samples, and to repair all areas where samples are taken.

2. Quality Assurance (QA) testing of the physical requirements of the geotextile fabric will be performed by the Engineer using random samples obtained from materials delivered to the job site.

3. The Engineer will perform field seam tests on random samples obtained in the field.

4. Unless otherwise shown on the Basic Contract Drawings, the Engineer will determine the lot sizes for testing based on ASTM D 4354 and the type and number (minimum three) of tests per lot.

1.05 DELIVERY, HANDLING AND STORAGE

Comply with AASHTO M288 to protect materials against moisture and ultraviolet exposure prior to installation.

1.06 SPARE MATERIALS

During construction, the Contractor shall have on hand sufficient spare geotextile materials and appurtenances as necessary to repair damage to permanent and temporary geotextile installations.

1.07 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.08 SUBMITTALS

For Submittal Requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. General

Fibers used for the manufacture of geotextiles and the threads used in joining geotextiles by sewing shall comply with the physical and chemical requirements of AASHTO M288.

B. Geotextile

For the indicated application, comply with the physical requirements of AASHTO M288 Table 1 Physical Requirements and with Permeability and Apparent Opening Size as noted on the Basic Contract Drawings.

1. Subsurface Drainage: "Class A"
2. Sediment Control: "Self Supported"
3. Erosion Control: "Class A"
4. Separation of Dissimilar Materials (including subgrade stabilization): "High Survivablility Level"

C. Temporary Silt Fences

1. Geotextiles for temporary silt fences shall meet the requirements for sediment control, self supported, of AASHTO M288 Table 1 unless otherwise shown on the Basic Contract Drawings.
2. Posts and appurtenances shall be in accordance with the fabric manufacturer's written recommendations, except as otherwise shown on the Basic Contract Drawings.
3. Prefabricated silt fences with the geotextiles affixed to the posts are permitted.

PART 3. EXECUTION

3.01 PREPARATION

A. Prepare surfaces against which the geotextile will be installed by clearing and grading as required to remove surface irregularities or projections which may interfere with the installation or which may damage the geotextile.

B. Plan the work such that the exposure of the geotextile between laydown and coverage shall be limited to a maximum of fourteen (14) days.

3.02 INSTALLATION

A. General

1. Install the geotextile as shown on the Basic Contract Drawings and as specified herein.
2. Unroll and place the geotextile to maintain a smooth surface and in such a manner that placement of overlying materials will not excessively stretch or tear the geotextile.
3. Factory or field sewn or sealed seams shall meet the applicable requirements of AASHTO M288 Table 1.
4. Unless otherwise shown on the Basic Contract Drawings or specified herein, overlapped seams shall have a minimum overlap of 12 inches except when placed underwater where the overlap shall be a minimum of three (3) feet.

5. Remove or repair damaged geotextile as directed by the Engineer. Repairs shall be made with a geotextile patch placed over the damaged area and extending three (3) feet beyond the perimeter of the damage, and shall be seamed to match the surrounding installation.

B. Subsurface Drainage Installations

1. At seams, overlap the fabric in the direction of flow with upstream over downstream.

2. Where seams are required in the longitudinal trench direction and within the trench, they shall be sewn or have a minimum overlap equal to the trench width.

C. Erosion Control Installations

1. Terminal ends of the geotextile shall be anchored at the crest and toe of slopes as shown on the Basic Contract Drawings.

2. For slope protection installations, successive sheets shall be overlapped with upstream over downstream and/or upslope over downslope.

3. Placement of armor stone, rip-rap and aggregate bedding onto the geotextile shall begin at the toe and proceed upslope. For underwater applications, the first layer of such material shall be placed the same day as the geotextile is installed.

4. The height from which material shall be dropped onto the geotextile shall be limited to one (1) foot unless otherwise shown on the Basic Contract Drawings.

D. Separation and Subgrade Stabilization Installations

1. Unroll the material in the direction of construction traffic unless otherwise directed by the Engineer. Adjacent rolls shall be overlapped in the direction of material placement and as shown on the Basic Contract Drawings.

2. Anchor the geotextile as required using pins, staples or piles of the material to be placed on the fabric.

3. Form curves cut from pieces lapped in the direction of construction or by folding in the direction of construction.

4. Placement of material onto the geotextile shall be as specified on the Basic Contract Drawings.

E. Sediment Control Installation

1. Install and maintain sediment controls, as shown on the Basic Contract Drawings.

2. Removal and disposal of temporary sediment controls, and restoration of the site shall be as shown on the Basic Contract Drawings.

PART 4. FIELD TESTS AND ADJUSTMENTS

A. Proofroll and correct deficiencies as required by the Basic Contract Drawings or as specified in other Sections of the Specifications.

B. Unless otherwise shown on the Basic Contract Drawings, correction of deficiencies and additional proof rolling shall be at no additional cost to the Authority.

C. Testing of field seams shall be by the Engineer as specified elsewhere herein.

END OF SECTION

SECTION 02274

GEOTEXTILES

APPENDIX "A"

SUBMITTALS

A. Submit manufacturer's certificates of compliance with all requirements for materials specified in this Section.

B. Submit fabric manufacturer's Quality Control (QC) plan for the production process. The plan shall specify the specific testing proposed to verify the physical and chemical properties required by this specification and the frequency of tests, including suggested lot sizes and number of tests per lot.

C. When required on the Basic Contract Drawingss, submit manufacturer's representative samples of the fabric to the Engineer of Materials, Engineering Materials Laboratory, Port Authority Technical Center, 241 Erie Street, Jersey City, NJ 07310-1397. The type, quantity and purpose of such samples shall be as shown on the Basic Contract Drawingss.

D. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one package per Section or trade, and sent to the Engineer for review.

END OF APPENDIX "A"

DIVISION 2

SECTION 02355

PILE LOAD TEST
STATIC AXIAL COMPRESSIVE

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for pile testing under static axial compressive load.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM D 1143	Method of Testing Piles Under Static Axial Compressive Load

1.03 SUBMITTALS

See Appendix A for Submittal Requirements.

PART 2. PRODUCTS

(Not Applicable)

PART 3. EXECUTION

3.01 PILE LOAD TESTS

A. Perform load tests on designated piles at locations shown on the Basic Contract Drawings or where ordered by the Authority. Load tests shall be performed prior to the start of production driving. If additional load tests are required during production driving, they shall be scheduled to result in minimum interference to construction operations. The scheduling of load tests shall be as approved by the Authority. No piles shall be driven within 200 feet of a pile undergoing load testing.

B. If the Contractor elects to drive indicator piles, the piles for load testing shall be incorporated into the Contractor's plan as approved by the Authority. Piles for load testing will be selected by the Authority after the indicator piles have been driven.

C. Selected test piles shall be load tested in conformance with the applicable provisions of ASTM D 1143 including Standard Loading Procedure and Standard Measuring Procedure or as otherwise directed by the Authority. The Contractor shall install reference beams and dial gages to measure both horizontal and vertical movements. Dial gages shall have a precision of one thousandth (0.001) of an inch and shall provide for a travel of three (3) inches.

D. The Contractor shall furnish swivel plate(s), base plate(s) and load cell(s) with matching steel bearing plates as required for use as shown on the Basic Contract Drawings. Protect benchmarks, test piles, reference beams, dial gauges, jacks, compensators and pressure tanks from the rays of the sun. In addition, provide a portable shelter to shield the Port Authority survey level instrument from the sun and wind, and provide necessary lighting and suitable heat to conduct the load test during the hours of darkness.

E. Structures for the load test shall be constructed in accordance with the Basic Contract Drawings and approved shop drawings. Test arrangement shall be designed so that loads are applied to the pile accurately and concentrically by means of certified, calibrated hydraulic jacks, pressure regulating devices and tanks, and hand jacks, so that there will be a constant load maintained under increasing settlement. Design the structures and test apparatus to safely carry the test loads during all stages of loading and unloading in a manner that will adequately support the vertical loads and prevent lateral movement. The load platform shall be supported by piles, cribbing or other approved means designed so as to prevent excessive settlement and to preclude differential settlement and tilting. Where shown on the Basic Contract Drawings, brace the top of the pile to prevent lateral movement and the unsupported length of the pile as necessary to prevent buckling. The system of bracing shall not restrain settlement of the pile.

F. The total test load to each test pile shall be as shown on the Basic Contract Drawings. Loading and unloading sequence will be established by the Entity performing thr design for the Contractor. Furnish manpower on a 24-hour per day basis to regulate the loads.

G. Optical survey and dial gauge readings of settlement and rebound will be taken by the Authority. The Contractor shall provide suitable steel pipe or angle members mounted on opposite sides of the test plate and to the reference beams which shall extend to a sufficient height to allow the Authority to install survey tape and obtain optical survey measurements. The Contractor shall assist the Authority in mounting the survey tape and in setting a benchmark outside the immediate test area.

END OF SECTION

SECTION 02355

PILE LOAD TEST

STATIC AXIAL COMPRESSIVE

APPENDIX A

SUBMITTALS

Three weeks prior to commencing load testing, submit shop drawings, showing details of the pile load test arrangement and the structures for applying the test load in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS. The Shop Drawings and associated calculations for all members, connections, and stiffeners shall be prepared by a Professional Engineer, licensed in the State in which the Work will be performed. The Shop Drawings shall be sealed and signed by the Professional Engineer.

END OF APPENDIX "A"

DIVISION 2

SECTION 02356

DYNAMIC PILE TESTING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for dynamic testing of piles.

B. Testing will be performed by the Contractor on piles selected by the Authority.

C. The Dynamic Pile Testing shall be performed by a firm approved by the Authority. The Contractor shall submit his Means and Methods for performing the Dynamic Pile Testing to the Authority for review prior to performing the testing.

D. The Contractor shall modify pile driving system or replace hammer if test results show that the pile driving system does not meet the specified minimum energy requirements.

1.02 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

(Not Applicable)

PART 3. EXECUTION

3.01 DYNAMIC PILE TESTING

A. During pile driving operations, dynamic measurements will be taken by the Contractor of force and acceleration at the tops of selected piles in the presence of the Authority. Readings will be taken using the equipment described in 3.01 D. In addition, the performance of the pile hammer will be evaluated by the Contractor using equipment described in 3.01 E and information listed in 3.01 B shall be reported to the Authority within 24 hours.

B. Measurements to be obtained will provide the following information:

1. Available kinetic energy developed by the hammer.
2. Transferred energy (efficiency) from hammer to pile;
3. Predicted ultimate static bearing capacity;
4. Maximum compressive force in pile;

5. Maximum tension force in pile;

6. Maximum impact velocity at pile top;

7. Maximum acceleration at pile top.

C. If dynamic measurements indicate that, the pile driving system does not provide the minimum transferred energy required, the Contractor shall either replace the hammer or make whatever modifications to the pile driving system that are necessary, subject to approval of the Authority, to provide the required minimum energy.

D. The Pile Driving Analyzer instrumentation equipment consists of two accelerometers and two strain gauges, the pile driving analyzer, a seven-channel cassette recorder, and an oscilloscope. The accelerometers and strain gauges are attached to the test piles with six bolts through pre-drilled and threaded holes. The wires from each gauge are collected at a connection box that hangs from the pile hammer using a chain. A single cable runs from the connection box to the Pile Driving Analyzer located on the ground.

E. The Hammer Performance Analyzer consists of a radar gun (radar antenna) connected by electrical cable to a box housing a signal conditioner and an output display (strip chart). The antenna is placed close to the base of the leads so that the moving hammer ram falls within the antenna's cone of observation. The measured ram velocity at impact shall be used to compute the available kinetic energy.

END OF SECTION

SECTION 02356DB

DYNAMIC PILE TESTING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. The qualifications of the firm performing the Dynamic Pile Testing, and the person in the field supervising the Dynamic Pile Testing and compiling and reviewing the data, verifying they both have a minimum of five (5) years experience in performing such work for construction of a similar size and scope as for this contract.

B. The Contractor's Means and Methods for performing the Dynamic Pile Testing.

DIVISION 2

SECTION 02363

STEEL PIPE PILES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for concrete-filled, closed-end, steel pipe piling.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Nondestructive Testing, Inc. (ASNT)
ASNT SNT-TC-1A	Recommended Practice No. SNT-TC-1A.
	American Society for Testing and Materials (ASTM)
ASTM A 36	Specification for Carbon Structural Steel.
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A 252	Specification for Welded and Seamless Steel Pipe Piles.
ASTM A 615	Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
	American Welding Society (AWS)
AWS D1.1	Structural Welding Code – Steel.
AWS D1.5	Bridge Welding Code.
AWS QC1	Certification of Welding Inspectors.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. Do not drive piles until excavation or filling in the area they are to occupy has been completed to the design grades.

2. Do not drive piles until the mudline is clear of debris or other materials that may interfere with pile driving.

3. When concrete is less than 7 days old, do not drive piles closer to the concrete than the distance computed by the formula below:

$$D = 1/7 \sqrt{E}$$

Where: E = Energy of pile hammer (in foot pounds)
D = Distance (in feet)

4. Do not drive piles until the Engineer has approved sequence of driving for all piles.

5. Protect existing structures, including utility lines and FAA navigational lighting..

B. Alignment and Tolerances

1. After splicing, the alignment of the centering of the undriven portion of the pile shall not deviate from the alignment of the centering of the driven portion of the pile by more than 3/8 inch in 40 feet.

2. Alignment deviation is defined as the horizontal offset of the centerline of the pile at the top of the pile divided by the length over which the offset is measured. After installation, the alignment deviation of the pile centerline shall not exceed two percent from vertical for vertical piles and two percent (shallower or steeper) from the design batter shown for batter piles.

3. Horizontal deviation is defined as the difference in horizontal position of any point on the centerline of the pile below the pile top from the design horizontal position of the corresponding point. After installation, the horizontal deviation of any point shall not be greater than an amount equal to four percent of the vertical distance from the cut-off elevation to the point in question.

4. A light source lowered to the bottom of the pile shall remain visible. However, if eye contact with the light source is lost, a measurement will be made by the Contractor with an inclinometer to determine if the pile meets the requirements of this Section.

5. Piles at cut-off elevation shall not deviate laterally from required location by more than the design tolerance. Piles shall not be pulled into location by more than amount allowed by the design.

1.04 QUALITY ASSURANCE

A. Welding and Splicing

1. Comply with applicable provisions of AWS D1.1 and AWS D1.5.

2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and if pertinent, has undergone recertification.

B. The Authority will perform Quality Assurance testing to ensure quality workmanship. Notify the Authority in writing 15 days prior to the start of fabrication and provide a detailed schedule for the duration of fabrication. The schedule shall include, at a minimum, the start and end dates for ordering material, cutting material, fabricating material and shipping material. If the schedule changes, submit a revised schedule.

C. Supply equipment and personnel, at no additional cost to the Authority, to assist in moving members as necessary for adequate access by the Authority for Quality Assurance inspections and testing.

D. Fabrication performed without prior approval of the following items will not be accepted. Ensure that a copy of all signed approvals by the Authority, including the following supporting documentation, is in the possession of the fabrication shop prior to the commencement of fabrication and is available to the Authority's Quality Assurance inspector at all times.

1. Shop Drawings.

2. Welding Procedure Specifications (WPS).

3. Procedure Qualification records (if applicable).

4. Welder qualifications.

5. Mill test reports.

6. Names and qualifications of Quality Control personnel, including an AWS Certified Welding Inspector (CWI) who meets AWS QC1 standards, and of nondestructive testing personnel who meet ASNT SNT-TC-1A Level II qualifications.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Steel Pipe Piles

ASTM A 252, Grade 2, minimum. Pipe piles shall be either seamless pipe or full penetration electric resistance butt welded with straight or spiral seams. Pipe shall be welded in a manner that welding shall not crack or fail when the pile is subjected to its intended use, including during driving. Arrange for the weld seam of each length of pipe to be ultrasonically tested by the manufacturer in accordance with the provisions for Nondestructive Electric Test of Weld Seam of ASTM A 53. Diameter and wall thickness shall be as specified by the design.

B. Concrete

Concrete shall be as specified in Division 3 Section entitled "Portland Cement Concrete, Long Form".

C. Grout

Grout shall be cementitious and proportioned as 94 pounds of cement and 5 gallons of water.

D. Reinforcing Bars

ASTM A 615, Grade 60, as specified in Division 3 Section entitled "Concrete Reinforcement".

E. Steel Shapes and Plates (for tip closure or pile point)

ASTM A 36.

2.02 SHOP PAINTING

A. Coating Steel Piles

For coating requirements for marine construction, see Division 2, Section 02392DB entitled "Zinc-Rich Epoxy/Coal Tar Epoxy Coating System for Steel Piling".

PART 3. EXECUTION

3.01 INSTALLATION

A. Pile Driving Equipment

1. Use rigid frame, fixed-lead type driving equipment capable of supporting the pile firmly in a vertical position or to the required batter.
2. Leads shall be of sufficient length so that use of a follower will not be necessary, unless otherwise approved by the Authority.
3. Use an approved driving head designed to properly fit the head of the pile or a cast steel, outside type drive sleeve to prevent damage to the top of the pile during driving.
4. Use an approved cap block cushion consisting of alternating plates of phenolic laminate and aluminum designed to prevent damage to the piles while also transmitting the amount of required transferred energy to the pile top. The phenolic laminated plates shall be either "Micarta" as manufactured by Westinghouse Electric Corp., 304 Hoover Street, North Hampton, SC 29924, or "Conbest" as manufactured by Penn State Metal Fabricators, 124 Newton Street, Brooklyn, NY 11222. Substitutes not employing phenolic laminate will not be permitted.
5. Do not use wood chips, small wood blocks, shavings or any extraneous material to absorb the energy of the hammer.
6. If piles cannot be installed using fixed-lead type driving equipment due to inaccessibility, use of hanging leads may be considered if the following provisions are complied with:
   a. Furnish a plan showing the piles that are considered inaccessible and that will not be driven using fixed-lead type driving equipment. The determination of the acceptability of using hanging leads will be made solely by the Authority.
   b. Use a driving frame template or false work to maintain location tolerance and orientation (batter) requirements specified in 1.03 B.
   c. Specify the type of piles or other method of support and minimum tip elevation of piles used to support frame template and false work.
   d. Specify the methods of retaining the driven piles in place upon removal of the frame template and prior to cap construction.
   e. Prior to driving piles at each bent or cap, furnish the following to the Authority:
      (1) Sequence of installation for all piles.
      (2) Survey of frame location and elevation at each bent or for each row of piles.

f. Survey location and orientation of piles upon completion of all piles in a bent or cap prior to driving piles in next bent or cap. Furnish access for the Engineer to perform visual inspection of piles.

g. Pile driving analyzer (PDA) measurements will be performed by the Contractor at the start of pile driving. If, as a result of using hanging leads, the Authority determines that additional PDA measurements are required to verify the consistent performance of driving system, the number and frequency of additional testing shall be as determined by the Authority. The Contractor shall perform additional tests at no cost to the Authority.

B. Pile Hammer

1. Use a pile hammer complying with the requirements of the design.

2. Keep hammer in good mechanical condition and operate it at the speed and pressure recommended by the manufacturer.

3. During pile driving operations, the Authority may require the Contractor to make occasional measurements of the velocity of the hammer ram using a Hammer Performance Analyzer (radar gun device), manufactured by Pile Dynamics, Inc., Cleveland, Ohio. If the energy per blow computed on the basis of the measured ram velocity at impact is less than 80 percent of the rated energy per blow as specified by the manufacturer of the pile hammer, make all necessary repairs so as to improve the energy output to a value of at least 80 percent of the rated energy per blow or, alternatively, replace the pile hammer.

4. Use air compressor or hydraulic pump that meets minimum requirements for capacity or horsepower, as recommended by hammer manufacturer.

C. Welding and Splicing

1. Perform welding in accordance with requirements for shielded metal arc welding of AWS D1.1 for buildings and other structures or AWS D1.5 for bridges.

2. Have all welds visually inspected by an AWS Certified Welding Inspector (CWI).

3. Nondestructively test all full penetration welds for 100 percent of the weld length by radiographic or ultrasonic methods, as approved by the Authority.

4. Coordinate the Work and timely notify the Authority to ensure compliance with all testing and inspection procedures required by the Authority.

5. Notify the Authority 24 hours prior to performing field welding.

6. Close pile tips with a steel plate or an angle-fin point, continuously welded to the pipe so that no portion of the plate or point extends beyond the outside diameter of pipe.

7. Unless the design requires stricter requirements, pile splice shall be as follows:

a. Splices within the top 20 feet from pile cut-off elevation or design grade, whichever is lower, shall be full penetration butt welds.

b. Splices below the top 20 feet, as described above, may be made with Advance Splicer Sleeve S-18000, manufactured by Associated Pile & Fitting LLC, Clifton, NJ or approved equal, provided both pipe ends are square cut and seated to bear. The sleeve shall be continuously welded. All shop splices shall be done as full penetration butt welds.

c. An approved jig or alignment device shall be used to maintain the required straightness of pipe specified in 1.03 B.1.

d. For splices made during pile installation, rigid frame pile leads may be used as a jig in a manner approved by the Authority.

8. Unless otherwise permitted by the Authority based on field conditions, the number and location of splices shall comply with the following limitations:

a. No more than three splices per pile over 100 feet long.

b. No more than two splices per pile up to 100 feet long.

c. No splice closer than 25 feet from the tip.

D. Pile Driving

1. Perform driving operations only in the presence of the Authority.

2. Maintain top of pile normal to the driving force. Maintain accurate alignment of the pile, hammer and leads to minimize bowing of pile during impact of the hammer ram.

3. Where groups of piles are required, drive the center pile of the group first and then drive the remaining piles in the group, progressing outward from the center.

4. Drive piles to the minimum tip penetration(s) and to the driving resistance as required by the design. Take corrective action, if required, to prevent observable impact bowing of pile at final driving resistance.

5. Drive piles without interruption from the first hammer blow until required penetration and driving resistance have been attained. If interruption of driving is necessitated by job requirements, as approved by the Authority, upon resuming driving, overcome friction due to the stoppage and drive or use other approved means of advancing the pile to the approximate tip elevation of immediately adjacent piles and to the required driving resistance.

6. When resistance to driving makes it impossible to advance the pile to the required minimum tip penetration, spud, jet, jet and drive or use such other means as necessary to permit advancement to required minimum tip penetration, and then drive to the design driving resistance. Jetting will be permitted only with approval of the Authority and within the limits specified by the Authority. If jetting is performed, immediately redrive adjacent piles to the required driving resistance.

7. Pre-drilling or pre-augering a hole of maximum diameter two inches smaller than the pile diameter may be used to advance the pile to a penetration no deeper than the required minimum tip penetration, subject to approval of the Authority, providing the pile is driven to the required driving resistance. In granular soils below the ground water level, stabilize the hole by use of drilling fluids as approved by the Authority.

8. At the completion of the driving operation on a pile, the pile shall be undamaged, free of leaks and other defects and in compliance with the requirements of this Section.

9. Cut piles off at the design cut-off elevation as soon as practical after driving and any required redriving as specified in 3.01 F.

10. When required, install indicator piles.

E. Corrections of Deficiencies

1. Notify the Authority immediately in writing of the failure of a pile to meet any requirement of this Section. Include all information required for the evaluation of remedial measures, including information required for redesign.

2. If the Authority determines that a pile does not meet the requirements of this Section due to encountering an obstruction, then the following shall apply:

   a. The Contractor will be compensated on a net cost basis as defined by 3.01 E.8 for all remedial work associated with the deficient pile, including changes to concrete and reinforcement steel, as approved by the Authority.

   b. If the Authority determines that a pile does not meet the requirements of this Section for any reason other than encountering an obstruction, the Contractor shall perform all remedial work associated with the deficient pile, including changes to concrete and reinforcement steel as directed by the Authority, at no cost to the Authority.

   c. An obstruction shall be defined as any natural or man-made object which does not permit the pile to be advanced by driving or driving and spudding with the approved pile driving hammer. Soils with naturally high driving resistance shall not be considered to be an obstruction.

   d. It shall be the sole determination of the Authority as to whether or not an obstruction has been encountered during pile driving.

3. If a pile fails to comply with the alignment or location requirements of 1.03 B, the Contractor shall calculate the load capacity requirements of that pile or, if in a pile group, each pile in that pile group, based on the actual "as-driven" alignment and locations. If the calculation indicates that the loading on that pile or, if in a pile group, on any pile in that pile group, exceeds 110 percent of the design load, then perform such remedial work as directed by the Engineer Of Record, including but not limited to redriving piles, furnishing and driving additional piles and modifying concrete or reinforcement steel.

4. In the case of a pile with some deficiency that affects load capacity, the Contractor shall calculate the load capacity requirements of that pile, based on its actual, "as-driven" location and alignment. If the calculation indicates that the loading on the pile exceeds some reduced allowable loading less than the design load, including a zero loading,, then perform such remedial work, including but not limited to redriving piles, furnishing and driving additional piles and modifying concrete or reinforcement steel.

5. The Contractor, at his option and at any time that he determines that a pile will not satisfy the requirements of this Section for a reason other than encountering an underground obstruction and subject to the provisions of 3.01 E.1, may abandon such pile and replace it. However, in exercising this option, the Contractor assumes the risk that such replacement pile or piles have not been installed at the proper design location and alignment so as to carry satisfactorily the design load as determined by subsequent analysis performed by the Authority. Such abandonment shall be for the Contractor's convenience at no cost to the Authority and subject to all applicable provisions of the Contract.

6. Abandoned piles shall be cut off at the mudline and filled with sand.

7. All work performed by the Contractor in accordance with 3.01 E.3, E.4, E.5 and E.6 shall be performed at no additional cost to the Authority, except as otherwise noted.

8. "Net Cost" shall be computed in the same manner as is compensation for extra work, including any percentage addition to cost, as set forth in the clause of the Contract regarding compensation for extra work. Performance of such net cost work shall be subject to all provisions of the Contract relating to performance of extra work. Compensation for net cost work shall not be charged against the total amount of compensation authorized for extra work.

F. Redriving Piles

1. Take optical survey measurements to establish the elevation of the top of each pile immediately after driving (or redriving) and, subsequently, after driving (or redriving) the entire pile group. Redrive piles that have heaved or uplifted 0.25 inch or more from their original elevations and piles immediately adjacent thereto.

2. Redrive until both the original tip elevation and the driving resistance have been obtained, except that if original tip elevation cannot be reached, driving may be discontinued at a resistance of 150 percent of the design driving resistance.

3. Equipment for redriving shall be as specified for original driving except that use of a free hanging hammer will be permitted.

4. Do not cut off piles until the Authority has determined that no further redriving is required.

G. Concrete Core

1. Fill piles approved with concrete in conformance with the requirements of Division 3 Section entitled "Portland Cement Concrete, Long Form".

2. Do not place concrete in piles for an individual pile group until all piles for that pile group have been driven.

3. Cover piles not immediately filled with concrete with caps to prevent any material from entering the piles.

4. Before concreting, remove water and other materials from each pile to achieve a clean, dry pile.

5. Immediately place two cubic feet of grout deposited in a manner to optimize coating the inside surface of the pile and fill the remainder of the pile with concrete in one continuous operation by methods that will prevent the segregation of ingredients. Adjust the rate of concrete placement as necessary to prevent void formation.

6. Place concrete into the pipe piles using a hopper with a spout having a cross sectional area of no more than 50 percent of the cross sectional area of the interior of the pipe pile. Position the hopper above the top of the pile to permit the escape of air during the concreting operations.

7. Temperature and other conditions for the depositing of concrete shall conform to the requirements of Division 3 Section entitled "Portland Cement Concrete, Long Form".

8. Where reinforcing is to be placed within a pile, stop placing concrete at the elevation of the bottom of the reinforcing, immediately place the reinforcing, and resume placement of concrete.

3.02 FIELD TESTS

A. Inspection

1. Cooperate with the Authority and furnish services as they may require for inspecting and obtaining data. Typical of these services shall be the measurement of length of piles, painting footmarks on piles, furnishing light and ladder if required, and moving materials or equipment as required to provide access to and clear observation of the piles.

2. After all piles for each pile group have been driven, the Authority may inspect each pile by means of a light source lowered to the bottom. If eye contact with the light source is lost in any pile, that pile will be further tested by the Contractor with an inclinometer.

3. The Contractor shall keep a record of each pile driven. This record will include the following data:

   a. Date of driving.

   b. Pile number.

   c. Type and size of pile.

   d. Type, number and location of splices.

   e. Pile length before driving.

   f. Length of cut-off.

   g. Elevation of pile top and tip to nearest 0.1 inch immediately after driving.

   h. Elevation of pile top after driving entire pile group to the nearest 0.1 inch to determine amount of heave.

   i. Final elevation of pile tip after required redriving of entire pile group.

   j. Lower limit (elevation) of pile coating after driving.

   k. Hammer type and size.

   l. Hammer speed.

   m. For impact hammers, blows per foot of driven length, and blows per inch where driving resistance exceeds 75 blows per foot.

   n. Blows per 1/2 inch of redrive.

   o. The time pile driving is started, interrupted, resumed and stopped.

   p. Description of any unusual circumstances affecting the driving of the particular pile.

   q. Sounded length of each pile.

   r. Slope of pile.

   s. Lowest elevation at which light source is fully visible and elevation at which eye contact with light source is lost.

END OF SECTION

SECTION 02363DB

STEEL PIPE PILES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings.

B. Certified mill test reports, including ultrasonic testing results of the weld seams, for steel pipe piles.

C. A complete description of each pile hammer, including operational characteristics, rated energy, date of purchase and date and description of last overhaul.

D. A complete description of the driving equipment including caps, leads, cap block cushion and guides.

E. The proposed procedure for splicing piles, including a plan for positioning all field and shop splices to meet requirements specified in 3.01 C.8, and detailed procedures for performing field splices.

F. Verification of welder qualifications.

G. Welding Procedure Specifications (WPS).

H. Procedure Qualification Records (if applicable).

I. Certifications and qualifications for AWS Certified Welding Inspector (CWI) meeting AWS QC1 standards, nondestructive testing personnel qualified to ASNT SNT-TC-1A Level II requirements and their respective employers. Include samples of inspection and testing forms to be used for the Work of this Contract.

J. Notification, in writing, 15 days prior to commencing fabrication of steel pipe piles.

K. Detail schedule for the duration of fabrication at each shop.

L. Welding inspection and test results within five calendar days.

M. The proposed sequence for driving all piles and proposed procedure for placing the concrete pile core.

N. Details of jetting, pre-drilling or pre-augering operations, if required to advance piles.

O. Proposed concrete mix and method of concrete placement as specified in Division 3 Section entitled "Portland Cement Concrete, Long Form".

P. Plan for installing indicator piles, including sequence of installation if Contractor elects to drive indicator piles.

Q. As-built drawing(s) showing the exact location of all piles driven and identifying abandoned piles.

R. Submit the following if hanging leads type driving equipment is used:

1. Plan showing inaccessible piles which will be driven using hanging leads.
2. Plan and section showing components of the driving frame template or false work.
3. Drawing showing type of piles and minimum tip elevation of piles used to support frame template.
4. Drawing showing the means of retaining the driven piles at location and orientation upon removal of the frame template.
5. Written description of the procedure to transmit required survey data specified in 3.01 A.6.e and 3.01 A.6.f.

END OF APPENDIX "

DIVISION 2

SECTION 02379

CAISSONS (DRILLED SHAFTS)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for caisson foundations bearing into soil or rock materials.

1.02 REFERENCES

The following is a list of the publications referenced in this Section:

American Concrete Institute

ACI 336.1 Standard Specification for the Construction of Drilled Piers.

1.03 QUALITY ASSURANCE

A. The entity performing the Work of this section shall have successfully completed not less than three contracts with soil or rock conditions, shaft sizes and depths similar to those contained in this project.

B. Caisson excavations shall be performed with an approved caisson drilling rig. All equipment shall be maintained in a satisfactory working condition and shall be operated by competent and experienced personnel throughout the operation.

C. Conduct layout work for each caisson to lines and levels required and provide final measurements of axial location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other data as required.

1. Record and maintain information pertinent to each caisson as described herein.
2. Provide dimensional record drawings showing actual installed location of each caisson, size and offset dimension and other data as noted herein or as directed. Provide actual top of caisson elevation and vertical control bench mark used for layout. Detail onto mylar sheets of approved size and sealed by a land Surveyor licensed in the state where the work is to be performed.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions:

1. The Contractor shall provide owners of adjacent property and utilities with a minimum seven-day notice before proceeding with the Work.

2. The Contractor shall protect all adjacent structures and utilities from damage due to the Work. Should uncharted or incorrectly charted structures or utilities be encountered during excavation, the Authority shall be immediately notified and consulted for directions as to procedure. The Contractor shall cooperate with the Authority, and public and private utility companies in keeping their respective services and facilities in operation. Damaged structures and utilities shall be repaired to the satisfaction of the Authority at no expense to the Authority.

3. No caisson construction operations shall be performed within 15 feet of concrete less than seven days old.

4. Caisson construction operations shall be performed only in the presence of the Authority.

B. Alignment and Tolerances

1. Unless otherwise shown on the Basic Contract Drawings, caissons shall be constructed so that the axis of the caisson, measured at the top of the caisson, is within 1-1/2 inches of the plan location.

2. Caissons shall be plumb, to within 1.5 percent of the length based on the total length of the shaft.

3. During construction of the caissons, the Contractor shall make frequent checks on the plumbness, alignment and dimensions of the caissons and shall correct immediately any deviation exceeding the allowable tolerances.

1.05 SUBMITTALS

See Appendix A for Submittal Requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Concrete:

Concrete shall conform to the requirements in Section 03364 entitled CONCRETE PLACED UNDERWATER. Concrete shall have a minimum 28 days compressive strength of 4,000 psi and a slump of 7 inch ± 1 inch, unless shown otherwise on the Basic Contract Drawings.

B. Reinforcing Steel:

ASTM A615, Grade 60 as specified in Section 03200 of these Specifications entitled CONCRETE REINFORCEMENT, and as shown on the Basic Contract Drawings.

C. Grout:

Mixture of one part Portland Cement to one part sand with sufficient water to provide a slump not to exceed 10 inches except where dry pack grout is called for on the Basic Contract Drawings.

D. Steel Cores:

ASTM A36, conforming to the requirements of Section 05120 of these specifications entitled "STRUCTURAL STEEL."

E. Casing:

1/2" minimum thickness, Grade 2 seamless or electrically welded pipe conforming to ASTM A252, unless otherwise shown on the Basic Contract Drawings.

F. Steel Cutting Shoe:

ASTM A148, grade 90-60.

PART 3. EXECUTION

3.01 INSTALLATION

A. CAISSON EXCAVATION

1. Prior to excavations for caissons, the Contractor shall locate and pre-excavate to expose portions of the existing utilities within the caisson work area, and provide support and protection as necessary such as not to adversely affect the integrity of the utilities due to construction activities. The excavation and support methods shall be approved by the Entity performing design for the Contractor.

2. The design of caissons is based on ground resistance to lateral and vertical loading. Excavation for caissons shall be advanced by rotary drilling methods approved by the Entity performing design for the Contractor which do not permit loss of ground and will not adversely affect existing utilities and adjacent structures. Equipment used shall be capable of excavating through the type of materials expected to be encountered, including boulders, rubble, and other obstructions, if present.

3. Use drilling tools and excavation procedures that minimize negative pressure in the excavation that might induce soil heave into the bottom of the excavation. An auger, if used, shall be withdrawn slowly. At completion of the excavation, clean the caisson bottom with an air-lift system or a clean-out bucket equipped with a one-way flap gate that prevents spoil in the bucket from re-entering the excavation.

4. The caisson excavations shall be of the sizes and dimensions and shall be carried to the depths shown on the Basic Contract Drawings.

5. Unsupported caisson excavations in the dry shall be permitted only in cohesive soils of sufficient strength to provide for a stable excavation with no observable inflow of ground water, as determined by the Authority. All other excavations shall be performed using either the slurry excavation method or the temporary casing method, as described in A.6 and A.7, below.

6. The slurry method of excavation consists of using drilling slurry to maintain stability of the excavation. Slurry shall conform to the requirements of Table 1 of ACI 336.1. Drilling slurry shall be maintained at a minimum of five feet above the ambient ground water table at all times. Slurry shall be completely cleaned prior to concrete placement by circulation to control uniformity and remove coarse materials. Temporary surface casings shall be used to aid shaft alignment and position, and to prevent sloughing of the top of the shaft excavation. Contractor shall submit plan for use of slurry for Authority's approval.

7. Temporary casing may be used to support the sides of the excavation and seal off the inflow of ground water. The casing shall be advanced by methods that do not create void space outside the casing. Where, in the opinion of the Authority, soil conditions will permit heave of soil or flow of water into the bottom of the casing, drilling fluid shall be introduced into the casing and maintained at a level above the ambient ground water level. Drilling ahead of the casing shall not be allowed, except where the soils below the bottom of the casing are self-supporting, as determined by the Authority. In soils that are sensitive to disturbance, in the opinion of the Authority, the casing shall be advanced by methods that do not disturb or displace the adjacent ground, including cleaning out the casing as it is advanced to prevent formation of a soil plug. Steel pipe casing shall be flush-joint type with sufficient strength to withstand handling stresses, concrete pressure, and surrounding earth and/or fluid pressures. The casing shall be clean and watertight. The diameter of the casing shall not be less than the specified diameter of the completed caisson.

8. Each excavated caisson will be examined by the Authority upon completion of excavation.

9. All excavated materials shall be disposed of away from the construction site. Procedures for temporary stockpiling and testing, if required, and disposal of the excavated materials shall be as described in the Contract Documents.

10. Construction of the caissons shall be performed so that placement of reinforcing steel and concrete is a continuous operation performed the same day that the excavation is completed.

11. Approved cutting shoes of hardened steel shall be welded to the bottom of each steel casing. In caissons that are to be socketed into rock, the casing shall be advanced sufficiently into the rock so as to prevent inflow of soil and water.

12. When driving through boulders, decomposed rock or other hard material overlying sound rock, care shall be taken to prevent damage to the cutting shoe or deformation of the steel shell.

13. Rock sockets below the casing, where shown, shall be drilled or chopped into the rock to the depths necessary to provide the required depth of socket in sound rock as shown on the Basic Contract Drawings or as directed by the Authority. The Contractor shall remove all rock fragments, soil or other foreign matter so as to provide a clean bearing surface at the bottom. Where shown on the Basic Contract Drawings, the Contractor shall use drilling equipment capable of precision drilling adjacent to existing structure, such as the Ingersoll-Rand Company "Magnum" drill or approved equal.

14. Where required, splicing sleeves in the steel casing shall be of the external type with a depth of at least 12". The ends of the shells shall be square-cut so that the sections shall bear on each other and shall be connected to the sleeves by continuous welds.

B. DEWATERING:

1. After completion of drilling, if feasible, caissons shall be dewatered to permit inspection in the "dry" by the Authority.

2. Caissons socketed in rock shall be tested as follows:

   a. Water in the casing shall be lowered to within 3 feet of the bottom of socket.

   b. After two hours, if the water level has risen less than one foot, remove the remaining water in the caisson to permit inspection. If the water level has risen more than one foot, redrive and reseat the caisson casing.

   c. After reseating the casing, repeat steps a. and b. above.

3. "Wet" Caissons

   a. If caissons cannot be dewatered as specified in B.2 above, it shall be considered a "wet" caisson and a full static head of water shall be maintained in the caisson. All foreign material shall be removed from the caissons by jetting with an airlift. This process shall be continued until the water runs clear and there is no intrusion of soil or rock materials into the socket.

   b. In cases where the ground water level is higher than the top of caisson, either a watertight extension shall be added to the top of the caisson to permit a full static head of water to develop in the extension, or drains and/or a wellpoint system around the caisson shall be used to lower the level of the water to a static level within the caisson, before proceeding as in 3a above.

C. REINFORCING STEEL

1. Reinforcing steel shall be free of mud, oil, or other coatings that adversely affect bond. Reinforcing bars shall be placed as shown on the Basic Contract Drawings with cover of not less than three (3) inches where exposed to soil.

2. The reinforcing cages, including splices, shall be detailed and submitted for Authority's approval. Cages shall be braced to retain their configuration throughout the placement of concrete and the extraction of temporary shaft casings.

3. Approved spacing devices shall be installed at sufficient intervals along the shaft to insure concentric location of the cage within the shaft excavation.

D. CONCRETE PLACEMENT

1. Immediately prior to positioning the reinforcing cage or structural steel core, clean bottom of caisson excavation as specified in 3.01 A.3. Concrete shall be placed immediately after examination and approval by the Authority of the excavated caisson and positioning of the reinforcing cage.

2. Concrete shall be placed in such a manner that will preclude segregation of aggregate, infiltration of water, or any other occurrence which will tend to decrease the strength of the concrete or the integrity of the finished caisson.

3. Concrete may be placed by free fall in a dry caisson excavation providing there is no observable inflow of ground water. Before concreting, any water or loose soil material shall be removed to provide a clean, dry caisson excavation. Concrete shall be placed using a hopper equipped with a spout or an elephant trunk sized to allow the concrete to fall without striking the rebar cage or the sides of the excavation. Concrete placement shall be continuous to the top elevation of the caisson. In caisson excavations which have an observable inflow of ground water, the caisson shall be filled with water or slurry, and concrete shall be placed by tremie or pump line, as described in 3.01 D.4 and 5 below.

4. Concrete in caissons filled with water or slurry shall be placed by a tremie or pump line as described herein and in accordance with Section 03364 of these specifications entitled CONCRETE PLACED UNDERWATER. The minimum inside diameter of a tremie line shall be eight (8) inches and four (4) inches for a pump line. The outside of the tremie line shall be smooth so that there is no possibility of a projection becoming hooked on the reinforcing cage as the line is withdrawn during concrete placement. The line shall be clean and watertight. The wall thickness of the line shall be sufficient to provide the necessary strength and stiffness. The line shall be deployed so that there is minimum contamination of the concrete.

5. The bottom of the tremie or pump line shall be sealed with a diaphragm or a plate that is pushed away by the hydrostatic pressure in the concrete-filled line when the line is raised slightly from the bottom of the caisson excavation.

   The bottom of the line shall then be kept a minimum of three (3) feet below the top of the column of fresh concrete. The concrete shall be placed in a continuous operation.

6. Temporary casing shall be withdrawn during concrete placement. Casing extraction shall be at a slow uniform rate, with the pull being kept in line with the vertical axis of the shaft. Concrete in the casing shall be maintained at a level sufficient to exceed the external soil and ground water pressure at all times during extraction.

7. After temporary casing is withdrawn, concrete shall be lightly vibrated or rodded to a maximum depth of five feet.

3.02 STEEL CORES

No splicing of cores will be permitted unless shown otherwise on the Basic Contract Drawings. Splices, where approved by the Authority, shall develop the full strength of the core section in both compression and bending. The Contractor shall use splice details developing the strength of the core sections similar to the HP 30,000 Champion Splices as manufactured by the Associated Pile and Fitting Corp. of Clifton, New Jersey or approved equal.

3.03 WELDING AND SPLICING

A. Perform all welding in accordance with requirements for shielded metal arc welding of AWS D1.1 for buildings or D1.5 for bridges and other structures.

B. Only use welders qualified by tests prescribed in AWS D1.1 or D1.5, as applicable.

C. Unless stricter requirements are shown on the Basic Contract Drawings, splice sections of permanent caisson with approved full penetration butt weld or use Advance Splicer Sleeve S-18000, as manufactured by Associated Pile and Fitting Corporation, Clifton, New Jersey or approved equal, if available for the shaft diameter shown on the Basic Contract Drawings. The sleeve shall be continuously welded on both ends to the casing so as to develop 100 percent of the bending capacity of casing section being spliced. Both casing ends shall be square cut and seated to bear. Use an approved jig or alignment device during welding to maintain the required straightness of casing specified in 1.04 B.2.

3.04 FIELD QUALITY CONTROLS

A. Integrity testing may be performed by the Authority

B. Inspection

1. Cooperate with the Authority and furnish services as he may require for inspecting and obtaining data. These services shall include but not limited to:

   a. The measurement of length of various equipment used in construction operations.

   b. Lowering of the Authority with a safety cage or harness down to rock sockets.

   c. Providing the Authority with a light for inspection and having the crane operator on alert duty all the time during the inspection of the caisson.

2. During the time the Authority is inspecting the caisson, there shall be no driving of caissons, piling or sheeting within 200 feet of the caisson being inspected nor any blasting within the construction site.

3. The Authority will keep records of each caisson installed. Such records will include the following data:

   a. Date of drilling; concrete placement

   b. Caisson designation

   c. Type and size of caisson

   d. Elevation of ground surface

   e. Elevation of bottom of caisson

   f. Length of temporary casing

   g. Log of drilling operations and materials encountered

   h. Composition and properties of drilling slurry

   i. Concrete composition and measured slump

   j. Method of concrete placement

   k. Volume of concrete placed

   l. Log of concrete placement operations

   m. Results of integrity testing

   n. Deviation of completed caisson from specified location and alignment

   o. Description of any grouting operations to repair caisson

4. In addition to all other inspection requirements for concrete as specified in this Section and in Section 03364 entitled "Concrete Placed Underwater", the Authority may direct that cores be obtained in accordance with procedures described in Item 3.05 herein to check on the quality of concrete placed.

3.05 BORING AND SAMPLING

A. When shown on the Basic Contract Drawings or when directed by the Authority, take borings before the start of caisson drilling operations, at the locations and to the depths specified by the Authority.

B. Drilling, soil sampling, and rock coring procedures shall be in accordance with the Technical Specification entitled "Test Borings and Monitor Well Installation," latest version.

C. Inspection of the boring operation and preparation of the boring log(s) will be by the Authority.

3.06 UNACCEPTABLE CAISSONS

A. Unacceptable caissons are caissons that are installed out of position, alignment, top or bottom elevation, damaged or not constructed in accordance with these specifications as indicated by the results of integrity testing or other examination by the Authority. The Authority, may evaluate the magnitude of loads, either lateral or axial, that can be supported by the as-built drilled shaft. Should it be determined that the as-built caisson is unacceptable, the Contractor shall repair the caisson to the satisfaction of the Authority or shall provide a replacement or an additional caisson as directed by the Authority that will conform to the specified requirements all at no additional cost to the Authority.

END OF SECTION

SECTION 02379

CAISSONS (DRILLED SHAFTS)

SUBMITTALS

APPENDIX A

Submit the following in accordance with the requirements of "Shop Drawings, Catalogue Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Proof of compliance with the experience requirements of 1.03 A.

B. Complete description of the proposed equipment and methods of caisson excavation and support of excavation.

C. Plan for use of bentonite slurry, if applicable, including design of slurry mix, methods and equipment for handling and disposing of slurry.

D. Details of concrete mix and ingredients as required in 1.05 of Section 03364 entitled CONCRETE PLACED UNDERWATER.

E. Shop drawings showing details of bracing of steel reinforcing cage or structural steel core, where shown, and design of spacing devices as required in 3.02 B.2 and 3; shop drawings or catalog cuts of all shoes and splices.

F. Details of equipment and methods for placing concrete into dry caissons and for tremie placement or direct pumping of concrete into caissons filled with water or slurry.

G. Certified mill test reports of all permanent caisson pipe, reinforcing and steel cores.

H. Detailed procedures for withdrawing temporary casing.

I. Soil and rock samples as specified in Item 3.05.

J. Record drawings showing the actual as-built location, alignment, elevation and dimensions of all caissons.

END OF APPENDIX "A"

DIVISION 2

SECTION 02391

PROTECTIVE COATING FOR STEEL PILING

PART 1. GENERAL

1.01 SUMMARY

This Section and Appendix A to this Section specify requirements for shop application of protective coating.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 950	Fusion Bonded Epoxy Coated Structural Steel H-Piling and Sheet Piling
ASTM D 3359	Standard Methods for Measuring Adhesion by Tape Test
ASTM D 4417	Method C
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM G 8	Cathodic Disbondment

U.S. Army Corps of Engineers (ACOE)

Paint Specification C-200A

Steel Structures Painting Council SSPC)

SSPC-SP 1	Solvent Cleaning
SSPC-SP 5	White Metal Blast Cleaning
SSPC-SP 10	Near-White Blast Cleaning
SSPC-SP 11	Power Tool Cleaning to Bare Metal
SSPC-PA 1	Shop, Field and Maintenance Painting
SSPC-PA 2	Measurement of Dry Paint Thickness with Magnetic Gages
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel

American Welding Society (AWS)

AWS D1.5	Guidelines

1.03 SUBMITTALS

See Appendix "A" for Submittals requirements.

PART 2. PRODUCTS

2.01 ABRASIVES

A. Abrasives shall be dry and free of oil, grease, corrosion producing chemicals, or other deleterious contaminants. Do not use silica sand.

B. Abrasives shall be shaped and sized to produce a sharp, angular profile height of 2-3 mils, unless the requirements of the coating manufacturer are more restrictive. In this case, comply with profile requirements specified by the approved coating manufacturer.

2.02 COATINGS

A. Fusion Bonded Epoxies

1. Scotchkote 206N, manufactured by 3M, St. Paul MN
2. Pipe Clad 2000, manufactured by Lilly Industries, Inc. North Kansas City, MO
3. Nap-Gard 72500, manufactured by Dupont Powder Coatings, Houston, TX

B. Coal Tar Epoxies

1. Bitumastic 300 M, manufactured by Carboline, St.Louis,MO
2. Hempel 119US-19990, manufactured by Hempel Coatings (USA), Inc. Houston, TX
3. Coal Tar Epoxy Series 9000, manufactured by Mercury Paint Corp., Brooklyn, NY
4. Sigma 3307 Coal Tar, manufactured by Sigma Coatings, Harvey, LA

C. Touchup coatings for repair of coating defects and damage, as recommended by the approved coating manufacturer.

PART 3. EXECUTION

3.01 SURFACE PREPARATION

A. Weld Spatter, Sharp Edges, and Holes

1. Remove slag, flux deposits, weld spatter, and surface irregularities such as slivers, tears, fins, and hackles; all within AWS D1.5 Guidelines. Grind all resulting burrs smooth, including burrs around holes. Do not remove any weld material that will weaken weld strength.

2. Prior to preparation, break sharp edges such as those created by flame cutting and shearing. The rolled edges of angles, channels, and wide flange beams do not normally require further rounding unless specifically shown on the Contract Drawings.

B. Compressed Air Cleanliness

1. Compressed air shall be free from moisture and oil contamination.

2. Use the white blotter test in accordance with ASTM D 4285 to verify the cleanliness of the compressed air. Conduct the test at the start of each shift for each compressor system.

3. If testing indicates contamination, soiling or discoloration visible on the paper, change filters, clean traps, add moisture separators or filters, or make adjustments as necessary to achieve clean, dry air. Reinspect surfaces prepared or coated since the last satisfactory test, and reblast such surfaces at no additional cost to the Authority.

C. Prior to dry abrasive blast cleaning, remove all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from bare steel in accordance with SSPC-SP 1 Solvent Cleaning.

D. Abrasive Blasting

1. All steel surfaces to be coated shall have SSPC-SP 10 Near White Blast Cleaning. Blast cleaning shall be accomplished using abrasive as stipulated in 2.01 herein.

2. For all steel surfaces to be coated provide a sharp, angular, uniform anchor pattern with a profile height of 2-3 mils, unless the requirements of the coating manufacturer are more restrictive. Peak counts per square inch shall be 80 or greater, when tested in accordance with ASTM D 4417, Method C.

3. SSPC-VIS 1 shall be used as an aid in determining the quality of cleaning.

3.02 PAINT STORAGE, MIXING AND HANDLING

A. Store materials not in actual use in tightly covered containers at a minimum ambient temperature of 45 degrees F in a well-ventilated area. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue. Protect from freezing where necessary.

B. Mixing and Thinning of Coal Tar Epoxies

1. Do not use coating materials that have exceeded their shelf life.

2. When required by the approved manufacturer, warm paints stored at less than 50oF to above 50oF prior to mixing.

3. Mix all coatings in accordance with the requirements of the approved coating manufacturer using mechanical equipment such as a jiffy mixer.

4. Mix only complete kits of multi-component materials. Mixing of partial kits is not allowed.

5. Do not use two component materials beyond the pot life established by the approved manufacturer's written instructions.

6. Do not thin any coatings unless approved in writing by the manufacturer and the Authority. If thinning is required and authorized, use only those types, brands, and amounts of thinner stipulated by the coating manufacturer.

3.03 COATING APPLICATION

A. General:

1. Apply the coatings in accordance with the requirements of this Section, the coating manufacturer, and SSPC-PA 1.

2. In the event of a conflict between the manufacturer's technical data and the requirements of this Section, comply with this Section unless the requirements of the manufacturer are more restrictive. In these cases, advise the Authority of the discrepancies in writing, and comply with the Authority's written resolution.

B. Quality of Surface Preparation and Time Restrictions Prior to Painting:

1. Verify that the surface exhibits the specified degree of cleaning immediately prior to coating. Reclean deficient areas. Do not apply coating unless the prepared surface is inspected and approved by the Authority.

2. Apply the first coat within 12 hours of cleaning to bare metal. If the bare substrate is allowed to remain uncoated for more than 12 hours, or rerusting is evident, reclean the surface prior to painting.

C. Surface Cleanliness Prior to Coating and Between Coats:

1. Do not perform coating application in areas where dust is being generated.

2. Thoroughly clean the surface of each coat prior to the application of the next to remove spent abrasive, dirt, dust, cement spatter, and other deleterious materials. Pay particular attention to the removal of detrimental residue from surfaces such as corners and pockets. Clean the surfaces by vacuuming or blowing down with compressed air.

3. If grease or oil have become deposited on the bare steel or on the surface of any of the applied coats, remove by solvent cleaning in accordance with SSPC-SP 1 prior to the application of the next coat. Use a solvent that is acceptable to the coating manufacturer.

D. Ambient Conditions During Coating Application of Coal Tar Epoxies:

1. Apply coatings under the following conditions unless the requirements of the coating manufacturer are more restrictive:

a. Surface and Air Temperatures - Between 50oF and 100oF.

b. Relative Humidity - Less than 90%.

c. Dew Point - Surface temperature at least 5oF above the dew point temperature of the surrounding air.

d. Frost/Rain - Do not apply coatings to surfaces containing frost or free standing water, or during rain, fog, or similar detrimental weather conditions.

2. Remove and replace any coating that is exposed to unacceptable conditions (e.g. rain or dew) prior to adequate curing.

E. Methods of Application:

1. For fusion bonded epoxies, coat exposed surfaces of steel piles within limits shown on the Basic Contract Drawings with electrostatically-applied, fusion-bonded epoxy to a minimum dry coat thickness of 18 mils, as tested in accordance with SSPC-PA 2. Follow the coating manufacturer's printed instructions regarding handling, mixing, preheating, application, post-baking and curing.

2. For coal tar epoxies, coat exposed surfaces of steel piles within limits shown on the Basic Contract Drawings using spray application to a minimum dry film thickness of 18 mils, as measured in accordance with SSPC-PA 2. Apply one or two coats as recommended by the approved manufacturer to achieve the required dry film thickness.

F. Performance Requirements

1. The cured coating shall be of uniform gloss and thickness and shall be free of blisters, pinholes, fisheyes, sags, runs and any other irregularities.

2. Test for continuity of coating with a holiday tester of 100 volts or less and repair all holidays detected to meet such test.

3. Conduct adhesion tests in accordance with ASTM D3359 or ASTM D4541 as directed by the Authority and repair all test areas. The acceptance criteria for the testing shall be obtained by the Contractor from the coating manufacturer and submitted for approval by the Authority. Remove all defective coating and reblast and recoat such areas in accordance with this Specification.

4. Maintain all quality control records on the results of all inspections and submit all results to the Authority as stipulated in Appendix "A".

G. Repair of Damaged & Unacceptable Coatings Before and After Driving:

1. Based upon results of the tests stipulated in 3.03 F. herein, repair coating as follows:

a. Surface preparation of defective area.

(1) Prepare the surface by cleaning in accordance with SSPC-SP 1 Solvent Cleaning followed by SSPC SP-3 Power Tool Cleaning. Use a solvent that is acceptable to the approved coating manufacturer.

(2) If the damage exposes the substrate, remove all loose material and prepare the steel in accordance with SSPC SP 11.

b. Coating Application in Repair Areas

(1) When the bare substrate is exposed in the repair area, reapply all coats of the system to the specified thickness.

(2) When the damage does not extend to the bare substrate, reapply to only the affected coats.

(3) Maintain the thickness of the system in overlap areas within the specified total thickness tolerances.

(4) For field touch-up after driving, use touch-up coatings as recommended by the approved coating manufacturer.

3.04 INSPECTION

A. Inspection will be performed in accordance with the Section of Division 1 entitled "Inspections and Rejections".

3.05 HANDLING

A. Use nylon slings to handle coated steel piles during handling, shipment and delivery to the construction site.

B. Do not handle or move coated steel piles until the coating has cured.

END OF SECTION

DIVISION 2

SECTION 02391

PROTECTIVE COATING FOR STEEL PILING

APPENDIX A

SUBMITTALS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - General Provisions:

1. Product Data:

   a. For specific products listed in 2.02 A., B. and C. of this Section, submit the following for each product:

      (1) Manufacturer's printed Technical Data Sheets and Material Safety Data Sheets (MSDS).

      (2) Manufacturer's printed product label and application instructions.

   b. For products other than those expressly listed in 2.02 A., B. and C. of this Section, submit the following for each product:

      (1) Information adequate for the Authority to compare the specified product and the proposed substitution; including, but not limited to, technical specifications, test data, references to product use in existing installations, or any other data required by the Authority.

2. Surface Preparation/Coating Plan:

   a. Written procedures for conducting the Work of this Section including but not limited to, the preparation of surfaces, abrasive "work mix" analysis; coating mixing, application, and repair; recoat times and cleaning between coats; and specific details for the preparation and coating of welds.

   b. A comprehensive listing of the equipment that will be used for surface preparation and coating. A description of equipment repair and replacement capability, including the procedures that will be followed in the event of equipment failure so that lost production time is kept to a minimum.

3. Steel Test Panel:

   a. Submit one 8" x 8" blasted steel test panel for approval by the Authority. The panel shall be prepared using the same procedures, equipment, and abrasive "work mix" described in A.2. herein. The approved test panel shall be used by the Authority as a standard of judgment for approval of production operations.

b. Identify the name and chemical composition of detergents or solutions that will be used if it is necessary to clean the surface of one coat prior to the application of the next. Only detergents which are environmentally safe and which will have no adverse effect on aquatic life are acceptable. Submit the MSD Sheets for the chemicals and detergents. Use chemicals and detergents that are acceptable to the coating manufacturer.

4. Quality Control Inspection Plan - Submit the quality control inspection plan that will be followed to confirm that all work under this Contract complies with the requirements of this Section. The plan shall include the following at a minimum:

   a. Inspection organization chart including lines of authority and the experience, training, and qualifications of all quality control personnel.

   b. Written inspection procedures for all phases of the Work, including the frequency of inspections that will be performed, and the handling of non-conforming Work.

   c. Documentation procedures including samples of the actual inspection forms that will be used for Work of this Section.

   d. Written description of equipment to be used for surface preparation and coating application inspection, calibration procedures, frequency of calibration, and the methods for handling equipment that is found to be out of calibration.

5. Inspection Log or Report:

   a. Submit one copy of the log or report form package to the Authority each seven calendar days.

END OF APPENDIX A

DIVISION 2

SECTION 02510

PLACEMENT OF PORTLAND CEMENT CONCRETE PAVING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for placement of Portland cement concrete pavement and bonded or unbonded Portland cement concrete overlays of existing pavement. For requirements for furnishing Portland cement concrete see Section 03301 entitled "Portland Cement Concrete, Long Form".

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway Transportation Officials (AASHTO)

AASHTO M 254	Corrosion Resistant Coated Dowel Bars.

American Society for Testing and Materials International (ASTM)

ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM D 1751	Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
ASTM D 4397	Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
ASTM E 950	Measuring the longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
ASTM E 1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph.

American Concrete Institute (ACI)

ACI 309	Guide for Consolidation of Concrete.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Placement and Protection During Inclement Weather

Do not commence placing operations when heavy rain or other damaging conditions appear imminent. Have on hand at the construction site at all times when placing concrete sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Suspend placement of concrete whenever rain or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete or changes the water content of the surface concrete. All unhardened concrete shall be immediately covered and protected from the rain or other damaging weather. Completely remove and replace at no cost to the Authority any pavement damaged by rain or other weather conditions.

B. Cold Weather Conditions

1. Cold weather concreting shall conform to the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".
2. Ensure that reinforcement, forms and ground with which concrete will be in contact are completely frost free. The use of chemicals to eliminate frost will not be permitted.
3. Comply with all provisions herein for placing and curing.

C. Hot Weather Conditions

Hot weather concreting shall conform to the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".

1.04 IN-PLACE PAVEMENT AND OVERLAY REQUIREMENTS

A. Concrete shall conform to the thicknesses shown on the Basic Contract Drawings. Acceptance will be on a lot basis as set forth in Section 03301 entitled "Portland Cement Concrete, Long Form". Test for thickness only after all corrections for smoothness and grade have been completed.

B. Pavement Alignment

Lateral deviation from the alignment of the pavement edge shown on the Basic Contract Drawings shall not exceed plus or minus 0.10 foot.

C. Final Surface Grade

The final surface shall conform to the finished grades shown on the Basic Contract Drawings within a target tolerance for vertical deviation of plus or minus 0.04 foot, except where closer tolerance is required for proper functioning of appurtenant structures and drainage. The final surface abutting existing pavements shall smoothly transition to the existing surface grades. The Engineer will test the final surface, which will be accepted or rejected on a lot basis as set forth in 3.03 B. For areas within the runway, taxiway or apron edge markings, and for roadways, the Engineer will adjust Contract compensation based on the percentage of grade measurements exceeding the target tolerance as set forth in 4.02 A. Make corrections for deficiencies as set forth in 3.05 B and D.

D. Surface Smoothness

1. Airfield Pavements

a. Longitudinal Direction

The final surface shall have a Profile Index of 15.0 inches or less per mile and no deviation shall be greater than 0.4 inch in 25 feet. Testing and acceptance will be on a lot basis as set forth in 3.03 A.1. Adjustment to Contract compensation will be made based on the Profile Index of the lot as set forth in 4.02 B. Make corrections for deficiencies in surface smoothness as set forth in 3.05 A and D.

b. Transverse Direction for areas within runway or taxiway edge markings and longitudinal and transverse direction for aprons and paved areas outside runway or taxiway edge markings

The final surface shall be smooth and free from irregularities greater than 1/4 inch when tested with a 16-foot straight edge. Testing and acceptance will be on a lot basis as set forth in 3.03 A.2. Make corrections for deficiencies in surface smoothness as set forth in 3.05 A and D.

2. Roadway Pavements

a. The final surface shall have a Profile Index of 15.0 inches or less per mile and no deviations shall be greater than 0.4 inch in 25 feet. Testing and acceptance will be on a lot basis as set forth in 3.03 A.1. Adjustment to Contract compensation will be made based on the Profile Index of the lot as set forth in 4.02 B. Make corrections for deficiencies in surface smoothness as set forth in 3.05 A and D.

b. Longitudinal direction for roadways where paving lane is less than 500 linear feet

Final surface shall be smooth and free of irregularities greater than 1/8 inch when tested with a 10-foot straight edge. Testing and acceptance will be as set forth in 3.03 A.1. Make corrections for deficiencies in surface smoothness as set forth in 3.05 A and D.

E. Check dowel bars and assemblies for position and alignment. The maximum permissible tolerance for dowel bar alignment in each plane, horizontal and vertical, shall be 2 percent or 1/4 inch per foot of dowel bar. Dowel position shall meet the following:

1. Horizontally, within plus or minus 1/2 inch of specified spacing.

2. Vertically, within plus or minus 1/2 inch at mid-depth of slab.

3. Midpoint of the dowel relative to the center of the joint, within one inch.

F. Airfield concrete pavements shall not exhibit any cracks prior to opening the pavement to aircraft operations. For all other pavement the concrete shall not exhibit any cracks prior to opening to normal operations.

G. For slipformed concrete not more than 15 percent of the total free edge of each five hundred feet of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch, and none of the free edges of the pavement shall have an edge slump exceeding 3/8 inch. The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches from the edge. Make corrections for deficiencies made as set forth in 3.05 C.1.f.

1.05 QUALITY ASSURANCE

A. Develop a Quality Control Program in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form". In addition to the requirements therein, the program shall address all elements which affect the quality of the pavement including but not limited to:

1. Placing and consolidation.
2. Joints.
3. Dowel placement and alignment.
4. Finishing and curing.
5. Surface smoothness.
6. Alignment and grade.
7. Thickness.
8. Surface preparation for unbonded overlays.
9. Surface preparation for bonded overlays.

B. Surface Smoothness

Perform quality control smoothness testing of the final surface using methods which produce results with measuring units and accuracy similar to the Engineer's acceptance testing specified in 3.03 A. As a minimum test the final surface of each day's paving after initial curing is completed. Submit written results to the Engineer after each test. Test results shall clearly identify the test location. Upon completion of all quality control testing and any required corrective work, the Engineer will perform acceptance testing in accordance with 3.03 A.

C. Final Surface Grade Side-Form Construction

Perform quality control surveys of forms to check grades. Measure elevations at the finished grade locations shown on the Basic Contract Drawings. Submit to the Engineer written survey results prior to scheduling concrete placement. The survey results shall identify the location of each measurement by station and offset, measured elevations to the nearest 0.01 foot, required finished grades from the Basic Contract Drawings and the difference between measured elevations and required elevations to the nearest 0.01 foot. This survey is for Contractor's quality control. Acceptance of the finished surface will be as specified in 3.03 B.

D. Final Surface Grade Slipform Construction

Perform quality control surveys to check grades immediately after initial curing is completed. Measure elevations at the finished grade locations shown on the Basic Contract Drawings. Submit the written survey results to the Engineer. The survey results shall identify the location of each measurement by station and offset, measured elevations to the nearest 0.01 foot, required finished grades from the Basic Contract Drawings and the difference between measured elevations and required elevations to the nearest 0.01 foot. This survey is for Contractor's quality control. Acceptance of the finished surface will be as specified in 3.03 B.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Portland Cement Concrete

Conform to the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".

B. Forms

1. Straight side forms shall be made of steel having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth equal to the prescribed edge thickness of the concrete without horizontal joint, and a base width equal to the depth of the forms.

2. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer.

3. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.

4. Forms with battered top surfaces and bent, twisted or broken forms shall be removed from the construction site. Repaired forms shall not be used until inspected and approved by the Engineer.

5. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall vary from a true plane by not more than 1/8 inch in 10 feet, and the upstanding leg shall vary by not more than 1/4 inch. The forms shall have provisions for locking the ends of abutting sections together tightly for secure setting.

6. Forms shall have a top flange approximately two inches wide.

7. Forms may be punched to admit dowels.

C. Joints

1. Preformed bituminous joint filler shall conform to ASTM D 1751 and shall be punched to admit dowels. Filler for each joint shall be furnished in a single piece for the full depth and width required for the joint.

2. Dowels shall be straight, smooth, solid round bars, free from burring or other deformation that would interfere with free movement in the concrete. They shall be resistant to abrasion resulting from pavement expansion and contraction and shall be one of the following:

   a. Carbon steel (ASTM A 615, Grade 60) tightly encased in stainless steel tubing or infused with chromium over the entire exposed surface.

   b. Organic coated steel dowel bars (ASTM A 615, Grade 60) conforming to AASHTO M 254.

3. Joint support assemblies shall be capable of maintaining dowels and joint filler where required, in proper position and alignment both before and during concrete placement.

4. For expansion joints, furnish and install metal or plastic sleeve-type end caps for dowel bars. End caps shall cover four inches of the dowel, with a closed end containing a compressible plug to hold the end of the sleeve at least one inch from the end of the dowel bar.

5. Shop applied bond breaker, if used, shall meet the pullout requirements for AASHTO M 254.

6. Tie bars (ASTM A 615, Grade 40) shall conform to Section 03200 entitled "Concrete Reinforcement".

D. Cement Paste

A uniform mixture of cement, fine aggregate and water with the consistency of a paste, broomed out of the concrete as it is placed. A separately mixed paste will not be permitted.

E. Grout

1. Epcon A7, manufactured by ITW Ramset/Red Head, Wood Dale, IL.

2. Epcon Ceramic 6, manufactured by ITW Ramset/Red Head, Wood Dale, IL.

3. HIT HY-150, manufactured by Hilti Fastening Systems, Tulsa, OK.

4. Keligrout, manufactured by Kelken Construction Systems, Parlin, NJ.

5. Power-Fast Cartridge, manufactured by Power Fastening, Inc., New Rochelle, NY.

6. Sure Anchor I (J-51), manufactured by Dayton Superior, Oregon, IL.

7. An approved equal, as accepted by the State of New Jersey Department of Transportation and New York State Department of Transportation, which is chemically cured.

F. Welded Wire Fabric shall conform to Section 03200 entitled "Concrete Reinforcement".

G. Polyethylene Film: ASTM D 4397, two-ply.

PART 3. EXECUTION

3.01 PREPARATION

A. Surface Preparation

1. Full-Depth Pavement

a. Side-Form Construction

(1) After completion of the fine grading of the base course, lay and anchor forms to lines and grades shown on the Basic Contract Drawings. The base course shall be prepared at least one foot beyond the edge of all forms and shall be in firm contact with the forms for their entire length. After the forms have been set to the correct grade, thoroughly tamp the base course, either mechanically or by hand, at both the inside and outside edges of the base of the forms when the forms are not placed on a previously paved surface.

(2) Ruts or depressions in the subgrade or subbase caused by hauling or usage of other equipment shall be filled with suitable material (not with concrete or concrete aggregates) as they develop and shall be thoroughly compacted by rolling. If damage occurs to a stabilized subbase, it shall be corrected full depth by the Contractor at no additional cost to the Authority.

(3) If base course is dry, moisten it by sprinkling with as much water as it will readily absorb and so that moisture penetrates to a depth of at least 1/2 inch. Where necessary, in the opinion of the Engineer, commence such sprinkling or thorough wetting from 12 to 36 hours prior to placing concrete. Remove any standing pools of water before placing concrete.

(4) If the base is asphalt concrete or asphalt stabilized and either the ambient temperature is greater than 75 degrees F or the asphalt surface temperature is above 90 degrees F, whitewash the base surface with white pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to depositing concrete.

b. Slipform Construction

(1) The base course and subbase course on which the concrete will be placed shall be widened to extend beyond the paving machine track to support the paver without displacement.

(2) After the base course is placed and compacted, test the surface for smoothness in the presence of the Engineer. Test smoothness using a 10-foot straight edge laid in successive positions 5 feet on-center parallel to the centerline of the pavement. Advance the straight edge along the pavement in movements not exceeding 5 feet. Correct base course surface smoothness deviations exceeding 1/4 inch by removing and replacing the base full-depth in the deficient area.

(3) Test the base course for vertical deviations from required grades. Run levels at intervals of 50 feet longitudinally and transversely to determine the elevation of the finished base course. Correct vertical deviations exceeding 0.04 foot by removing and replacing the base full-depth in the deficient area. Submit test results to the Engineer in writing for approval before placement of concrete.

(4) Moisten base course and whitewash as set forth in 3.01 A.1.a (3) and (4).

2. Unbonded Concrete Overlays

a. Side-Form Construction

(1) Remove asphalt pavement in areas shown on the Basic Contract Drawings by milling, scraping or scarifying and chipping.

(2) Repair underlying pavement as directed by the Engineer.

(3) On milled asphalt surfaces, whitewash the surface with white-pigmented curing compound meeting the requirements of Section 03301, entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200-square feet. After application of the whitewash, allow pavement to cool prior to depositing concrete.

(4) Where shown on the Basic Contract Drawings, place an asphalt concrete leveling course as shown on the Basic Contract Drawings. Asphalt concrete shall conform to Section 02561 entitled "Asphalt Concrete Paving (FAA)", or Section 02551 entitled "Asphalt Concrete Paving".

(5) Where an asphalt concrete leveling course is required and the ambient temperature is 75 degrees F or greater, whitewash the surface with a white-pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to the depositing of concrete.

b. Slipform Construction

(1) Remove asphalt pavement in areas shown on the Basic Contract Drawings by milling, scraping or scarifying and chipping.

(2) Repair underlying pavement as directed by the Engineer.

(3) On milled surfaces or on an asphalt leveling course, whitewash the surface with white-pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to depositing concrete.

(4) Where shown on the Basic Contract Drawings, place an asphalt concrete leveling course as shown on the Basic Contract Drawings. Asphalt concrete shall conform to Section 02561 entitled "Asphalt Concrete Paving (FAA)", or Section 02551 entitled "Asphalt Concrete Paving".

(5) Where an asphalt concrete leveling course is required and the ambient temperature is 75 degrees F or greater, whitewash the surface with a white-pigmented curing compound meeting the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form". Apply at a minimum rate of one gallon per 200 square feet. After application of the whitewash, allow pavement to cool prior to the depositing of concrete.

3. Bonded Concrete Overlays

a. Remove asphalt pavement in areas shown on the Basic Contract Drawings by milling, scraping or scarifying and chipping.

b. All surfaces that will be in contact with concrete shall be abrasive blasted or shot blasted within 8 hours of the start of concrete placement or if the area was open to vehicular traffic after final closure of the traffic prior to concrete placement, but not more than 8 hours before placement of overlay.

c. After removal and abrasive blasting, thoroughly clean concrete surfaces of dust, concrete particles, slurry produced by wet sawing or wet scarifying and other debris by oil-free air blast followed by water blast to the satisfaction of the Engineer. Remove all standing water. Complete surface cleaning just prior to placing concrete.

d. Abrasive blasting shall conform to the applicable requirements of Section 02574 entitled "Abrasive Blasting of Pavements".

e. The prepared surface will be tested for bond strength in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

f. In the event that full-depth slab repair is required by the Engineer in areas found to be deteriorated, preparation for concrete shall not commence on newly placed slabs earlier than 14 days after placement of base slab concrete or until the concrete has attained a compressive strength of 4,000 psi.

g. Moisten prepared surface immediately prior to placing concrete. Remove any standing water or pools.

B. Placing Forms

1. Prior to setting of forms, the Engineer will approve the preparation of the base or existing pavement upon which the concrete is to be placed.

2. Form sections shall be tightly locked and shall be free from play or movement in any direction. Stake forms into place with not less than 3 pins for each 10-foot section. Place a pin at each side of every joint. Set forms so that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Clean and oil forms prior to the placing of concrete.

3. Check alignment and grade of forms and make corrections prior to placing concrete. Form alignment and grade shall meet the requirements set forth in 1.04 B and C.

4. Straighten bent dowels, whether placed under this Contract or by others, using tools approved by the Engineer. Do not apply heat to dowels.

5. Clean forms, dowels and all steel which will be embedded in concrete, of all loose rust, scale, paint and other objectionable materials. Coat forms with non-staining mineral oil or other approved material before each use.

6. Check all form locking devices to ensure that they are in place and properly secured.

7. Do not place concrete until the Engineer has approved the form work and the base course or existing pavement upon which the concrete is to be placed.

3.02 APPLICATION

A. Pavement Joints

1. Furnish and install materials for joints as specified herein and in Section 02578 entitled "Pavement Joint Sealing".

2. The type, size, shape and location of joints shall be as shown on the Basic Contract Drawings.

3. Construct all joints true to line with their faces perpendicular to the surface of the pavement. Joints shall vary by not more than 1/2 inch from line and shall be true to line with not more than 1/4-inch variation in 10 feet from their designated position. The vertical surface of the pavement adjacent to all formed joints shall be finished to a true plane and edged to a radius of 1/8 inch or as otherwise shown on the Basic Contract Drawings.

4. Joint filler shall be supported in the support assembly perpendicular to the slab surface, shall be set below the surface of the slab to accommodate the sealant, and the top edge of the joint filler shall be protected during concrete placement by a metal channel cap.

5. Contraction joints shall be saw cut. To saw cut contraction joints use a two stage sawing operation. A chalk line or other suitable guide shall be used to mark the alignment of the joint. The first stage saw cut shall be one saw blade in width and to the depth shown on the Basic Contract Drawings. Sawing shall commence as soon as the concrete has reached its final set and cutting does not chip, spall or tear the concrete regardless of weather conditions. Have on hand a sufficient number of saws and cut all joints in one continuous operation. The saw shall produce a cut that does not ravel or damage the concrete 1/8 inch beyond the edge of the sawcut. Immediately after saw cutting, thoroughly flush the joint with water to remove all waste from sawing. Have on hand one standby saw in good working order and an ample supply of saw blades at the construction site at all times during sawing operations. Perform second stage saw cuts not sooner than 72 hours after concrete is placed or curing is completed, whichever is less. Second stage sawing shall cut the slot required for the joint sealer to the dimensions shown on the Basic Contract Drawings.

6. Plan each day's operations to end against a temporary bulkhead, at a contraction joint or at a thickened edge joint.

7. Where required on the Basic Contract Drawings, form keyways in the plastic concrete by means of side forms. The keyway shall be formed to a tolerance of 1/4 inch in any direction. The dimension of the keyway forms shall vary by not more than plus or minus 1/4 inch from the mid-depth of the pavement.

B. Dowels and Tie Bars

1. Place dowels of required size and type at locations shown on the Basic Contract Drawings.

2. Set all dowels and tie bars accurately, parallel to the pavement surface and, except for skewed or irregular joints, perpendicular to the pavement joint. The maximum permissible tolerance on dowel bar alignment and position shall meet the requirements of 1.04 E.

3. At all contraction joints and construction joints, apply a thin even film of lubricating oil to one-half of each dowel, unless the dowels are coated with a shop applied bond breaker.

4. Support dowels and tie bars rigidly using approved assemblies capable of holding dowels or tie bars and joint filler in position during the entire construction operation.

5. Install dowels and tie bars in existing or previously placed concrete as follows:

   a. Core drill holes in existing concrete. Do not use impact or percussion drills if spalling of the concrete occurs.

   b. Clean out hole and grout dowels and tie bars in place in accordance with the grout manufacturer's printed instructions.

   c. Coat exposed portions of dowels with lubricating oil, unless the dowels are coated with shop applied bond breaker.

6. Tie bars shall consist of deformed bars installed in joints as shown on the Basic Contract Drawings. Place tie bars at right angles to the centerline of the concrete slab and space them at intervals shown on the Basic Contract Drawings. They shall be held in position parallel to the pavement surface and in the middle of the slab depth. When tie bars extend into an unpaved lane, they may be bent against the form at construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, lubricated or enclosed in sleeves.

C. Placing Concrete

1. General

   a. Unless otherwise specified on the Basic Contract Drawings, the Contractor has the option of side-form or slipform paving.

   b. At any point in the concrete conveyance, the free vertical drop from one point to another or to the underlying surface shall not exceed 3 feet.

   c. Place concrete only in the presence of the Engineer and by methods approved by the Engineer.

   d. Place concrete for full-depth pavement on a moistened surface, but take precautions to prevent water from entering and ponding where concrete is being placed or setting.

2. Side-Form Method

a. For the side-form method, deposit concrete in such a manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or non-agitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, place and spread concrete using an approved mechanical spreading device that prevents segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels – not rakes. Do not allow workers to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substance.

b. Deposit concrete as near to expansion and contraction joints as possible without disturbing them but do not dump concrete from the discharge bucket or hopper onto a joint assembly unless the hopper is centered above the joint assembly.

c. Thoroughly consolidate concrete against and along the faces of all forms and previously placed concrete and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Do not permit vibrators to come in contact with a joint assembly.

3. Slipform Method

a. Place concrete with an approved crawler-mounted, slip-form paver designed to spread, consolidate and shape the freshly placed concrete in one complete pass of the machine so that a minimum of hand finishing will be necessary to achieve a dense and homogeneous pavement in conformance with requirements of the Basic Contract Drawings and Specifications. Place concrete directly on top of joint assemblies to prevent them from moving when the paver moves over them. Side forms and finishing screeds shall be adjustable to the extent required to achieve the specified pavement edge and surface tolerance. The side forms shall be of dimensions, shape and strength to support the concrete laterally for a sufficient length of time so that no edge slumping exceeds the requirements set forth in 1.04 G. Complete final finishing while the concrete is still in the plastic state.

b. In the event that slumping or sloughing occurs behind the paver or if there are any other structural or surface defects which, in the opinion of the Engineer, cannot be corrected within specified tolerances, immediately cease paving operations until proper adjustment of the equipment or satisfactory procedures and pavement are achieved. Complete the balance of the work with the use of standard metal forms and the formed method of placing and curing. Any concrete not corrected to permissible tolerances shall be removed and replaced at no cost to the Authority.

c. Operate the slipform paver on staked string lines on each side of the paver to control vertical and horizontal placement. The string line shall consist of piano wire and shall be supported as required to prevent sag.

D. Concrete Placing and Finishing Equipment

1. Side-Formed Pavements 8-Inches Thick or Greater

a. Concrete shall be spread, screeded, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. Use internal vibrators to effectively consolidate concrete for the full paving width without causing segregation. The rate of vibration of internal type vibrators shall be not less than 7,000 cycles per minute. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than one foot from the vibrating element. Furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

The previous criteria relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete.

b. Use manual, hand-held vibrators adjacent to joint assemblies and similar locations where gang-mounted vibrators are not practical.

c. Check all vibrators prior to the start of Work and a minimum of twice daily to verify that they are working properly.

d. Provide manual tools, such as bull floats, trowels, straight edges, brooms and other similar hand tools.

2. Side-Formed Pavements Less than 8-Inches Thick

a. For pavements less than 8 inches thick vibrating surface pans or screeds will be allowed. Operating frequencies for surface vibrators shall be as required to achieve uniform consolidation without excess latents being developed at the surface of the finished concrete.

b. Provide manual tools, such as bull floats, trowels, brooms and other similar hand tools.

c. Use manual, hand-held vibrators adjacent to joint assemblies and similar locations where gang-mounted vibrators are not practical.

d. Check all vibrators prior to the start of work and periodically during construction progress to verify that they are working properly.

3. Slipform Paver

The slipform paver shall be equipped with traveling side forms of sufficient dimensions, shapes and strength to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section.

a. The slipform paver shall be operated and manned by personnel experienced and trained on the operation of the equipment.

b. The slipform paver shall, when arriving at the construction site and at each time the paver is transported from one location to another, be thoroughly inspected and checked, by an experienced person, preferably the manufacturer's representative, for misalignment, warping, breakage or inadvertent changes in the settings of various control elements. This shall include inspecting the configuration of the main screeds when in paving position. Perform inspections in accordance with the recommendations of the manufacturer of the slipform paver used for the Work.

c. The slipform paver shall be of a type that permits vertical adjustment of side tracks so that where there is existing pavement, the machine can operate with one track placed on the existing pavement and the other placed on the subgrade.

d. The slipform paver will be subject to approval by the Engineer prior to starting paving operations. The paver shall be self-propelled and designed for the specific purpose of placing, screeding, consolidating and finishing concrete pavement slabs true to grade and cross-section in one complete pass without the use of fixed forms. The slipform paving machine shall be equipped with electronically controlled devices to control the grade and alignment of the finished surface from wire lines on both sides of the paver regardless of the condition of the surface the paver is traveling upon. The paver shall be equipped with means for spreading the concrete to a uniform depth before it enters the throat of the paver. The paver shall vibrate the concrete internally with sufficient intensity to consolidate the concrete throughout its entire depth and width. The paver shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements. It shall weigh at least 2200 pounds per foot of paving lane width and be powered by an engine having at least 6.0 horsepower per foot of lane width. Vibrators shall be the internal type. Operating frequency for internal vibrators shall be between 8,000 and 12,000 vibrations per minute. Average amplitude for the internal vibrators shall be 0.025-0.05 inches. The number, spacing, and frequency shall be sufficient to achieve a dense and homogeneous pavement and to meet the recommendations of ACI 309 "Guide for Consolidation of Concrete". Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. Provide an electronic or mechanical means to monitor vibrator status. Check vibrator status a minimum of two times per day or when requested by the Engineer.

E. Placing Reinforcing Steel

The type and amount of steel reinforcement shall be as shown on the Basic Contract Drawings. For pavement thickness of 12 inches or more, install reinforcement steel by the strike-off method wherein a layer of concrete is deposited on the underlying material, consolidated and struck to the indicated elevation of the steel reinforcement. The reinforcement shall be laid upon the prestruck surface, and the remaining concrete shall then be placed and finished in the required manner. When placement of the second lift causes the steel to be displaced horizontally from its original position, provisions shall be made for increasing the thickness of the first lift and depressing the reinforcement into the hardened concrete to the required elevation. The increase in thickness shall be only as necessary to permit corrected horizontal alignment to be maintained. Any portions of the bottom layer of concrete that have reached initial set shall be removed and replaced with newly mixed concrete. Initial set is defined as concrete, which cannot be worked with a vibrator. For pavement less than 12 inches thick, position reinforcement on suitable chairs securely fastened to the base prior to concrete placement. Vibrate concrete after the steel has been placed. Regardless of placement procedure, the reinforcing steel shall be free from coating which could impair the bond between the steel and concrete. Regardless of the equipment or procedures used for installing reinforcement, ensure that the entire depth of concrete is adequately consolidated.

F. Consolidation and Finishing

1. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material; it shall be firmly placed without voids or segregation under and around all load-transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as set forth in 3.02 C.2.c. After the concrete has been placed and vibrated adjacent to the joints, operate the paver or finisher in a manner to avoid damage to or misalignment of joints. If uninterrupted operations of the paver or finisher, to, over and beyond the joints, cause segregation of concrete or damage to or misalignment of joints, the paver or finisher shall be stopped when the screed is approximately 10 inches from the joint. Segregated concrete shall be removed from the front of and off the joint; and the forward motion of the paver or finisher shall be resumed. Thereafter, the paver or finisher may be run over the joint without lifting the screed, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

2. The concrete shall be spread as soon as it is placed, and it shall be struck off and screeded by a paver or finisher. The machine shall go over each area once. When side forms are used, the tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling or other variation tending to affect the precision finish. During operation of the paver-finisher, maintain a uniform ridge of concrete ahead of the front screed for its entire length. When in operation, the paver-finisher shall be moved forward, always moving in the direction in which the work is progressing, and so manipulated that neither end is raised from the side forms during the striking-off process. The finished surface shall be uniform in texture, true to grade and cross section and free from porous areas. Wetting the surface to facilitate finishing will not be permitted.

3. Hand finishing methods will not be permitted, except under the following conditions: in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on grade; in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Concrete, as soon as placed, shall be struck off and screeded. Use an approved portable screed. Provide a second screed for striking off the bottom layer of concrete when reinforcement is used.

4. Apply water-fog or evaporation retardant immediately after the concrete has been worked with the paver or finisher, as set forth in Section 03301 entitled "Portland Cement Concrete, Long Form".

5. Use bull floats sparingly.

6. While the concrete is still plastic, test for trueness with a 16 foot straightedge swung from handles 3 feet longer than one-half the width of the slab. Hold the straightedge in contact with the surface in successive positions parallel to the centerline and go over the whole area from one side of the slab to the other, as necessary. Advance in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 inch thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. Cut down and refinish high areas. Give special attention to ensure that the surface across joints meets the smoothness requirements set forth in 1.04 D. Straightedge testing and surface corrections shall continue until the entire surface is free from observable departures from the straightedge and until the slab conforms to the required grade and cross section.

7. Any paver or finisher operation which requires appreciable hand finishing shall be immediately stopped and proper adjustments made or the equipment replaced.

G. Surface Texturing

Apply broom finish to all horizontal surfaces, unless otherwise shown on the Basic Contract Drawings, subject to the following:

1. Apply finish when the water sheen has practically disappeared and before applying the curing compound.

2. Use push broom or floor brush type, not less than 18 inches wide and made of good quality bass or bassine fibers not more than 4-1/2 inches long and with handles longer than half the width of the slab.

3. Provide adequate number of brooms to keep up with other operations. When high early strength concrete is used, give extra care and attention to ensure proper finish is applied prior to initial set of the concrete.

4. Wash and thoroughly dry brooms at frequent intervals and remove worn or damaged brooms from the construction site.

5. Draw broom across previously finished surface from the centerline to each edge of the paving strip with a slight overlap of strokes.

6. Corrugations thus made in surface shall be uniform in appearance, approximately 1/16 inch in depth and not more than 1/8 inch in depth.

7. Complete brooming before initial set of concrete and before concrete is in a condition in which the surface will be torn or unduly roughened.

H. Edging

Immediately following surface texturing, carefully finish the edges of slab along sides and at joints with an approved edging tool to form a smooth rounded surface of 1/8-inch radius and subject to the following:

1. Where corners or edges of slabs have crumbled and at any locations which have leaked sufficient mortar to make proper finishing difficult, remove loose fragments and soupy mortar, and fill solidly with a mixture of correct proportions and consistency and finish.

2. Edges shall be smooth, to line and free of unnecessary tool marks.

I. Removal of Forms

Removal of forms shall be subject to the following:

1. Exercise care not to damage concrete.

2. Do not remove until approved by Engineer.

3. Do not remove sooner than 12 hours after placing concrete except for concrete with an initial cure time of 6 hours.

4. After removal of forms, patch areas of concrete which, in the opinion of the Engineer, show excessive honeycomb by cutting out defective areas and by keying and refilling them with a mortar of cement, water and sand in the same proportions as those in the concrete.

5. After forms are removed, cure sides of slabs in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

3.03 FIELD TESTS

A. Smoothness Testing

1. Longitudinal Direction

a. The Engineer will use a lightweight profilometer meeting the requirements of ASTM E 950 Class 1 to measure the pavement surface profile.

b. The profile will be measured prior to opening the pavement to normal operations. Sweep the pavement prior to profilometer testing.

c. The profilometer test results will be used to simulate California profilograph testing of the pavement. The simulation will be used to compute the Profile Index in inches per mile using a 0.2 inch blanking band, in accordance with ASTM E 1274. A straight line moving average smoothing filter with a filter length of 3.00 feet will be used.

d. Testing will be performed on a lot basis. A lot is defined as an area consisting of 500 linear feet of consecutive concrete slabs in the longitudinal direction. When less than 250 feet remains after dividing the pavement into 500 linear foot lots, the remaining length will be added to the adjacent lot. When more than 250 feet remains a short lot will be tested.

e. For paving lanes 20 feet or less in width measurements will be made along the centerline of the concrete pavement slabs. Two lines of measurement will be made for paving lanes greater than 20 feet in width. Each line of measurement will be six feet from and parallel to the centerline of the concrete pavement slabs. The average of the two measurements will be considered as the result for the lot.

f. The Profile Index for the length of paving lane in each lot is converted to the Profile Index of the lot in inches per mile using the following formula:

$$PI = PT \times \frac{5280}{L}$$

Where:

PI	=	Profile Index, inches per mile
PT	=	Profile Index, inches per length in feet of paving lane in a lot
L	=	Length of the paving lane in the lot in feet

2. Transverse Direction

a. A lot is defined as 50,000 square feet of final paved surface. Where paving areas are not equally divisible into 50,000 square foot lots, odd sized lots between 25,000 and 75,000 square feet will be used. The odd sized lots will be used for the area remaining after the paved area is divided into 50,000 square foot lots.

b. Each lot will be evaluated by the Engineer with a 16-foot rolling straightedge provided by the Contractor and subject to approval by the Engineer. The Engineer at his sole discretion may elect to use a lightweight profilometer and straightedge simulation in lieu of rolling straightedge testing. Measurements will be made perpendicular to the centerline of the paving lanes at the center of each slab. Designed breaks in grade shown on the Basic Contract Drawings will not be included in the measurements. When measurements within a lot exceed the tolerance specified in 1.04 D, correct the deficiency in accordance with 3.05 A.

3. Longitudinal direction for roadways where paving lane lengths are less than 500 linear feet.

a. The Engineer will evaluate each paving lane with a 10-foot long rolling straightedge, which marks the length of surface variations that exceed the required tolerance.

b. Sweep the pavement prior to measurement.

c. Measurement will be taken along the centerline of each paving lane.

d. The Engineer will calculate the percentage of final surface which exceeds the required tolerance by dividing the measured length of the marked surface deficiencies by the total length of the paving lane.

B. Final Surface Grade Testing

1. Runways, Taxiways and Aircraft Aprons

The grades of the final surface of each lot will be measured at the finished grade locations shown on the Basic Contract Drawings. A lot is defined as 50,000 square feet of final pavement surface. Where paving areas are not equally divisible into 50,000 square foot lots, odd sized lots between 25,000 and 75,000 square feet will be used. The odd sized lots will be used for the area remaining after the paved area is divided into 50,000 square foot lots. Perform the survey jointly with the Engineer.

2. Roadways

The grades of the final surface of each lot will be measured at the finished grade locations shown on the Basic Contract Drawings. A lot is defined as 15,000 square feet of final pavement surface. Where paving areas are not equally divisible into 15,000 square foot lots, odd sized lots between 7,500 and 22,500 square feet will be used. The odd sized lots will be used for the area remaining after the paved area is divided into 15,000 square foot lots. Perform the survey jointly with the Engineer.

3.04 PROTECTION AND CURING

A. Protect concrete against defacement, loss of moisture and rapid temperature changes for at least seven days (except for concrete that has initial cure time of less than seven days) from the beginning of curing operations. Protect unhardened concrete from rain and flowing water. Protection shall include, but not be limited to:

1. Have all equipment and materials required for adequate protection and curing on hand ready for installation, prior to commencing concrete placement. Failure to make such provisions or failure to properly protect and cure concrete will be the cause for immediate suspension of concreting operations.

2. Immediately after form removal, protect and cure sides of slabs exposed by such removal, in the same way as provided for slab surfaces.

3. Do not use any covering material that has become contaminated with sugar, tannic acid or any other substance detrimental to Portland cement concrete.

4. Keep concrete surfaces wet at all times when covering materials are not in place.

B. Curing

Cure concrete in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

C. Use of Pavement

1. Do not use new pavement for construction equipment and provide such barricades as may be required to prevent the entrance of traffic on concrete slabs until fully cured.

2. The Engineer may allow traffic on concrete slabs earlier if tests of the samples of concrete taken during the placing of the slab show that the concrete has attained a minimum flexural strength of 550 psi.

3. If only the paver or finisher is to be carried on a previously placed slab in order to place concrete in adjacent lanes, a minimum flexural strength of 400 psi will be sufficient. Take precautions to prevent damage to the previously placed concrete.

3.05 CORRECTION OF DEFICIENCIES

A. Deficiencies in Surface Smoothness

1. Make corrections as specified in 3.05 D at no cost to the Authority in the event of the following:

   a. Longitudinal direction within Runway or Taxiway edge markings, and for roadways where paving lane length equals or exceeds 500 feet- The Profile Index exceeds 22.0 inches per mile, or the surface profile deviations exceed 0.4 inch in 25 feet, when tested in accordance with 3.03 A.1 unless the Engineer elects to accept the deficient surface subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 D.

   b. Transverse direction within runway or taxiway edge markings, longitudinal and transverse for aprons and paved areas outside runway or taxiway.

      (1) 15 percent of all measurements in a lot exceed the requirements of 1.04 D.2 when tested in accordance with 3.03 A.2.

      (2) Any deviations exceed 1/2 inch when tested with a 16-foot straightedge.

   c. Longitudinal direction for roadways where paving lane is less than 500 feet.

      (1) 15 percent of all measurements in a lot exceed the requirements of 1.04 D.2.b when tested in accordance with 3.03 A.3.

      (2) Any deviations exceed 1/4 inch when tested with a 10-foot straightedge.

B. Deficiency in Final Surface Grade

Make corrections as specified in 3.05 D at no cost to the Authority in the event of the following:

1. 15 percent of all measurements in a lot exceed the requirements of 1.04 C, when tested in accordance with 3.03 B.

2. Any individual measurement exceeds a grade tolerance of 0.06 foot when tested in accordance with 3.03 B.

3. Following the correction of deficiencies, the Engineer will retest the final surface of the concrete. In the event grade tolerance is exceeded, make additional corrections at no cost to the Authority.

C. Other Deficiencies

1. Remove and replace full concrete slabs in full depth pavement or bonded and unbonded overlays as specified in 3.05 D.3 and at no additional cost to the Authority if any of the following deficiencies exist in the finished pavement:

   a. Percent Within Tolerance Limits (PWL) for flexural strength is below 55 when calculated as specified in Section 03301 entitled "Portland Cement Concrete, Long Form".

   b. Percent Within Tolerance Limits (PWL) for thickness is below 55 percent when calculated in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form" using thicknesses measured after any required diamond grinding.

   c. Slabs exhibiting any cracks prior to opening the pavement to aircraft or normal operations, except as provided in Section 03301 entitled "Portland Cement Concrete, Long Form".

   d. Percent Within Tolerance Limits (PWL) for bond strength is below 55 when calculated in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form".

   e. For quick curing concrete if the initial flexural strength does not meet the requirements of Section 03301 entitled "Portland Cement Concrete, Long Form".

   f. For slipform concrete if the edge slump requirements of 1.04 G are not met.

   However, the Engineer may elect to accept the deficient concrete. In that case, if the Engineer and Contractor agree in writing that the concrete shall not be removed, it will be paid for at 50 percent of the Contract unit price as specified in Section 03301 entitled "Portland Cement Concrete, Long Form".

2. Remove and replace bonded overlays if more than 5% of a lot is found to be delaminated, when tested in accordance with Section 03301 entitled "Portland Cement Concrete, Long Form". Remove and replace delaminated concrete as approved by the Engineer.

D. Corrections

1. Remove and replace, or diamond grind, pavement deficient in surface smoothness, or final surface grade tolerance in accordance with all applicable requirements of the Basic Contract Drawings and this Section, at times approved by the Engineer, so as not to interfere with operations of the Authority or others using the area.

2. Diamond Grinding

   a. Diamond grinding may be used to correct deficiencies in surface smoothness and surface grade tolerance subject to approval by the Engineer. However, if removal of more than 3/4 inch of pavement is required to correct any deficiency, the deficient area shall be removed and replaced.

   b. The diamond grinding equipment shall be as approved by the Engineer and shall have a minimum grinding head of 36 inches and 54 to 59 diamond blades per foot of shaft.

c. Where grinding is required, grind the entire width of the pavement by the length of defective area. If, in the sole opinion of the Engineer, the deficiencies are closely spaced and grinding individual areas will adversely affect ride, grind the entire pavement surface.

d. Perform grinding prior to joint sealing and grooving.

e. Dispose of slurry produced from grinding operations off Authority property.

f. Perform diamond grinding, if required, at no additional cost to the Authority.

3. Remove and Replace Slabs

a. Remove and replace shall mean the removal of an entire slab or slabs even if the deficient area is only a portion of a slab.

b. Where removal is required, all edges of the slab or slabs shall be saw-cut full depth with a concrete saw. All saw cuts shall be perpendicular to the slab surface. Following edge sawcutting the slab shall be further divided by sawcutting full depth, at appropriate locations, and each piece lifted and removed. Suitable equipment shall be used to provide a vertical lift, and approved safe lifting devices shall be used for attachment to slab sections. No mechanical in-place breakers shall be used for slab removal.

c. Install dowels of the same size and spacing as shown on the Basic Contract Drawings, using drilling and grouting procedures specified in 3.02 B.5.

d. Repair any damaged base as directed by the Engineer.

e. Clean the surfaces of all joint faces of loose materials and contaminates. Coat all joint faces with a double application of curing compound. Do not allow curing compound to touch dowel bars.

f. Place concrete as specified for original construction.

PART 4. ADJUSTMENTS TO CONTRACT COMPENSATION

4.01 GENERAL

A. Notwithstanding other adjustments to Contract compensation or corrections specified herein for various deficiencies, no payment will be made for material that must be removed to correct deficiencies, or for that material placed in excess of the plus tolerance for the total thickness of concrete course as specified in 1.04 A.

B. The assigned unit price for concrete shall be one hundred thirty dollars ($130.00) per cubic yard or, in the case of Classified Work, the actual Contract unit price bid for the appropriate concrete item in the Schedule of Unit Prices For Classified Work.

C. Adjustments for surface smoothness and final surface grade will be based on the final test results, which are measured after the correction of deficiencies. Reductions in payment will be determined by the following:

$R = A \times T \times D \times F \times 0.037$

Where:

R = Reduction in payment per lot for surface smoothness or final surface grade, dollars

A = Area of lot, square feet

T = Design Thickness of Pavement in feet

D = Price per CY of concrete, assigned unit price or Contract unit price as set forth in 4.01 B.

F = Contract Unit Price Adjustment Factor specified in 4.02 A and 4.02 B.

Reductions in payment for failure to meet surface smoothness and final surface grades are calculated separately for the entire pavement or overlay surface. Deductions from Contract compensation are made for the requirement (surface smoothness or final surface grade), which results in the greatest payment reduction. Reductions for surface smoothness or final surface grade are in addition to all other adjustments to Contract compensation.

D. When the Engineer elects to adjust Contract compensation in lieu of correcting areas with deficiencies in surface smoothness, the Contract Unit Price Adjustment Factor specified in 4.01 C will set at 0.10.

4.02 ADJUSTMENT TO CONTRACT COMPENSATION FOR PAVEMENT DEFICIENCIES

A. Deficiency in Final Surface Grade Tolerance

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Exceeding Final Surface Grade Tolerance" by entering the appropriate row with the percentage of all measurements within a lot which exceed the grade tolerance, measured in accordance with 3.03 B, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR EXCEEDING FINAL SURFACE GRADE TOLERANCE	
Measurements Exceeding Grade Tolerance (Percent)	Contract Unit Price Adjustment Factor
0.0 – 5.0	0
5.1 – 10.0	0.05
10.1 – 15.0	0.25
15.1 and up	Corrective Work required as specified in 3.05.B.

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 C.

B. Deficiency in Surface Smoothness

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Surface Smoothness" by entering the appropriate row with the Profile Index, measured and calculated in accordance with 3.03 A.1, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR SURFACE SMOOTHNESS	
Average Profile Index (inches per mile)	Contract Unit Price Adjustment Factor
0.0 - 15.0	0.00
15.1 - 16.0	0.02
16.1 - 17.0	0.04
17.1 - 18.0	0.06
18.1 - 20.0	0.08
20.1 - 22.0	0.10
22.1 and up	Corrective Work required as specified in 3.05 A

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 C.

END OF SECTION

SECTION 02510

PLACEMENT OF PORTLAND CEMENT CONCRETE PAVING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

Submit detailed working drawings of formwork.

B. Samples

1. Sample of the joint dowel assembly.
2. Sample of the preformed bituminous joint filler.

C. Name of manufacturer and model number of the paver-finisher.

END OF APPENDIX "A"

DIVISION 2

SECTION 02553

ASPHALT CONCRETE PAVING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for plant mix macadam base course, bottom course, top course, bridge deck membrane, tack coat and overlay of existing pavement with asphalt concrete using performance graded asphalt specified in 2.02 B.

B. Except as in 1.01 C below, recycled asphalt concrete pavement (consisting of reclaimed asphalt pavement blended with new materials) may be used to the maximum percentages specified in 1.04 C.2.b.

C. Recycled asphalt concrete shall not be used in mixes where modified asphalts or "Rosphalt 50" additive are used.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M320	Performance-Graded Asphalt Binder.
AASHTO R028	Practice for Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV).
AASHTO T313	Method of Test for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR).
AASHTO T315	Method of Test for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR).
AASHTO T048	Method of Test for Flash and Fire Points by Cleveland Open Cup.
AASHTO T240	Method of Test for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test).

American Society for Testing and Materials (ASTM)

ASTM C 88	Test Method For Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
ASTM C 117	Test Method for Materials Finer than 75-micrometres (No. 200) Sieve in Mineral Aggregates by Washing.
ASTM C 127	Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
ASTM C 128	Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.

ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C 566	Test Method for Total Evaporable Moisture Content of Aggregate by Drying.
ASTM C 1252	Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced By Particle Shape, Surface Texture, and Grading).
ASTM D 75	Practice for Sampling Aggregates.
ASTM D 242	Specification for Mineral Filler for Bituminous Paving Mixtures.
ASTM D 692	Specification for Coarse Aggregate for Bituminous Paving Mixtures.
ASTM D 979	Practice for Sampling Bituminous Paving Mixtures.
ASTM D 995	Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
ASTM D 1073	Specification for Fine Aggregate for Bituminous Paving Mixtures.
ASTM D 2041	Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
ASTM D 2172	Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures.
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
ASTM D 2726	Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
ASTM D 3203	Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
ASTM D 3549	Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
ASTM D 3666	Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials.
ASTM D 4125	Test Methods for Asphalt Content of Bituminous Mixtures by the Nuclear Method.
ASTM D 4318	Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4402	Test Method for Viscosity Determinations of Asphalt at Elevated Temperatures Using a Rotational Viscometer.
ASTM D 4791	Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
ASTM D 4867	Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures.
ASTM D 5444	Test Method for Mechanical Size Analysis of Extracted Aggregate.
ASTM D 5821	Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
ASTM D 5976	Specification for Type 1 Polymer Modified Asphalt Cement for Use in Pavement Construction.

ASTM D 6084	Test Method for Elastic Recovery of Bituminous Materials by Ductilometer.
ASTM D 6307	Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method.
ASTM D 6926	Practice for Preparation of Bituminous Specimens Using Marshall Apparatus.
ASTM D 6927	Test Method for Marshall Stability and Flow of Bituminous Mixtures.
ASTM E 178	Practice for Dealing With Outlying Observations.
ASTM E 950	Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
ASTM E 1274	Test Method for Measuring Pavement Roughness Using a Profilograph.
	Asphalt Institute – Manual Series
MS-2	Mix Design Methods for Asphalt Concrete, and Other Hot-Mix Types.
MS-20	Asphalt Hot-Mix Recycling.
	Dept. of Transportation – Federal Aviation Administration (FAA)
FAA ERLPM	Eastern Region Laboratory Procedures Manual.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Job Conditions

1. Apply tack coat only when the base surface is dry and the ambient temperature in shade has not been below 32 degrees F for 12 hours immediately prior to application, unless otherwise approved by the Engineer.

2. Do not place asphalt concrete upon a wet or frozen surface.

3. The minimum laydown temperature shall be 310 degrees F or greater when the base surface temperature is 50 degrees F or less and not less than 275 degrees F when the base temperature is greater than 50 degrees F. Measure the asphalt concrete temperature in the truck, at the paver.

4. For asphalt mixes containing "Rosphalt 50", the minimum laydown temperature is 350 degrees F, regardless of the base surface temperature. Measure the asphalt concrete temperature in the truck, at the paver.

5. The minimum allowable base temperature for a lift thickness is shown in the following table:

Nominal Lift Thickness (inches)	Minimum Allowable Base Temperature (degrees F)
2 or greater	32
1-1/2 or greater, but less than 2	40
Less than 1-1/2	50

6. If nominal lift thickness is two inches or greater and the base temperature is below 32 degrees F, the Engineer may approve paving operations if the Contractor can demonstrate, prior to commencing with paving, that density and mat texture uniformity can be achieved. All other requirements apply.

7. In case of sudden rain, the Engineer may at his sole discretion permit placing of mixture already in transit from the plant, provided the surface to be paved is free from pools of water and laydown temperatures conform to the above tabulation. Such permission, however, shall not be interpreted as a waiver of any of the quality requirements.

8. When using design mixes containing "Rosphalt 50" retain the services and arrange for a technical representative of the "Rosphalt 50" manufacturer to be present in the field during the first three days of installation of "Rosphalt 50" paving mix.

B. Asphalt Concrete Mix Design

1. Design asphalt concrete job mix formula based on the "Mix Design Table" specified in 2.03 A and specimen compaction temperature specified in 1.04 E.3.

2. Design top and bottom courses and bridge deck membrane to the following target values: [1]

Marshall Stability at 75 blows (ASTM D 6927) - 2150 lbs., min. except 1,000 lbs, min. for bridge deck membrane

Flow Value, 0.01 inch gradation (ASTM D 6927) - 8 to 16, except 15 to 40[2] for bridge deck membrane

Marshall Air Voids, Percent, (ASTM D 3203)[3]:

Top course (except Mix I-6A, and mixes containing "Rosphalt 50")	2.8 to 4.2
Top course, Mix I-6A	5.3 to 6.7
Bottom course	3.8 to 5.2
Bridge Deck Membrane	1.5 Max.
Mixes containing "Rosphalt 50"	0 to 2.0

Percent Voids Filled with Asphalt:

Mix I-2A; I-4A; I-5A; PA-5	70 to 80
Mix I-4; I-5; I-6A	65 to 80
Bridge Deck Membrane	95 to 100
Mixes containing "Rosphalt 50"	90 to 100

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1 For asphalt concrete mixes with five percent of the aggregate or greater retained on the 1" sieve, the Engineer may require the use of six-inch molds to increase the repeatability of Marshall test results. For six-inch molds Marshall stability shall be 4800 lbs. minimum at 113 blows with 22.5 lb. hammer and 18-inch drop and the flow value shall be within the 12 to 24 range.

2 Flow may be higher than 40 if other properties meet section requirements and if approved by the Engineer.

3 Determine by comparing bulk specific gravity (ASTM D 2726) to maximum specific gravity (ASTM D 2041).

Voids in the Mineral Aggregate (VMA), Percent, Minimum:

Mix I-2A	12
Mix I-4A	13
Mix I-4; PA-5	14
Mix I-5; I-5A	16
Mix PA-5 with "Rosphalt 50"	16
Mix I-5A with "Rosphalt 50"	18
Mix I-6A	19
Bridge Deck Membrane	20

3. Plant mix macadam base course (Mix I-1) shall be a mixture designed within the gradation limits specified in 2.03 A. When approved by the Engineer, bottom course (Mix I-2A) may be used in lieu of Mix I-1 provided it meets all requirements for bottom course.

4. The design job mix formula shall indicate definite percentages passing for each sieve fraction of aggregate and the asphalt content.

5. Design new job mix formula for each asphalt plant used, whenever there is a change in material or when field conditions dictate a need for redesign.

6. When required by the Engineer, determine the tensile strength ratio of specimens of the composite paving mixture by procedures specified in ASTM D 4867. The value shall be not less than 80 percent.

C. Plant Production Requirements

1. The asphalt concrete mixture or its components shall not be heated to a temperature outside the limits specified in 3.02 A.

2. Top and bottom courses and bridge deck membrane, shall have 100 percent of the material in each lot equal, exceed or fall within the range of the following acceptance limits*:

   Marshall Stability at 75 blows (ASTM D 6927) - 1800 lbs. min, except 1000 lbs. minimum for bridge deck membrane

   Flow Value, 0.01 inch gradation (ASTM D 6927) - 8 to 16, except 15 to 40** for bridge deck membrane

   If the Percent of Material Within Tolerance Limits (PWL) of the lot is less than 90 percent, corrections for deficiencies in Marshall Stability and Flow shall be made as set forth in 3.03 C.

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* If six-inch molds are required as set forth in 1.03 B.2, Marshall stability shall be 4000 lbs. minimum at 113 blows with 22.5 lb. hammer, 18-inch drop and the flow value shall be within the 12 to 24 range.
** Flow may be higher than 40 if other properties meet Section requirements and if approved by the Engineer.

3. Modified Asphalt Performance Grade

Modified asphalt shall meet the performance grade requirements set forth in 2.02 B, when tested in accordance with 1.04 E.12. When material fails to meet the requirements, make corrections in accordance with 3.03 E.

4. Marshall Air Voids

The target bands for Marshall air voids shall be as set forth in 1.03 B.2. Acceptance shall be on a lot basis as specified in 1.04 E.3. The acceptance of each lot will be based on the Percent of Material Within Tolerance Limits (PWL) as set forth in 4.03 B.5. Adjustment to Contract compensation will be made if the PWL of the lot is less than 90 percent as set forth in 4.03 D. If the PWL of the lot equals or exceeds 90 percent and the PWL for pavement joint density for the lot equals or exceeds 90 percent, the percentage adjustment to compensation will be between 100 and 106 as set forth in 4.03 D.

The Tolerance Limits for Marshall air voids, percent, (ASTM D 3203) are:

Top course, (except Mix I-6A)	2.0 to 5.0
Top course, Mix I-6A	4.5 to 7.5
Bottom Course	3.0 to 6.0
Bridge deck membrane	1.5 Max.
Mixes containing "Rosphalt 50"	0 to 2.0

5. Tensile Strength Ratio

The Tensile Strength Ratio shall meet the requirement set forth in 1.04 E.15. When material that is produced fails to meet the requirements, make corrections in accordance with 3.03 F.

6. Retain the services and arrange for a technical representative of the "Rosphalt 50" manufacturer to be present in the plant during the first three days of production.

D. In-Place Pavement Requirements

1. Surface Smoothness

a. Longitudinal direction for roadways where paving lane lengths equal or exceed 500 linear feet.

The final surface shall have a Profile Index of 15.0 inches per mile or less and no deviations 0.4 inch or greater in 25 feet. Testing and acceptance will be on a lot basis as set forth in 1.04 E.10.a. Make corrections for deficiencies in surface smoothness as set forth in 3.03 A. Adjustment to Contract compensation will be made based on the Profile Index of the lot as set forth in 4.03 E.

b. Longitudinal direction for roadways where paving lane length is less than 500 linear feet.

Final surface shall be smooth and free of irregularities greater than 1/8 inch when tested with a 10-foot straight edge. Testing and acceptance will be on a lot basis as set forth in 1.04 E.10.b. Make corrections for deficiencies in surface smoothness as set forth in 3.03 A. Adjustment to Contract compensation will be made based on the Profile Index of the lot as set forth in 4.03 E.

c. Longitudinal and transverse direction for parking lots and port container storage areas.

The final surface shall not exhibit ponding of water and shall be free-draining. Testing and acceptance will be as set forth in 1.04 E.10.c. Make corrections for deficiencies as set forth in 3.03 A.

2. Density

a. In-Place Mat Density

The target for in-place mat density is 98 percent or better (97 percent for pavement on roadway structures). Acceptance will be on a lot basis as set forth in 1.04 E.5. The acceptance of each lot will be based on the Percent of Material Within Tolerance Limits (PWL), as set forth in 4.03 B.5. Adjustment to Contract compensation will be made based on the PWL of the lot as set forth in 4.03 C. The lower tolerance limit for pavement mat density is 96.3 percent (95.7 percent for pavement on roadway structures).

a. In-Place Joint Density

The target for in-place joint density is 97 percent or better (96 percent for pavement on roadway structures). Acceptance will be on a lot basis as set forth in 1.04 E.6. The acceptance of each lot will be based on the Percent of Material Within Tolerance Limits (PWL), as set forth in 4.03 B.5. Adjustment to Contract compensation will be made based on the PWL of the lot for surface course only as set forth in 4.03 F. The lower tolerance limit for pavement joint density is 93.3 percent.

b. Plant mix macadam base course shall have stone thoroughly interlocked, interstices reduced to a minimum, and creeping of mixture no longer visible and with no further increase in density achievable by additional rolling.

3. Thickness

a. Pavement courses shall conform to thicknesses shown on the Basic Contract Drawings within the following tolerances:

Course or Combination of Courses	Tolerance (in inches) Plus or Minus*
Thickness of top or membrane course	1/4
Total thickness of top course and bottom course	1/4
Total thickness of plant mix macadam base course, bottom course, and top course	1/4
Overlay thickness shall be measured by the tolerance in 1.03 D.4	--

* All measurements for this purpose shall be to the nearest 1/8th inch.

4. Final Surface Grade

The final surface shall conform to the finished grades shown on the Basic Contract Drawings within a target tolerance for vertical deviation of plus or minus 0.04 foot, except where closer tolerance is required for proper functioning of appurtenant structures and drainage. The final surface abutting existing pavements shall smoothly transition to the existing surface grades and shall not exhibit ponding of water. The Engineer will test the final surface, which will be accepted or rejected on a lot basis as set forth in 1.04 E.11. The Engineer will adjust Contract compensation based on the percentage of grade measurements exceeding the target tolerance as set forth in 4.03 D. For all areas when 15 percent or more of the grade measurements exceed the target grade tolerance or where any individual measurement exceeds a 0.06-foot grade tolerance, make corrections for deficiencies in final surface grade as set forth in 3.03 D.

5. In-Place Air Voids

Asphalt concrete shall have in-place air voids between 2.0 percent and 8.0 percent (9.0 percent for bottom course and materials placed on roadway structures). Asphalt concrete containing "Rosphalt 50" additive shall have in-place air voids less than 6.0 percent. The Engineer will test in-place air voids in accordance with 1.04 E.7. When material fails to meet the requirements, make corrections for deficiencies in accordance with 3.03 B.

1.04 QUALITY CONTROL/ASSURANCE

A. General

1. Establish, provide and maintain an effective quality control system which shall ensure that the materials and completed construction submitted for acceptance conform to Contract requirements whether manufactured or processed by the Contractor or procured from subcontractors or vendors.

2. Pre-Paving Construction Meeting

   a. A pre-paving meeting will be conducted at the construction site by the Engineer a minimum of 20 days prior to the first day of laydown to discuss Contractor (suppliers) mixes, plant quality control, field quality control, tack coat, control strip, requirements for mat and joint densities, equipment (including rollers, Material Transfer Vehicle and paver), smoothness and grade control, segregation, workmanship, quality assurance testing, incentive and disincentive criteria and any other pertinent specified requirements.

   b. Record, type and distribute meeting minutes to all attendees of the meeting within 5 days of the date of the meeting.

   c. Do not schedule the pre-paving construction meeting until all submittals pertaining to the paving operation have been submitted and approved.

3. At no additional cost to the Authority, make arrangements for the project superintendent and a qualified representative to be present at every segment of the paving operations, including, but not limited to the following:

   a. Asphalt Producer's Quality Control Manager.

   b. Contractor's representative for site quality control testing.

c. Paving crew foreman.

d. Smoothness testing personnel.

e. Survey crew chief.

4. Submit to the Engineer certification in writing stating that all of the testing equipment to be used is properly calibrated and will meet the specifications applicable for the specified test procedures. Upon Engineer's request, test samples to demonstrate an acceptable level of performance.

5. Perform quality control sampling, testing and inspection during all phases of the Work at rates sufficient to ensure that the Work conforms to the Contract requirements, and at minimum test frequencies required by 1.04 D.

B. Quality Control Plan

1. Establish and maintain a Quality Control Plan (Plan) along with all the personnel, equipment, supplies and facilities necessary to obtain samples, perform and document tests and meet specification requirements. For Contracts requiring 1,000 tons of asphalt concrete or more, the Plan is required. For Contracts requiring less than 1,000 tons of asphalt concrete, the Plan is not required.

2. Describe the Plan in a written document. Submit the written Plan to the Chief of Materials Engineering, Materials Engineering Unit for review at least 28 calendar days prior to the start of paving operations.

3. In the absence of an approved Quality Control Plan, the Authority will make no payments for materials, which are subject to specific quality control.

4. The Plan may be operated wholly or in part by the Contractor or by an independent organization but it shall in all cases remain the responsibility of the Contractor.

5. Plan Contents: The Plan shall be organized to address at least the following items:

a. Quality control organization chart.

b. Area of responsibility and authority of each individual.

c. Names and qualifications of personnel as required by 1.04 B.7.d.

d. A listing of any outside organizations such as testing laboratories that will be employed by the Contractor and a description of the services they will provide.

e. A testing plan which lists the tests required to be performed by the Contractor, the frequency of testing, sampling locations and the location of the testing facilities.

f. Procedures for ensuring that tests are performed in accordance with the testing plan, that they are documented and that proper corrective actions are taken when necessary.

g. Procedures for ensuring that testing equipment is available, that it complies with specified standards and that it has been calibrated against certified standards.

h. Procedures for verifying that tests are taken in accordance with the appropriate AASHTO and ASTM standards.

i. Procedures for daily submittal of test results to the Engineer.

j. An action plan detailing procedures to be used to correct unsatisfactory production processes and construction practices, when tests indicate materials fail to meet specifications for any of the following:

(1) Aggregate gradation.

(2) Mat and joint density.

(3) Marshall air voids.

(4) Surface smoothness.

(5) Grades.

6. Plan Elements: The Plan shall address all elements which affect the quality of the pavement including but not limited to:

a. Mix Design.

b. Aggregate Gradation.

c. Quality of Materials.

d. Stockpile Management.

e. Proportioning / Temperature Control of Mixture Components.

f. Mixing and Transportation.

g. Placing and Finishing.

h. Joints.

i. Compaction.

j. Surface smoothness and grades.

7. Quality Control Organization

a. Implement the Quality Control Plan by the establishment of a separate Quality Control Organization. Develop and submit an organization chart to show all quality control personnel integrated with other management, production, and construction functions and personnel.

b. The organization chart shall identify all quality control staff required to implement all elements of the quality control program, including inspection and testing functions for different items of work.

c. If an outside organization or independent testing laboratory is used for implementation of all or part of the Plan, the personnel assigned will be subject to the qualification requirements of 1.04 B.7.d. The organization chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

d. The Quality Control Organization shall consist of at least the following personnel:

(1) Plan Administrator

The Plan Administrator shall be an employee of the Contractor. The Plan Administrator shall have prior quality control experience on a project of size and scope comparable to those of this Contract. In addition, the Plan Administrator shall meet one of the following requirements:

(a.) Licensed Professional Engineer with one year of asphalt paving experience as approved by the Engineer.

(b.) Engineer-in-Training with two years of asphalt paving experience as approved by the Engineer.

(c.) An individual with three years of highway and/or airport paving experience as approved by the Engineer and with a Bachelor Degree in Civil Engineering, Civil Engineering Technology or Construction.

(d.) Construction Materials Technician certified at Level III by the National Institute for Certification in Engineering Technologies (NICET).

(e.) Highway Materials Technician certified at Level III by NICET.

(f.) Highway Construction Technician certified at Level III by NICET.

(g.) A NICET certified Engineering Technician in Civil Engineering Technology with 5 years of asphalt paving experience as approved by the Engineer.

Certification at an equivalent level by a State or nationally recognized organization will be acceptable in lieu of NICET certification. The Plan Administrator shall have full authority to institute any and all actions necessary for the successful operation of the Plan to ensure compliance with the Specifications. The Plan Administrator shall report directly to a responsible officer in the Contractor's organization. The Administrator may supervise Plans on more than one project provided that he can upon request be at the construction site within one hour.

(2) Quality Control Technicians

Provide a sufficient number of Quality Control Technicians to adequately implement the Plan. Quality Control Technicians shall be engineers, engineering technicians, or experienced craftsmen holding a current certificate issued by the New Jersey Society of Asphalt Technologists, Inc. (NJSAT) or other Engineer-approved certifying agency or organization. (Information regarding the certification procedure can be obtained by contacting NJSAT.)

The Quality Control Technicians shall report directly to the Plan Administrator and shall perform the following functions:

(a.) Inspection of all plant equipment used in proportioning and mixing to ensure proper calibration and operating conditions.

(b.) Performance of quality control tests necessary or desirable to adjust and control mix proportioning in accordance with the job mix formula.

(c.) Inspection of all equipment used in placing, finishing and compacting material to ensure proper operating condition.

(d.) Inspection during construction to ensure placement, joint construction and compaction is in conformance with the Specifications and will produce a finished product that meets Specification requirements.

(e.) Performance of all quality control testing as required by 1.04 D, including density monitoring.

8. Testing Laboratory

a. The Plan must provide for a fully equipped asphalt laboratory located at the plant or construction site. It shall be available for joint use by the Contractor for quality control testing and by the Engineer for acceptance testing and must have adequate equipment for the performance of the tests required by these Specifications. The Engineer shall have priority in use of the equipment necessary for acceptance testing.

b. The effective working area of the laboratory shall be a minimum of 250 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 70 degrees F plus or minus 5 degrees F.

c. In addition to the equipment required for testing, the laboratory shall be equipped with a paper copier and facsimile machine to be utilized by the Engineer.

d. Keep laboratory facilities clean and maintain all equipment in proper working condition. Allow the Engineer unrestricted access to inspect the Contractor's laboratory facility and to witness quality control activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies or testing personnel and procedures. When in the Engineer's opinion deficiencies may adversely affect test results, immediately suspend delivery and placement of asphalt materials and do not resume until the deficiencies are satisfactorily corrected.

9. Noncompliance

In cases where quality control activities do not comply with either the Contractor's Quality Control Program or the Contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, the Engineer may order the Contractor to replace ineffective or unqualified quality control personnel.

C. Source of Aggregate and Sampling

1. Virgin Aggregate

a. Select sources of virgin aggregates well in advance of the time the materials are required for the construction. When the aggregates are obtained from a previously approved source, submit random hot bin samples, if requested by the Chief of Materials Engineering, Materials Engineering Unit, a minimum of 14 calendar days prior to the start of production and if from a source not previously approved, submit random hot bin samples a minimum 45 calendar days prior to the start of production. Sampling of the hot bin materials for job mix formulation will be observed by the Engineer and identical samples will be obtained for verification of the job mix formulation by the Authority's Materials Engineering Unit. The Engineer may require the proposed mix formulation to be batched at the asphalt plant and tested in the presence of the Engineer.

b. Where previously used or concurrent job mix formulations are to be used, the taking of hot bin samples may be waived by the Engineer.

2. Reclaimed Asphalt Pavement

a. Where reclaimed asphalt pavement material is permitted, it shall have 100 percent passing 1/2 inch sieve and shall be a mixture of only coarse aggregate, fine aggregate, and asphalt cement, free of solvents or other contaminating substances. The fine aggregate contained in the reclaimed asphalt pavement shall have a plasticity index not greater than 4 when tested in accordance with ASTM D 4318.

(1) Maintain stockpiles of reclaimed asphalt pavement in a manner to prevent contamination with other aggregates and keep covered in order to maintain a low moisture content of the reclaimed asphalt pavement.

b. Unless otherwise shown on the Basic Contract Drawings, the maximum proportion of reclaimed asphalt pavement permitted within each mix shall be 10 percent for top and bottom courses and 25 percent for base course.

c. Contractor's reclaimed asphalt pavement will be considered for use provided that the Engineer is notified of the intended use and that he approves the reclaimed asphalt pavement. Take at least six representative samples, each at least 7 pounds, from each stockpile. Each stockpile shall not exceed 3000 tons. Sample in accordance with ASTM D 75. Sampling will be observed by the Engineer. Take duplicate samples and submit them with mix design for verification. Test samples in accordance with ASTM D 2172 to determine asphalt cement content; test recovered aggregate in accordance with ASTM C 136 for gradation.

d. Once a reclaimed asphalt pavement stockpile has been approved for use, the stockpile shall be dedicated to the Contract and no reclaimed asphalt pavement may be added to the stockpile. If there is an insufficient amount of reclaimed asphalt pavement in the stockpile to complete the Work, a new, separate stockpile may be made and shall be tested for acceptance as aforementioned.

3. Locate stockpiles of reclaimed asphalt pavement and of new aggregate so as to prevent intermingling.

4. When more than one asphalt plant is to be used to supply asphalt concrete to the construction site, each asphalt plant shall use a similar job mix formula, as approved by the Engineer.

5. Locations and timing of random sampling will be determined by the Engineer in accordance with Section 6 of FAA ERLPM.

D. Contractor's Quality Control Tests

1. Perform all quality control tests necessary to control the production and construction processes. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, Marshall properties and temperatures. Obtain samples at the direction of the Engineer for the purpose of quality control testing. Random sampling procedures specified in Section 6 of FAA ERLPM shall be used for determining the selection of samples as follows:

   a. Take four samples of freshly mixed material per each lot (one sample from each sublot) for top, bottom, and base courses and bridge deck membrane. Take samples in accordance with ASTM D 979 from material at the mixing plant.

      A lot will be defined as one day's production for each mix. Production rates for each mix will be obtained by the Engineer from the asphalt plant at the start of each day's production. A sublot will be defined as a quarter of a lot based on the initial production forecast for the mix. Maximum lot size will be 2000 tons. If a day's production is forecast over 2000 tons, the forecast quantity shall be divided into two or more equal lots. Should actual production be greater than the initial forecast of production for a given mix, the additional production will be divided into the same sublot sizes as initially calculated. If one or two additional sublots are produced they will be added to that days lot with n=5 or 6 for sublots. If three or more additional sublots are produced in a day, an additional lot will be established for that particular day.

      If actual production is less than the initial forecast for a given mix but sufficient material was produced to constitute three sublots, a lot will be formed with three sublots (n=3). Should actual production constitute only one or two sublots, the sublots will be added either to the previous lot or the next production lot, whichever is closer in time. Each sublot shall contain a minimum of 75 tons of material.

      Where more than one plant is simultaneously producing material for the job, the lot sizes shall apply separately for each plant.

   b. Test samples to determine asphalt content in accordance with ASTM D 2172, D 4125 or D 6307. Test recovered aggregate to determine gradation in accordance with ASTM D 5444. In addition, when automated recording plants are used, submit printouts of asphalt content to the Engineer.

   c. Prepare three plugs from each sample and test them in accordance with ASTM D 6926 using automatic compaction procedures. Determine Marshall air voids in accordance with ASTM D 3203. For each sublot, determine the maximum theoretical density in accordance with ASTM D 2041.

Voids filled with asphalt, for each plant sample, shall be computed as follows:

(1) Determine asphalt content in percentage by volume (I) using:

$$I = \frac{P_b \times G_{mb}}{G_b}$$

Where:

I = Percentage by volume of asphalt

Pb = Percentage by weight of asphalt

Gmb = Bulk specific gravity of compacted mixture

Gb = Specific gravity of asphalt

(2) Determine percent voids filled with asphalt (VF) as follows:

$$VF = \frac{I \times 100}{I + P_a}$$

Where:

VF = Percent voids filled with asphalt

I = Percentage by volume of asphalt

P_a = Percent Marshall air voids

Estimate voids in the Mineral Aggregate (VMA) by adding the asphalt content in percentage by volume to the percent of air voids. Use bulk specific gravities to calculate VMA.

d. Take hot bin or feeder belt composite samples of top, bottom and base course aggregates and bridge deck membrane mixes at least twice daily and check gradation in accordance with ASTM C 136, including washing material passing No. 8 sieve in accordance with ASTM C 117.

e. At least six times daily, check and record temperatures at necessary locations to determine the temperatures of:

(1) aggregates and asphalt immediately before introduction to the pugmill or dryer drum;

(2) the mixture immediately after discharge from the pugmill or dryer drum;

(3) the mixture at the spreader on the construction site.

f. Reclaimed Asphalt Pavement

(1) Where reclaimed asphalt pavement is being used as a substitute for some of the virgin aggregate, take a sample of freshly mixed recycled asphalt concrete in accordance with ASTM D 979 and determine the moisture content at least twice daily. Moisture determinations shall be based on the weight loss, determined by heating an approximately 4-pound sample of the freshly mixed materials for one hour in an oven at 280 plus or minus 5 degrees F. The moisture content of the freshly mixed recycled asphalt concrete shall not exceed 0.5 percent.

(2) Take a sample of reclaimed asphalt pavement from the approved stockpile at least once daily and test in accordance with ASTM D 2172 to determine asphalt content and gradation in accordance with ASTM D 5444. The resulting asphalt content and aggregate gradation shall be similar to the average test results of the reclaimed asphalt pavement submitted with job mix formula. If there is a variation of plus or minus 1.0 percent in the asphalt content or plus or minus 10 percent in aggregate gradation on any sieve, a second sample shall be taken and tested in the same manner as the first sample. If the results are similar to that of the first sample, take appropriate measures to adjust the mixture to compensate for the variation in the reclaimed asphalt pavement.

g. Moisture Content of Aggregate

For the drum plants the moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

h. Moisture Content of Mixture

The moisture content of the mixture shall be determined once per lot in accordance with the procedure given in 1.04 D.1.f(1). The moisture content in the freshly mixed asphalt concrete shall not exceed 0.5 percent. If the moisture content is 0.5 percent or greater, then stop production and adjust plant operation.

i. Perform additional testing as required to ensure that mixtures produced meet the requirements of this Section.

2. Control Charts

Maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation and asphalt content. When test results exceed certain limiting values, take action to bring the asphalt concrete production process under tighter control. The Action Limit is the limiting value at which corrective actions shall be made while production may continue. The Suspension Limit is the limiting value at which production must be suspended while corrections are made. Production shall not resume until Contractor's corrections are approved by the Engineer.

Post control charts in a location satisfactory to the Engineer and keep charts current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter and the Contractor's test results. Use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If in the Engineer's opinion the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may suspend production or acceptance of the material.

a. Individual Measurements

Establish control charts for individual measurements to maintain process control within tolerance for aggregate gradation and asphalt content. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS		
Sieve	Action Limit	Suspension Limit
1"	±6%	±9%
3/4"	±6%	±9%
1/2"	±6%	±9%
3/8"	±6%	±9%
No. 4	±6%	±9%
No. 8	±5%	±7.5%
No. 16	±5%	±7.5%
No. 30	±3%	±4.5%
No. 50	±3%	±4.5%
No. 100	±2%	±3%
No. 200	±2%	±3%
Asphalt Content	±0.45%	±0.7%

b. Range

Establish control charts for range to control process variability for the test parameters and Suspension Limits listed below. Compute the range for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, adjust the Suspension Limits by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

CONTROL CHART LIMITS BASED ON RANGE	
(Based on n = 2)	
Sieve	Suspension Limit
1"	11 %
3/4"	11 %
1/2"	11 %
3/8"	11 %
No. 4	11 %
No. 8	9 %
No. 16	9 %
No. 30	6 %
No. 50	6 %
No. 100	3.5 %
No. 200	3.5 %
Asphalt Content	0.8 %

c. Corrective Action

The Quality Control Plan shall indicate that appropriate action shall be taken when the asphalt concrete production process is out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and shall describe Contractor's actions to bring the process into control. A process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two consecutive points fall outside the Action Limit line for individual measurements.

3. Document quality control efforts using copies of the sample forms contained in the FAA ERLPM, Appendix C, in its entirety, or use Authority forms obtained from the Engineer. Make test results available to the Engineer daily.

4. If a storage silo is used:

a. Check the silo to see that it can properly store the asphalt concrete for the time involved.

b. Take samples of asphalt concrete as it is unloaded from the silo and check them for conformance to this Section. If the asphalt concrete appears segregated, stop using the storage silo until it is demonstrated to the Engineer that the condition has been corrected.

c. Silo storage time is governed by previous State DOT approval, not to exceed 24 hours.

5. Unless otherwise noted on the Basic Contract Drawings, and subject to the approval of the Engineer, select an area to be called a Control Strip from the first day's production of each mix. Each Control Strip shall be a minimum of 100 feet long and two spreader widths wide and shall be constructed to meet the requirements of this Section and in the same manner as the remainder of the course it represents. Take three random samples at the plant and test them for stability, flow and air voids in accordance with 1.04 D.1.c. Take three randomly selected cores from the pavement mat and three along the longitudinal pavement joint and test them to determine density in accordance with 1.04 E.5 and E.6. Use the same means and methods which will be used to construct longitudinal and transverse joints as referred to in 1.04 B.6.h and 3.02 F.1 and F.2.

   The purpose of the Control Strip is to demonstrate that the pavement may be constructed using the proposed equipment and methods of operation and to obtain all quality requirements prior to the start of full production. Construct a new Control Strip whenever there is a change in equipment, methods of operation or type or source of material or whenever there is a change in the job mix formula. The Control Strip may become part of the completed pavement if it meets the requirements of this Section.

6. Include, as part of the Quality Control Plan, the use of a nuclear density device to aid in meeting the specified target densities. Calibrate the nuclear density device with the control strip cores. If other than a nuclear density device is used it shall be calibrated with an additional set of pavement cores.

7. Surface Smoothness

   Perform quality control smoothness testing of the final surface. For paving lanes 500 feet or greater in length, the testing equipment shall be capable of measuring the Profile Index of the final surface, in inches per mile using a 0.2 inch blanking band, in accordance with ASTM E 1274. As a minimum test the final surface of pavement, along the center of each paving lane once during each day of paving. Submit written test results to the Engineer after each test. Test results shall identify the location of each test including starting and end stations and offset from centerline of pavement. For paving lanes less than 500 feet, test the centerline of the paving lanes with a 10-foot long straightedge capable of marking locations which exceed the surface smoothness tolerance. Upon completion of all quality control testing and any required corrective work, the Engineer, in accordance with 1.04 E.10, will perform acceptance testing.

8. Final Surface Grade

Perform quality control surveys immediately after the top course has been compacted, to check final grades. Measure elevations at the finished grade locations shown on the Basic Contract Drawings. Provide the Engineer with the survey results at the completion of each work period. The survey results shall identify the location of each measurement by station and offset, measured elevations to the nearest 0.01foot, required finished grades from the Basic Contract Drawings and the difference between measured elevations and required elevations to the nearest 0.01 foot. This survey is for Contractor's quality control; acceptance of the finished surface shall be as specified in 1.04 E.11.

9. For Work performed, either wholly or in part, in the State of New Jersey, provide a representative present during all paving operations who shall be certified by the New Jersey Society of Asphalt Technologists, Inc. (NJSAT) as an Asphalt Paving Construction Technologist.

E. Engineer's Sampling and Testing

1. Produce asphalt concrete in approved automated plants equipped with interlocks and printouts meeting the requirements of ASTM D 995 and subject to the following:

   a. Plant interlocks and printouts shall be in operation during production and two (2) copies of all printouts shall be furnished to the Engineer daily.

   b. Have scales certified by an approved agency at least every 180 calendar days. Submit copies of certifications to the Engineer upon request.

2. Provide labor and equipment to take samples, except cores, to check thickness and density.

3. The Engineer will perform acceptance testing for Marshall air voids, stability and flow. Samples will be taken from trucks at the plant, in accordance with FAA ERLPM, Section 6. These samples will be from the sublots that were sampled in 1.04 D.1.a. The Engineer will prepare three plugs from each sample and test them in accordance with ASTM D 6927 using automatic compaction procedures. The specimen compaction temperatures will be within the following range as measured within 1/2 inch from the outside edge:

Performance Grade	Temperature Degrees F
PG 64-22, PG 70-22	275 - 295
PG 76-22	300 - 320
PG 82-22	305 - 325
PG 64-22 in mixes containing "Rosphalt 50"	390 - 410

Air voids, voids in mineral aggregate and voids filled with asphalt will be determined in accordance with ASTM D 3203 and 1.04 D.1.c. The average test values obtained from each lot of top and bottom courses and bridge deck membrane must conform to the parameters specified in 1.03 C.

In lieu of sampling and testing in the field, the Engineer may sample and perform acceptance testing at the plant. The Contractor will be advised at the start of Work where the Engineer will sample and test.

4. For thickness determination, exclusive of overlay and bridge deck membrane pavement, the Engineer will divide each course into area lots consisting of the area covered by the lot sampled as specified in 1.04 D.1.a and he will further subdivide each lot into four equal sublots. The Engineer will take one 4-inch diameter core randomly in each sublot to check thickness of the top and bottom courses. One-fourth of all such cores will continue through the plant mix macadam base course. Thickness will be determined in accordance with ASTM D 3549.

   For bridge deck membrane, the Engineer will verify the thickness by measuring with an appropriate measuring device through the newly placed membrane course. After the measurement has been obtained, the locations shall be re-sealed to prevent any leakage.

5. Mat Density

   a. The Engineer will determine the in-place density of the Control Strip and subsequently placed pavements by taking cores at random locations as specified below.

   b. Cores taken from the top and bottom courses and bridge deck membrane in place and any other specimens taken at the construction site, sampled in accordance with the random sampling procedures as specified in 1.04 D.1, will be tested by the Engineer for bulk specific gravity in accordance with ASTM D 2726. Cores will not be taken closer than one foot from a transverse or longitudinal joint for pavement mat density determination. The in-place density of the pavement course will be the ratio of the in-place specific gravity to the laboratory Marshall bulk specific gravity expressed as a percentage.

   c. Cores taken from courses containing more than 10 percent air voids will be tested by the Engineer for density (Bulk Specific Gravity) according to the following equation:

$$S.G. = \frac{W}{12.87\, d^2 h}$$

S.G.	=	Bulk Specific Gravity
W	=	Weight, Dry Specimen (grams)
d	=	Measured Diameter* (inches)
h	=	Measured Height* (inches)

   Laboratory bulk specific gravity and computation of in-place density will be as specified in 1.04 E.5.b above.

* Average of 5 equally spaced measurements around the core

d. The average in-place density determination, taken from the area covered by the lot sampled as specified in 1.04 D.1.a, will be determined by the Engineer by summing up the sublot in-place density readings obtained from a lot and dividing the total by the number of sublots. The in-place density from each sublot will be obtained using a core reading taken from each sublot on a random basis and dividing by the Marshall bulk density (ASTM D 6926 and ASTM D 2726) taken for that sublot. Any core with a thickness less than twice the largest sieve size to retain more than 5 percent of any aggregate will be discarded and additional random cores will be taken as required to ensure representative readings.

e. The Engineer will repeat the procedure specified in a. through d. above whenever a change is made in the type or source of material or whenever a new job mix formula is approved for material from the same source.

6. Joint Density

The Engineer will take one joint core from each sublot of all surface courses or from the underlying lifts as defined in 1.04 D.1.a and will test it in accordance with 1.04 E.5. For joint cores the lowest Marshall bulk density for sublots forming the joint will be used to compute the in-place density. The Engineer will take cores from directly over the longitudinal joint in line with the location of the random cores taken under 1.04 E.5.b. When a paving lane has two longitudinal joints, both joints will be cored. The in-place joint density will be determined separately for each joint, and the joint producing the lowest in-place density will be used to determine payment. Based on site and placement conditions the Engineer may elect to core only one joint.

7. In-Place Air Voids

The Engineer will calculate the in-place mat air voids for each sublot in accordance with ASTM D 3203, by comparing the bulk specific gravity (ASTM D 2726) of the cores taken as specified in 1.04 E.5.b to the maximum laboratory specific gravity (ASTM D 2041).

8. Patch all areas where samples are taken with an approved asphalt concrete or Portland cement concrete properly tamped to fill all voids and struck off flush with the surface within 24 hours after sampling.

9. The Engineer may at any time, notwithstanding previous plant approval, reject and require the Contractor to dispose of any batch of asphalt concrete mixture which is rendered unfit for use due to contamination, segregation or incomplete coating of aggregate. Such rejection may be based on visual inspection, only. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer and, if the Contractor can demonstrate in the laboratory, in the presence of and to the satisfaction of the Engineer, that such material was erroneously rejected, the Contractor will be compensated for the material.

10. Surface Smoothness

a. Longitudinal direction for roadways where paving lane lengths equal or exceed 500 linear feet:

(1) The Engineer will test the final surface of the pavement parallel to the direction of paving for smoothness. A lightweight profilometer meeting the requirements of ASTM E 950 Class 1 will be used to measure the pavement surface profile.

(2) The profilometer test results will be used to simulate California profilograph testing of the pavement. The simulation will be used to compute the Profile Index in inches per mile using a 0.2 inch blanking band, in accordance with ASTM E 1274. A third-order Butterworth low pass filter with a filter length (cutoff wavelength) of 2.0 feet will be used. Scallops will be rounded to the nearest 0.01-inch. The blanking band will be centered on a straight line determined by least - squares fit over the length of the lot. The simulation will also be used to identify any surface deviations in excess of 0.4 inch in 25 feet. Designed breaks in grade shown on the Basic Contract Drawings will not be included in the Profile Index computations.

(3) Clean the pavement prior to testing. Testing will be performed on a lot basis. A lot is defined as 500 linear feet of paving lane. When less than 250 feet remains after dividing the pavement into 500 linear foot lots, the remaining length will be added to the adjacent lot. When more than 250 feet remains, a short lot will be tested.

(4) For paving lanes up to 20 feet in width, three measurements will be made along the centerline of paving lanes. The profile index of the lot will be computed by averaging the profile index of each measurement.

(5) For paving lanes greater than 20 feet in width, three measurements will be made at two locations, each six feet from and parallel to the centerline of the paving lane. The Profile Index of the lot will be computed by averaging the Profile Index of each of the two measured profiles.

(6) The Profile Index for the length of paving lane in each lot is converted to the Profile Index of the lot in inches per mile using the following formula:

$$PI = PT \times \frac{5280}{L}$$

Where:

PI = Profile Index, inches per mile

PT = Profile Index, inches per length in feet of paving lane in a lot

L = Length of the paving lane in the lot in feet

b. Longitudinal direction for roadways where paving lane lengths are less than 500 linear feet:

(1) The Engineer will evaluate each paving lane with a 10-foot long rolling straightedge, which marks the length of surface variations that exceed the required tolerance.

(2) The Contractor shall sweep the pavement prior to measurement.

(3) Measurement will be taken along the centerline of each paving lane.

(4) The Engineer will calculate the percentage of final surface which exceeds the required tolerance by dividing the measured length of the marked surface deficiencies by the total length of the paving lane.

c. Longitudinal and transverse direction for parking lots and port container areas:

(1) At the completion of paving, and in the presence of the Engineer, thoroughly cover the pavement with water using a water distribution vehicle. In areas that do not adequately drain the water from the surface, or hold water, remove and replace the deficient area as approved by the Engineer and in accordance with 3.03 A.

11. Final Surface Grade

The Engineer will measure grades of the final surface of each lot at the finished grade locations shown on the Basic Contract Drawings. Where paving lanes are 20 feet or greater in width, an additional line of grades, located at the center of the paving lane and spaced at 25 feet longitudinally, will be measured. A lot is defined as 50,000 square feet of final pavement surface. The transverse limit of the lot will be the transverse limit of paving. Where paving areas are not equally divisible into 50,000 square foot lots, odd sized lots between 25,000 and 75,000 square feet will be used. The odd sized lots will be used for the area remaining after the paved area is divided into 50,000 square foot lots. Perform the survey jointly with the Engineer.

12. The Engineer will perform acceptance testing of modified asphalt to determine whether it meets the performance grade requirements set forth in 2.02 B. Samples will be collected at the asphalt plant for each lot of asphalt concrete produced, as specified in 1.04 D.1.a. The Engineer will sample the liquid asphalt from the plant storage tanks which must be equipped with a sample valve.

13. The Engineer will measure the temperature of each load of asphalt concrete. Any load of asphalt concrete with temperature exceeding 350 degrees F will be rejected (excluding mixes that contain "Rosphalt 50" additive). For mixes containing "Rosphalt 50" additive, any load produced with temperature exceeding 500 degrees F will be rejected.

14. Where there is a discrepancy between the Contractor's test results and those of the Engineer, the Engineer's test results shall govern.

15. The Engineer may perform acceptance testing during production to determine whether the asphalt concrete meets the Tensile Strength Ratio (TSR) requirements of this paragraph. For each lot of asphalt concrete, defined in 1.04 D.1.a, one sample will be obtained from a truck at the plant and tested in accordance with ASTM D 4867. Suspend production if test results indicate that the TSR is less than or equal to 80 percent. Submit a plan to the Engineer for approval indicating how the problem will be corrected and ensure that TSR values greater than 80 percent will be consistently produced before commencing production once again.

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer of asphalt cement shall be approved by either the New York State Department of Transportation (NYSDOT) or the New Jersey Department of Transportation (NJDOT).

B. Modified Asphalt shall be one of the following. No substitutions permitted.

1. "Stellarflex SP" - NuStar Asphalt Refining LLC; Paulsboro, NJ.
2. "Elvaloy RET" - DuPont Co.; Wilmington, DE.
3. "Kraton" - Kraton Polymers, LLC; Houston, TX.
4. "Polykote" - Suit-Kote Corp.; Cortland, NY.
5. "Vestoplast S" modifier - Evonik Degussa Corp.; Parsippany, NJ.

C. Additive shall be the following. No substitutions permitted.

1. "Rosphalt 50" additive - Chase Construction Products/Royston Div. of Chase Corp.; Pittsburgh, PA.

2.02 MATERIALS

A. Aggregates

1. If the tensile strength ratio of the specimens of composite mixture is less than 80 percent, as specified in 1.03 B.6, the aggregates will be rejected unless the Contractor treats the asphalt with an approved anti-stripping agent. The amount of anti-stripping agent added to the asphalt shall be sufficient to produce a tensile strength ratio of not less than 80 percent.

2. Coarse Aggregate: Material retained on the No. 8 sieve

a. Except for use in the top lift of the top course within the roadway pavement edge markings as shown on the Basic Contract Drawings, coarse aggregate shall conform to ASTM D 692, except as follows: use broken stone or crushed gravel having not less than 75 percent by weight of pieces with two or more fractured faces and 85 percent by weight having at least one fractured face (ASTM D 5821), with a maximum of 8 percent of flat or elongated pieces (ASTM D 4791), with a maximum percentage of wear (ASTM C 131) of 40 percent and with a magnesium sulfate loss (ASTM C 88) of not more than 12 percent for a five-cycle test period.

b. For the top lift of the top course within the roadway pavement edge markings as shown on the Basic Contract Drawings, coarse aggregate shall conform to ASTM D 692 except as follows: use broken stone which shall be trap rock or gneiss of uniform quality obtained from a source approved by the NYSDOT or the NJDOT for use in asphalt concrete. The aggregate shall have not less than 75 percent by weight of pieces with two or more fractured faces, with a maximum of 8 percent of flat or elongated pieces (ASTM D 4791), with a maximum percentage of wear (ASTM C 131) of 30 percent and with a magnesium sulfate loss (ASTM C 88) of not more than 12 percent for a five-cycle test period.

c. A flat particle is one having a ratio of width to thickness greater than five; an elongated particle is one having a ratio of length to width greater than five.

3. Fine Aggregate: Material passing the No. 8 sieve and retained on the No. 200 sieve

Fine aggregate shall be a blend of washed, textured sand and stone screenings conforming to ASTM D 1073 with a maximum percentage of wear (ASTM C 131) of 30 percent and with a magnesium sulphate loss (ASTM C 88) of not more than 18 percent for a five-cycle test period, a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318. When tested in accordance with ASTM D 2419, the sand equivalent value shall be 35 or greater.

Textured sand shall be defined as sand which when tested in accordance with ASTM C 1252, Method A, results in uncompacted voids greater than 45.0 percent. Sand that has a low texture value and slag shall not be used.

4. Mineral filler shall conform to ASTM D 242 and shall have a ratio to asphalt cement by weight not exceeding 1.2.

B. Asphalt

Asphalt shall be one of the following, conforming to the requirements of AASHTO M320 and as specified within table entitled "Requirements for Performance Graded Asphalts" for the Performance Grade (PG) as shown on the Basic Contract Drawings.

1. Asphalt Cement

Asphalt cement shall meet the requirements for PG 64-22, unless otherwise shown on the Basic Contract Drawings.

2. Modified Asphalt

Modified Asphalt shall be one of the following. No substitution is permitted.

a. "Kraton" (SEBS), "Polykote", "Elvaloy RET" or "Stellarflex SP" meeting the requirements for PG 76-22 or PG 82-22 as shown on the Basic Contract Drawings.

b. Asphalt cement modified with "Vestoplast S", may be used where PG 76-22 is specified and subject to the following:

(1) Add "Vestoplast S" to the asphalt concrete mixture at a rate of 7 percent by weight of asphalt cement, by substitution.

3. Additive

Where "Rosphalt 50" is used in a mix design, add "Rosphalt 50" additive to the asphalt concrete mixture at a rate of 2.25 percent by weight of total mix.

C. Tack Coat

1. Unless otherwise shown on Basic Contract Drawings, tack coat shall be asphalt cement as specified in 2.02 B.1 above.

2. For mixes containing "Rosphalt 50", use bond coat in place of tack coat as specified in Specification Section 02555.

D. Resultant Asphalt Cement

Resultant asphalt cement shall be a mixture of new asphalt cement as specified in 2.02 B.1 above, asphalt cement extracted from the reclaimed asphalt pavement and recycling agents if required.

REQUIREMENTS FOR PERFORMANCE GRADED ASPHALTS

PERFORMANCE GRADE (PG)	64-22	70-22	76-22	82-22
These Tests Performed on Original Binder:				
Flash Point Temperature (AASHTO T048): Minimum, Degrees Celsius.	230	230	230	230
Dynamic Shear (AASHTO T315): G*/SIN DELTA, Minimum, 1.00 kPa, Test Temperature At 10 Rad/s, Degrees Celsius.	64	70	76	82
Rotational Viscosity (ASTM D 4402): Maximum, 3 Pa-s, Test Temperature, Degrees Celsius.	135	135	135	135
Separation Test - R&B (ASTM D 5976): Percent Difference Maximum Degrees Celsius.	--	--	4.5	4.5
These Tests Performed on Rolling Thin Film Oven Test (RTFOT) Residue:				
Mass Loss (AASHTO T240): Maximum Percent.	1.00	1.00	1.00	1.00
Dynamic Shear (AASHTO T315): G*/SIN DELTA, Minimum, 2.20 kPA, Test Temperature at 10 Rad/s, Degrees Celsius.	64	70	76	82
Elastic Recovery (ASTM D 6084, Method A) 25 Degrees Celsius, 10 cm Elongation, Immediately Cut, 60 Minutes, Minimum Percent.	--	--	75	80
These Tests Performed on Pressure Aging Vessel (PAV) Residue:				
Pav Aging Temperature (AASHTO R028): Degrees Celsius.	100	100	100	100
Dynamic Shear (AASHTO T315): G*/SIN DELTA, Maximum, 5000 kPa, Test Temperature at 10 Rad/s, Degrees Celsius.	25	28	31	34
Creep Stiffness (AASHTO T313): S, Maximum, 300 MPa m-Value, Minimum 0.300, Test Temperature at 60 Seconds, Degrees Celsius.	-12	-12	-12	-12

* Varies from the New Jersey Interagency Engineering Committee Standard

2.03 MIXES

A. Mix Design Table

Mix Designation and Percentage by Weight Passing Sieves								
Sieve Size	Bottom Course	Top Course						Bridge Deck Membrane
	I-2A	I-4A	PA-5	PA-5 with "Rosphalt 50"	I-5A	I-5A with "Rosphalt 50"	I-6A	
1 1/4"	100	---	---	---	---	---	---	---
1"	90-100	100	---	---	---	---	---	---
3/4"	70-84	78-98	100	100	---	---	---	---
1/2"	54-68	64-77	72-98	88-98	100	100	---	---
3/8"	44-54	52-67	60-82	74-84	80-100	90-100	100	100
No. 4	28-36	33-46	40-56	48-58	55-85	55-65	85-93	95-100
No. 8	17-25	27-35	31-39	30-40	32-42	35-45	74-82	71-79
No. 16	12-20	17-23	19-25	24-32	20-30	24-32	---	59-67
No. 30	7-15	12-18	13-19	16-24	12-22	16-24	50-58	47-55
No. 50	5-11	8-12	8-16	10-16	7-16	10-16	24-32	25-35
No. 100	3-9	6-10	5-10	6-10	3-12	6-10	9-15	14-22
No. 200	1-5	3-6	3-6	2-6	2-6	2-6	4-8	12-16
Asphalt, Weight by Percent of Total Mixture								
	3.5-4.5	4.4-5.2	5.2-6.2	***5.0	5.8-6.5	***5.0	6.5-8.00	8.00-9.00**

** Asphalt shall be modified asphalt as specified in 2.02 B.2 above and meet the requirements for PG 76-22.

*** Asphalt binder content prior to addition of "Rosphalt 50 LT". "Rosphalt 50 LT" shall be added to the mix at a rate of 2.25% by weight of the mix (aggregate + binder).

FROM NEW JERSEY INTER-AGENCY ENGINEERING COMMITTEE STANDARD BITUMINOUS CONCRETE MIXTURE DESIGN TABLE			
Mix Designation and Percentage By Weight Passing Sieves			
	Plant Mix Macadam Base Course	Top Course	
Sieve Size	I-1	I-4	I-5
1 1/2"	100	-----	-----
1"	90-100	100	-----
3/4"	60-80	95-100*	-----
1/2"	-----	75-95*	100
3/8"	15-40	65-85*	80-100
No. 4	0-10	35-65	55-75
No. 8	-----	25-50*	30-60*
No. 16	-----	18-40	20-45
No. 30	-----	12-30	15-35
No. 50	-----	10-23*	10-30
No. 100	-----	-----	-----
No. 200	-----	3-6*	3-8*
Asphalt, Weight by Percent of Total Mixture			
	2.5-3.1	5.2-6.5*	5.5-7.0*

Note No. 1 - Material passing the No. 200 sieve may consist of fine particles of the aggregate, mineral filler, or both. Material passing the No. 30 sieve shall be non-plastic when tested in accordance with the requirements of ASTM D 4318.
Note No. 2 - Lift Thickness shall be no less than two times the nominal maximum size of the aggregate (See Note No. 6).
Note No. 3 - If the aggregate does not satisfy tensile strength ratio requirements, add an approved anti-stripping agent (See 2.02 A.1).
Note No. 4 - Job Mix Formula shall follow a smooth curve within the specified limits for all sieve sizes of the Mix Design Table, but shall not fall on the maximum density line and shall not cross the maximum density line below the No. 4 sieve. The maximum density line will be determined by the Engineer by plotting the gradations on a .45 power graph paper, and drawing a straight line between the amount passing the No. 200 sieve and the amount, which is retained on the largest sieve.
Note No. 5 - Notify the Engineer if a satisfactory Job Mix formula using the Mix Design Table cannot be obtained.
Note No. 6 - Nominal maximum size is one sieve size larger than the first sieve to retain more than 10 percent of the aggregate, based on the Contractor's job mix formula.

* Varies from the New Jersey Interagency Engineering Committee Standard

B. Job Mix Formula and Checklist

1. The laboratory used to develop the job mix formula shall meet the requirements of ASTM D 3666. Before construction starts, submit to the Engineer a certification signed by the manager of the laboratory stating that it meets these requirements. The certification shall contain as a minimum:

   a. Qualifications of personnel: laboratory manager, supervising technician and testing technicians.

   b. A listing of equipment to be used in developing the job mix.

   c. A copy of the laboratory's quality control system.

2. Develop Job Mix Formula using procedures contained in Chapter V, "Marshall Method of Mix Design" of the Asphalt Institute's Manual Series No. 2 (MS-2) and, where applicable, "Asphalt Hot-Mix Recycling", Manual Series No. 20 (MS-20); and furnish information for the following checklist:

   a. General

      (1) Contractor and Contract number.

      (2) Type of bituminous mixture.

      (3) Type and source of aggregates.

      (4) Type and source of asphalt.

   b. Aggregates

      (1) Sieve analysis of each aggregate to be used in mixture in accordance with ASTM C 136. The minus 200 fraction shall be tested by the laboratory or technician doing the mix design in accordance with ASTM C 117.

      (2) Physical test of aggregates - soundness, wear, percent fractured faces and percent flat or elongated particles.

      (3) Bulk specific gravity and absorption in accordance with ASTM C 127 for coarse aggregate and ASTM C 128 for fine aggregate. The aggregate shall be sampled by the laboratory or technician doing the mix design from the plant hot bins or feeder belt.

      (4) Proportion used of each type aggregate.

      (5) Theoretical gradation of combined proportions of aggregates.

   c. Asphalt

      (1) Type and grade.

      (2) Specific gravity.

      (3) Type of antistripping agent (if required).

   d. Optimum Asphalt Content Determination in accordance with ASTM D 1559

      (1) Compactive effort (75 or 113 blows applied to specimen, each face, as appropriate).

      (2) Actual specific gravity and unit weight of each specimen.

      (3) Percentage of asphalt in each specimen.

(4) Theoretical specific gravity of each specimen calculated.

(5) Graph of stabilities vs. asphalt content.

(6) Graph of flow values vs. asphalt content.

(7) Graph of voids filled with asphalt vs. asphalt content.

(8) Graph of Marshall air voids vs. asphalt content.

(9) Graph of voids in the mineral aggregate vs. asphalt content.

(10) Graph of unit weight vs. asphalt content.

(11) Visual description of specimens at optimum asphalt content (i.e., dry, flushing, etc.).

(12) Graph of Temperature vs. Viscosity of Asphalt.

e. Summation of Established Job Mix Formula

(1) Combined gradation of aggregates.

(2) Optimum asphalt content from above graphs.

(3) Specified job mix tolerance range.

(4) Mixing Temperature.

(5) Temperature of mix at point of discharge into haul units.

(6) Compaction Temperature.

f. Summation of the Characteristics of the Mixture at Optimum Asphalt Content

(1) Stability, pounds.

(2) Flow value, hundredths of an inch.

(3) Actual specific gravity of laboratory compacted mixture.

(4) Maximum specific gravity of paving mix at optimum asphalt content in accordance with ASTM D 2041.

(5) Total voids (air), percent, in laboratory compacted mixture.

(6) Voids filled with asphalt, percent, in laboratory compacted mixture.

(7) Voids in the mineral aggregate, percent, in laboratory compacted mixture.

(8) Actual unit weight (lbs./cu. ft.) of laboratory compacted mixture.

(9) Tensile Strength Ratio - ASTM D 4867.

g. Verification of Job Mix Formula Characteristics

Where the asphalt content for the proposed Job Mix Formula does not coincide with the asphalt content used in the trial specimens, prepare an additional set of specimens for the proposed Job Mix Formula asphalt content to verify that actual Marshall results duplicate those anticipated from the curves.

PART 3. EXECUTION

3.01 PREPARATION

A. Clean all underlying pavement surfaces and previous courses of all loose and foreign material by sweeping with hand brooms, power sweepers or blowers as directed by the Engineer. Remove permanent pavement markings and reflectors.

B. Verify that required grade and density tolerances of previous courses have been obtained before placing asphalt concrete.

C. Construct keyways for overlay pavements as shown on the Basic Contract Drawings by using longitudinal or transverse cuts into the existing pavement and removing the necessary amount of pavement to provide a smooth transition from the new to existing asphalt concrete surfaces.

D. Tack Coat

1. Apply tack coat by brush on edges of all previously placed or existing pavement and surfaces of manholes and other structures that will be in contact with pavement course to be placed.

2. Apply tack coat by pressure distributor to existing pavement surface to receive new pavement course or where a course is not placed within 24 hours for roadway areas after placement of the underlying course, except as specified in 3.02 E.7 and 3.02 F.2. However, if the underlying pavement course has not been exposed to traffic and, in the opinion of the Engineer, has been kept clean, tack coat shall not be required when a course is placed beyond the time frame mentioned above.

3. Unless otherwise shown on the Basic Contract Drawings, the tack coat shall be at an application rate and temperature range of 0.05 to 0.10 gallons per square yard and 275 to 350 degrees F, respectively. The tack coat application rate for Portland cement concrete surfaces shall be 0.10 to 0.15 gallons per square yard.

4. Protect structures such as manhole frames and covers, joints and steel faced curbs within areas to be tack coated, prior to tack coating, by masking them with tar paper, polyethylene film or other approved materials.

5. After the application of tack coat, follow immediately with placement of asphalt concrete pavement course. Take precautions necessary to maintain and protect the tack coated surface from damage until the next course is placed, including placement and removal of sand as necessary to blot up excess material.

6. All tack coated surfaces shall be paved or protected prior to opening the area to traffic.

E. Mixing Plant Requirements for Recycled Asphalt Concrete

1. Batch plants shall have an appropriately located metering device for adding the reclaimed asphalt pavement to the heated new aggregate and shall provide an accurate method for proportioning the reclaimed asphalt pavement into the mixture.

2. The batch plant's dryer may have to be operated at temperatures higher than with all new materials. If necessary, modify the dryer and the dust collection system to prevent damage.

3. Drum-mix plants shall have an appropriately located metering device for adding the reclaimed asphalt concrete to the dryer-mixer in a manner that does not damage the asphalt in the reclaimed material. Ensure that an accurate method for proportioning the reclaimed asphalt concrete into the mixture is provided. Make provisions for compensating for the moisture in the reclaimed asphalt concrete.

4. The mixing for a drum-mix plant shall be such as to achieve an intimate blending of the new and reclaimed materials and a complete coating of all aggregate particles.

5. At the Contractor's option, the batch or drum-mix plant may be equipped with a surge-storage bin at the mixture discharge point.

3.02 APPLICATION

A. Mixing in Plant

1. Place aggregate through a dryer and heat to temperature not exceeding 350 degrees F (excluding mixes that contain "Rosphalt 50" additive). For mixes containing "Rosphalt 50" additive, place aggregate through a dryer and heat to temperature not exceeding 550 degrees F.

2. Screen aggregate to appropriate fractions and place each fraction in a storage bin over mixer unit.

3. Use equipment conforming to ASTM D 995 for preparation of paving mixtures, except provide one bin for fine aggregate, three for coarse aggregate, and one for reclaimed asphalt pavement (if applicable).

4. Introduce aggregate into mixer at between 250 and 350 degrees F (between 450 and 500 degrees F for mixes containing "Rosphalt 50" additive) and dry mix for minimum of 5 seconds (7 seconds for mixtures containing "Vestoplast S", 10 seconds for mixes containing "Rosphalt 50" additive) before adding asphalt. Where reclaimed asphalt pavement or "Vestoplast S" is used, add to mixer after dry mixing and before asphalt cement. Where "Rosphalt 50" additive is used, add to the mixer during the dry mixing.

5. Heat asphalt to a temperature not exceeding 325 degrees F (350 degrees F for modified asphalt) and introduce it into mixer at a temperature of not less than 275 degrees F (300 degrees F for modified asphalt).

6. Mix as long as necessary, but not less than 30 seconds (not less than 70 seconds for mixes containing "Rosphalt 50" additive) after introduction of asphalt cement, to completely and uniformly coat aggregate particles.

7. Regulate temperature of mixture according to outdoor temperature and as necessary to meet minimum laydown temperatures specified in 1.03 A.3 and 4. However, asphalt concrete mix production temperatures leaving the plant shall be as follows:

Type of Asphalt	Temperature Degrees F
Asphalt Cement	275 - 325
Modified Asphalt – PG 76-22	305 - 335
Modified Asphalt – PG 82-22	310 - 340
Asphalt containing "Rosphalt 50"	410 - 450

Any deviation from these temperatures must be approved by the Chief of Materials Engineering, Materials Engineering Unit. Use of storage silos will be permitted provided such silos are approved as specified in 1.04 D.4.

B. Delivery, Placing and Spreading

1. Trucks used for hauling asphalt concrete mixtures shall have tight, clean and smooth metal beds free from kerosene and other solvents. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened. Trucks used for hauling asphalt concrete mixtures containing "Rosphalt 50" additive shall have heated bodies and a suitable cover, securely fastened, to protect the mixture from adverse weather.

2. Load trucks using a minimum of three drops. The first load shall be approximately 40% of the total weight of the mix to be hauled and shall be loaded into the center of the front half of the truck. The truck shall then be pulled forward so that the next 40 percent or so of the total load can be deposited into the center of the back half of the bed, near the tailgate. The vehicle shall then be moved backward so that the remaining 20 percent of the mix can be dropped into the center of the bed, between the first two piles.

3. Deliveries shall be scheduled so that placing and compacting of mixture is uniform without stopping and starting of the paver. Hauling over freshly placed material will not be permitted until the material has been compacted, as specified herein, and allowed to cool to ambient temperature.

4. Spread evenly, screed and finish each course to tolerances and requirements specified in this Section.

5. Asphalt concrete pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of asphalt concrete which will meet the specified thickness, smoothness and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

   The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture.

6. An automatic screed control system shall be used which is capable of automatically maintaining the specified screed elevation and transverse slope. The control system shall be automatically actuated from a reference system by a sensor.

   The control system shall be capable of working in conjunction with any of the following reference systems:

   a. Ski-type device 40 to 60 feet in length.

   b. Taut stringline (wire) set to grade.

c. Laser beam set to grade.

7. Before commencing each day's paving, clean the paver of any material left from previous paving operations.

8. Place asphalt concrete paving in minimum 10-foot wide strips, except the last strip, which may be a lesser width if necessary.

9. Begin along high sides of areas and proceed towards low side of areas with a one directional slope. Start on centerline and work both ways for crowned pavements.

10. The longitudinal joint in one lift shall offset the longitudinal joint in the lift immediately below by at least 1 foot; however, the longitudinal joint in the surface lift shall be at the centerline of the pavement. Transverse joints in one lift shall be offset by at least 10 feet from transverse joints in the previous lift. Within the same lift, transverse joints in adjacent lanes shall be offset a minimum of 10 feet.

11. When starting paving operations at transverse joints, provide four starting block strips under full length of paver screed. Blocks shall be of a thickness appropriate for the lift being placed.

12. The paver's hopper shall be kept half full throughout the paving day. The wings shall not be emptied until the end of the paving day. Residual material shall be disposed of off Authority property.

13. No raked asphalt concrete material shall be broadcast back onto the pavement mat. Raked material shall be placed back in the paver hopper or disposed of.

14. Use hand placing and finishing methods, as approved by the Engineer, in small areas where use of power equipment is impractical. Lutes shall be used for hand spreading.

15. After density requirements have been meet, and a minimum of one hour after completion of rolling, reduce mat temperature by the controlled application of water, as directed by the Engineer. Allow the compacted mat to cool to 140 degrees F before opening to vehicular traffic.

C. Grade Control

1. Remove grade stakes just prior to rolling of the plant mix macadam base course.

2. The Engineer will provide benchmarks and alignment controls adjacent to each area of construction, which shall be checked and maintained by the Contractor.

3. Perform Contractor's quality control surveys immediately after top course has been rolled to check final surface grades, in accordance with 1.04 D.8.

4. Establish and maintain required lines and grades, including crown and cross slope, for each course during paving operations.

5. Use only qualified surveyors licensed in the State in which Work is being performed.

D. Compaction Equipment

1. Use power rollers weighing not less than 10 tons, having wheel loads of at least 250 lbs./linear inch of combined static and dynamic force and equipped with adjustable scrapers to keep wheel surfaces clean and with efficient means of keeping them wet to prevent the mixture from sticking to the roller.

2. Use types and quantities of equipment as necessary to meet all quality and production requirements of this Section.

3. Do not use steel rollers with pits, flat spots or grooves worn into rolling surface. Roller shall be capable of reversing without backlash.

4. Keep roller on asphalt concrete to avoid contamination of pavement with foreign material.

E. Rolling

1. Commence as soon as material will sustain roller without undue displacement, cracking or shoving.

2. The speed of the roller shall at all times be sufficiently slow to avoid displacement of the hot mixture and to be effective in compaction. Immediately correct any displacement occurring as a result of reversing the direction of the roller, or from any other cause.

3. The sequence of rolling operations shall be at the discretion of the Contractor.

4. Perform rolling with types and quantity of rollers as may be necessary to satisfy all of the pavement quality requirements specified herein.

5. Do not re-roll cold in-place asphalt concrete with a steel wheel or vibratory roller to attempt to increase density. A pneumatic tire roller may be used, subject to approval by the Engineer.

6. At end of each day's operations or when paving is interrupted sufficiently to allow mixture to cool, make a stop by means of tapering the course and form a transverse joint.

7. When resuming operations, cut back joint to expose a granular surface for full depth of the course, paint exposed edge with tack coat, place fresh mixture against joint, tamp and roll.

8. Any pavement that becomes loose and broken or mixed with dirt, develops check-cracking, or is in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at no cost to the Authority. Skin patching will not be allowed.

9. For asphalt concrete mixes containing "Rosphalt 50", breakdown rolling shall begin immediately after laydown and finish rolling shall be performed when the mix temperature is between 210 degrees F and 140 degrees F.

F. Joints

1. Form all joints in such a manner as to ensure a continuous bond between the courses and to obtain the required density, as demonstrated, tested and approved in the control strip. All joints shall have the same texture as other sections of the course and shall meet the requirements for density, smoothness and grade. Minimize raking of joints. Any mix raked from joint shall be discarded and not broadcast back onto the mat.

2. For transverse joints, the roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a temporary stop. After a temporary stop and prior to the continuation of paving, the tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face before placing the adjacent lane. Apply tack coat on all newly exposed contact surfaces before placing any fresh mixture against the joint.

3.03 CORRECTIONS OF DEFICIENCIES

A. Deficiencies in Surface Smoothness

1. Make corrections as specified below at no cost to the Authority in the event of the following:

   a. Longitudinal Smoothness for roadways where paving lane lengths equal or exceed 500 linear feet.

      (1) The Profile Index exceeds 22.0 inches per mile, or the surface profile deviations exceed 0.4 inches in 25 feet, when tested in accordance with 1.04 E.10.a, unless the Engineer elects to accept the deficient surface subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 H and I.

   b. Longitudinal and transverse direction for parking lots and port container storage areas.

      (1) In areas that do not adequately drain the water from the surface, or that otherwise hold water.

   c. Longitudinal direction for roadways where paving lane length is less than 500 feet.

      (1) 15 percent of all measurements in a paving lane exceed the requirements of 1.03 D.1.c when tested in accordance with 1.04 E.10.b.

      (2) Any deviations exceeding 1/4 inch when tested with a 10-foot straightedge.

2. The area of deficiencies in surface smoothness and/or surface grade tolerance is defined as the area of the lot defined in 1.04 E.10.a.(3), b.(1), except for parking lots and port container storage areas where the area of deficiencies will be determined by the Engineer based on the results of the test specified in 1.04 E.10.c.

3. Remove and replace, or diamond grind, pavement deficient in surface smoothness, in accordance with all applicable requirements of the Basic Contract Drawings and this Section, at times approved by the Engineer, so as not to interfere with operations of the Authority or others using the area.

4. Remove and replace shall mean milling a minimum depth of twice the nominal maximum aggregate size of the asphalt concrete and repaving to the finished grade shown on the Basic Contract Drawings with the same type asphalt concrete mix as removed. Remove existing pavement as necessary to provide square joints for the full depth of the overlay.

5. Diamond grinding may be used to correct deficiencies in surface smoothness and surface grade tolerance subject to approval by the Engineer. However, if removal of more than 3/4 inch of pavement is required to correct any deficiency, the deficient area shall be removed and replaced.

6. Diamond grinding equipment shall be approved by the Engineer and have a minimum grinding head of 36 inches and at least 5 blades per inch of shaft. Diamond grinding shall not be performed when the temperature of the asphalt concrete surface exceeds 80 degrees F. Slurry produced from grinding operations shall be properly disposed of off Authority property.

7. Where corrections are required, the entire width of the paving lane by the length of defective area shall be corrected. In the sole opinion of the Engineer, if the deficiencies are closely spaced and correcting individual areas will adversely affect ride, the entire pavement surface shall be corrected.

8. Following the correction of deficiencies, the Engineer will retest the finished surface of the asphalt concrete. In the event the Profile Index or surface profile deviations exceed the required values, make additional corrections at no cost to the Authority.

B. Deficiencies in In-Place Air Voids of Top and Bottom Courses and Bridge Deck Membrane

1. With the exception of bridge deck membrane, any pavement sublot with in-place mat air voids less than 2.0 percent or greater than 8.0 percent (9.0 percent for bottom course and materials placed on roadway structures) shall be removed and replaced at no additional cost to the Authority. For mixes containing "Rosphalt 50" additive, any pavement sublot with in-place mat air voids greater than 6.0 shall be removed and replaced at no additional cost to the Authority. For paving lifts other than the top lift of asphalt concrete, the Engineer may elect to accept deficient material subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 G.

2. For bridge deck membrane, any pavement sublot found to be below the lower density limit as specified in 1.03 D.2.a or having air voids greater than 2.0 percent shall be removed and replaced at no additional cost to the Authority.

C. Deficiencies in Marshall Stability and Flow

In accordance with 1.03 C.2 for stability and flow, if the Percentage of Material Within Tolerance Limits (PWL) of a lot for either parameter as set forth in 4.03 B.5 equals or exceeds 90 percent, the lot will be acceptable. If the PWL for either parameter is less than 90 percent, determine the reason and take corrective action immediately. If the PWL is below 80 percent for either parameter, stop production and make adjustments to the mix.

D. Deficiency in Final Surface Grade

1. When more than 15 percent of all measurements within a lot exceed the grade tolerance, measured in accordance with 1.04 E.11, remove and replace or diamond grind the entire lot in accordance with 3.03 A, unless the Engineer elects to accept the deficient surface, subject to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 H and I.

2. When any individual measurement exceeds a grade tolerance of plus or minus 0.06 foot, remove and replace the surface of the area exceeding the tolerance in accordance with 3.03 A.

3. Following the correction of deficiencies, the Engineer will retest the final surface of the asphalt concrete. In the event grade tolerance is exceeded, make additional corrections at no cost to the Authority.

E. Deficiencies in the Performance Grade Requirements of Modified Asphalt

Remove and replace the deficient material on a lot basis, unless the Engineer elects to accept the deficient material subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 G.

F. Deficiencies for Tensile Strength Ratio (TSR)

Remove and replace the deficient material on a lot basis if the TSR is less than or equal to 60 percent , unless the Engineer elects to accept the deficient material subject to an adjustment to Contract compensation. Adjustments to Contract compensation will be made as set forth in 4.01 G.

PART 4. ADJUSTMENTS TO CONTRACT COMPENSATION

4.01 GENERAL

A. Where the Contract requires less than 500 tons of asphalt concrete, no adjustments to Contract compensation will be made as specified herein.

B. Where the Contract requires 500 tons or more of asphalt concrete, adjustments to Contract compensation will be made as specified in 4.03 A, B, C, D, E and F.

C. Notwithstanding other adjustments to Contract compensation or corrections specified herein for various deficiencies, no payment will be made for material placed above the allowable tolerance above required grade as specified in 1.03 D.4, or for material that must be removed to correct deficiencies, or for that material placed in excess of the plus tolerance for the total thickness of each course as specified in 1.03 D.3.

D. The computations for adjustments to Contract compensation may require conversion between tons and square yards. Such conversion will be made using the actual computed weight per square yard per inch of thickness determined from the lot's average bulk specific gravity for each type of course times the density of water at 70 degrees F.

E. Adjustments to Contract compensation for in-place mat densities, in-place joint densities for surface course and Marshall air voids shall be determined by applying percentages, calculated as specified in 4.03 B, to the assigned unit price of Sixty Dollars ($60.00) or One Hundred Sixty Dollars ($160.00) for mixes containing "Rosphalt 50", per ton of asphalt concrete; or in the case of Classified Work, by applying such percentages to the actual Contract Unit Price bid for the appropriate asphalt concrete item in the Schedule of Unit Prices for Classified Work, but in no case less than Sixty Dollars ($60.00) or One Hundred Sixty Dollars ($160.00) for mixes containing "Rosphalt 50", per ton of asphalt concrete.

F. The percentage adjustment to the unit price specified in 4.01 E for Marshall air voids, mat density and joint density of the surface course shall be as follows, except as set forth in 4.01 G:

1. When all values calculated in accordance with 4.03 B are 100 percent or greater, the highest value will be used to adjust Contract compensation.

2. When all values calculated in accordance with 4.03 B are less than 100 percent, the lowest value will be used to adjust Contract compensation.

3. When values calculated in accordance with 4.03 B are both greater and less than 100 percent, the product of the highest and lowest values will be used to adjust Contract compensation.

G. When the Engineer elects to adjust Contract compensation in lieu of removal and replacement of material with deficient in-place mat air voids, tensile strength ratio or deficiencies in modified asphalt performance grade, the percentage adjustment to the unit price specified in 4.01 E will be set at 50 percent. No further adjustment will be made for Marshall air voids, mat density or joint density of the surface course.

H. Adjustments for surface smoothness and final surface grade will be based on the final test results, which will be measured after the correction of deficiencies. Reductions in payment will be determined by the following:

$R = A \times D \times F \times T \times 0.00646$

Where:

R = Reduction in payment per lot for surface smoothness or final surface grade, dollars

T = Thickness of final pavement lift, inches

A = Area of lot, square feet

D = Price per ton of asphalt concrete, assigned unit price or contract unit price as set forth in 4.01 E

F = Contract Unit Price Adjustment Factor specified in 4.03 D and 4.03 E

Reductions in payment for failure to meet surface smoothness and final surface grades will be calculated separately for the entire pavement or overlay surface. Deductions from Contract compensation will be made for the requirement (surface smoothness or final surface grade) which results in the greatest payment reduction. Reductions for surface smoothness or final surface grade will be in addition to all other adjustments to Contract compensation.

I. When the Engineer elects to adjust Contract compensation in lieu of correcting areas with deficiencies in surface smoothness or final surface grade, the Contract Unit Price Adjustment Factor specified in 4.01 H will set at 0.10 for surface smoothness and 0.25 for final surface grade.

4.02 ADJUSTMENT TO CONTRACT COMPENSATION FOR THICKNESS DEFICIENCY IN PLANT MIX MACADAM BASE COURSE

A. Where the deficiency of a plant mix macadam base course core exceeds the allowable minus tolerance in plant mix macadam base course thickness, one additional core will be taken by the Engineer in each of the other three sublots adjacent to the core taken in accordance with 1.04 E.4. Plant mix thickness for the area of entire lot will be the average of the four cores.[4] Where there is a deficiency in the average of the four cores in excess of the allowable minus tolerance, the total thickness of succeeding courses in the area of entire lot shall be increased by the amount the deficiency exceeds the allowable tolerance.

B. For each additional lot resampled in accordance with 4.02 A above, there will be deducted from the Contract compensation, in addition to adjustments for deficiencies as hereinafter specified, an amount of One Thousand Dollars ($1,000.00).

4.03 ADJUSTMENT TO CONTRACT COMPENSATION FOR DEFICIENCIES IN TOP AND BOTTOM COURSES AND BRIDGE DECK MEMBRANE

A. Deficiency in Thickness

Thickness of each course, excluding overlay, will be the average of the four cores in the lot for each course[5]. Deductions from Contract compensation for deficiencies in thickness of top course or total of top and bottom courses, modified as may be required by 4.02 A, will be the following amounts (deducted per square yard) for the entire area lot:

Amount of Minus Deficiency (inches)	Amount of Payment Deduction (Dollars per Square Yard)
Greater than 1/4 and up to 1/2	1.00
Greater than 1/2 and up to 3/4	2.00

For minus deficiencies in excess of 3/4 inch either in average of four cores or in any individual core, at the Engineer's option, remove and replace deficient pavement or place an overlay that will satisfy all requirements of this Section.

B. Deficiency in In-Place Mat Density, In-Place Joint Density and Marshall Air Voids

1. Top and bottom courses will be approved on a lot basis with each lot coinciding with that defined in 1.04 D.1.a.

2. Density

a. In-place mat density specified in 1.03 D.2.a will be evaluated for Section compliance using the average of the random sublot in-place density determinations from cores of the area covered by the lot specified in 1.04 D.1.a.

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4 In determining average thickness, if any core exceeds required thickness by more than 1/2 inch, the thickness of that core will be assumed to be 1/2 inch in excess of required thickness.

5 In determining average thickness, if any core exceeds required thickness by more than 1/4 inch, the thickness of that core will be assumed to be 1/4 inch in excess of required thickness.

b. In-place joint density specified in 1.03 D.2.b will be evaluated for Section compliance using the average of random sublot in place joint density determinations from cores of the area covered by the lot specified in 1.04 D.1.a.

3. Marshall air voids will be evaluated for Section compliance using the average of the random sublot void determinations from hot mix samples from the lot specified in 1.04 D.1.a.

4. The Engineer will check each lot for in-place mat densities, in-place joint densities for surface courses only, and Marshall air voids with adjustments to Contract compensation based on the Percentage of Material Within Tolerance Limits (PWL) as determined by 4.03 B.5 below and by the "Table For Estimating Percent of Lot Within Tolerance Limits-PWL (Standard Deviation Method)". No deficient lot will be approved without an adjustment to Contract compensation made in accordance with the tables entitled "Adjustment to Contract Compensation For In-Place Mat Density and Marshall Air Voids" and "Adjustment to Contract Compensation for In-Place Joint Density".

5. Method of Estimating Percentage of Material Within Tolerance Limits (PWL)

a. Locate sampling positions on the lot by use of random sampling procedures specified in FAA ERLPM, Section 6.

b. Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with 1.04 D and E.

c. Determine the average value of all samples ($\overline{X}$).

d. Find the standard deviation (Sn) by use of the following formula:

$$S_n = \sqrt{d_1^2 + d_2^2 + d_3^2 + \ldots + d_n^2/n-1}$$

Where

S_n = standard deviation of the number in the set

$d_1, d_2,$ = deviation of the individual sample values $X_1, X_2, \ldots$ from the average value that is,

d_1 = $(X_1 - \overline{X})$, $d_2 = (X_2 - \overline{X})$, $d_n = (X_n - \overline{X})$

n = number of sublots

e. Find the Lower Quality Index (QL) by subtracting the lower tolerance limit (L) from the average values ($\overline{X}$) and dividing the result by standard deviation (Sn).

$$Q_L = \frac{\overline{X} - L}{S_n}$$

f. Find the Upper Quality Index (QU) by subtracting the average value ($\overline{X}$) from the upper tolerance limit (U) and dividing the result by standard deviation (Sn).

$$Q_U = \frac{U - \overline{X}}{S_n}$$

g. The percentage of material above lower tolerance limit (PL) and the percentage of material below upper tolerance limit (PU) will be found by entering the "Table For Estimating Percent of Lot Within Tolerance Limits - PWL (Standard Deviation Method)" with QL and QU, using the column appropriate to the total number (n) of sublots and reading the number under the column headed "Percent Within Tolerance Limits (PWL)". If the values fall between values shown on the table, use the next higher value for PL or PU.

h. For asphalt concrete properties with only a lower tolerance limit (stability, mat density, joint density), the Percentage of Material Within Tolerance Limits (PWL) equals PL. For asphalt properties with upper and lower tolerance limits (air voids and flow) determine PWL using the following formula:

$$PWL = (P_U + P_L) - 100$$

i. If the tests within a lot include a very large or a very small value which appears to be outside the limits of variation, the Engineer will check for an outlier in accordance with ASTM E 178, at a significance level of 5 percent, to determine if this value will be discarded when computing Percentage of Material Within Tolerance Limits (PWL).

C. Adjustment to Contract compensation for each lot will be made in accordance with the formula contained in the table entitled "Adjustment to Contract Compensation For In-Place Mat Density and Marshall Air Voids" by entering the appropriate row with the value of PWL and performing the calculation indicated for that PWL to determine the percentage adjustment of the unit price (specified in 4.01).

ADJUSTMENT TO CONTRACT COMPENSATION FOR IN-PLACE MAT DENSITY AND MARSHALL AIR VOIDS	
Percentage of Material Within Tolerance Limits (PWL)	Percentage Adjustment of the Unit Price (specified in 4.01 E and 4.01 F)
96-100	106
90-96	PWL + 10
80-90	0.5 (PWL) + 55
65-80	2.0 (PWL) – 65
Below 65	[6]

[6] The lot shall be removed and replaced to meet Section requirements as ordered by the Engineer. In lieu thereof, and subject to the provisions in 3.03 B for mandatory removal and replacement, the Contractor and the Engineer may agree in writing that, for purposes of practicality, the deficient lot shall not be removed and adjustment to Contract compensation shall be made at 75 percent of the unit price specified in 4.01 E.

D. Deficiency in Final Surface Grade Tolerance

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Exceeding Final Surface Grade Tolerance" by entering the appropriate row with the percentage of all measurements within a lot which exceed the grade tolerance, measured in accordance with 1.04 E.11, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR EXCEEDING FINAL SURFACE GRADE TOLERANCE	
Measurements Exceeding Grade Tolerance (Percent)	Contract Unit Price Adjustment Factor
0.0 – 5.0	0.00
5.1 – 10.0	0.05
10.1 – 15.0	0.25
15.1 and up	Corrective work required as specified in 3.03 D

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 H.

E. Deficiency in Surface Smoothness

Adjustment to Contract compensation for each lot will be made using the table entitled "Adjustment to Contract Compensation for Surface Smoothness", by entering the appropriate row with the Profile Index, measured and calculated in accordance with 1.04 E.10, and by reading the number under the column headed "Contract Unit Price Adjustment Factor".

ADJUSTMENT TO CONTRACT COMPENSATION FOR SURFACE SMOOTHNESS	
Average Profile Index (inches per mile)	Contract Unit Price Adjustment Factor
0.0 - 15.0	0.00
15.1 - 16.0	0.02
16.1 - 17.0	0.04
17.1 - 18.0	0.06
18.1 - 20.0	0.08
20.1 - 22.0	0.10
22.1 and up	Corrective work required as specified in 3.03 A

The Contract Unit Price Adjustment Factor is used to calculate adjustments to Contract compensation as specified in 4.01 H.

F. Adjustment to Contract compensation for each lot will be made in accordance with the formula contained in the table entitled "Adjustment to Contract Compensation for In-Place Joint Density" by entering the appropriate row with the value of PWL and by performing the calculation indicated for that PWL to determine the percentage adjustment of the unit price (specified in 4.01 E.).

ADJUSTMENT TO CONTRACT COMPENSATION FOR IN-PLACE JOINT DENSITY	
Percentage of Material Within Tolerance Limits (PWL)	Percentage Adjustment of the Unit Price (specified in 4.01 E and 4.01 F)
96 – 100	106
90 – 96	PWL + 10
80 – 90	0.25 x PWL + 77.5
65 – 80	PWL + 17.5
Below 65	[7]

[7] The lot shall be removed and replaced to meet Section requirements as ordered by the Engineer. In lieu thereof, and subject to the provisions in 3.03 B for mandatory removal and replacement, the Contractor and the Engineer may agree in writing that, for purposes of practicality, the deficient lot shall not be removed and adjustment to Contract compensation shall be made at 75 percent of the unit price specified in 4.01 E.

TABLE FOR ESTIMATING PERCENT OF LOT WITHIN TOLERANCE LIMITS - PWL (STANDARD DEVIATION METHOD)

Percent Within Tolerance Limits (PWL)	Positive Values of Q_L or Q_U n = Number of Sublots					
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4716
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630
87	1.0597	1.1100	1.1173	1.1191	1.1199	1.1204
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015
83	0.9939	0.9900	0.9785	0.9715	0.9672	0.9643
82	0.9749	0.9600	0.9452	0.9367	0.9325	0.9281
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958

TABLE FOR ESTIMATING PERCENT OF LOT WITHIN TOLERANCE LIMITS - PWL (STANDARD DEVIATION METHOD)

Percent Within Tolerance Limits (PWL)	Positive Values of Q_L or Q_U n = Number of Sublots					
	n = 3	n = 4	n = 5	N = 6	n = 7	n = 8
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747
70	0.6787	0.6000	0.5719	0.5583	0.5504	0.5454
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592
66	0.5563	0.4800	0.4545	0.4424	0.4354	0.4310
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4031
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855
56	0.2164	0.1800	0.1688	0.1636	0.1613	0.1592
55	0.1806	0.1500	0.1408	0.1363	0.1338	0.1322
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0792
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264
50	0.0	0.0	0.0	0.0	0.0	0.0

G. Additional Tests

1. In the event the Contractor elects to question the original density test results obtained from a particular lot for either the mat density or joint density, the Contractor may request additional testing of that lot in writing within 48 hours of receipt of the written test results from the Engineer. Upon written request received from the Contractor for such additional testing, the Engineer will test one additional sample from each sublot from randomly selected locations in the pavement where the lot was placed. The redefined test will consist of the Engineer's original samples and the additional Contractor's requested samples. The "Percent of Material Within Tolerance Limits-PWL" will be determined in accordance with 4.03 B.5. The value will be used to determine any adjustment to Contract compensation. Only one resampling per lot will be permitted.

2. Additional tests requested by the Contractor shall be paid for by the Contractor to the Authority at the rate of One Thousand Dollars ($1,000) per lot tested.

4.04 ADJUSTMENT TO CONTRACT COMPENSATION FOR CHANGES IN THE INDEX PRICE OF ASPHALT CEMENT

A. General

An adjustment to Contract compensation will be made for changes in the index price of the asphalt cement in asphalt concrete and plant mix macadam base and for tack coat, as set forth in 4.04 C, provided that the Contract requires a total of 500 tons or more of asphalt concrete and plant mix macadam base course.

B. Engineer's Method of Measurement

1. Asphalt concrete including top course and bottom course and plant mix macadam base course will be measured by the ton. The weight will be determined by one of the following methods:

   a. A weigh ticket printed by an automatic printer system used in conjunction with an automated batching and mixing system. The printed ticket shall show the date, the individual weights of the various components of the asphalt concrete or plant mix macadam base course mixture in a batch, the total weight of each batch and the sum of the all batch weights in the truckload. At the completion of each day's work, a producer's representative shall certify in writing that the total weight supplied was correct.

   b. A weigh ticket printed by an automatic scale showing the tare and gross weights of the truck as determined for each trip and the time and date indicating when the empty truck was tarred and when the loaded truck departed from the plant. Time and date may be printed automatically by a time clock. However, the net weight must be documented on each delivery ticket by a State certified weigh master.

   c. In the event of a breakdown of an automatic printer system, weigh tickets showing the gross, tare and net weight of each truck, as entered and certified by a weigh master, will be accepted for a period not exceeding the necessary repair time as certified by a State licensed repairman.

A weigh ticket shall be furnished for each truckload. Material will not be accepted unless accompanied by a weigh ticket, which shall be legible and clearly indicate the printed heading of the supplier and location of the batch plant, the title of the Contract for which delivery is intended, the time and date, truck number, lot number and mix number of material being furnished and the total net weight in each truckload.

2. Tack coat will be measured by the gallon at a temperature of 285 degrees F.

C. Asphalt Price Adjustment

1. The asphalt price adjustment for the asphalt cement in asphalt concrete or plant mix macadam base course will be determined monthly using the following formula:

$$Ac = (A - BA) \times T$$

Where Ac = Asphalt Cement Price Adjustment, in dollars
A = Asphalt Cement Price Index[8], in dollars per ton
BA = Basic Asphalt Cement Price Index[9], in dollars per ton
T = Tons of New Asphalt Cement[10]

2. The asphalt price adjustment for tack coat will be determined on a monthly basis using the following formula:

$$At = (A - BA) \times (C) \times (G) \times 0.003986$$

Where At = Asphalt Cement Price Adjustment for tack coat, in dollars
C = Petroleum Content of the Tack Coat in Percent by Volume: Use 1.0 for asphalt cement and cutbacks
A = Asphalt Cement Price Index[8], in dollars per ton
G = Tack Coat Furnished in Gallons and Applied at 285°F, where one gallon is equal to 0.003986 ton
BA = Basic Asphalt Cement Price Index[9], in dollars per ton

3. Should a monthly Asphalt Cement Price Index increase 50 percent or more over the Basic Asphalt Cement Price Index, no additional asphalt concrete, or plant mix macadam base shall be furnished for the Contract without written approval from the Engineer.

4. Should a monthly Asphalt Price Index decrease from the Basic Asphalt Price Index, payments will be decreased accordingly.

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8 The Asphalt Cement Price Index is the price in dollars per ton (English Units), published by the New Jersey Department of Transportation for the area North of Route 195, for the month during which the asphalt concrete paving or tack coat application occurred.

9 The Basic Asphalt Cement Price Index is the price in dollars per ton (English Units), published by the New Jersey Department of Transportation, for the area North of Route 195, for the month immediately prior to the month during which bids are received.

10 The weight of asphalt cement eligible for price adjustment including all conventional and modified asphalt concrete and plant mix macadam base course will be determined by multiplying the percentage of new asphalt cement in the approved job mix formula by the weight of asphalt concrete mixture, measured in accordance with 4.04 B.

5. Asphalt price adjustments will not be made in those months for which the Monthly Asphalt Cement Price Index has changed by less than five percent from the Basic Asphalt Cement Price Index.

6. If the Asphalt Cement Price Index is adjusted more than once in a month, the asphalt price adjustment may be made.

END OF SECTION

SECTION 02553

ASPHALT CONCRETE PAVING

APPENDIX "A"

SUBMITTALS

A. Submit to the Chief of Materials Engineering , Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey, 07310-1397, for approval, all Job Mix Formulae with Checklist (specified in 2.03 B) for each type of asphalt concrete mix, from each plant and each new source of material at least 10 days prior to the start of production.

B. Submit certified test data, location of each type aggregate to be used and quantities to be obtained from each location and make arrangements for the Materials Engineering Unit to obtain samples from each such location for checking against the samples submitted. Take all samples in accordance with requirements of ASTM D 75 and ASTM D 242.

C. If requested, submit to the Chief of Materials Engineering, Materials Engineering Unit samples of each type aggregate to be used and from each source with proper identification as to source, type of aggregate and Contract number. Submit in clean, sturdy bags and in the following amounts for each sample when requested:

Reclaimed Asphalt Pavement (when used)	50 lbs.
Coarse Aggregate	25 lbs.
Fine Aggregate	25 lbs.
Mineral Filler	5 lbs.

D. Submit for each type asphalt cement proposed for use to the Chief of Materials Engineering, Materials Engineering Unit the following for approval. Resubmit the data each time asphalt cement from a different source is proposed.

1. The name and location of the supplier(s).
2. An analysis of such asphalts by the supplier, certifying that the results of tests comply with the requirements of AASHTO M320 and this Section.
3. If requested, submit four 1-quart samples of the asphalt cement.

E. Submit for each additive proposed for use to the Chief of Materials Engineering, Materials Engineering Unit, the following for approval:

1. The name and location of the supplier(s).
2. An analysis of such additive by the supplier, certifying the chemical properties and compliance with this Section.
3. If requested, submit a sample of the additive, in the manufacturer's original sealed bag or container.

F. For mixes containing "Rosphalt 50" additive, the manufacturer ,Chase Construction Products/Royston Division of Chase Corporation, may request samples of aggregates, asphalt cement and/or additives to be submitted to them in their laboratory to develop or verify the Job Mix Formulae.

G. In lieu of submitting samples of aggregates, asphalt cement and/or additives, the Engineer may verify the Job Mix Formulae at the plant.

H. Submit quality control plan and control charts to the Chief of Materials Engineering, Materials Engineering Unit, for approval, at least 5 days prior to the start of production.

I. Submit to the Chief of Materials Engineering, Materials Engineering Unit, the name of the supplier and an analysis of the asphalt tack coat to be used on the Contract.

J. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one package per Section or trade, and sent to the Engineer of review.

END OF APPENDIX "A"

DIVISION 2

SECTION 02575

PAVEMENT MILLING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the removal of asphalt concrete and Portland cement concrete pavement by milling.

1.02 JOB CONDITIONS

To minimize work interruptions, make provisions to ensure that spare parts for removal equipment and a qualified mechanic are available from a local distributor of the equipment.

PART 2. PRODUCTS

(None Required)

PART 3. EXECUTION

3.01 PAVEMENT REMOVAL

A. Equipment

1. Milling equipment shall be a self-propelled planing, grinding or cutting machine, with variable operating speeds and automatic grade controls, capable of removing asphalt and concrete pavement without the use of heat.
2. Front-end loader excavating equipment shall be used.
3. Pneumatic hammers shall not be heavier than nominal 30-pound class when used on bridge decks.

B. In the removal of pavement, do not deposit any material in catch basins, or on existing construction that is to remain in place. Any material so deposited shall be promptly removed.

C. Do not damage or disturb any adjacent pavements, joint structures or existing construction that are to remain in place. Should such damage occur due to the Contractor's operations, repairs shall be immediately made to the satisfaction of the Engineer.

D. Sawcut existing pavement to the required depths and horizontal limits of removal areas shown on the Basic Contract Drawings. Sawcutting may be eliminated if, in the opinion of the Engineer, mechanical removal equipment results in a satisfactory straight vertical edge of pavement. However, sawcutting shall not be eliminated in areas shown as "Sawcut" on the Basic Contract Drawings.

E. Remove existing pavement to the limits and depths shown on the Basic Contract Drawings.

F. For removal of pavement along curves or other tight areas not accessible to the milling machine, or for removal of deteriorated concrete, use pneumatic hammers or mechanical chippers. On bridge decks, equipment shall not be operated at an angle exceeding 45 degrees relative to the pavement surface.

G. Where milled pavement is not required to be overlayed, milling shall be accomplished by coordinating machine and drum speeds of operation so as to produce a surface to permit passage of traffic at posted speed limit without impaired directional control. Surface shall be free from gouges, continuous grooves, ridges and delaminated areas and shall have a uniformly textured appearance consisting of discontinuous longitudinal striations.

H. Where milled areas are required to be reopened to traffic prior to overlaying, ramp the perimeter of the milled area and around roadway castings and similar appurtenances if they become exposed, to provide smooth, safe transition for traffic between milled and unmilled surfaces.

I. Remove all debris resulting from removal operations promptly. Thoroughly clean the Work area to the satisfaction of the Engineer.

Use hand brooms, mechanical sweepers or vacuum equipment for cleanup immediately before the end of each work period.

Dispose of material resulting from removal operations away from Authority property unless otherwise shown on the Basic Contract Drawings.

END OF SECTION

DIVISION 2

SECTION 02580

THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for thermoplastic reflectorized pavement markings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Association of State Highway and Transportation Officials (AASHTO)
AASHTO M 247	Specification for Glass Beads Used in Pavement Markings.
AASHTO M 249	Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form).
AASHTO T 250	Standard Method of Test for Thermoplastic Traffic Line Material.
	American Society for Testing and Materials (ASTM)
ASTM D 36	Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus).
ASTM D 1155	Test Method for Roundness of Glass Spheres.
ASTM D 1214	Test Method for Sieve Analysis of Glass Spheres.
	Federal Highway Administration (FHWA)
MUTCD	Manual on Uniform Traffic Control Devices.
	Federal Standards
FED-STD-595C	Colors Used in Government Procurement.

1.03 QUALITY ASSURANCE

A. The quality and workmanship of the completed marking installation shall conform to 3.02 C.4.

B. Warranty

Arrange for the completed marking installation to be warranted to the Authority, from the date of issuance of the Certificate of Final Completion, against peeling, chipping, flaking, delamination and shoving for a period of one year. The warranty shall run to the Authority's benefit and shall grant the Authority a direct right of action against the manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Use thermoplastic material that has been manufactured in block form and packaged in suitable corrugated containers to which it will not adhere during shipment or storage. Each container shall weigh approximately 50 pounds and shall consist of blocks approximately 12 inches x 36 inches x 2 inch in size. Each container shall be sealed at the point of manufacture and plainly marked with the color, basic resin type (either hydrocarbon or alkaloid), manufacturer's name, batch number and date of manufacture, and a statement stating the contents meet the requirements of this Section. Each batch manufactured shall have its own separate number. The label shall warn the user that the material shall not be heated in excess of 440 degrees F gauge.

B. Arrange for the reflective glass spheres for drop-on application to be shipped in strong moisture resistant bags each containing approximately 50 lbs of reflective glass spheres. Each bag shall be marked with the name and address of the manufacturer, the name and weight of the material, a statement stating the contents meet the requirements of this Section, date of manufacture and batch number.

C. Arrange for primer to be shipped in pails, drums or other strong containers. Each container shall be plainly marked with the brand name of the product, the name and address of the manufacturer, the date of manufacture, the quantity of material, the date of expiration or shelf life and appropriate hazard warnings. Primers shall be shipped to the construction site with instructions for use affixed to each container.

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. White and yellow reflectorized thermoplastic shall conform to AASHTO M 249.

1. Composition Requirements

The thermoplastic material composition shall be specifically formulated for application at temperatures greater than 400 degrees F true (measured with high precision laboratory grade equipment) and shall show no significant breakdown or deterioration at a true temperature of 450 degrees F.

a. The binder component shall be formulated as hydrocarbon resin or formulated as alkaloid base product, unless otherwise shown on the Basic Contract Drawings. The pigment, beads and filler shall be uniformly dispersed in the binder resin.

b. The thermoplastic material shall be free from all skins, dirt and foreign objects and shall comply with the following requirements:

	Percentage by Weight	
Component	White	Yellow
Binder	18.0 Min.	18.0 Min.
Titanium Dioxide	10.0 Min.	---
Glass Beads	30 - 40	30 - 40
Calcium Carbonate and Inert Fillers	42.0 Max.	*
Yellow Pigments	---	*

*Relative amounts and types of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided that the other composition requirements of this Specification are met and the yellow pigment does not contain chromates or lead.

2. Physical Properties of Composition

a. Colors

White thermoplastic composition, as placed, shall be white, free from dirt or tint, and shall match FED-STD-595C - Color 17886 . Yellow thermoplastic composition, as placed, shall be yellow, free from dirt, and shall match FED-STD-595C - Color 13538.

b. Drying Time

When applied at a temperature of 412.5 ±12.5 degrees F and in a thickness between 1/8 inch and 3/16 inch, the thermoplastic material shall be completely solid after it cools to ambient temperature and shall show no damaging effects from traffic after 2 minutes when the air temperature is 50 ±3 degrees F and after 10 minutes when the air temperature is 90 ±3 degrees F.

c. Color Retention

The thermoplastic material shall not change color during the warranty period.

d. Yellowness Index

White thermoplastic material shall not exceed a yellowness index of 0.12 when tested in accordance with AASHTO T 250.

e. Softening Point

The thermoplastic material shall have a softening point of 215 ±15 degrees F when tested in accordance with ASTM D 36.

f. Specific Gravity

The specific gravity of the thermoplastic material as determined by a water displacement method at 25 degrees C shall not exceed 2.15.

g. Cracking Resistance at Low Temperature

After heating the thermoplastic material for 240 ±5 minutes at 425 ±3 degrees F, applying to concrete blocks and cooling at 15 ±3 degrees F, the material shall show no cracks.

h. Impact Resistance

After heating the thermoplastic material for 240 ±5 minutes at 425 ±3 degrees F and forming test specimens, the impact resistance after cooling to ambient temperature shall be a minimum of 10 inch-pounds.

i. Flowability

After heating the thermoplastic material for 240 ±5 minutes at 425 ±3 degrees F and testing for flowability, the residue (sample weight that doesn't flow out) of the white thermoplastic shall not exceed 18 percent and the residue of the yellow thermoplastic shall not exceed 21 percent.

j. Fumes

The thermoplastic material shall not exude fumes that are toxic, obnoxious and/or injurious to persons or property when it is heated during application.

B. Reflective Glass Spheres (Mix Component and Drop-On)

Reflective glass spheres for use in the thermoplastic composition and for drop-on shall conform to AASHTO M 247 - Type 1.

1. The glass spheres shall be colorless; clean; transparent; free from milkiness or excessive air bubbles, and essentially clean from surface scarring or scratching. They shall be spherical in shape and at least 70 percent of the glass beads shall be true spheres when tested in accordance with ASTM D 1155.

2. The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 25 degrees C.

3. The glass spheres shall have the following gradation when tested in accordance with ASTM D 1214.

U.S. Standard Sieve	Mass % Passing
No. 20	100
No. 30	75-95
No. 50	15-35
No. 100	0-5

4. Glass spheres for drop-on shall be treated with a moisture-proof coating meeting the flow requirements of AASHTO M 247 Section 4.4, shall not absorb moisture during storage, shall remain free from clusters and shall flow freely from dispensing equipment.

C. Primer

Primer for use on both bituminous and Portland cement concretes shall be of the type recommended by the manufacturer of the thermoplastic material and shall be designed to dry tack-free in under 5 minutes.

2.02 BASIS OF ACCEPTANCE

A. Thermoplastic material will be accepted on the basis of sampling and inspection at the place of manufacture or in warehouse lots as determined by the Engineer. In addition, deliver all samples with the manufacturer's certified test results and identification of the binder formulation (e.g., "formulated as a hydrocarbon resin"). Any unauthorized tampering, opening or breaking of seals on the containers between the time of sampling and delivery to the construction site shall be cause for rejection of the material.

B. The minimum batch size of thermoplastic material when tested shall be not less than 3000 lbs., unless the total order is less than that amount.

C. Primers will be subject to approval by the Engineer prior to use. Requests for approval shall include technical data including brand name, instructions for use and hazard warnings.

D. Any rejected materials shall be immediately replaced with materials meeting the requirements of this Section.

PART 3. EXECUTION

3.01 APPLICATION EQUIPMENT

A. General

Thermoplastic application equipment will be subject to approval by the Engineer prior to the start of application.

1. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

2. Unless otherwise approved by the Engineer, all longitudinal pavement marking lines shall be striped using only mobile applicator equipment. Longitudinal pavement marking lines include broken lines (skip line), edge lines, barrier lines and solid lines as defined by the FHWA "MUTCD".

   a. Portable applicator equipment will be acceptable for placing all other markings; and for longitudinal marking where use of mobile applicator equipment is impractical, as approved by the Engineer.

3. Apply thermoplastic material to the primed pavement surface by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, equipment suitable for maintaining the temperature and controlling the flow of material.

4. For heating the thermoplastic material, the applicator equipment shall include melting kettle(s) of such capacity as to allow for continuous marking operations. The melting kettle(s) may be mounted on a separate "supply" vehicle or included as part of the application equipment. The kettle(s) shall be capable of automatically heating the thermoplastic material to, and maintaining it at, an indicated and accurate gauge temperature of 420 degrees F to 430 degrees F. The heating mechanism shall incorporate a thermostatically controlled indirect heat transfer medium. Direct heating of the melting kettle by flame will not be permitted.

5. Thermoplastic material temperature gauges accurate to plus or minus 15 degrees F shall be provided at both ends of each kettle and reservoir, and in each extrusion shoe, in such a manner as to be visible so that an operator can monitor the thermoplastic material temperature throughout the marking operation.

6. Applicator equipment including separate "supply" kettles shall be constructed to continuously mix and agitate the thermoplastic material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe(s) shall be so constructed as to prevent accumulation and clogging. All parts of the equipment that come into contact with thermoplastic material shall be so constructed as to be easily accessible and exposable for cleaning and maintenance. The equipment shall be constructed so that mixing and conveying parts, up to and including the extrusion shoe(s), maintain the material at the required application temperature.

7. The applicator equipment shall be so constructed as to:

   a. Ensure continuous uniformity in the dimensions of the stripe;

   b. Provide a means for cleanly cutting off stripe ends squarely;

   c. Provide a method of applying "skip" lines; and

   d. Be capable of applying various widths of traffic markings from 3 to 12 inches wide.

8. The applicator equipment shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow up to 10 lbs. per 100 sq. ft. of thermoplastic material. The bead dispenser shall be automatically operated in such a manner that it will dispense beads only while the thermoplastic material is being applied.

9. Applicator equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

B. Mobile Applicator Equipment

1. The mobile applicator shall be a truck mounted, self-contained pavement marking machine that is capable of applying hot thermoplastic material by the extrusion method. The applicator shall be equipped to maintain and apply the thermoplastic material at an indicated and accurate gauge temperature of 420 degrees F and at the widths and thicknesses specified in this Section. The applicator shall be capable of operating continuously and of installing a minimum of 20,000 linear feet of longitudinal markings in 8 hours.

2. The mobile applicator shall be equipped with melting kettle(s) or materials storage reservoir(s) and a glass bead hopper of such capacity as to allow for continuous marking operations. The kettle(s) or reservoir(s) shall be capable of heating and holding the thermoplastic material at an indicated and accurate gauge temperature of 420 degrees F.

3. The mobile applicator shall be equipped with an extrusion shoe(s) and shall be capable of marking edge line and center line stripes. The extrusion shoe(s) shall be:

   a. Closed, heat jacketed or suitably insulated units;

   b. Able to apply the molten thermoplastic at an indicated and accurate gauge temperature greater than 415 degrees F; and

   c. Capable of extruding a uniform line pre-set at 3 to 12 inches wide at a thickness of not less than 1/8 inch nor more than 3/16 inch.

4. The mobile applicator shall be equipped with an electronic and programmable line pattern control system, or mechanical control system, so as to be capable of applying skip or solid lines in any sequence, and through any extrusion shoe in any cycle length.

C. Portable Applicator Equipment

1. The portable applicator shall be a hand operated equipment, specifically designed for placing hot extruded thermoplastic material in installations such as crosswalks; stop bars; legends; arrows; and short lengths of lane, edge and centerlines. The portable applicator reservoir shall be loaded with hot thermoplastic material from the supply vehicle melting kettle(s).

2. The portable applicator shall be equipped with all necessary components (including material storage reservoir, glass bead hopper, temperature gauges, bead dispenser, extrusion shoe and heating accessories) so as to be capable of holding and applying the molten thermoplastic at indicated and accurate gaufge temperatures greater than 415 degrees F; of extruding a line of generally uniform cross-section, pre-set at 3 to 12 inches in width, and at a thickness of not less than 1/8 inch nor more than 3/16 inch.

3.02 INSTALLATION

A. General

1. Apply pavement markings at the locations and in accordance with the patterns and dimensions shown on the Basic Contract Drawings and the FHWA "MUTCD".

2. Before commencing any pavement marking Work, submit a schedule of operations to the Engineer for approval.

3. When pavement markings are applied under traffic conditions, provide all necessary qualified personnel, flags, markers and signs to maintain and protect traffic and to protect marking operations and the new markings until thoroughly set. Perform short duration lane and work area closures in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

4. Apply pavement markings in the general direction of traffic. Striping against the direction of traffic flow will not be permitted.

5. Remove all tracking marks, spilled thermoplastic and thermoplastic applied in unauthorized areas, to the satisfaction of the Engineer.

6. When necessary, establish marking alignment points at 25 ft. intervals throughout the length of the marking area, or as otherwise approved by the Engineer.

7. Apply thermoplastic pavement markings to dry pavement surfaces. At the time of installation, the pavement surface temperature shall be a minimum of 55 degrees F and the ambient temperature shall be a minimum of 49 degrees F and rising.

B. Surface Cleaning and Preparation of Pavement

1. Clean the pavement surfaces to be marked to the satisfaction of the Engineer immediately prior to priming and marking application. Perform surface cleaning and preparation only in the area of the thermoplastic markings application.

2. At the time of application of the thermoplastic material, ensure that all pavement surfaces are dry, free of oil, dirt, dust, grease and similar foreign materials and that the primer is tack-free.

C. Application

1. Apply a primer to all pavement surfaces (new and existing) to be marked. Apply primer to bituminous concrete and Portland cement concrete pavements, as applicable, at the rates and in accordance with the recommendations of the manufacturer of the thermoplastic material. The primer shall dry tack-free in less than 5 minutes.

2. Apply the thermoplastic material at an indicated and accurate gauge temperature no lower than 415 degrees F at the point of deposition. As used in this Section, the point of deposition shall be defined as within the extrusion shoe.

3. Immediately following application, drop reflective glass spheres onto the molten thermoplastic marking at the rate of 5 lbs. per 100 sq. ft. of composition.

4. Upon cooling to ambient pavement temperature, the resultant marking shall be a well-adhered reflectorized strip of a thickness not less than 1/18 inch nor more than 3/16 inch, and of the width and dimensions shown on the Basic Contract Drawings, capable of resisting deformation by traffic. The exposed marking surface shall be smooth, with no pockmarks, blisters or other surface blemishes evidencing improper application, improper temperature or equipment malfunction. The pavement markings shall show a smooth alignment with continuous uniformity of the required dimensions and widths.

END OF SECTION

SECTION 02580

THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Detailed catalog cuts and manufacturer's specifications of thermoplastic materials, reflective glass spheres and primer, and test data demonstrating conformance to the requirements of this Section.

B. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 2

SECTION 02582

PREFORMED REMOVABLE RETRO-REFLECTIVE PAVEMENT MARKING TAPE

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the following:

A. Preformed removable retro-reflective pavement marking tape for lane lines, stop lines, crosswalks, traffic arrows, symbols, and legends.

B. Removal of existing pavement markings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section.

American Association of State Highway and Transportation Officials (AASHTO)

Manual for Signing and Pavement Markings of the National System for Interstate and Defense Highways

American Society for Testing and Materials (ASTM)

ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 1535	Method for Specifying Color by the Munsell System
ASTM E 303	Using the Brit Pendulum Test and Method for Measuring Surface Frictional Properties

Federal Highway Administration (FHWA)

Manual on Uniform Traffic Control Devices for Streets and Highway

1.03 QUALITY ASSURANCE

A. Tolerances

1. Width of Lines: Minus zero, plus 1/8 inch.
2. Length of skip or lane lines and unpainted surface between the skip lines shall be plus or minus 3 inches.
3. Location of Directional Arrows, Messages, and Stripes

   Within 2 inches of locations shown on the Basic Contract Drawings.
4. Size of Letters and Arrows: Plus or minus 2 inches.

1.04 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.05 SUBMITTALS

For Submittal Requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. Material for preformed removable retroflective pavement marking tape shall consist of white or yellow 3M Scotch-Lane Brand #5710 (white) and #5711 (yellow) tape for line Work, and Series SMF-270 for symbols and legends, or approved equal.

B. Prefabricated legends, symbols and line markings shall conform to the applicable shapes and sizes specified in FHWA Manual on Uniform Traffic Control Devices for Streets and Highway and shall be fabricated from maximum width material to provide the least number of contiguous pieces.

C. Prefabricated lines, legends and symbols shall be precoated with a pressure-sensitive adhesive which is compatible with bituminous concrete and portland cement concrete, and which adheres securely to the roadway.

D. The removable retro-reflective film shall not contain metallic foil and shall consist of high quality preformed plastic materials and pigments, with glass beads uniformly distributed throughout its cross-sectional area and shall have a retro-reflective layer of glass beads bonded to the top surface. A non-metallic medium such as fiberglass, shall be incorporated into the film to facilitate removal.

E. The surface of the retro-reflective preformed plastic film shall provide a minimum skid resistance value of 50 BPN units when tested in accordance with ASTM E 303.

F. The preformed plastic film shall provide a neat and durable marking that will not flow or become distorted due to temperature. The preformed plastic film shall be weather resistant, shall show no appreciable fading, lifting or shrinkage throughout the life of the marking and shall show no significant tearing, roll back, movement or other signs of poor adhesion.

G. The thickness of the retro-reflective preformed plastic film without adhesive shall be not less than 60 mils and not more than 90 mils.

H. The film shall conform to roadway surface contours, breaks and faults during the action of traffic. The film shall have the characteristic of fusing with itself and previously applied marking film of the same composition.

I. The film shall have a minimum tensile strength of 100 psi of cross section when a 1.0-inch wide strip is tested in accordance with ASTM D 638 at a temperature between 70 and 80 degrees F and a jaw speed of 0.25 inch per minute.

J. A sample measuring 1 inch by x 3 inches shall be able to support a dead weight of 4 pounds for not less than 5 minutes at a temperature between 70 and 80 degrees F.

K. The marking film shall be tested for adhesive shear strength in accordance with ASTM D 638.

L. Pigments shall be compounded to maintain the original film color throughout the expected life of the film. White film composition, as placed, shall be white, free from dirt or tint. Yellow film composition, as placed, shall be yellow, free from dirt or tint, and shall be a reasonable visual match to Munsell book notation 10YR8/14 in accordance with ASTM D 1535.

M. The preformed plastic film shall have a minimum of 20 percent by weight of glass beads with a minimum of 2 percent of the beads adhered to the top of the film.

N. The marking film shall be removable from bituminous concrete and portland cement concrete intact or in large pieces, either manually or with a roll-up device, at temperatures above 40 degrees F without the use of heat, solvents, grinding or blasting.

O. All pavement marking materials shall be manufactured and packaged in accordance with the manufacturer's recommendations and in a manner to permit storage for a period of not less than one year from date of purchase.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Pavement markings shall be applied at the locations and in accordance with the patterns and dimensions shown on the Basic Contract Drawings and the FHWA Manual on Uniform Traffic Control Devices for Streets and Highway.

2. Give 48 hours advance notice to the Engineer of the time when pavement marking and striping are to be performed.

3. When pavement markings are applied under traffic conditions, provide all necessary qualified personnel, and traffic control devices to maintain and protect traffic, and to protect marking operations and the new markings until thoroughly set. Short duration lane and work area closures shall be in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

B. Cleaning and Preparation of Pavement Surfaces

1. Cleaning and surface preparation shall be confined to the surface area shown on the Basic Contract Drawings for the application of new pavement marking material; and the surface area of existing pavement markings that are shown on the Basic Contract Drawings for removal.

2. Surface preparation Work shall include cleaning for lines or cleaning for letters and symbols. Lines include: broken line; dotted line; solid line; channelizing line; barrier lines; stop lines; crosswalk lines; and crossbars. When lines are installed, the area of preparation shall be at least the width of the new pavement marking, or existing line, plus 1 inch on each side. When letters and symbols are installed the area of preparation shall be sufficiently large to accommodate the new marking, or to remove the existing marking. Materials used for cleaning pavement of existing marking and any new spills, spatter, or overspray shall not damage the paved surface.

3. Whenever a marking area is cleaned by grinding, scraping, or sandblasting, the cleaning Work shall be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect the motorist. When such cleaning Work is completed, the pavement surface shall be thoroughly blown-off with compressed air to remove residue and debris resulting from such Work.

4. On new concrete pavements, cleaning operations shall not begin until sufficient cure time has elapsed after the placement of concrete unless otherwise approved by the Engineer. New concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, pavement markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting Work shall be to clean and prepare the concrete surface such that:

   a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

   b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

   c. All remaining curing compound is intact; all loose and flaking material is removed.

   d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

5. Existing pavement markings shall be removed for the purpose of preparing the pavement surface for the application of new pavement markings in the same location as the existing markings, or to remove existing markings that are in good condition which, if allowed to remain, will interfere with or otherwise conflict with newly applied marking patterns as determined by the Engineer in his sole discretion. New pavement markings shall not be applied over existing markings unless approved by the Engineer.

C. Application

1. The application of pavement markings shall be performed in the general direction of traffic. Striping against the direction of traffic flow shall not be permitted

2. The Contractor shall establish marking alignment points throughout the length of the marking area as approved by the Engineer.

3. The retro-reflective, preformed marking film shall adhere to bituminous concrete and portland cement concrete surface courses when applied according to the manufacturer's recommendations at surface temperatures down to 50 degrees F. A primer shall be applied to the roadway surface when recommended by the manufacturer. The roadway surface shall be dry at the time of marking application. Dirt, debris, loose particles and heavy oil residues shall be removed from the road surface application areas immediately prior to the installation of the preformed marking film.

4. Applied tape shall not be overlapped and only butt splices shall be used. Preformed marking film lines shall be placed with a mechanical applicator to provide lines which are neat, accurate and uniform without the use of heat, solvents or other additional adhesive means and shall be immediately ready for traffic after application.

5. Preformed marking film for symbols and legend shall be carefully laid and aligned using butt splices only.

6. All new markings shall be immediately tampered in place with a rubber tire roller weighted at 100 pounds per inch of width minimum, or approved equal.

7. The Contractor shall prepare or remove and reapply any pavement markings that fail to satisfy the requirements specified in this Section at no cost to the Authority.

8. The Contractor shall continuously monitor, maintain and repair all installed pavement markings until completion of the Contract.

END OF SECTION

SECTION 02582

PREFORMED REMOVABLE RETRO-REFLECTIVE PAVEMENT MARKING TAPE

APPENDIX "A"

SUBMITTALS

A. Submit detailed catalog cuts, manufacturer's specifications and test data of products proposed for use demonstrating conformance to requirements of this Section in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.

B. A schedule of pavement marking and striping to be performed.

C. Submit proposed means of cleaning, removing, or obliterating existing or unsatisfactory markings to the Engineer for approval prior to commencing corrective work.

D. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 2

SECTION 02588

TRAFFIC PAINT PAVEMENT MARKINGS

PART 1. GENERAL

1.01 SUMMARY

This section specifies requirements for the installation of new painted pavement markings and the removal of any related or conflicting pavement markings. The Contractor shall furnish and apply pavement marking paints, including glass beads thereto, at the locations and in accordance with patterns indicated on the Basic Contract Drawings or as instructed by the Engineer, and in conformance with these Specifications.

1.02 REFERENCES

The following is a listing of the publications and specifications referenced in this Section:

Federal Highway Administration (FHWA)

Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)

American Society for Testing and Materials (ASTM)

ASTM D 1155	Test Method for Roundness of Glass Spheres
ASTM D 1213	Test Method for Crushing Resistance of Glass Spheres
ASTM D 1214	Test Method for Sieve Analysis of Glass Spheres
ASTM D 1535	Method for Specifying Color by the Munsell System

A. Federal Specification - (Reference specification for testing procedures only. See Part 2 of this Section for complete specification requirements.)

1. TT-P-85e, September 15, 1977
2. Federal Test Method Standard 141b, dated February 1, 1979 (or more recent) Paint, Vanish, Lacquer, and related materials.
3. Current ASTM tests.

1.03 QUALITY ASSURANCE

A. Warranty

The pavement markings shall be warranted by the Contractor against abrasion, bleeding, blistering, chipping, cracking, fading, flaking, loss of adhesion, peeling, softening, or other deterioration for a period of 6 months from the date of installation or until the markings are normally worn away by traffic.

B. Tolerances

1. Width of Lines: Minus zero, plus 1/8 inch.

2. Length of skip or lane lines and unpainted surface between the skip lines shall be plus or minus 3 inches.

3. Location of Directional Arrows, Messages, and Stripes Within 2 inches of locations shown on the Basic Contract Drawings.

4. Size of Letters and Arrows: Plus or minus 2 inches.

1.04 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.05 SUBMITTALS

For Submittal Requirements, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. Formulation and Manufacturing - The paint shall be formulated and manufactured from first grade raw materials and shall be free from defects and imperfections that might adversely affect the serviceability of the finished product. The materials shall show no hard settling or gelling upon storage in the sealed containers as received that will affect the performance of the product. The paint shall be furnished ready for use. No additional thinner shall be added. Total volatile organic substances (VOC's) in the paint shall not exceed 2.08 lbs/gal. (250 grams/liter). The paint shall contain less than .06% lead or chromium in final composition.

B. Directional Reflectance - The daylight directional reflectance of the white paint (without glass spheres) shall not be less than 84% and not less than 54% for yellow (relative to magnesium oxide), when tested in accordance with ASTM E-97. Furthermore, the yellow shall substantially match the "Light Limit V +" chip on the Highway Yellow Color Tolerance Chart (PR Color #1, June 1965). Yellow shall conform to the Federal Standard 595a No. 33538.

C. Flexibility - The paint shall show no cracking or flaking when tested in accordance with Federal Specification TT-P-85e, Section 3.4.6.

D. Bleeding - The paint shall have a minimum, bleeding ratio of 0.94 when tested in accordance with Federal Specification TT-P-85e, Section 4.4.8. The asphalt-saturated felt shall conform to Federal Specification HH-R-590.

E. Weight/Gallon - The paint shall have a minimum weight per gallon of 14.5 yellow; 15.1 white.

F. Viscosity - The consistency of the paint shall be not less than 75 or more than 100 Krebs Units at 25 C, when tested in accordance with ASTM D-562.

G. Dry Opacity - ASTM D-2805, The film shall be applied with a .005 inch Bird Applicator. The minimum Contract Ratio of the white and yellow paint shall be 0.96.

H. Water Resistance - The paint shall conform to Federal Specification TT-P-85e, Section 3.4.7. There shall be no blistering or appreciable loss of adhesion, softening or other deterioration after examination.

I. Field Drying Time - The paint, when applied at 11 mils +/- 1 mil wet film thickness and 160 F at the gun and with a glass spheres at the rate of six pounds per gallon of paint, shall dry to no pickup under 1 minute when tested by simulated passing with a passenger car. A line showing no visual deposition of the paint to the pavement surface when viewed from a distance of fifty feet shall be considered non-tracking and conforming to the requirement of the field drying time.

J. Lab No Pickup - The paint when tested by Federal Specification TT-P-85e, Section 4.4.6 shall not be greater than 30 min.

K. Fineness of Grind - The paint shall have a minimum fineness of grind of 3 Hegman.

L. Total Non-Volatile - The paint shall have a total non-volatile content of not less than 85% by weight.

M. Abrasion Resistance - No less than 35 Liters of sand shall be required for removal of the baked paint film. The abrasion resistance test shall be in accordance with TT-P-85e, Section 3.5.2.1 (10 Liters per mil of dried paint).

N. Shelf Life - The paint shall have a usable shelf life of not less than 6 months. The paint shall have no hard settling, caking or separation. The paint shall be able to be mixed easily by means of mechanical stirrer. Paint is to be stored in inside structures at normal room temperature.

O. The paint shall be lead and chromium-free (less than .06%).

P. The dried paint shall match Federal Color Standards -- White 595a and Yellow 33538.

Q. Appropriate cleaning solvents are to be prescribed. These solvents are to be environmentally safe per NY & NJ Regulations.

R. Material Safety Data Sheets (MSDS) are to be part of every shipment and test sample of paint and cleaning solvent.

S. The beads for reflectorizing the paint shall be glass of a composition designed to be highly resistant to traffic wear and to the effects of weathering. The beads shall be colorless; clean, transparent, free from milkiness or excessive air bubbles, and essentially free from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres.

1. The silica content of the glass beads shall not be less than 60%.

2. The beads shall have a refractive index between 1.50 and 1.65 when tested by the liquid immersion method at 25 C.

3. The spheres shall meet the following gradation:

U.S. Standard Sieve	Min.	Max.
Passing No. 20; Retained No. 30	5%	20%
Passing No. 30; Retained No. 50	30%	75%
Passing No. 50; Retained No. 80	9%	32%
Passing No. 80	0%	10%

4. The beads shall show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps. They shall flow freely, and to the satisfaction of the Engineer, from the dispensing equipment at any time when surface and atmospheric conditions are satisfactory for painting.

5. The glass beads shall be packed in waterproof, plastic lined burlap or plastic lined paper bags. Each bag shall be marked with the name and address of the manufacturer and the name and net weight of the material.

T. Testing of Glass Beads - The properties indicated above shall be determined in accordance with the following methods of test:

1. Sphericity - Irregularly shaped particles (out-of-round) shall be tested in accordance with ASTM D1155.

2. Gradation - Tested in accordance with ASTM D1214.

3. Moisture Resistance - The spheres shall pass the following moisture resistance test:

   Place two pounds of spheres in a washed cotton bag, having a thread count of 50 per square inch (warp and woof) and immerse the bag in a container of water for 30 seconds. Remove the bag and force excess water from the sample by squeezing the bag. Suspend and allow to drain for two hours at room temperature (70-72 F). Then, mix the sample in the bag by shaking thoroughly. Transfer sample slowly to a clean, dry glass funnel having a stem 4" in length, with 3/8" inside diameter stem entrance opening and a minimum exit opening of 1/4". The entire sample shall flow freely through the funnel without stoppage. When first introduced into the funnel, if the spheres clog, it is permissible to lightly tap the funnel to initiate the flow.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. All final, interim and temporary pavement markings and patterns shall be placed as shown on the Basic Contract Drawings and in accordance with the Federal MUTCD.

2. Before any final pavement marking work is begun, a schedule of operations shall be submitted to the Engineer for approval. A schedule for temporary markings and patterns for detours and other temporary traffic controls shall also be submitted to the Engineer for approval prior to placement. At least 48 hours advance notice must be given to the Engineer before performing any pavement marking work.

3. When pavement markings are applied under traffic the Contractor shall provide all necessary flaggers, signs, and other traffic control devices to maintain and control traffic, and to protect the marking operation and the new markings until thoroughly dry. The application of pavement markings shall be done in the general direction of traffic; striping against traffic shall not be allowed. Short duration lane and work area closures shall be in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

4. The Contractor shall be responsible for cleaning the pavement to the satisfaction of the Engineer, of dust, dirt and other foreign material that may be detrimental to the adhesion of the paint film.

5. Detour and other temporary or conflicting markings shall be removed as soon as practicable as directed by and to the satisfaction of the Engineer. If darkness or inclement weather interferes with the removal operations, such operations shall be accomplished during the next daylight period or as soon thereafter as weather permits.

6. The method of removal is subject to the approval of the Engineer. Painting out pavement markings is generally not permitted, and if approved will only be permitted for very short-term use. Grinding, scraping, sandblasting, etc., must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect the motorist.

7. When necessary, the Contractor shall establish marking line points at 30 foot intervals throughout the length of the pavement, or as directed by the Engineer.

8. The paint shall be applied in strict accordance with the manufacturer's recommendations for use. Further, at the time of application pavement surfaces shall be thoroughly dry.

B. Application of Pavement Markings

1. Except as noted herein painted pavement markings shall be applied with atomizing spray type striping machines. The striping equipment may be either truck mounted or hand operated. All equipment shall be compatible with and suitable for the application of the type of paint being used.

2. Applied markings shall have clean-cut edges, true and smooth alignment and a minimum uniform wet film thickness of 15 mils. Glass beads shall be applied uniformly over and into the wet paint film at the rate of 6 lbs. per gallon of paint. Glass bead dispensers shall be of a type that will mechanically and automatically give such performance.

3. Upon approval by the Engineer, paint rollers or brushes may be used for marking cross-hatched and solid painted gore areas, letters, symbols, stop bars, short temporary detours or other such areas as directed by the Engineer. When rollers and brushes are allowed, glass beads shall be applied to the wet paint film at the specified rate and in a manner suitable to the Engineer.

4. The Contractor shall repaint, or remove and reapply, any pavement markings that fail to satisfy the requirements specified in this Section, at no cost to the Authority.

5. The Contractor shall continuously monitor, maintain, and repair all installed pavement markings until completion of the Contract.

END OF SECTION

SECTION 02588

TRAFFIC PAINT PAVEMENT MARKINGS

APPENDIX "A"

SUBMITTALS

A. Submit detailed catalog cuts, manufacturer's specifications and test data of products proposed for use demonstrating conformance to the requirements of this Section, in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS.

B. A schedule of pavement marking to be performed.

C. Submit proposed means of cleaning, removing, or obliterating existing or unsatisfactory markings to the Engineer for approval prior to commencing corrective work.

D. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 2

SECTION 02610

EXTERIOR SANITARY SEWER GRAVITY SYSTEM

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for exterior sanitary sewer gravity systems.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

American Society for Testing and Materials (ASTM)

ASTM A 746	Ductile Iron Gravity Sewer Pipe
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 117	Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 822	Terminology Relating to Concrete pipe and Related products
ASTM C 924	Standard Practice for Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
ASTM C 969	Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 1103	Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM D 883	Standard Terminology relating to Plastics
ASTM D 2321	Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D 2680	Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride)(PVC) Composite Sewer Piping

ASTM D 2751	Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	Poly(Vinyl Chloride) (PVC) Large diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
	American Water Works Association (AWWA)
AWWA C 104	Cement-Mortar Lining for Ductile-Iron Pipe Fittings for Water
AWWA C 105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C 110	Ductile-Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids
AWWA C 111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

1.03 QUALITY ASSURANCE

A. Any entity performing the Work of this Section shall have at least three years of installation experience on projects with sanitary sewer piping systems and appurtenances of types and sizes similar to that required under this Contract.

B. Pipe will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced, at no additional cost to the Authority.

C. Pipe may be inspected at the place of manufacture by the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving pipe.

B. Care shall be taken when storing pipe to prevent damage to Authority or other public or private property and any property so damaged shall be repaired at the Contractor's expense.

1.05 SUBMITTALS

For Submittals, see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

For each of the specified materials, manufacturer shall be one of the following, or approved equal.

A. Ductile Iron Sewer Pipe and Fittings

American Cast Iron Pipe Co., North Birmingham, Alabama
Griffin Pipe Products Co., Downers Grove, IL.
McWane, Inc., Birmingham, Alabama
Atlantic States Cast Iron Pipe Co. Phillipsburg, NJ
U.S. Pipe and Foundry Co., Orlando, FL.

B. Gaskets

Hamilton Kent Manufacturing Co., Toronto, Ontario
Diplomatic Marine, Inc., Houston, TX
General Sealants, Inc., Anaheim, CA

C. Reinforced Concrete Pipe

N.J. Concrete Pipe Co., Bayonne, NJ
Price Bros., Inc., Dayton, OH
Vianini Pipe, Inc., Somerville, NJ

D. Plastic Pipe and Fittings

Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
J. M. Manufacturing
Contech Construction Products, Inc., Wappingers Falls, NY

2.02 MATERIALS

Use any of the pipe systems specified below unless otherwise shown on the Basic Contract Drawings or specified herein.

A. Ductile Iron Gravity Sewer Pipe and Fittings

1. ASTM A 746, thickness Class 50 unless otherwise shown on the Basic Contract Drawings, with push-on joints, and cement mortar lining, that shall be twice the standard thickness specified in AWWA C 104.

2. In uncontaminated soil, joints shall be sealed with continuous ring rubber gaskets conforming to AWWA C 111.

3. Where pipe installation in contaminated soil is shown on the Basic Contract Drawings, use neoprene gaskets conforming to AWWA C 111.

B. Reinforced Concrete Pipe

1. ASTM C 76, Class V, Wall B or Wall C, unless otherwise shown on the Basic Contract Drawings. Use ASTM C 150, Type II Portland cement. Pipe joints shall be tongue and groove or bell and spigot, and shall be sealed with a continuous gasket. Lifting holes in pipe will not be permitted.

2. In uncontaminated soil, pipe joints shall be sealed with rubber gaskets. Design of joints and physical requirements for rubber gaskets shall conform to ASTM C 443. Rubber gaskets shall be the following types of rubber gaskets manufactured by Hamilton Kent Manufacturing Co., or approved equal:

   a. "Tylox Type C" for straight tongue and groove pipe

   b. "Tylox Superseal " for offset pipe

   c. "Tylox Type 0" for recessed pipe

3. Where pipe installation in contaminated soil is shown on the Basic Contract Drawings, pipe joint shall be sealed with a continuous rubber ring gasket and with a preformed plastic gasket. Plastic gasket shall conform to AASHTO M 198, except that gasket size, lengths, quantity of primer and packing material shall be in accordance with the gasket manufacturer's recommendation. Preformed flexible plastic gaskets shall be the following, or approved equal:

   a. "Ram-Nek", as manufactured by Diplomatic Marine, Inc.

   b. "GS-79" as manufactured by General Sealants, Inc.

C. Plastic Pipe

1. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings

   ASTM D 3034, bell and spigot push-on type joint with rubber "0" ring gasket, SDR (Ratio of the outside pipe diameter to minimum wall thickness) not greater than 35 for sizes 3 to 15 inches in diameter and ASTM F 679 for sizes 18 to 36 inches in diameter

2. Joints shall meet the requirement of ASTM D 3212 and gaskets shall conform to ASTM F 477.

3. Where contaminated soil is shown on the Basic Contract Drawings, plastic pipe and fittings shall not be permitted.

D. Manholes and Other Structures

Manholes and other structures shall be in accordance with the requirements of the Section entitled "Manholes and Drainage Structures."

E. Polyethylene Encasement for Ductile Iron Sewer Pipe and Cast Iron Soil Pipe, AWWA C 105, Class C polyethylene, 8-mil thickness.

F. Crushed Stone for Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

PART 3. EXECUTION

3.01 EXAMINATION

Where the sewer line is to cross existing utilities, the Contractor shall verify their elevation and horizontal location through excavation of the test pits shown on the Basic Contract Drawings.

3.02 INSTALLATION

A. Excavation

1. Excavate pipe trench in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Basic Contract Drawings.
2. For plastic pipe installations, remove all rocks or other hard objects larger than 1-1/2 inches in size from the area within 12 inches of the pipe.
3. In the course of excavation, should the trench or subtrench width exceed the outside diameter of pipe plus two feet, the Engineer may require remedial measures to reduce the load on the pipe such as the use of concrete cradle or concrete arch bedding, or reinforced concrete encasement. Or the Engineer may require the Contractor to substitute a stronger pipe capable of withstanding the increased load. A subtrench is defined as a trench excavated for pipe placement within a wider trench.
4. If ground water is encountered, prevent accumulation of water in trench by methods approved by the Engineer. Pipe shall be laid in a dry trench.

B. Pipe Support and Backfilling

1. For plastic pipe installations, do not use blocking or mounding to bring the pipe to grade. Conform to the applicable requirements of ASTM D 2321.
2. Where concrete cradles are shown on the Basic Contract Drawings, support the pipe at proper alignment and grade, place concrete (as specified in the Section entitled "PORTLAND CEMENT CONCRETE") to dimensions shown and vibrate same. Concrete, when cured, shall support the full length of pipe.
3. Where crushed stone bedding is shown on the Basic Contract Drawings, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that pipe laid on same will be at the proper grade and alignment. Make suitable excavations for pipe bells, where applicable, so that the bottom reaction and support are confined to the pipe barrel. After installation of pipe on the compacted crushed stone material, place and compact additional crushed stone bedding material to the dimensions as shown on the Basic Contract Drawings.

4. Continue backfilling of the trench from the pipe support limits reached in 3.02 B.2 and 3 above in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING."

C. Pipe Installation

1. Immediately prior to placement in the trench, all pipe and appurtenances shall be inspected in the presence of the Engineer to verify that they are internally clean and free of damage. Damaged units shall be immediately removed from the construction site and replaced to the satisfaction of the Engineer and at no additional cost to the Authority.

2. When lowering pipe and appurtenances into the trench and joining the units, take precautions to ensure that the interior of the pipeline remains clean.

3. Lay pipe true to line and grade, with uniform bearing under the full length of the barrel, without break from structure to structure, and with bell or grooved end facing upgrade. Adjustments to the line and grade shall be made by scraping away or adding material under the pipe.

4. Prior to start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or gradeboard setup to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if, in the opinion of the Engineer, the alternate system produces equivalent accuracy.

5. Make up pipe joints in accordance with the manufacturer's instructions taking extreme care that joints are clean and free of foreign materials. Support pipe free of bedding during the joining process to avoid disturbing the subgrade. Pipe joints shall be sufficiently tight to meet testing specified herein.

6. In large diameter sewers with compression-type pipe joints, or where considerable force is required to insert the spigot fully into the bell, come-alongs and winches or other equipment may be rigged to provide the necessary force. Inserts shall be used to prevent the sewer pipe from being thrust completely home prior to checking gasket location. After the gasket is checked, the inserts shall be removed and the joint completed.

7. Close all openings in the pipeline with watertight plugs when pipelaying is stopped at the conclusion of the work period or if work is interrupted for any reason.

8. Install polyethylene encasement prior to backfilling ductile iron sewer pipe.

3.03 FIELD TESTS

Unless otherwise shown on the Basic Contract Drawings, test all installed sewer pipe by infiltration/exfiltration test except that an air test will be required in lieu of the exfiltration test during the period that a Federal, State, or local "Water Drought Emergency" has been officially declared. Testing shall be performed in the presence of the Engineer.

A. Infiltration/Exfiltration Test

1. Equipment and procedures used in performing the infiltration/exfiltration test shall be in accordance with ASTM C 969 and subject to the approval of the Engineer.

2. Measure infiltration with a weir or other suitable measuring device.

3. The allowable infiltration rate including manholes shall be 200 gallons/inch of internal diameter/mile of sewer tested/24 hours, when the average groundwater head on the test section is 6 feet or less. When the average groundwater head on the test section is over 6 feet, the allowable infiltration rate shall be that given above multiplied by the ratio of the square root of the average groundwater head to the square root of the base head of 6 feet. If the infiltration rate exceeds the allowable limits given above, take the following remedial action:

   a. Take up and relay entire length of pipe, or

   b. At the Contractor's option, conduct additional tests to determine if excess infiltration can be attributed to a portion of the line. If it can, replacement may be confined to the faulty portion.

   c. Repeat tests until all pipelines prove satisfactory.

4. When an infiltration test is not practicable because of dry trench conditions, perform an exfiltration test. For exfiltration testing, the allowable leakage limit including manholes shall be 200 gallons/inch of internal diameter/mile of sewer tested/24 hours, when the average head on the test section is 3 feet or less. When the average head on the test section is greater than 3 feet, the allowable leakage shall be that given above multiplied by the ratio of the square root of the average test head to the square root of the base test head of 3 feet. Perform exfiltration tests, where directed by the Engineer, as follows:

   a. Fill sewer between successive manholes using a manhole standpipe system to provide test head.

   b. Determine leakage by measuring water required to maintain test head for required test period.

   c. If exfiltration leakage exceeds the rate specified above proceed with the remedial action specified in 3.03 A.3.

5. Brace the test line in both lateral directions to prevent movement of pipe.

6. Submit one copy of all test result data to the Engineer on a daily basis.

B. Air Test

1. Equipment and procedures used in performing the air test for Reinforced Concrete Pipe and Ductile Iron Pipe shall be subject to the approval of the Engineer and in accordance with ASTM C924 for pipes up to 24 inches diameter and ASTM C1103 for pipes greater than 24 inches diameter.

2. Equipment and procedures used in performing the air test for Polyvinyl Chloride Pipe shall be subject to the approval of the Engineer and in accordance with ASTM F 1417.

3. The Contractor is directed to the safety precautions necessary when performing air tests as specified in ASTM C924, ASTM C1103 and ASTM F 1417.

4. Unless otherwise approved by the Engineer, the lines shall be tested from structure to structure.

5. Coat all capped and plugged fittings and all joints with soap solution to detect leakage.

6. Air control equipment shall be equippea with proper valves and pressure gages capable of controlling the air entry rate to the test section and monitoring the air pressure in the pipeline. The pressure relief valve shall be tested to ensure it is functioning properly.

7. Supply air to the test section slowly, filling the pipe until the minimum required test pressure, not to exceed 5 psig, is maintained. When groundwater elevation above the pipe indicates a test pressure in excess of 5 psig, discontinue air testing and conduct an infiltration test.

8. The minimum test time shall be as specified in ASTM C 924 or ASTM C 1103 or ASTM F 1417. Where the test section includes laterals or pipes of different sizes, determine equivalent length by the ratio of the square of the diameter to the square of the diameter of the main line in accordance with Appendix X1 of ASTM C 924.

9. If the pipe section or joint exceeds the allowable pressure loss specified by ASTM C 924 , ASTM C 1103 and ASTM F 1417 respectively, the section or joint shall be considered to have failed the test. Repairs shall be made as specified in 3.03 A.3 above.

10. Submit one copy of all test result data to the Engineer on a daily basis.

3.04 PROTECTION

A. Care shall be taken not to damage or displace installed pipe and joints during construction of pipe supports, backfilling testing and other activities.

B. Where pipe is damaged or displaced, take remedial measures as directed by the Engineer including but not limited to retesting of joints, relaying pipe or replacing pipe. All such remedial measures shall be performed at no additional cost to the Authority.

END OF SECTION

SECTION 02610

EXTERIOR SANITARY SEWER SYSTEM

SUBMITTALS

APPENDIX "A"

A. Submit catalog cuts of pipes and gaskets for pipe joints including manufacturer's installation instructions.

B. Submit certificate from gasket manufacturer certifying that the proposed gaskets comply with the requirements specified in this Section and that the gaskets are compatible with the type of pipe joint used.

C. Submit certificate from the pipe manufacturer certifying that such pipe complies with the requirements specified in this Section.

D. Submit to the Chief of Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07302-1397, certified test data covering gradation and composition of crushed stone for pipe bedding proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag that shall not permit loss of any of the material.
2. Clearly label the container or bag of the sample with Contract location, title and number; the name of the material supplied; and location of the source.
3. The Engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.
4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

E. Submit plans, methods, equipment and procedures as applicable for:

1. Prevention of a accumulation of groundwater specified in 3.02.
2. Alternate method of line and grade control specified in 3.02.
3. Infiltration/exfiltration and/or air testing specified in 3.03.

F. Submit results of the tests specified in 3.03 on a daily basis.

G. Submit "As Built" drawings in accordance with the Section entitled "UTILITY RECORD DRAWINGS" of Division 1 of the Specifications.

END OF APPENDIX "A"

DIVISION 2

SECTION 02665

EXTERIOR WATER SUPPLY SYSTEM - DUCTILE IRON PIPE FOR NEW YORK FACILITIES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for ductile iron pipe and appurtenances to be used for exterior water supply systems for Port Authority facilities in New York.

1.02 REFERENCES

The following is a listing of the publications referenced in this section:

	American National Standards Institute (ANSI)
ANSI B 16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ANSI/NSF-61	Drinking Water Systems Components-Health Effects
	American Society for Testing and Materials (ASTM)
ASTM A 48	Gray Iron Castings
ASTM A 536	Ductile Iron Castings
ASTM B 88	Seamless Copper Water Tube
ASTM C 117	Test Method for Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
	American Water Works Association (AWWA)
AWWA C 104	Cement - Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C 105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C 110	Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids
AWWA C 111	Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings
AWWA C 151	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C 153	Ductile-Iron Compact Fittings, 3 in. Through 16 in., for Water and Other Liquids
AWWA C 500	Metal-Seated Gate Valves for Water Supply Service
AWWA C 600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C 651	Disinfecting Water Mains
	Steel Structures Painting Council (SSPC)
SSPC SP-3	Power Tool Cleaning

1.03 QUALITY ASSURANCE

Any entity performing the Work of this Section shall have at least three years of installation experience on projects with piping systems of types and sizes similar to that required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Ductile iron pipe delivered to the construction site shall be stacked or laid out along the route of the system to be installed, as directed by the Engineer. If stacked, conform to AWWA C 600.

B. Care shall be taken when handling pipe and appurtenances to ensure that neither the cement lining, the exterior coating nor the pipe and appurtenances itself is damaged. Pipe or appurtenances that are damaged will be rejected and replaced in kind at no additional cost to the Authority.

C. Hydrants, gate valves, valve boxes, glands, gaskets, copper tubing and fittings, and other similar items shall be stored at the construction site under lock and key.

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.06 SUBMITTALS

For Submittals, see Appendix A.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Manufacturer of the ductile iron pipe and appurtenances shall be one of the following and no substitutions will be permitted:

American Cast Iron Pipe Company (Co.), Birmingham, Alabama
EBAA Iron Sales, Incorporated (Inc.) , Eastland, Texas
Griffin Pipe Products Co. , Florence, New Jersey
McWane, Inc. , Birmingham, Alabama
United States (U.S.) Pipe & Foundry Co. , Birmingham, Alabama

2.02 MATERIALS

A. All materials (and installation) of the ductile iron exterior water supply system shall comply with the requirements of the City of New York, Department of Environmental Protection, Bureau of Water Supply.

B. Ductile Iron Pipe - 3 Inches and Larger

Use one of the following at the Contractor's option:

1. Push-On Joint

a. "Tyton" Joint, as manufactured by U.S. Pipe & Foundry Co. and Griffin Pipe Products Co., "Fastite" Joint, as manufactured by American Cast Iron Co., or "Push-On" Joint, as manufactured by McWane, Inc. conforming to AWWA C 151, Special Thickness Class 52 for pipe 3 inches and 4 inches, Special Thickness Class 56 for pipe 6 inches through 12 inches, and Special Thickness Class 54 for pipe larger than 12 inches. Pipe shall be cement-mortar lined and coated with a petroleum asphaltic coating approximately 1 mil thick on the outside of the pipe. Cement-mortar lining shall be twice the standard thickness specified in AWWA C 104. Rubber-gaskets shall conform to AWWA C 111. Cement-mortar lining, asphaltic coating and rubber-gaskets shall comply with the requirements of ANSI/NSF-61.

b. Where joint restraint is shown on the Basic Contract Drawings, one of the following systems, as approved by the pipe manufacturer, shall be used to restrain push-on joints:

(1) "Field-Lok" gaskets for 4 inches through 24 inches, as manufactured by U.S. Pipe & Foundry Co. and Griffin Pipe Products Co.

(2) "TR Flex" , including "TR Flex Gripper Rings" , for pipe 4 inches through 64 inches, as manufactured by U.S. Pipe & Foundry Co. "TR Flex Gripper Rings" are available for pipe 4 inches through 36 inches.

(3) "Flex-Ring" including field-adaptable rings, for pipe 4 inches through 12 inches, as manufactured by American Cast Iron Pipe Co.

(4) "Lok-Ring" for pipe 14 inches through 54 inches, as manufactured by American Cast Iron Pipe Co.

(5) "Fast-Grip" gaskets for 4 inches through 16 inches, as manufactured by American Cast Iron Pipe Co.

(6) "Lok-Fast" for pipe 4 inches through 54 inches, as manufactured by American Cast Iron Pipe Co.

(7) "Snap-Lok", including "Snap-Lok FC", for pipe 6 inches through 24 inches, as manufactured by Griffin Pipe Products Co.

(8) "Type A Restrain", including lock ring with set screw, for pipe 6 inches through 24 inches, and "Type B Restrain" for pipe 30 inches and 36 inches, as manufactured by McWane, Inc.

2. Mechanical Joint

a. "Mechanical" Joint as manufactured by American Cast Iron Pipe Co., Griffin Pipe Products Co., McWane, Inc., or U.S. Pipe & Foundry Co. conforming to AWWA C 151, Special Thickness Class 52 for pipe 3 inches and 4 inches, Special Thickness Class 56 for pipe 6 inches through 12 inches, and Special Thickness Class 54 for pipe larger than 12 inches. Pipe shall be cement-mortar lined and coated with a petroleum asphaltic coating approximately 1 mil thick on the outside of the pipe. Cement-mortar lining shall be twice the standard thickness specified in AWWA C 104. Rubber-gaskets shall conform to AWWA C 111. Cement-mortar lining, asphaltic coating and rubber-gaskets shall comply with the requirements of ANSI/NSF-61.

b. Where joint restraint is shown on the Basic Contract Drawings, one of the following systems, as approved by the pipe manufacturer, shall be used to restrain mechanical joints:

(1) "MJ Gripper" glands for pipe 4 inches through 12 inches, as manufactured by U.S. Pipe & Foundry Co.

(2) "Bolt-Lok", including "Bolt-Lok FC", for pipe 4 inches through 24 inches, as manufactured by Griffin Pipe Products Co.

(3) "Megalug" series for pipe 3 inches through 48 inches, as manufactured by EBAA Iron Sales, Inc.

(4) "F-1058 Ductile Iron Retainer Gland" for pipe 4 inches through 24 inches, as manufactured by McWane, Inc., or approved equal.

C. Fittings for Ductile Iron Pipe shall be ductile iron conforming to AWWA C 110 and/or AWWA C 153. Ductile iron fittings shall be cement-mortar lined to twice the standard thickness specified in AWWA C 104 and coated with a petroleum asphaltic coating approximately 1 mil thick on the outside of the pipe. Joint type shall be push-on or mechanical with restraint in accordance with appropriate joint type. Cement-mortar lining, asphaltic coating and rubber-gaskets shall comply with the requirements of ANSI/NSF-61.

D. Copper Tubing - 2 inches and Smaller

ASTM B 88, Type K, O50

E. Fittings for Copper Tubing

ANSI B 16.18 solder joint pressure fittings, or flared joint fittings.

F. Fire Hydrants

1. Low Pressure (Standard) Fire Hydrants

Hydrants shall meet the requirements of the City of New York, Department of Environmental Protection, Bureau of Water Supply and Wastwater Collection, "Purchase Specifications for Dry Barrel Fire Hydrants". Fire hydrant shall be "S Series New York Standard", as manufactured by U.S. Pipe & Foundry Co. Hydrants shall open in a clockwise direction. Unless otherwise shown on the Basic Contract Drawings, the hydrants shall have a standard 6-inch mechanical joint inlet connection. Hydrant colors shall be as specified in Appendix B.

2. High Pressure Fire Hydrants

Hydrants shall be Metropolitan 250; Model M 94, as manufactured by U.S. Pipe & Foundry Co. Hydrants shall have a 5 1/4 valve opening and shall be fitted with two 2 1/2 hose nozzles and one 4 1/2 pumper nozzle with City of New York threads. Hydrants shall open in a clockwise direction. Unless otherwise shown on the Basic Contract Drawings, the hydrants shall have a standard 6-inch mechanical joint inlet connection. Hydrant colors shall be as specified in Appendix B.

G. Gate Valves

1. Valves shall be New York Pattern Metropolitan Type, as manufactured by U.S. Pipe & Foundry Co. or M & H Valve Co., Anniston, Alabama. Valves shall be nut operated, non-rising stem valves, and open in a clockwise direction unless otherwise shown on the Basic Contract Drawings. Valves 3 inches through 12 inches shall be rated for 200 psi working pressure, 400 psi test pressure. Valves larger than 12 inches shall be rated for 150 psi working pressure, 300 psi test pressure. Valves up to and including 12 inches shall be made for vertical stem installation unless otherwise shown on the Basic Contract Drawings. Valves larger than 12 inches shall be made for vertical (with enclosed spur gearing) or horizontal (with enclosed bevel gearing and tracks, rollers and scrapers) stem installation as shown on the Basic Contract Drawings and the valve bodies and discs shall be square bottom configuration. Valves larger than 12 inches shall furnished with bypasses in accordance with AWWA C 500.

2. Indicator Valves and Posts

a. Valves and posts shall be UL listed and shall have the direction of plainly marked by an arrow cast on the head of the post. Provide lock with breakable hasp.

b. Color of indicator posts shall be red.

H. Valve Boxes

Valve boxes shall be of the type shown on the Basic Contract Drawings and shall be fabricated of ASTM A 48, Class 30B cast iron. Manhole cover for valve skirt and frame shall be of the material shown on the Basic Contract Drawings. Where cast iron is shown, manhole cover shall be fabricated of ASTM A 48, Class 30B cast iron. Where ductile iron is shown, manhole cover shall be fabricated of ASTM A 536, Grade 60-40-18, or Grade 65-45-12, ductile iron. Ductile iron manhole covers shall bear the letters "D.I." in a clearly visible manner on the upper surface. Valve chambers shall be furnished and installed as shown on the Basic Contract Drawings for valves larger than 12 inches.

I. Wet Tap Connections

Use clamp type tapping sleeves and valve conforming to the requirements of Standard Drawing No. 10251-X-A of the City of New York, Department of Environmental Protection, Bureau of Water Supply, for connecting to existing service. The tapping valve shall have a hub end outlet connection.

J. Crushed Stone for Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to the gradation specified below, determined in accordance with ASTM C 117 and C 136. Recycled concrete aggregate shall contain not less than 95 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section entitled "Aggregate Base Course".

Sieve Size	Total Percent By Weight Passing Sieve
2 1/2 inch	100
1 inch	60 - 100
3/4 inch	45 - 85
3/8 inch	30 - 60
No. 10	14 - 30
No. 40	3 - 15
No. 200	0 - 3

K. Hydrant Fenders or Pipe Guards

1. Size and weight of pipe guards and hydrant fenders shall be as shown on the Basic Contract Drawings.
2. Concrete for footing and pipe fill shall be Class B concrete conforming to the requirements specified in the Section entitled "Concrete".
3. Color of pipe guards and hydrant fenders shall be yellow.

L. Paint for Rods, Bands, Nuts, Bolts, Washers, and Other Appurtenances

Bitumastic No. 50, as manufactured by Koppers Co., No. CA-50, as manufactured by the Barrett Division of Allied Chemical and Dye Corporation, or approved equal.

M. Paint for Fire Hydrants, Indicator Posts, Hydrant Fenders, and Pipe Guards

The prime (or first) coat shall be Carbomastic 15 LO and the finish (or second) coat shall be Carboline 133 HB, satin finish, aliphatic polyurethane, both as manufactured by the Carboline Company, or approved equal. Prime and finish coats shall be products of same manufacturer.

N. Paint for Pipe, Valves, Fittings, and Appurtenances Within Valve Chamber (Only)

Carbomastic 15 LO, as manufactured by the Carboline Company, or approved equal. Color of paint shall be black.

O. Polyethylene Film for Ductile Iron Pipe

AWWA C 105, Low Density or High Density (Cross-Laminated) polyethylene film, Class C

PART 3. EXECUTION

3.01 INVESTIGATION

Where the pipeline is to cross existing utilities, as shown on the Basic Contract Drawings, the Contractor shall verify their elevation and horizontal location through excavation of test pits or other approved exploratory means.

3.02 PREPARATION

Prior to the start of the pipeline installation, the Contractor shall have in place those items shown on the Basic Contract Drawings and required by the Specifications for the maintenance of traffic.

3.03 INSTALLATION

A. Operation of Valves

Unless directed by the Engineer, the Contractor shall not operate existing valves.

B. Excavation and Backfill

1. Perform trench excavation and backfilling in accordance with the requirements of the Section entitled "EXCAVATION, BACKFILLING AND FILLING" to the alignment and grades shown on the Basic Contract Drawings. Unless otherwise shown on the Basic Contract Drawings, pipe shall have a minimum cover of four feet.

2. If groundwater is encountered, prevent its accumulation in the trench bottom by methods approved by the Engineer. No pipe shall be installed if there is water in the trench at or above the level of the bottom of the bell.

3. Over-excavation and the use of timber blocking beneath the pipe may be permitted to meet the requirements of 3.03 B.2, where the groundwater volume is such that, in the opinion of the Engineer, the requirements of 3.03 D.4 cannot be attained or the Contractor is unable to maintain groundwater accumulation below the level of the bottom of the bell.

C. Polyethylene Encasement

1. Install polyethylene encasement using one of the installation methods described in AWWA C 105.

2. Pipe surface shall be totally cleaned prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or embedment material from becoming trapped between the pipe and the polyethylene encasement.

3. The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with the minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene due to backfilling operations.

4. Overlaps and ends shall be secured with adhesive tape, string or plastic tie straps to hold the polyethylene encasement in place until backfilling operations are complete.

D. Pipe Installation

1. Install ductile iron pipe in accordance with AWWA C 600 and Section 4 of AWWA C 651.

2. If an obstruction that is not shown on the Basic Contract Drawings is encountered and interferes with the installation of Work under this Contract, the Contractor shall notify the Engineer. No work shall be performed until directed by the Engineer. Alterations or deviation in the alignment and grade shown on the Basic Contract Drawings or the removal, relocation or reconstruction of the obstruction shall be approved by the Engineer.

3. Place calcium hypochlorite granules or tablets in the water main, as specified in Section 5.1.1 of AWWA C 651, prior to placing pipe in the trench.

4. Where crushed stone bedding is shown on the Basic Contract Drawings, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that pipe laid on same will be at proper grade and alignment. Make suitable excavations for pipe bells so that the bottom reaction and support are confined to the pipe barrel. After installation of pipe on the compacted layer, place and compact additional crushed stone bedding material in small lifts to the dimensions shown.

5. Immediately prior to their placement in their trench, all pipe, valves, hydrants, fittings, and/or appurtenances shall be inspected in the presence of the Engineer to verify that they are internally clean and free of damage to the materials, linings and coatings.

6. When lowering the pipe into the trench and joining the units, take all necessary precautions to ensure that the interior of the pipeline remains clean.

7. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the conclusion of any Work period or if work is interrupted for any reason to preclude contamination of the pipeline. Plugs shall be fitted with a means for venting.

E. Pipe Restraint

1. Pipe shall be restrained where and as shown on the Basic Contract Drawings. Use only the pipe manufacturer's approved joint restrain system.

2. Where push-on joint pipe is to be restrained, install one of the systems specified in 2.02 B.1.b in accordance with the manufacturer's recommendation and printed instructions.

3. Where mechanical joint pipe is to be restrained, install one of the systems specified in 2.02 B.2.b in accordance with the manufacturer's recommendation and printed instructions. Retainer glands shall be installed using certified calibrated torque wrenches. The torque for various size bolts shall be:

Pipe Size (inches)	Bolt Size (inches)	Torque Range (ft. - lbs.)
3	5/8	45 – 60
4 - 24	3/4	75 – 90
30 - 36	1	100 – 120
42 - 48	1-1/4	120 – 150

Set screws shall be tightened 180 degrees apart to ensure a uniform bearing. Torque on the set screws shall not exceed the manufacturer's recommended torque.

4. Where restraint under 2 and 3 above is not possible, install bands and rods, as directed by the Engineer.

F. Hydrant Installation

1. Install hydrants as shown on the Basic Contract Drawings and orient hydrants nozzles so that they do not point directly at hydrant fenders or pipe guards, walls, poles or other obstructions.

2. Relocate existing hydrants as shown on the Basic Contract Drawings. Exercise care in removal and relocation operations so as not to damage the hydrants. Any portions of the hydrants damaged by the Contractor shall be repaired or replaced by the Contractor, as directed by the Engineer and to his satisfaction, at no additional cost to the Authority.

G. Wet Tap Connections

1. Prior to installing tapping sleeve, thoroughly clean the exterior surface of the existing pipe, and lightly dust the interior surface of the tapping sleeve with calcium hypochlorite powder.

2. Where wet tap connections are to be performed on existing pipes encased in polyethylene, apply two or three wraps of polyethylene adhesive tape completely around the pipe prior to mounting the tapping machine and chain. After the wet tap connection is completed, inspect the polyethylene for damage and repair if needed.

H. Painting

1. Rods, Bands, Nuts, Bolts, Washers, and Other Appurtenances

a. Before backfilling, and prior to installing any required polyethylene encasement, apply two, heavy, brush coats of paint specified in 2.02 L to all rods, bands, nuts, bolts, washers and other appurtenances.

2. Pipe, Valves, Fittings, and Appurtenances Within Valve Chamber (Only)

a. After installation, apply two, 5-mil thick, brush coats of paint as specified in 2.02 N to all pipe, valves and fittings located within valve chambers as shown on the Basic Contract Drawings.

b. Prepare surfaces and apply the coating in accordance with the manufacturer's printed instructions.

3. Fire Hydrants, Indicator Posts, Hydrant Fenders, and Pipe Guards

a. Prior to painting, all surfaces to be painted shall be cleaned to the requirements of SSPC SP-3.

b. Paint fire hydrants, indicator posts, hydrant fenders, and pipe guards with prime and finish coats of paints specified in 2.02 M.

I. Concrete Encasement and Foundations

Before backfilling, the Engineer shall verify that the concrete encasement and concrete hydrant foundations are installed where and as shown on the Basic Contract Drawings. The Contractor shall not backfill until the Engineer has inspected and approved said work.

3.04 FIELD TESTS

Warning: The testing methods described below are specific for water-pressure testing. These procedures should not be applied for air-pressure testing because of the serious safety hazards involved.

A. Hydrostatic Pressure and Leakage Tests

1. After completion of the pipeline installation, including backfill, but prior to final connection to the existing system, conduct in the presence of the Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C 600.

2. Provide all equipment required to perform the leakage and hydrostatic pressure tests.

3. The test pressure shall be not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.

4. The hydrostatic test shall be of at least a 2-hour duration.

5. No pipeline installation will be approved if the pressure varies by more than 5 psi during the duration of the hydrostatic pressure test.

6. Before applying the test pressure, air shall be expelled completely from the section of piping under test. Corporation cocks shall be installed so that the air can be expelled as the pipeline is being filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the tests, the corporation cocks shall be removed and plugged.

7. Slowly bring the piping to the test pressure and allow the system to stabilize prior to conducting the leakage test. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.

8. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the hydrostatic pressure test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material at no cost to the Authority, and test shall be repeated to the satisfaction of the Engineer.

9. No pipeline installation will be approved if the leakage is greater than that determined by the following, formula:

$$L = \frac{SD\sqrt{p}}{133{,}200}$$

Where:

L = the allowable leakage, in gallons per hour
S = the length of pipe tested, in feet
D = the nominal diameter of the pipe, in inches
p = the average test pressure during the leakage test, in pounds per square inch (gauge)

10. If leakage exceeds the rate as determined in 3.04 A.9, locate the source and make repairs as necessary, to the satisfaction of the Engineer.

B. Disinfection, Flushing and Sampling

1. Disinfect the pipeline installation in accordance with AWWA C 651, except that liquid chlorine shall not be used.

2. Upon completion of the retention period required for disinfection, flush the pipeline until the chlorine concentration of water leaving the pipeline is no higher than that generally prevailing in the existing system or is acceptable for domestic use.

3. Dispose of the chlorinated water in conformance with all Federal, State and Municipal laws, ordinances, rules, and regulations. If there is any possibility that the chlorinated discharge will cause damage to the environment, then a neutralizing chemical shall be applied to the chlorinated water to neutralize thoroughly the chlorine residual remaining in the water.

4. After final flushing and before the pipeline is connected to the existing system, or placed in service, the Contractor shall employ an approved independent testing laboratory to sample, test and certify the water for conformance with the purity standards of the City of New York, the United States Environmental Protection Agency and the Federal Clean Water Act Health Standards. The Engineer shall be furnished with a copy of such certification by the testing laboratory, and no installation will be approved without such certification.

3.05 PROTECTION

A. Care shall be taken not to damage or displace installed pipe and joints during construction of pipe supports, backfilling testing and other activities.

B. Where pipe is damaged or displaced, take remedial measures as directed by the Engineer including but not limited to retesting of joints, relaying pipe or replacing pipe. All such remedial measures shall be performed at no additional cost to the Authority.

END OF SECTION

SECTION 02665

EXTERIOR WATER SUPPLY SYSTEM - DUCTILE IRON PIPE FOR NEW YORK FACILITIES

APPENDIX "A"

SUBMITTALS

A. Submit resume' indicating name, address, and previous work experience of entity performing the Work of this Section, prior to performing the Work of this Section.

B. Submit "Piping Layout" drawings, including details specified in "D".

C. Submit catalog cuts for: pipe, fittings, pipe restraint system, fire hydrants, gate valves, wet tap sleeve and valve, valve boxes, including manhole cover, and paints including manufacturer's installation instructions.

D. Submit shop drawings of valve chambers and hydrant fenders or pipe guards.

E. Submit certificate from the ductile iron pipe manufacturer certifying that the ductile iron pipe, including joint restrain system to be used with the pipe, and rubber gaskets comply with the requirements specified in this Section.

F. Submit certificate from the ductile iron fitting manufacturer certifying that such ductile iron fitting complies with the requirements specified in this Section.

G. Submit certificate from the copper tubing and fitting manufacturer certifying that the copper tubing and fitting comply with the requirements specified in this Section.

H. Submit certificate from the indicator valve and post manufacturer certifying that the indicator valve and post complies with the requirements specified in this Section.

I. Submit certificate from the valve box and manhole cover manufacturer certifying that the valve box and manhole cover complies with the requirements specified in this Section.

J. Submit to the Manager, Materials Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07302-1397, certified test data covering gradation and composition of the crushed stone for pipe bedding proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag that shall not permit loss of any of the material.

2. Clearly label the container or bag of the sample with Contract location, title and number; the name of the material supplied; and location of the source.

3. The engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.

4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

5. Contractor must notify the Engineer when material is delivered to the construction. Field sampling and testing will be performed by Materials Engineering Personnel for quality assurance purpose. These field samples must also receive approval before any of the material is used.

K. Submit certificate from the polyethylene film manufacturer that such polyethylene film complies with the requirements specified in this Section.

L. Submit plans, methods, procedures, and types of equipment as applicable for:

1. Verifying location of existing utilities specified in 3.01.
2. Prevention of accumulation of groundwater specified in 3.03 B.2.
3. Hydrostatic pressure and leakage tests specified in 3.04 A.
4. Disinfection, flushing and sampling as specified in 3.04 B.

M. Submit, for approval, the name, address and qualifications of the independent testing laboratory to be employed to sample, test and certify the water for conformance to purity standards.

N. Submit results of field tests specified in 3.04 A. and B.

O. Submit "As Built" drawings conforming to the following:

1. Drawings shall be in ink on mylar sheets measuring 34 inches horizontally by 22 inches vertically.
2. A 1/2-inch border shall be provided around the full perimeter of each sheet.
3. A title box measuring 5 inches horizontally by 3 inches vertically shall be located in the lower right hand corner and shall contain the following information from top to bottom:
   a. "Port Authority of New York and New Jersey"
   b. Contract title as it appears in the title box on the Basic Contract Drawings
   c. Subtitle: "As Built Water Main Locations"
   d. Name and address of Contractor
   e. Contract number as it appears in the title box on the Basic Contract Drawings
   f. Date of completion
4. The "As Built" drawings shall be drawn to a scale of 1 inch = 30 feet, or approved equal, and shall show the alignment and grade of the water main to such an extent that the exact location of the water main can be determined in the field utilizing such "As Built" drawings. In addition, valves, fittings, including distance between fittings, connections, and thrust restraint method employed shall be shown.

P. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

SECTION 02665

EXTERIOR WATER SUPPLY SYSTEM - DUCTILE IRON PIPE FOR NEW YORK FACILITIES

APPENDIX "B"

A. Fire Hydrant Colors

Paint fire hydrants as follows:

		Pressure		Outlet
Facility	Zone	Barrel	Bonnet	Caps
City of New York Streets	All	Black	Silver	Black
Holland Tunnel	Plaza Areas	Black	Silver	Black
Holland Tunnel	In Tunnel	Red	Red	Red
Lincoln Tunnel	Plaza Areas	Red	Silver	Red
Lincoln Tunnel	In Tunnel	Red	Silver	Red
George Wash. Bridge	All	Red	Red	Red
Staten Island Bridges	All	Red	Red	Red
LaGuardia Airport	High	Yellow	Yellow	Yellow
LaGuardia Airport	Low	Black	Black	Black
John F. Kennedy I.A.	High	Yellow	Yellow	Yellow
John F. Kennedy I.A.	Low	Black	Silver	Black
Brooklyn Piers	All	Yellow	Yellow	Yellow
Yonkers Industrial Park	All	Red	Yellow	Red

END OF APPENDIX "B"

DIVISION 2

SECTION 02720

MANHOLES AND DRAINAGE STRUCTURES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for precast and cast-in-place concrete manholes and drainage structures.

B. Definition of terms shall be in accordance with ASTM C 822.

1.02 REFERENCES

A. The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)
ACI 318	Building Code Requirements for Structural Concrete and Commentary.
	American Society for Testing and Materials (ASTM)
ASTM A 48	Specification for Gray Iron Castings.
ASTM A 536	Specification for Ductile Iron Castings.
ASTM B26	Specification for Aluminum-Alloy Sand Castings.
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 55	Specification for Concrete Building Brick.
ASTM C 117	Test Method for Materials Finer than 75μm (No. 200) Sieve in Mineral Aggregates by Washing.
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C 150	Specification for Portland Cement.
ASTM C 1329	Specification for Mortar Cement.
ASTM C 443	Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C 497	Test Methods for Concrete Pipe, Manhole Sections, or Tile.
ASTM C 822	Terminology Relating to Concrete Pipe and Related Products.
ASTM C 891	Practice for Installation of Underground Precast Concrete Utility Structures.

ASTM C 913	Specification for Precast Concrete Water and Wastewater Structures.
ASTM C 923	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
ASTM C 990	Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

1.03 ENVIRONMENTAL REQUIREMENTS

Cold and hot weather requirements shall conform to the applicable requirements of Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM" except that in a precast plant the ambient temperature may be below 40 degrees F providing that forms and product are preheated and heat cured and protected. Temperature recording devices shall be used.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. As approved by the Engineer, the Contractor may substitute cast-in-place concrete manholes and drainage structures which conform in size and strength to the precast concrete structures shown on the Basic Contract Drawing and as specified in this Section. As approved by the Engineer, the Contractor may also substitute precast concrete structures which conform in size and strength to the cast-in-place concrete structures shown on the Basic Contract Drawing and as specified in this Section. Equivalent strength of substituted structures shall be based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of lifting devices for precast structures shall conform to ASTM C 913.

C. Design of joints for precast concrete structures shall conform to ASTM C 913. Unless otherwise shown on the Basic Contract Drawing, joints shall be designed for leakage not to exceed 0.025 gallons per hour per foot of joint at 3 feet of head.

1.05 QUALITY ASSURANCE

A. Workmen shall be experienced and skilled in the fabrication and installation of precast and cast-in-place concrete manholes and drainage structures.

B. Precast concrete manholes and drainage structures, including castings, will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced, at no additional cost to the Authority.

C. Precast concrete manholes and drainage structures may be inspected by the Engineer at the place of manufacture.

D. Where manholes and drainage structures are cast-in-place, do not place concrete until the Engineer has inspected the formwork and verified that the dimensions and concrete reinforcing are in accordance with details shown on the Basic Contract Drawing, on approved shop drawings and as specified in this Section.

E. Conform to the applicable requirements for quality assurance of Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM" except that, if the concrete is precast, the producer shall maintain a fully equipped testing lab and employ a Quality Control Technician to perform Quality Control Tests. Unless otherwise shown on the Basic Contract Drawing, Quality Control Tests for precast concrete shall consist of compression tests on a minimum of two cylinders for each day's production tested in accordance with ASTM C 39 for cylinders or ASTM C 497 for drilled cores. Acceptance shall be based on the requirements of ACI 318.

F. Tolerances of dimensions, squareness, joint surfaces, reinforcement location, and thickness of slabs and walls for precast structures shall conform to ASTM C 913.

G. Castings shall be of uniform quality, free from sand holes, shrinkage cracks and other defects. Surface of the castings shall be free from burnt-on sand and shall be smooth. Bearing surfaces between grates or covers and frames shall be cast or machined with such precision that continuous, full and uniform bearing is provided throughout the perimeter area of contact. The bearing contact with the frame shall be non-rocking when in place and under the influence of traffic or other loads. Pairs of machined castings shall be match marked to facilitate subsequent identification at installation.

1.06 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and drainage structures.

B. Care shall be taken when storing precast concrete manholes and drainage structures to prevent damage to Authority or other public or private property, and any property so damaged shall be repaired at no additional cost to the Authority.

C. Each precast concrete structure shall be clearly marked by indentation or waterproof paint to indicate the date of manufacture, manufacturer and identifying symbols and/or numbers shown on the Basic Contract Drawing to indicate its intended use.

1.08 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

For each of the specified materials, manufacturer shall be one of the following, or approved equal:

A. Manhole and Drainage Structure Frames, Covers and Grates

Frames, cover and grates shall be as shown on the Basic Contract Drawing.

B. Resilient Connectors

1. NPC Inc., Milford, NH 03055.
2. Press-Seal Gasket Corporation, Fort Wayne, IN 46804.
3. A-Lok Products Inc., Tullytown, PA 19007.

2.02 MATERIALS

A. Concrete

1. Concrete including concrete mixes shall be Category VI with a minimum 28-day compressive strength of 5000 psi for precast and 4000 psi for cast-in-place concrete manholes and drainage structures in accordance with the applicable requirements of Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

B. Joints

1. Unless otherwise shown on the Basic Contract Drawing, joints shall not be permitted in manholes and drainage structures.
2. Joints between precast sections, which occur four feet or more below finished grade, shall be sealed with rubber gaskets conforming to ASTM C 443 or a preformed flexible plastic gasket as specified in 2.02 B.3.
3. Where a preformed flexible plastic gasket is shown on the Basic Contract Drawing, joints between precast sections shall be sealed with a preformed flexible plastic gasket conforming to ASTM C 990, except that gasket size, lengths, quantity of primer and packing material shall be in accordance with the manufacturer's recommendation. Preformed flexible plastic gaskets shall be one of the following, or approved equal:
   a. "Ram-Nek", as manufactured by Henry Co., El Segundo, CA.
   b. "CONSEAL CS-102", as manufactured by the Concrete Sealants, Inc, New Carlisle, OH.
   c. "PRO-STIK", as manufactured by Press-Seal Gasket Corporation, Fort Wayne, IN.

C. Steel Reinforcement

1. Steel reinforcement shall conform to Section 03200 entitled "CONCRETE REINFORCEMENT".
2. There shall be a continuity of reinforcement at all corners of the structure.

D. Silt Buckets

1. Cast aluminum silt bucket shall be furnished and installed for all sanitary sewer manhole structures shown on the Basic Contract Drawing and shall be fabricated of aluminum Alloy 319, conforming to ASTM B 26.

E. Frames, Grates and Covers

1. Frames shall be of the type shown on the Basic Contract Drawing and shall be fabricated of Class 35B cast iron, conforming to ASTM A 48.

2. Covers and grates shall be of the types and materials shown on the Basic Contract Drawing. Where cast iron is shown, manhole covers and drainage grates shall be fabricated of Class 35B cast iron, conforming to ASTM A 48. Where ductile iron is shown, manhole covers and drainage grates shall be fabricated of Grade 65-45-12, or Grade 80-55-06 ductile iron and castings, conforming to ASTM A 536 and shall bear the letters "D.I." in a clearly visible manner on the upper surface.

3. Frames, covers or grates of other materials shall be as shown on the Basic Contract Drawing.

4. Each casting shall be identified by the name of the producing foundry, origin and date of manufacture, ASTM designation number and class of cast or ductile iron.

F. Masonry Collar for Frame

1. Concrete Building Brick: ASTM C 55.

2. Mortar Cement

ASTM C 1329, Type M.

G. Crushed Stone Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

H. Connection Between Structure and Pipe

1. Unless otherwise shown on the Basic Contract Drawing, the opening between the wall of the structure and the wall of the pipe shall be sealed with mortar cement conforming to ASTM C 1329, Type M or a resilient connector.

2. Resilient connector shall conform to ASTM C 923. If resilient connector is not integrally cast into the wall of the structure, provide cast or cored opening of the size specified by manufacturer of the resilient connector.

2.03 FABRICATION

Manufacture of precast concrete structures shall conform to ASTM C 913.

PART 3. EXECUTION

3.01 PREPARATION

A. Ensure proper orientation of the structure to accommodate pipes.

B. Immediately prior to placement in the excavation, precast concrete structures shall be inspected in the presence of the Engineer to verify that they are internally clean and free of damage. Damaged units shall be removed from the construction site and replaced, at no additional cost to the Authority. Subject to the approval of the Engineer, damaged precast concrete structures may be repaired in a manner that ensures that the structure will conform to the requirements of this Section and its intended use. Acceptance of repaired units is at the sole discretion of the Engineer.

3.02 INSTALLATION

A. Excavation and Backfill

1. Excavate for manhole or drainage structure in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to depth shown on the Basic Contract Drawing. Provide clearance around the sidewalls of the structure as required for construction.

2. If ground water is encountered, prevent accumulation of water in excavations by methods approved by the Engineer. Manhole or drainage structure shall be placed in a dry trench.

3. Where the possibility exists of a watertight structure becoming buoyant in a flooded excavation, take necessary steps to avoid flotation of the structure.

B. Support and Backfilling

1. Manhole or drainage structure shall be supported at proper grade and alignment on crushed stone bedding or other support system, as shown on the Basic Contract Drawing.

2. Backfill excavation for manhole or drainage structure in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING".

C. Installation of Precast Concrete Sructure

1. To ensure safety, precast concrete structures shall be lifted only at the lifting points so designated by the manufacturer.

2. When lowering manhole or drainage structure into the excavation and joining pipe to the structure, take precautions to ensure that the interior of the pipes and structure remains clean.

3. Set precast concrete structure so that it is fully bearing on crushed stone bedding, compacted in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" or set on other support system as shown on the Basic Contract Drawing.

4. For multiple section structures, lower and set the base section before placing additional sections. Ensure joint integrity by removing all foreign materials from joint surfaces and verify that sealing materials are placed properly. Avoid misalignment by using guide devices affixed to the lower section or as otherwise approved by the Engineer. Joint seal material may be installed at the manufacturer's plant prior to delivering to construction site.

5. Verify that manholes and drainage structures installed satisfy required alignment and grade.

6. Remove knockout or core the structure for pipe so as not to create an opening in excess of that required. Fill resultant annular space with mortar cement or with a resilient connector installed in accordance with manufacturer's instructions.

7. Cut pipe to finish flush with interior of structure.

8. Shape inverts through manhole as shown on the Basic Contract Drawing.

D. Installation of Cast-In-Place Concrete Structure

1. Prepare crushed stone bedding or other support system shown on the Basic Contract Drawing, to receive the base slab as specified for precast structures in 3.02 C.3.

2. Erect forms in accordance with Section 03100 entitled "CONCRETE FORMWORK" and ensure that forms are braced against all movement.

3. Furnish and install reinforcing steel in accordance with the details shown on the Basic Contract Drawing and in accordance with Section 03200 entitled "CONCRETE REINFORCEMENT".

4. After formwork and reinforcing steel are inspected and approved by the Engineer, place and cure concrete in accordance with Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

5. Complete installation in accordance with 3.02 C above.

E. Installation of Frame and Cover or Grate

1. Set frame using mortar cement and masonry as shown on the Basic Contract Drawing. Radially laid concrete brick shall have 1/4-inch thick vertical joints at inside perimeter. Lay all concrete brick in a full bed of mortar cement and completely fill all joints. Where more than one course of concrete brick is required, stagger vertical joints.

2. Set frame and cover two inches above finished grade for manhole structure located in unpaved area. Otherwise, set frame and cover flush with finished grade.

3. Set frame and grate flush with finished grade for all catch basins or drainage inlets, unless otherwise shown on the Basic Contract Drawing.

4. Manhole, inlet and catch basin frames, grates, and covers shall be fitted together and match-marked to avoid rocking of covers and grates. All castings shall be set firm and snug and shall not rattle.

3.03 VERTICAL ADJUSTMENT OF EXISTING STRUCTURES

A. Where shown on the Basic Contract Drawing, adjust the elevation of existing manhole or drainage structure to finished grade.

B. Existing frame and grate or cover shall be carefully removed, cleaned of all mortar fragments to the satisfaction of the Engineer and set to the finished grade in accordance with 3.02 E.

C. When removal of an existing reinforced concrete wall is required, the concrete shall be removed so as not to damage the existing reinforcing bars. The bars shall be cleaned of all concrete to the satisfaction of the Engineer and bent into the new concrete top slab or spliced to vertical reinforcement, as shown on the Basic Contract Drawing.

D. Bond new concrete to existing concrete in accordance with requirements specified in Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

3.04 FIELD TESTS

Field tests will be used by the Engineer to evaluate and approve cast-in-place concrete in accordance with Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

3.05 PROTECTION

Protection and curing of concrete shall be in accordance with Section 03301 entitled "PORTLAND CEMENT CONCRETE, LONG FORM".

END OF SECTION

SECTION 02720

MANHOLES AND DRAINAGE STRUCTURES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Shop drawings of precast concrete and cast-in-place manholes and drainage structures.

B. Catalog Cuts

1. Catalog cuts of frames, grates and covers.
2. Catalog cuts of gaskets for joints in precast concrete manholes and drainage structures, including manufacturer's installation instructions.
3. Catalog cuts of resilient connectors.

C. Submit design calculations prepared by a Professional Engineer, licensed in the State where the Work is being performed:

1. For design of substitute manhole or drainage structure. Calculations shall demonstrate that the substituted design is equivalent to the design shown on the Basic Contract Drawing.

D. Submit certificate from gasket manufacturer certifying that the gaskets comply with the specified requirements and that the gaskets are compatible with the type of joint used.

E. Submit plans, methods, equipment and procedures as applicable for:

1. Prevention of accumulation of groundwater as specified in 3.02.
2. Methods other than guide devices to avoid misalignment of joints during installation of precast concrete structures as specified in 3.02.
3. Methods to prevent flotation of watertight structures as specified in 3.02.
4. Installation of resilient connectors as specified in 3.02 C.6.

F. Submit to the Chief of Materials Engineering, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, certified test data covering gradation and composition of the crushed stone for bedding proposed for use.

1. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

G. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 2

SECTION 02722

STORM DRAINAGE SYSTEM

(INFILTRATION/EXFILTRATION TESTING NOT REQUIRED)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for exterior storm drainage systems not requiring infiltration/ exfilitration testing.

B. Definition of terms relating to Reinforced Concrete Pipe and Plastic Pipe shall be in accordance with ASTM C 822 and ASTM D 883 respectively.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 746	Ductile Iron Gravity Sewer Pipe
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 117	Test Method for Material Finer Than .075mm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 507	Reinforced Concrete Elliptical Culvert Storm Drain and Sewer Pipe
ASTM C 655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 822	Terminology Relating to Concrete Pipe and Related Products
ASTM D 883	Standard Terminology relating to Plastics
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications
ASTM D 3212	Standard Specification for Joints for Drain and sewer Plastic Pipes Using flexible Elastometric Seals
ASTM F 2306	12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity Flow Storm Sewer and Subsurface Drainage

application

American Water Works Association (AWWA)

AWWA C 104	Cement- Mortar Lining for Ductile-Iron Pipe Fittings for Water
AWWA C 105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C 110	Ductile-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C 111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

1.03 QUALITY ASSURANCE

A. Any entity performing the Work of this Section shall have at least three years of installation experience on projects with piping systems of types and sizes similar to that required under this Contract.

B. Pipe will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced at no additional cost to the Authority.

C. Pipe may be inspected at the place of manufacture by the Engineer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving pipe.

B. Care shall be taken when storing pipe and appurtenances so as not to damage Authority or other public or private property, and any property so damaged shall be repaired at the Contractor's expense.

1.05 SUBMITTALS

For Submittals, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

Use any of the pipe sytems specified below unless otherwise shown on the Basic Contract Drawings.

A. Reinforced Concrete Pipe

1. ASTM C 76, Class V, Wall B or Wall C for Circular Reinforced Concrete Pipe, ASTM C 507, Class HE-IV for Horizontal Elliptical Pipe and Class VE-VI for Vertical Elliptical Pipe, unless otherwise shown on the Basic Contract Drawings. Use ASTM C 150, Type II Portland cement. Pipe joints shall be tongue and groove or bell and spigot, and shall be sealed with a continuous gasket. Lifting holes in pipe will not be permitted.

2. Pipe joints shall be sealed with rubber gaskets. Design of joints and physical requirements for rubber gaskets shall conform to ASTM C 443. Rubber gaskets shall be the following types of rubber gaskets, manufactured by Hamilton Kent Manufacturing Co., Toronto, Ontario or approved equal:

a. "Tylox Type C" for straight tongue and groove pipe

b. "Tylox Superseal " for offset pipe

c. "Tylox Type 0" for recessed pipe

B. Ductile Iron Pipe

1. ASTM A 746, minimum wall thickness Class 50 unless otherwise shown on the Basic Contract Drawings, with push-on joints, and cement mortar lining, which shall be twice the standard thickness in AWWA C 104.

2. Joints shall be sealed with continuous ring rubber gaskets conforming to AWWA C 111.

3. Polyethylene Encasement for Ductile Iron Sewer Pipe: AWWA C 105, Class C polyethylene, 8-mil thickness.

C. Corrugated Polyethylene Pipe

1. ASTM F 2306, high density Polyethylene pipe, joints shall be bell and spigot and sealed with a continuous gasket.

2. Pipe joints shall be sealed with continuous ring rubber gaskets and conforming to ASTM F 477 and meet the requirements of ASTM D 3212.

C. Crushed Stone for Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

PART 3. EXECUTION

3.01 EXAMINATION

Where the storm drain is to cross existing utilities, the Contractor shall verify their elevation and horizontal location through excavation of the test pits shown on the Basic Contract Drawings.

3.02 INSTALLATION

A. Excavation

1. Excavate pipe trench in accordance with Section 02221 entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Basic Contract Drawings.

2. In the course of excavation, should the trench or subtrench width exceed the outside diameter of pipe plus two feet for nominal diameters up to 18 inches or outside diameter plus three feet for nominal diameters in excess of 18 inches, the Engineer may require remedial measures to reduce the load on the pipe such as the use of concrete cradle or concrete arch bedding, or reinforced concrete encasement. Or the Engineer may require the Contractor to substitute a stronger pipe capable of withstanding the increased load such as ASTM C 655 or ASTM A 746. A subtrench is defined as a trench excavated for pipe placement within a wider trench.

3. If ground water is encountered, prevent accumulation of water in trench by methods approved by the Engineer. Pipe shall be laid in a dry trench.

B. Pipe Support and Backfilling

1. Where concrete cradles are shown on the Basic Contract Drawings, support the pipe at proper alignment and grade, place concrete (as specified in the Section entitled "CONCRETE") to dimensions shown and vibrate same. Concrete, when cured, shall support the full length of pipe.

2. Where crushed stone bedding is shown on the Basic Contract Drawings, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that pipe laid on same will be at the proper grade and alignment. Make suitable excavations for the pipe bells, where applicable so that the bottom reaction and support are confined to the pipe barrel. After installation of pipe on the compacted layer, place and compact additional bedding material in small lifts to the dimensions shown.

3. a. Reinforced Concrete Pipe and Ductile Iron Pipe

Continue backfilling of the trench from the pipe support limits reached in 3.02 B.1 and 2 above in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING".

b. Corrugated Polyethylene Pipe

Place pipe embedment and backfilled in accordance with ASTM D 2321.

C. Polyethylene Encasement for Ductile Iron Pipe

1. Install polyethylene encasement on all ductile iron pipes using one of the installation methods described in AWWA C 105.

2. Pipe surface shall be totally cleaned prior to installation of the polyethylene encasement. During installation, care shall be exercised to prevent soil or bedding material from becoming trapped between the pipe and the polyethylene encasement.

3. The polyethylene film shall be fitted to the contour of the pipe to effect a snug, but not tight, encasement with the minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, or fittings, and to prevent damage to the polyethylene due to backfilling operations.

4. Overlaps and ends shall be secured with adhesive tape, string or plastic tie straps to hold the polyethylene encasement in place until backfilling operations are complete.

D. Pipe Installation

1. Immediately prior to placement in the trench, all pipe shall be inspected in the presence of the Engineer to verify that it is internally clean and free of damage. Damaged units shall be removed from the construction site and replaced to the satisfaction of the Engineer, at no additional cost to the Authority.

2. When lowering pipe into the trench and joining the units, take precautions to ensure that the interior of the pipeline remains clean.

3. Lay pipe true to line and grade, with uniform bearing under the full length of its barrel, without break from structure to structure, and with bell or grooved end facing upgrade. Adjustments to line and grade shall be made by scraping away or adding bedding material under the pipe.

4. Prior to start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or gradeboard setup to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if, in the opinion of the Engineer, the alternate system produces equivalent accuracy.

5. Make up pipe joints in accordance with the manufacturer's instructions and taking extreme care that joints are clean and free of foreign materials. Support pipe free of the bedding during the joining process to avoid disturbing the subgrade.

6. In large diameter sewers with compression-type pipe joints, or where considerable force will be required to insert the spigot fully into the bell, come-alongs and winches or other equipment may be rigged to provide the necessary force. Inserts shall be used to prevent the sewer pipe from being thrust completely home prior to checking gasket location. After the gasket is checked, the inserts shall be removed and the joint completed.

7. Close all openings in the pipeline with watertight plugs when pipelaying is stopped at the conclusion of the work period or if work is interrupted for any reason.

8. Install polyethylene encasement prior to backfilling ductile iron pipe.

3.03 PROTECTION

A. Care shall be taken not to damage or displace installed pipes and joints during construction of pipe supports, backfilling and other operations.

B. Where pipe is damaged or displaced, take remedial measures as directed by the Engineer including but not limited to relaying pipe or replacing the pipe and/or testing of joints. All such remedial measures shall be performed at no additional cost to the Authority.

END OF SECTION

DIVISION 2

SECTION 02722

STORM DRAINAGE SYSTEM -

(INFILTRATION/EXFILTRATION TESTING NOT REQUIRED)

APPENDIX "A"

SUBMITTALS

A. Submit catalog cuts of gaskets for pipejoints including manufacturer's installation instructions.

B. Submit certificate from gasket manufacturer certifying that the proposed gaskets comply with the specified requirements and that the gaskets are compatible with the type of pipe joint used.

C. Submit certificate from the pipe manufacturer certifying that such pipe complies with the requirements specified in this Section.

D. Submit certificate from the polyethylene film manufacturer that such polyethylene film complies with the requirements specified in this Section.

E. Submit to the Manager, Materials, Engineering Division, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07310-1397, certified test data covering gradation and composition of the crushed stone for pipe bedding proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag which shall not permit loss of any of the material.
2. Clearly label the container or bag of the sample with: Contract location, title and number; the name of the material supplied; and location of the source.
3. The Engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.
4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

F. Submit plans, methods, equipment and procedures as applicable for:

1. Prevention of accumulation of groundwater specified in 3.02.
2. Alternate method of line and grade control specified in 3.02.

G. Submit "As Built" drawings in accordance with the Section entitled "UTILITY RECORD DRAWINGS" of Division 1 of the Specifications.

END OF APPENDIX "A"

DIVISION 2

SECTION 02730

EXTERIOR SANITARY SEWER PRESSURE SYSTEM

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for exterior sanitary sewer pressure systems.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM A 377	Standard Index of Specifications for Ductile Iron Pressure Pipe
ASTM C 117	Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	Portland Cement
ASTM C 361	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
	American Water Works Association (AWWA)
AWWA C 104	Cement-Mortar Lining for Ductile-Iron Pipe Fittings for Water
AWWA C 105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C 110	Ductile-Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids
AWWA C 111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C 151	Ductile Iron Pipe Centrifugally Cast, for Water or Other Liquids
AWWA C 301	Prestressed Concrete Cylinder Pipe, Steel Cylinder Type
AWWA C 600	Installation Ductile-Iron Water Mains and Their Appurtenances
AWWA M 9	Concrete Pressure Pipe

1.03 QUALITY ASSURANCE

A. Any entity performing the Work of this Section shall have at least three years of installation experience on projects with sanitary sewer piping systems and appurtenances of types and sizes similar to that required under this Contract.

B. Pipe will be visually inspected by the Engineer when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced, at no additional cost to the Authority.

C. Pipe may be inspected at the place of manufacture by the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's instructions for unloading, storing and moving pipe.

B. Care shall be taken when storing pipe to prevent damage to Authority or other public or private property and any property so damaged shall be repaired at the Contractor's expense.

1.05 SUBMITTALS

For Submittals, see Appendix "A".

PART 2. PRODUCTS

2.01 MANUFACTURERS

For each of the specified materials, manufacturer shall be one of the following, or approved equal.

A. Ductile Iron Sewer Pipe and Fittings

American Cast Iron Pipe Co., North Birmingham, Alabama
Griffin Pipe Products Co., Downers Grove, IL.
McWane, Inc., Birmingham, Alabama
Atlantic States Cast Iron Pipe Co. Phillipsburg, NJ
U.S. Pipe and Foundry Co., Orlando, FL.

B. Gaskets

Hamilton Kent Manufacturing Co., Toronto, Ontario
Diplomatic Marine, Inc., Houston, TX
General Sealants, Inc., Anaheim, CA

C. Prestressed Concrete Cylinder Pipe

Price Bros., Inc., Dayton, OH
Vianini Pipe, Inc., Somerville, NJ

2.02 MATERIALS

Use any of the pipe systems specified below unless otherwise shown on the Basic Contract Drawings or specified herein.

A. Ductile Iron Pipe - 3 inch and Larger.

1. Push-on-Joint pipe AWWA C151, Class 52 for pipe 3 in. and larger, cement-mortar lined and with an asphaltic coating on the inside and on the outside. Cement-mortar lining shall be twice the standard thickness specified in AWWA C104. Rubber gaskets shall conform to AWWA C111.

2. Joint restraint is required for push-on-joint pipe. One of the following systems, or an approved equal, shall be used:

   a. "Field-Lok" gaskets for pipe 4 in. through 12 in., as manufactured by U.S. Pipe and Foundry Co.

   b. "Flex-Ring" for pipe 4 in. through 12 in., as manufactured by American Cast Iron Pipe Co.

   c. "TR FLEX" for pipe 4 in. through 54 in., as manufactured by U.S. Pipe and Foundry Co.

3. Fittings for Ductile Iron Pipe - 350 psi Pressure Rating

   AWWA C110, cement-mortar lined with an asphaltic coating on the inside and on the outside. Lining, coatings and joint type shall be as specified for ductile iron pipe.

B. Concrete Pressure Pipe

1. Concrete Pressure Pipe, ASTM C 361 covers pipe for up to 125 feet of hydrostatic head and Prestressed Concrete Lined Cylinder or Embedded Cylinder Pipe shall conform to the latest revision of AWWA C 301, unless otherwise shown on the Basic Contract Drawings. Pipe joints shall be bell and spigot type or double spigot and sleeve type, and shall be sealed with a continuous gasket. Lifting holes in pipe will not be permitted.

2. Rubber gaskets for Concrete Pressure Pipe shall conform to ASTM C 361 and Prestressed Concrete Pipe shall conform to AWWA C 301 and shall be designed and manufactured so that the completed joint withstand an internal water pressure in excess of the highest pressure to the pipe will be subjected without showing any leakage.

C. Manholes and Other Structures

Manholes and other structures shall be in accordance with the requirements of the Section entitled "Manholes and Drainage Structures."

D. Polyethylene Encasement for Ductile Iron Sewer Pipe, AWWA C 105, Class C polyethylene, 8-mil thickness.

E. Gate Valves

1. Types of valves shall be as shown on the Basic Contract Drawings.

2. Non-rising Stem Valves

Valves 3 in. through 12 in. shall be New York Pattern Metropolitan Type, manufactured by U.S. Pipe and Foundry Co., or approved equal. Valves shall be non-rising stem, nut operated and open to the right (clockwise) unless otherwise shown on the Basic Contract Drawings. Valves shall be rated for 200 psi working pressure, 400 psi test pressure and shall be set vertical unless otherwise shown on the Basic Contract Drawings.

F. Check Valves

Valves 3 in. and larger shall be iron body, bronze mounted, full opening swing check valves. Valves shall be outside spring and lever, with flange ends. The valves shall be the equal of those manufactured by M&H Valve of Dresser Industries, Style 259; or approved equal.

G. Air Release Valves

Contractor shall install 2 in. air release valves with backflushing connection and hose as manufactured by APCO Inc., Model 400 WA, reduced height; or approved equal.

H. Bitumastic Paint

"Bitumastic No. 50" as manufactured by the Koppers Company or No. "CA-50" manufactured by the Barrett Division of the Allied Chemical and Dye Corporation, or approved equal.

I. Paint for Pipe, Valves and Fittings Within Valve Chambers

The prime (or first) coat shall be Carbomastic 15 and the finish (or second) coat shall be Carboline 133 HB, satin finish, aliphatic polyurethane,both as manufactured by the Carboline Company, or approved equal. Prime and finish coats shall be products of the same manufacturer. Color of the paint shall be black.

J. Crushed Stone for Pipe Bedding

Crushed limestone, gneiss, trap rock or recycled Portland cement concrete aggregate conforming to ASTM C 33, size number 67. Recycled concrete aggregate shall contain not less than 90 percent crushed Portland cement concrete and shall be in accordance with the requirements of the Section 02231 entitled "AGGREGATE BASE COURSE".

PART 3. EXECUTION

3.01 EXAMINATION

Where the sewer line is to cross existing utilities, the Contractor shall verify their elevation and horizontal location through excavation of the test pits shown on the Basic Contract Drawings.

3.02 INSTALLATION

A. Excavation

1. Excavate pipe trench in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING" in the location and to the depth shown on the Basic Contract Drawings.

2. In the course of excavation, should the trench or subtrench width exceed the outside diameter of pipe plus two feet, the Engineer may require remedial measures to reduce the load on the pipe such as the use of concrete cradle or concrete arch bedding, or reinforced concrete encasement. Or the Engineer may require the Contractor to substitute a stronger pipe capable of withstanding the increased load. A subtrench is defined as a trench excavated for pipe placement within a wider trench.

3. If ground water is encountered, prevent accumulation of water in trench by methods approved by the Engineer. Pipe shall be laid in a dry trench.

B. Pipe Support and Backfilling

1. Where concrete cradles are shown on the Basic Contract Drawings, support the pipe at proper alignment and grade, place concrete (as specified in the Section entitled "PORTLAND CEMENT CONCRETE") to dimensions shown and vibrate same. Concrete, when cured, shall support the full length of pipe.

2. Where crushed stone bedding is shown on the Basic Contract Drawings, place and compact crushed stone bedding material in the bottom of the trench to provide a firm but slightly yielding surface and to an elevation such that pipe laid on same will be at the proper grade and alignment. Make suitable excavations for pipe bells, where applicable, so that the bottom reaction and support are confined to the pipe barrel. After installation of pipe on the compacted crushed stone material, place and compact additional crushed stone bedding material to the dimensions as shown on the Basic Contract Drawings.

3. Continue backfilling of the trench from the pipe support limits reached in 3.02 B.2 and 3 above in accordance with the Section entitled "EXCAVATION, BACKFILLING AND FILLING."

C. Pipe Installation

1. Install ductile iron pipe in accordance with AWWA C 600 and concrete pressure pipe in accordance with AWWA M 9.

2. Immediately prior to placement in the trench, all pipe and appurtenances shall be inspected in the presence of the Engineer to verify that they are internally clean and free of damage. Damaged units shall be immediately removed from the construction site and replaced to the satisfaction of the Engineer and at no additional cost to the Authority.

3. When lowering pipe and appurtenances into the trench and joining the units, take precautions to ensure that the interior of the pipeline remains clean.

4. Lay pipe true to line and grade, with uniform bearing under the full length of the barrel, without break from structure to structure, and with bell or grooved end facing upgrade. Adjustments to the line and grade shall be made by scraping away or adding material under the pipe.

5. Prior to start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or gradeboard setup to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if, in the opinion of the Engineer, the alternate system produces equivalent accuracy.

6. Make up pipe joints in accordance with the manufacturer's instructions taking extreme care that joints are clean and free of foreign materials. Support pipe free of bedding during the joining process to avoid disturbing the subgrade. Pipe joints shall be sufficiently tight to meet testing specified herein.

7. Close all openings in the pipeline with watertight plugs when pipelaying is stopped at the conclusion of the work period or if work is interrupted for any reason.

8. Install polyethylene encasement accordance with AWWA C105, prior to backfilling ductile iron sewer pipe.

3.03 FIELD TESTS

Hydrostatic Pressure and Leakage Tests

1. After completion of the pipeline installation, but prior to backfilling and prior to final connection to the existing system, conduct in the presence of the Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.

2. Provide all pumps, meters, piping and associated equipment required by AWWA C600.

3. No pipeline installation will be approved if the pressure varies by more than 5 psi during the duration of the hydrostatic pressure test.

4. No pipe line installation will be approved if the leakage is greater than that determined by the following formula:

$$\frac{L = SD \times P^{1/2}}{133{,}200}$$

where:

L =The allowable leakage, in gallons per hour.

S =The length of pipe tested, in feet.

D =The nominal diameter of the pipe, in inches.

P =The average test pressure during the leakage test shall not be less than 100 psi unless otherwise shown on the Basic Contract Drawings, for a period of not less than two hours.

5. Locate the source of leakage and make repairs as necessary to any pipeline failing to meet the requirements of 3.03 A.3 and 4.

3.04 PROTECTION

A. Care shall be taken not to damage or displace installed pipe and joints during construction of pipe supports, backfilling testing and other activities.

B. Where pipe is damaged or displaced, take remedial measures as directed by the Engineer including but not limited to retesting of joints, relaying pipe or replacing pipe. All such remedial measures shall be performed at no additional cost to the Authority.

END OF SECTION

SECTION 02730

EXTERIOR SANITARY SEWER PRESSURE SYSTEM

SUBMITTALS

APPENDIX "A"

A. Submit catalog cuts of pipes and gaskets for pipe joints including manufacturer's installation instructions.

B. Submit certificate from gasket manufacturer certifying that the proposed gaskets comply with the requirements specified in this Section and that the gaskets are compatible with the type of pipe joint used.

C. Submit certificate from the pipe manufacturer certifying that such pipe complies with the requirements specified in this Section.

D. Submit to the Chief of Material, Materials Engineering Unit, Port Authority Technical Center, 241 Erie Street, Jersey City, New Jersey 07302-1397, certified test data covering gradation and composition of crushed stone for pipe bedding proposed for use, together with one 75-pound representative sample of the material.

1. Submit the sample in a clean, sturdy container or bag that shall not permit loss of any of the material.
2. Clearly label the container or bag of the sample with Contract location, title and number; the name of the material supplied; and location of the source.
3. The Engineer will approve or disapprove the proposed material within 21 days after receipt of the sample.
4. Do not deliver material to the construction site from any source until the Engineer has approved the material from that source.

E. Submit plans, methods, equipment and procedures as applicable for:

1. Prevention of a accumulation of groundwater specified in 3.02.
2. Alternate method of line and grade control specified in 3.02.
3. Infiltration/exfiltration and/or air testing specified in 3.03.

F. Submit results of the tests specified in 3.03 on a daily basis.

G. Submit "As Built" drawings in accordance with the Section entitled "UTILITY RECORD DRAWINGS" of Division 1 of the Specifications.

END OF APPENDIX "A"

DIVISION 2

SECTION 02832

METALLIC-COATED STEEL CHAIN LINK FENCE AND GATES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for aluminum-coated and zinc-coated steel chain link fence including the following:

1. Furnishing and installing new fencing;
2. Removal of existing fencing;
3. Relocation of existing fencing.

B. Definitions of terms related to chain link fencing shall be in accordance with ASTM F 552.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)
ACI 318	Building Code Requirements for Structural Concrete.
	American Society for Testing and Materials (ASTM)
ASTM A 121	Specification for Metallic-Coated Carbon Steel Barbed Wire.
ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A 392	Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
ASTM A 491	Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
ASTM A 817	Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire.
ASTM A 824	Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence.
ASTM B 117	Practice for Operating Salt Spray (Fog) Apparatus.
ASTM B 429	Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
ASTM F 552	Standard Terminology Relating to Chain Link Fencing.
ASTM F 567	Practice for Installation of Chain-Link Fence.
ASTM F 626	Specification for Fence Fittings.
ASTM F 900	Specification for Industrial and Commercial Swing Gates.
ASTM F 1043	Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.

ASTM F 1083	Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
ASTM F 1184	Specification for Industrial and Commercial Horizontal Slide Gates.
ASTM F 1345	Specification for Zinc - 5% Aluminum Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric.

1.03 QUALITY ASSURANCE

Upon request arrange for the Engineer to inspect all fencing materials at the place of manufacture.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Arrange for fence fabric and accessories to be delivered to the construction site in packed cartons or firmly tied rolls.

B. Verify that each package is identified and bears the manufacturer's name.

C. Store fence fabric and accessories in a secure and dry area.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Sliding gates shall be one of the following with no substitutions permitted:

"Easy Track" by
Boundary Fence and Railing Systems, Inc.
Richmond Hill, NY 11418

"Internal Roller" by
Anchor Fence/Master Halco Inc.
Baltimore, MD 21224

"Fortress Gate" by
Tymetal Corporation
Clifton Park, NY 12065

2.02 MATERIALS

A. General

1. Chain link fence components shall be zinc-coated steel except as otherwise permitted herein for fabric, barbed wire and gate framing.

2. Take field measurements prior to preparation of Shop Drawings and fabrication.

3. Unless otherwise specified herein or shown on the Basic Contract Drawings, materials, coatings and shapes shall be of uniform type and manufacture.

B. Fence Fabric

1. Unless otherwise shown on the Basic Contract Drawings, comply with ASTM A 817 for 0.192-inch diameter, 2-inch mesh, wire fabric.

2. Type II, Class 2 Zinc-Coated (Galvanized) fabric shall comply with ASTM A 392.

3. Type I Aluminum-Coated (Aluminized) fabric shall comply with ASTM A 491.

4. Type III Zinc - 5% Aluminum - Mischmetal coated fabric shall comply with ASTM F 1345.

5. Fence fabric height shall be as shown on the Basic Contract Drawings. For fabric height of 6 feet and over, top and bottom selvage shall be twisted and barbed, unless otherwise shown on the Basic Contract Drawings. For fabric height of less than 6 feet, both top and bottom selvages shall be knuckled.

6. Apply clear acrylic sealer to selvage area after weaving.

C. Barbed Wire

1. Each line of barbed wire shall consist of two strands of No. 12 1/2 gage (0.099-inch diameter) wires twisted with 4-point No. 14 gage barbs spaced approximately 5 inches apart. The barbed wire shall conform to ASTM A 121, Class 3 (0.8 oz/sf) zinc-coated or ASTM A 121, Type II aluminum-coated steel barbed wire with aluminum alloy barbs.

2. Extension arms shall be 45 degrees, extended outward as shown on the Basic Contract Drawings and slotted to support three lines (unless otherwise shown on the Basic Contract Drawings) of barbed wire such that the outermost line is positioned approximately 12 inches horizontally from the fence line.

3. End and intermediate vertical members of gates shall be extended vertically 12 inches and shall be provided with the necessary clips to secure barbed wire.

D. Fence Framing

1. Steel posts and rails shall conform to ASTM F 1043 for Heavy Industrial Fence.

2. External and internal protective coatings shall conform to ASTM F 1043 for the fence framework material group furnished. Framework shall demonstrate the ability to withstand salt spray when tested in accordance with ASTM B 117 based on certified test results, as follows:

   a. Exterior: 1000 hours with maximum 5 percent red rust.

   b. Interior: 650 hours with maximum 5 percent red rust.

3. Zinc-coated (galvanized) round steel pipe shall conform to the applicable portions of ASTM F 1083, Standard Weight Pipe (Schedule 40) with a minimum yield strength of 25,000 psi.

4. Unless otherwise shown on the Basic Contract Drawings, equivalent steel sections may be substituted for the sections shown on the Basic Contract Drawings. Equivalent sections shall conform to ASTM F 1043 Group IC - Round Steel Pipe, Group II - Roll Formed Steel Shapes or Group III - Hot-rolled Shapes and shall have bending strengths at least equal to those of the sections shown as determined by ASTM F 1043.

5. Rail sleeves and connectors shall allow for expansion and contraction of the rail. Use sleeves of the same material as the rail having a minimum length of 6 inches, or provide rails swedged at one end for a minimum length of 3 inches for connecting into a continuous run. Furnish and install suitable fittings for securing rails to terminal posts.

E. Gates

1. General

a. Gate types, opening widths and directions of operation shall be as shown on the Basic Contract Drawings.

b. Gates shall conform to the requirements specified for metallic-coated steel chain link fence except that aluminum alloy framing conforming to ASTM B 429 may be used.

c. Gates shall be designed for operation by one person.

d. Where shown on the Basic Contract Drawings, gates shall be topped with three lines of barbed wire, meeting the requirements of 2.02 C.1.

2. Swing Gates

a. Swing gates shall be factory assembled and shall swing 180 degrees.

b. Swing gates shall conform to ASTM F 900 except that framing shall be assembled by welding at the corners. Use of corner fittings will not be permitted.

3. Sliding Gates

a. Sliding gates shall be factory-assembled by one of the manufacturers specified in this Section.

b. For overhead and cantilever sliding gates, the materials, manufacture and dimensions and weights of frame members and posts shall, at a minimum, meet the requirements of ASTM F 1184, Class 2 (internal rollers).

c. Rollers for overhead and cantilever sliding gates shall be equipped with ball bearings. Non-sealed ball bearings shall be provided with a grease fitting for periodic maintenance. Rollers shall be secured to post or frame without welding.

4. Cantilever Sliding Gates

a. The gate leaf frames and tracks shall be fabricated of aluminum conforming to ASTM B 429 alloy 6063-T6 or as required to meet the performance requirements of ASTM F 1184 and specified herein.

b. Frame members shall be minimum 2-inch square, 0.91 lb/ft aluminum tubing assembled by welding at all corners to form a rigid, one-piece unit. Fabric shall be securely stretched and held in the center of the tubing. All cantilever overhang frames shall have 3/8-inch brace rods. For gate leaf sizes 23 feet to 30 feet, an additional lateral support rail shall be welded adjacent to the top and bottom horizontal rails.

c. The single leaf opening size shall determine the minimum overhang as follows:

Opening	Overhang
Up to 10'-0"	6'-6"
10'-1" to 14'-0"	7'-6"
14'-1" to 22'-0"	10'-0"
22'-1" to 30'-0"	12'-0"

d. The track shall be a combined integral track and rail. The rail shall be an aluminum extrusion having a minimum total weight of 3.72 pounds per foot and designed to withstand a reaction load of 2000 pounds. The roller track assembly shall be designed for the same reaction load as the rail and shall consist of two swivel type zinc die cast trucks having four sealed-lubricant ball bearing wheels of a minimum 2-inch diameter by 9/16-inch width. Provide two side-rolling wheels to ensure alignment of truck in track for each gate leaf. Fasten trucks to post brackets by minimum 7/8-inch diameter, 1/2-inch shank ball bolts.

e. Provide galvanized steel guide wheel assemblies for each supporting post. Each assembly shall consist of two rubber wheels of minimum 4-inch diameter with oil-impregnated bearings. The assembly shall be attached to the post so that the bottom horizontal member will roll between the wheels and can be adjusted to maintain plumb gate frames and proper alignment.

F. Tension Wire: ASTM A 824, Type I or Type II.

G. Accessories and Fittings

1. Furnish all necessary fittings for installation of fence as a complete unit including, but not limited to, post and line caps, rail and brace ends, rail sleeves, tie wires and clips, tension and brace bands, tension bars, truss rods and barbed wire extension arms.

2. Fence fittings shall conform to ASTM F 626.

3. Ferrous accessories and fittings shall be zinc-coated at a minimum of 1.2 oz./sf. in accordance with ASTM A 153, unless otherwise specified herein.

4. Furnish malleable iron non-lift-off type hinges offset to permit 180 degree swing gate opening.

5. Furnish malleable iron forked type latch with padlock eye suitable for operation from both sides of gate.

6. Furnish 2-inch cylinder type padlock for each gate and provide 3 keys for each padlock.

7. Furnish gate stops for double gates consisting of a mushroom type flush plate with anchors capable of being set in concrete and designed to engage center drop rod or plunger.

8. Furnish keepers to hold the gate leaf in the fully open position until manually released.

9. Wire ties shall be of the same material and coating as the fabric.

H. Concrete

Concrete for post footings shall attain a minimum compressive strength of 3000 psi in 28 days and shall conform to the requirements of ACI 318 for mixing and placing.

PART 3. EXECUTION

3.01 PREPARATION

Prepare the grade and remove surface irregularities, if any, which may cause interference with the installation of chain link fence.

3.02 REMOVAL OF EXISTING FENCING

A. Where shown on the Basic Contract Drawings, remove existing fence including fabric, gates, posts and other appurtenances. Cut post footings flush with the ground surface and grout resulting voids, unless otherwise shown on the Basic Contract Drawings.

B. Fencing materials and debris resulting from removal operations shall be disposed of away from Authority property, unless otherwise shown on the Basic Contract Drawings.

3.03 INSTALLATION

A. Comply with applicable provisions of ASTM F 567.

B. Install fence with all posts vertical and all components to the line and grade shown on the Basic Contract Drawings.

C. Connect to existing fence at an existing terminal post or by installation of an end post. Subject to approval by the Engineer, an existing line post may be converted to a terminal post by installation of appropriate brace rails and brace rods.

D. The clear opening from end posts to buildings, fences and other structures shall not exceed 2 inches.

DIVISION 2

SECTION 02841

W-BEAM AND THRIE-BEAM GUIDE RAIL

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for W-beam and Thrie-beam guide rail.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 30	Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail
AASHTO M 102	Steel Forgings, Carbon and Alloy, for General Industrial Use
AASHTO M 133	Preservatives and Pressure Treatment Process for Timber
AASHTO M 180	Corrugated Sheet Steel Beams for Highway Guardrail

American Society for Testing and Materials (ASTM)

ASTM A 36	Structural Steel
ASTM A 123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 563	Carbon and Alloy Steel Nuts

1.03 QUALITY ASSURANCE

A. Guide rails and appurtenances may, at the option of the Engineer, be inspected at the place of manufacture.

B. Furnish certificate for each type material specified in 2.01, certifying that such material complies with the applicable specified requirements.

C. Guide rails and appurtenances will be visually inspected when delivered to the construction site. Any such material that does not meet requirements of this Section or is damaged, shall be removed from the construction site and replaced with satisfactory material.

D. All stages of installation will be inspected by the Engineer for compliance with the provisions hereof and conformance to required line and grade. Any failures to comply shall be immediately corrected to the satisfaction of the Engineer.

1.04 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.05 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Steel Guide Rail and Terminal Sections

AASHTO M 180, CLASS B, TYPE 2, for W-Beam or Thrie-Beam, as shown on the Basic Contract Drawings.

B. Posts, Spacers, Plates, Rub Rail and Anchorage Units

ASTM A 36 of type and size shown on the Basic Contract Drawings, galvanized in accordance with ASTM A 123. No punching, drilling, cutting or welding will be permitted after galvanizing. When shown on the Basic Contract Drawings, provide rub rail.

C. Bolts and Nuts

Conform to AASHTO M 180.

D. Miscellaneous Hardware for End Treatments

When end treatments are shown on the Basic Contract Drawings, conform to AASHTO M 180 except as follows:

1. Guide rail end treatment cables shall conform to AASHTO M 30, Type 1 with Class A coating. Swaged fittings shall be fabricated from forged steel conforming to AASHTO M 102.

2. Nuts for guide rail end treatment shall conform to ASTM A 563, Grade A.

3. Plates and rods for guide rail end treatment shall be structural steel conforming to ASTM A 36 and galvanized in accordance with ASTM A 123.

E. Timber Posts for Breakaway Cable Terminals

Where shown on the Basic Contract Drawings, provide timber posts having a stress grade of 1200 pounds per square inch or more as tested in accordance with requirements of West Coast Lumber Inspection Bureau, Southern Pine Inspection Bureau or other appropriate Timber Association. Posts may be rough sawn or dressed and shall be treated with a preservative conforming to AASHTO M 133 with retention property of six pounds of creosote per cubic foot of timber, minimum.

PART 3. EXECUTION

3.01 INSTALLATION

A. Posts shall be set to the required depth. Posts shall be plumb, properly spaced and to the prescribed line and grade as shown on the Basic Contract Drawings.

B. Prior to driving the posts or excavating for concrete footings, the exact location of underground utilities that may conflict with the posts shall be determined. Post spacing may be adjusted by six inches or double spacers may be used, as approved by the Engineer, to eliminate such conflicts.

C. Damage to utilities due to the performance of the Work shall be located and repaired at no additional cost to the Authority.

D. The rail elements shall be erected with the top edge in a straight line or smooth curve, parallel or concentric to the roadway. Where a vertical transition is required, the top edge of rail elements shall form the chords of a smooth vertical curve. No punching, drilling, reaming, cutting or welding of the rail elements will be permitted in the field.

E. Where earth is of a type that cannot be drilled using a mechanical earth auger, obtain approval from the Engineer for an alternate method of installing posts.

F. If concrete Footings are required, support posts at proper line and grade as shown on the Basic Contract Drawings in such a manner so that they will not be displaced during concreting operations.

G. Use erectors trained by manufacturer.

H. Touch up all damage to the zinc coating with an approved type paint.

I. Paint portions of posts to be imbedded in concrete with two heavy coats of an approved bitumastic paint.

3.02 STAGING FOR INSTALLATION ADJACENT TO EXISTING ROADWAYS

Install W-beam and Thrie-beam guide rail in the following sequence:

A. Approach terminal end shall be the first section installed.

B. Posts and rails shall be constructed in the direction of traffic.

C. At the end of a work period, all posts that have been installed shall have the rail elements attached.

D. New guide rail shall be installed prior to the removal of an existing system, if any, unless otherwise shown on the Basic Contract Drawings.

END OF SECTION

SECTION 02841

W-BEAM AND THRIE-BEAM GUIDE RAIL

APPENDIX "A"

SUBMITTALS

Submit Detailed shop drawings of all components of the guide rail installation in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 – GENERAL PROVISIONS.

END OF APPENDIX "A"

DIVISION 2

SECTION 02842

TEMPORARY TRAFFIC BARRIERS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for temporary traffic barriers.

B. Coordinate the Work of this Section with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

C. Materials and constructions of this Section constitute temporary facilities that are and shall remain the property of the Contractor unless otherwise shown on the Basic Contract Drawing.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 36	Structural Steel
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners
ASTM D 1751	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

West Coast Lumber Inspection Bureau (WCLIB)

Standard Grading Rules

1.03 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

Provide new materials or, if acceptable to the Engineer, undamaged previously used materials in serviceable condition conforming to requirements specified in this Section. Provide materials suitable for the use intended.

B. Precast Concrete Barriers

1. White Portland cement proportioned to produce 3000 psi reinforced concrete.

2. Joint fillers shall conform to ASTM D 1751

C. Timber Barriers and Curbs

1. Lumber

Douglas Fir or Hem-Fir, WCLIB Standard Grade, Dressed on 4 sides (S4S).

2. Penetrating Sealer

Transparent colorless wood sealer which is effective in retarding transmission of moisture at cross-grain cuts and which shall not interfere with paint finish.

3. Paint Finish

Exterior alkyd resin reflectorized paint in colors shown on the Basic Contract Drawing.

D. Connector, Anchors, Accessories

Fabricated ASTM A 36 shapes, plates and bars welded into assemblies required, with ASTM A 307 steel bolts, lag bolts and other fasteners as required. Finish each assembly and fastener with ASTM A 123 hot-dip zinc coating.

E. Concrete Barrier Flags

Aluminum, 6 x 6 inch, with weather-resistant reflective silver sheet suitable for daylight and night hours.

F. Concrete Barrier Lights

High intensity flashers of type specified in "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

G. Timber Barrier Markers

Light-retroreflective markers as shown on the Basic Contract Drawing.

2.02 CONSTRUCTION FEATURES

A. Fabricate exposed traffic approach end of barriers with a gradual taper with no blunt ends, arranged to redirect the path of a vehicle parallel to the line of normal traffic flow.

B. Fabricate concrete barriers with a cross section of a portable, concrete safety shape barrier as shown on the Basic Contract Drawing.

1. Fabricate in lengths of 20 feet or less with the rectangular footing cut out at regular intervals to ensure storm water runoff.

2. Furnish connections at vertical joints that will develop the full strength of the barrier system and ensure that the individual elements are aligned to provide a smooth, continuous barrier face.

3. Provide barrier lights as shown on the Basic Contract Drawing.

C. Fabricate timber barriers and curbs of type and size shown on the Basic Contract Drawing. Paint as shown on the Basic Contract Drawing, or if not shown, paint white with rails of alternating orange and white stripes that slope down toward the side on which traffic is to pass. All paint shall be reflectorized.

PART 3. EXECUTION

3.01 PREPARATION

Provide and place temporary traffic control devices in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1.

3.02 INSTALLATION

A. Install barriers and curbs at locations shown on the Basic Contract Drawing.

B. Provide bituminous pavement shimming and leveling as required to ensure smooth, continuously aligned barriers and curbs.

C. Provide 1/2 inch wide joints between ends of barriers and curbs. At concrete barriers, fill joint with premolded bituminous joint filler.

D. Secure barriers against lateral displacement by use of drift pins or anchor bolts drilled into roadway surface.

E. Connect, and continuously operate, concrete barrier lights.

3.03 ADJUSTMENTS

A. Maintain, clean, relocate and replace barriers and curbs as required to protect motorists, pedestrians and workers throughout the Work of this Contract.

B. Remove barriers away from Authority property, when the need has ended, when replaced by approved use of permanent construction, or when directed by the Engineer.

C. Complete, or if necessary, restore permanent construction. Replace construction that cannot be satisfactorily repaired. Remove temporary paving that is not intended for or acceptable for integration into permanent paving.

END OF SECTION

SECTION 02842

TEMPORARY TRAFFIC BARRIERS

APPENDIX "A"

SUBMITTALS

Submit shop drawings of concrete barriers, including details of vertical joint connections, and details of proposed method of relocating concrete barriers in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 – GENERAL PROVISIONS.

END OF APPENDIX "A"

DIVISION 2

SECTION 02844

TEMPORARY CONCRETE BARRIER

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for temporary concrete barriers.

B. Coordinate the Work of this Section with the requirements of "MAINTENANCE OF TRAFFIC AND WORK AREA PROTECTION" of DIVISION 1 - GENERAL PROVISIONS.

C. Materials and constructions of this Section constitute temporary facilities that are and shall remain the property of the Contractor unless otherwise shown on the Basic Contract Drawings.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM A 36	Structural Steel
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners
ASTM C 150	Portland Cement

1.03 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CONSTRUCTION FEATURES AND MATERIALS

A. General

Provide new barriers and materials or, if acceptable to the Engineer, undamaged previously used barriers and materials in serviceable condition conforming to the requirements specified in this Section, and as shown on the Basic Contract Drawing.

After delivery, a construction site inspection of the barriers and equipment will be made by the Engineer. If any barriers and equipment has been damaged or if, for any reason, the equipment does not comply with the requirements herein, the Contractor shall repair or replace the barriers and equipment at its own cost and expense, even though the barriers and equipment had been inspected for shipment. After such satisfactory replacement and/or repair and subsequent Engineer written approval, the barriers shall be installed.

B. Precast Concrete Barriers

1. Shall be manufactured with white portland cement concrete in accordance with the Basic Contract Drawing which depict New York and New Jersey requirements. If the Basic Contract Drawing are superseded by later New York or New Jersey Standards, then the most recent Standards shall be used, and the Contractor shall furnish Shop Drawing(s) in accordance with paragraph 1.03 B highlighting the change(s).

2. Concrete shall be proportioned to produce 3000 psi reinforced concrete.

3. Barrier sections less than 10 feet shall have one drainage pocket, and sections greater than 10 feet shall have two drainage pockets conforming to the size shown on the Basic Contract Drawing, or styrofoam pads shall be provided to allow adequate drainage, as shown on the Basic Contract Drawing.

4. Connectors, Anchors and Accessories:- Fabricated ASTM A 36 shapes, plates and bars welded into assemblies required, with ASTM A 307 steel bolts, and other fasteners as required. Finish each assembly and fastener with ASTM A 123 hot-dip zinc coating.

C. Barrier Reflectors

If specified on the Basic Contract Drawing, barrier reflectors shall be 6" x 6", high intensity reflectorized, spaced at 20 feet on center with a minimum mounting height of 30 inches to the bottom of the reflectors. The reflector shall be white or yellow, matching the pavement edgeline, or as shown on the Basic Contract Drawing.

D. Barrier Lights

If specified on the Basic Contract Drawing barrier lights shall be steady burn Type C, spaced at 20 feet on center with a minimum mounting height of 30 inches to the bottom of the lens or as specified on the Basic Contract Drawing. Type B flashing lights shall be placed on the approach end of barrier at 10 feet on center or as shown on the Basic Contract Drawing.

E. Chain Link Fence

If specified in the Basic Contract Drawingss, chain link fence shall be placed on top of the temporary concrete barrier as shown on the Basic Contract Drawing.

F. Glare/Gawk Shield

Install glare / gawk shield as specified by the manufacturer or as shown on the Basic Contract Drawing.

PART 3. EXECUTION

3.01 PREPARATION

Protect the installation, maintenance, relocation and removal by providing and placing temporary traffic control devices in accordance with the requirements of the specification titled "Maintenance of Traffic and Work Area Protection" in Division 1.

3.02 INSTALLATION

A. Install barriers at locations shown on the Basic Contract Drawing.

B. Provide styrofoam pad shimming and leveling as required to ensure smooth and continuously aligned barriers.

C. Taper ends of barriers shall be flared away from traffic at a rate of 10 to 1 or flatter. Terminate blunt approach end with an impact attenuator as approved by the Engineer in accordance with paragraph 1.03 D or as specified on the Basic Contract Drawing.

D. Secure barriers against lateral displacement by use of drift pins or anchor bolts drilled into roadway surface or as shown on the Basic Contract Drawing.

E. Install reflectors and lights as specified herein, and as shown on the Basic Contract Drawing.

3.03 MAINTENANCE

A. Maintain, clean, relocate and replace barriers, reflectors and lights as required to protect motorists, pedestrians, and workers throughout the Work of this Contract.

3.04 REMOVAL

A. Remove barriers away from Authority property, when the need has ended, when replaced by approved use of permanent construction, or when directed by the Engineer.

B. Restore damaged permanent construction, and replace construction that cannot be satisfactorily repaired, all at no cost to the Authority.

END OF SECTION

SECTION 02844

TEMPORARY CONCRETE BARRIER

SUBMITTALS

APPENDIX "A"

Submit the following for approval by the Engineer in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Certification from the concrete barrier supplier stating that the concrete barrier(s) meet the requirements of the Basic Contract Drawing.

B. Shop Drawings detailing departures from the Standard Drawings included in the Contract Documents.

C. Proposed equipment Catalog Cuts and procedures to be used for installing, maintaining, relocating and removing the barrier(s).

D. Proposed end treatment details and Catalog Cuts including but not limited to impact attenuator type.

END OF APPENDIX A

DIVISION 2

SECTION 02846

TEMPORARY WATER-FILLED BARRIER

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for temporary water-filled barriers.

B. Coordinate the Work of this Section with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

C. Materials and constructions of this Section constitute temporary facilities that are and shall remain the property of the Contractor unless otherwise shown on the Basic Contract Drawing.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM A 36	Structural Steel
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners

1.03 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CONSTRUCTION FEATURES AND MATERIALS

A. General

B. Provide new barriers and materials or, if acceptable to the Engineer undamaged previously used barriers and materials in serviceable condition conforming to the requirements specified in this Section.

After delivery, a construction site inspection of the barrier and equipment will be made by the Engineer. If any barrier or equipment has been damaged or if, for any reason, the barrier or equipment does not comply with the requirements herein, the Contractor shall repair or replace the barrier and equipment at its own cost and expense, even though the equipment had been inspected for shipment. After such satisfactory replacement and/or repair and subsequent Engineer written approval, the barrier shall be installed.

C. Water-Filled Barriers

Shall be manufactured by Energy Absorption System Inc., or approved equal, and be installed in alternating white and orange sections.

D. Barrier Reflectors

Barrier reflectors shall be installed as specified by the manufacturer, or as shown on the Basic Contract Drawing. Reflectors shall be high intensity reflectorized, with the color, white or yellow, matching the pavement edgeline, or as shown on the Basic Contract Drawing.

E. Barrier Lights

Install low intensity steady burn type C barrier lights as specified by the manufacturer or as shown on the Basic Contract Drawing.

F. Glare / Gawk Shield

Install glare / gawk shield as specified by the manufacturer or as shown on the Basic Contract Drawing.

PART 3. EXECUTION

3.01 PREPARATION

Protect the installation, maintenance, relocation and removal by providing and placing temporary traffic control devices in accordance with the requirements of the specification titled "Maintenance of Traffic and Work Area Protection" in Division 1.

3.02 INSTALLATION

A. Install barriers at locations shown on the Basic Contract Drawing, in alternating white and orange sections.

B. Approach ends of barriers shall be flared away from traffic at a rate of 10 to 1 or flatter or as shown on the Basic Contract Drawing. End treatment shall be provided by leaving the water out of the first section, and the pin out of the exposed end, or as specified by the manufacturer.

C. Secure barriers against lateral displacement by use of drift pins or anchor bolts drilled into roadway surface or as shown on the Basic Contract Drawing.

D. Install reflectors and lights as specified herein, or as shown on the Basic Contract Drawing.

3.03 MAINTENANCE

A. Maintain, clean, relocate and replace barriers, reflectors and lights as required to protect motorists, pedestrians, and workers throughout the Work of this Contract.

3.04 REMOVAL

A. Remove barriers away from Authority property, when the need has ended, when replaced by approved use of permanent construction, or when directed by the Engineer.

B. Restore damaged permanent construction and replace construction that cannot be satisfactorily repaired, all at no cost to the Authority.

END OF SECTION

SECTION 02846

TEMPORARY WATER-FILLED BARRIER

APPENDIX "A"

SUBMITTALS

Submit the following for approval by the Engineer in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:

A. Certification from the water-filled barrier supplier stating that the water-filled barriers meet the requirements of the Basic Contract Drawing.

B. Shop Drawings detailing departures from the Standard Drawings included in the Contract Documents.

C. Proposed equipment Catalog Cuts and procedures to be used for installing, maintaining, relocating and removing the barrier(s).

END OF APPENDIX "A"

DIVISION 2

SECTION 02850

PLYWOOD SIGN PANELS AND WOOD SIGN POSTS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the following:

A. Plywood sign panels for use in the construction of temporary (TYPE 1) and permanent (TYPE 2) guide, warning and regulatory roadway signs. Sign type usage, TYPE 1 or TYPE 2, shall be identified on the Basic Contract Drawings for each required sign.

B. Wood sign posts and footings for both TYPE 1 and TYPE 2 sign panel side-of-road installations.

1.02 REFERENCES

The following is a listing of organizations and publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals (LTS-2).

Manual for Signing and Pavement Markings of the National System for Interstate and Defense Highways (MUTCD)

AASHTO M 168	Wood Products

American Society for Testing and Materials (ASTM)

ASTM A 153	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM B 209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 211	Aluminum-Alloy Bar, Rod and Wire
ASTM B 221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM D 245	Methods for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber
ASTM A 307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A 325	Quenched and Tampered-Steel Bolts and Studs with suitable Nuts and Plain Washers
ASTM D 2555	Methods for Establishing Clear Wood Strength Values

American Wood Preservers Association (AWPA)

AWPA C 1	Timber Products - Preservative Treatment by Pressure Processes
AWPA C 14	Wood for Highway Construction, Pressure Treatment

Douglas Fir Plywood Association

Federal Highway Administration (FHWA)

Manual on Uniform Traffic Control Devices for Streets and Highway (MUTCD)

Standard Alphabets for Highway Signs

Standard Lower-case Alphabets for Highways

United States Department of Commerce (USDC)

Product Standard PS-1 Soft Plywood, Construction and Industrial

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design of signs and sign structure shall provide sufficient strength to withstand a wind loading of 80 miles per hour as per AASHTO LTS-2.

B. Sign supports and framing shall be designed to meet the required wind loading. Posts shall be designed for direct embedment in the soil by excavation and back fill, or by driving with hand or mechanical equipment.

1.04 QUALITY ASSURANCE

Each plywood sheet shall be grade marked and certified in accordance with the standards adopted by the Douglas Fir Plywood Association.

1.05 DELIVERY, STORAGE AND HANDLING

All sign components and materials shall be transported and handled in a manner that shall cause no permanent deformation, injury or damage. Sign components and materials to be stored shall be stored above ground.

1.06 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.07 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Plywood Sign Panels

1. Plywood sign panels shall conform to the requirements set forth in USDC Product Standard PS-1 for Douglas Fir Plywood.

2. The plywood panels for TYPE 1 signs shall be exterior-type plywood, 5-ply and A-C grade or better.

3. The plywood panels for TYPE 2 signs shall be high-density overlay, exterior marine-type plywood, 5 ply and B-B grade or better. Inner plies for TYPE 2 panels shall be B grade veneers or better.

4. The thickness of plywood sign panels and plywood battens shall be not less than 1/2 inch for TYPE 1 panels and not less than 3/4 inch for TYPE 2 signs.

5. The overlay surface for TYPE 2 plywood sign panels shall consist of a cellulose-fibre or sheet, in which not less than 40 percent by weight of the laminate shall be a thermo-setting resin of the phenol or melamine type. The resin-impregnated material shall be not less than 0.009 inches thick and shall weigh at least 60 lbs per 1000 square feet of single face, including both resin and fiber. The resin impregnation shall be sufficient to attach the surfacing material to the plywood. The bond shall be equal in performance to the glue lines between the sheets of veneer that make up the plywood.

6. The face of the cellulose-fibre overlay surface for TYPE 2 panels shall be hard, smooth, and of such quality that further finishing by paint or varnish is not required to fabricate the sign as specified in 2.03 of this Section.

B. Panel Sheeting and Screen Printing

1. Reflectorized Sheeting

   Shall be Scotchlite Brand Engineer Grade Series 2200 (heat activated adhesive) or Series 3200 (pressure sensitive adhesive) as manufactured by the Traffic Control Materials Division of the 3M Co., 223-3N 3M Center, St. Paul, Minnesota 55144, or approved equal.

2. Non-Reflectorized Sheeting

   Shall be Scotchcal Brand film Series 650 (heat activated adhesive) or Series 3600 (pressure sensitive adhesive) as manufactured by the Traffic Control Materials Division of the 3M Co., or approved equal.

3. Screen Printing Inks, Thinners and Toners

   a. Scotchlite Brand Process Colors Series 700 for use on Reflectorized Sheeting.

   b. Scotchcal Brand Process Colors Series 3900 and 4100 for use on Non-Reflectorized Sheeting.

   c. Approved equals for use on approved reflective and non-reflective sheetings.

4. Panel sheeting (reflective or non-reflective) and screen printing usage shall be shown on the Basic Contract Drawing.

C. Wood Sign Posts

1. Wood sign posts shall be dry, No. 1 grade, S4S, Douglas Fir, Southern or Ponderosa Pine, Hemlock, Spruce or Western Larch conforming to the applicable requirements of AASHTO M 168. The posts shall be straight and true, free of splits, knots and warps or, of steel or aluminum components.

2. All the posts shall be pressure-treated with CCA in accordance with the applicable requirements of AWPA C1 and AWPA C 14.

3. Posts shall be surfaced four sides, have a uniform cross-section, and shall be sized not less than 4 inches by 4 inches. The post shall be graded for the following stress grades in accordance with the grading rules developed from ASTM D 245 for the selected stress grades. Using the clean wood properties of ASTM D 2555, the bending stress of the post in a TYPE 1 panel installation shall be not less than 1200 psi, and not less than 4000 psi for a TYPE 2 panel installation.

D. Stiffeners, Brackets and Miscellaneous Hardware

1. Horizontal and vertical sign panel stiffeners (Z bars) and panel brackets shall be fabricated of aluminum alloy 6061-T6 conforming to ASTM B 221.

2. Other miscellaneous aluminum hardware including bolts, nuts, washers, screws, rivets, pull-type lockbolts and serrated or knob stem blind rivets shall be fabricated to meet the requirements of ASTM B 209 and ASTM B 211 for Alloy 2024-T4. Component designated as Alloy 2024-T4 shall be given a chromated sealed anodic coating.

3. High strength steel bolts, nuts and washers shall conform to ASTM A 325. High-strength bolts, nuts and washers shall be galvanized in accordance with ASTM A 153.

E. Footings

1. Soil bearing plates shall be attached at the bottom of the post as required in 1.03 of this Section, or as shown on the Basic Contract Drawing.

2. Breakaway post, if required, shall be as shown on the Basic Contract Drawing. Breakaway post and footings shall be designed in accordance with the requirements of 1.03 of this Section.

3. Concrete footings, if required by 1.03 of this Section, shall be Class "B" concrete conforming to the Section entitled "Concrete."

4. Portable sign supports shall be as described in "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

2.02 CONSTRUCTION FEATURES

A. Sign face text, symbol, and border layouts shall be in accordance with "Maintenance of Traffic and Work Area Protection", of Division 1 - GENERAL PROVISIONS, or the Basic Contract Drawing conforming to the requirements of:

1. The AASHTO Manual for Signing and Pavement Marking of the National System of Interstate and Defense Highways.

2. The FHWA MUTCD.

3. The FHWA Standard Alphabets for Highway Signs.

4. The FHWA Standard Lower-case Alphabets for Highways.

B. Sign characters shall be as shown on the Basic Contract Drawing and shall include letters, numerals, symbols and borders.

C. Sign corner and border radii shall be approximately one-eighth of the height of the sign but shall not exceed 12 inches. Sign borders shall be of the same type character as the legend and shall be approximately the same width as the stroke width of the major lettering or the sign.

2.03 FABRICATION

A. Holes shall be drilled; cut edges shall be smooth and true, and free from burrs or ragged breaks. All fabrication except for cutting the lower ends of embedded posts shall be done in the shop. The plywood panels shall be clean, dry, and free from oils, dust, grit, or any other contaminants that would adversely affect the adhesion of the Reflectorized and Non-Reflectorized sheeting.

B. In preparing TYPE 1 panels for Reflectorized and Non-Reflectorized Sheeting, the entire Grade A surface to be covered shall be wiped down with a tack cloth to remove all saw dust and sanding residue.

C. In preparing TYPE 2 panels for Reflectorized and Non-Reflectorized Sheeting, the entire portion of the overlay surface to be covered, shall first be given a light, firm abrasion with steel wool (medium to fine grade) saturated with xydol, V.M.&P. Naphtha or similar commercial solvent. The surface shall then be wiped clean and dry. An alternate method of panel pre-treatment that consists of a solvent wipe, immediately followed by vapor degreasing (tri-chloroethylene) for a minimum period of 6 minutes may be used.

D. All panel and batten surfaces to be glued shall be slightly roughened and then glued with waterproof adhesive prior to assembly.

E. After panel preparation, the edges and back or rear surface of all TYPE 2 panels and battens shall be painted with two coats of approved white exterior paint.

PART 3. EXECUTION

3.01 INSTALLATION

A. The Contractor shall erect and remove signs as shown on the Basic Contract Drawing, or as ordered by the Engineer, and in such a manner that the traveling public is informed and protected at all times.

B. Side-of-road ground mounted signs shall normally be erected so that the sign face is truly vertical to the profile line and the intersection angle measured between the sign face and the centerline of the travel lane, which the sign serves shall be 93 degrees. Where lanes divide or on curves, sign faces shall be oriented so as to be most effective both day and night, and to avoid the possibility of specular reflection.

C. The wood sign posts for side-of-road mounting shall be embedded in the soil to the depth required by the design specified in 1.03 of this Section. The hole for the embedment shall be excavated using a manual post-hole digger or appropriate size power driven auger. After the hole has been excavated, the post shall be aligned to the sign face direction, held vertical in the hole and suitable excavated material shall be tamped in the annular space. Holes resulting from sign post removals shall be filled by the Contractor to restore the area to its original state as directed by the Engineer.

D. All signs shall be securely fastened to their supports with bolts, nuts and washers of aluminum (2024-T4 alloy) or hot-dip galvanized steel conforming to 2.01 D of this Section, as required by the design specified in 1.03 of this Section.

E. Plywood battens and aluminum panel stiffeners shall be utilized as required by 1.03 of this Section and shall conforming to the applicable requirement of 2.01 of this Section.

F. Horizontal and vertical sign clearances shall be as shown on the Basic Contract Drawing.

G. Other non-wood post mounting of plywood signs, such as overhead sign installations shall be as shown in the Basic Contract Drawing.

H. Concrete footings, if required by 1.03 of this Section, shall be placed in accordance with the requirements of the Section of these Specifications entitled "Concrete," and shall not extend more than 4 inches above grade.

3.02 FIELD INSPECTION

A. Immediately prior to erection, all material shall be inspected by the Engineer for damage.

B. The Engineer will inspect each completely erected sign for proper location, line and grade of signs, vertical post alignment, condition, appearance, reflectorization and visibility.

C. As the Work progresses, the location, position and condition of all signs shall be monitored by the Contractor in accordance with "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

END OF SECTION

SECTION 02850

PLYWOOD SIGN PANELS AND WOOD SIGN POSTS

APPENDIX "A"

SUBMITTALS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:

1. Detailed sign face layout for all TYPE 2 sign panels showing letter height, width, brush stroke, spacing between letters, words, symbols and lines, border width, symbols details, and overall dimensions of the sign panels. Detailed sign face layouts are not required for TYPE 1 sign panels.
2. Shop drawings of sign panel and posts showing the sizes of the members and their connection details. The shop drawings shall also show the total length of the posts for each sign and give an elevation view of each of the completely erected signs with vertical clearance below the lowest sign panel to adjacent roadway, and other relevant dimensions.
3. Catalog cuts of all the materials to be used for sign faces.

B. Prior to fabrication, submit computations for the design of the sign panels and supports, as required in 1.03 of this Section, signed by a Professional Engineer licensed to practice in the State where the Work is to be performed.

C. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 2

SECTION 02851

ALUMINUM SIGN PANELS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the following:

A. Aluminum sign panels for use in the construction of directional, guide, warning and regulatory roadway signs.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals (LTS-2)

Manual for Signing and Pavement Markings of the National System for Interstate and Defense Highways

American Society for Testing and Materials (ASTM)

ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 325	High-Strength Bolts for Structural Steel Joints
ASTM A 325	High-Strength Bolts for Structural Steel Joints
ASTM B 209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 211	Aluminum-Alloy Bar, Rod and Wire
ASTM B 221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes

American Welding Society (AWS)

AWS D 1.2	Structural Welding Code - Aluminum

Federal Highway Administration (FHWA)

Manual on Uniform Traffic Control Devices for Streets and Highway (MUTCD)

Standard Alphabets for Highway Signs

Standard Lower-case Alphabets for Highways

Standard Traffic Signs

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design of signs, supports and framing shall provide sufficient strength to withstand a wind loading of 80 miles per hour as per AASHTO LTS-2.

1.04 DELIVERY, STORAGE, AND HANDLING

All sign components and materials shall be transported and handled in a manner that shall cause no permanent deformation, injury or damage. Sign components and materials to be stored shall be stored above ground.

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.06 SUBMITTALS

Refer to Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Aluminum Sign Panels

1. Aluminum sheets and plates shall comform to ASTM B 209, alloy 6061-T6.

2. Fabricate panels from standard sheet widths. The thickness for panel sizes of 30 inches by 30 inches or smaller shall be 0.080 inch and the thickness of larger panels shall be 0.125 inch unless otherwise shown on the Basic Contract Drawing.

3. The panel blanks shall be free from laminations, blisters, open seams, pits, holes, or defects that may affect their strength, appearance or use. The thickness shall be uniform and the blanks shall be commercially flat.

B. Panel Sheeting and Screen Printing

1. Reflectorized Sheeting

Scotchlite Brand High Intensity Grade Series 2800 (heat activated adhesive) or Series 3800 (pressure sensitive adhesive) as manufactured by the Traffic Control Materials Division of the 3M Co., 223-3N 3M Center, St. Paul, Minnesota 55144, or approved equal, and shall meet or exceed the reflecting requirements associated with High Intensity Grade, sheetings.

2. Non-Reflectorized Sheeting

Scotchcal Brand film Series 650 (heat activated adhesive) or Series 3600 (pressure sensitive adhesive) as manufactured by the Traffic Control Materials Division of the 3M Co., or approved equal.

3. Screen Printing Inks, Thinners and Toners

a. Scotchlite Brand Process Colors Series 700 for use on Reflectorized Sheeting, or approved equal

b. Scotchcal Brand Process Colors Series 3900 and 4100 for use on Non-Reflectorized Sheeting, or approved equal

4. Panel sheeting (reflective or non-reflective) and screen printing usage shall be as shown on the Basic Contract Drawing.

C. Stiffeners, Brackets and Miscellaneous Hardware

1. Horizontal and vertical sign panel stiffeners (Z bars) and panel brackets shall be fabricated of aluminum alloy 6061-T6 conforming to ASTM B 221.

2. Other miscellaneous aluminum hardware including bolts, nuts, washers, screws, rivets, pull-type lockbolts and serrated or knob stem blind rivets shall be fabricated to meet the requirements of ASTM B 209 and B 211 for Alloy 2024-T4. Component designated as Alloy 2024-T4 shall be given a chromated sealed anodic coating.

3. High strength steel bolts, nuts and washers shall conform to ASTM A 325. High-strength bolts, nuts and washers shall be galvanized in accordance with ASTM A 153.

4. Stainless steel nuts shall conform to ASTM A 194, Grade 8F, except that the nuts shall be lock nuts with semifinished hex nuts equivalent to American Standard Heavy Series. Stainless steel bolts, washers, and screws shall conform to ASTM A 193, austenitic steel.

2.02 CONSTRUCTION FEATURES

A. Sign face text, symbol, and border layouts shall be in accordance with the Basic Contract Drawing and conform to the following requirements of:

1. The AASHTO Manual for Signing and Pavement Marking of the National System for Interstate and Defense Highways.

2. The FHWA Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD).

3. The FHWA Standard Alphabets for Highway Signs.

4. The FHWA Standard Lower-case Alphabets for Highways.

B. Sign characters shall be as shown on the Basic Contract Drawing.

C. Sign corner and border radii shall be approximately one-eighth (1/8) of the height of the sign but shall not exceed 12 inches; or as shown in the FHWA Standard Traffic Sign. Sign borders shall be of the same type character as the legend and shall be approximately the same width as the stroke width of the major lettering or the sign, or as shown in the FWHA Standard Traffic Sign.

2.03 FABRICATION

A. All shearing, cutting and punching shall be performed prior to preparing the blanks for application of reflective material. All edges and corners shall be filed or ground smooth, leaving the entire sign blank free from sharp edges and burrs.

B. The blanks shall be cleaned, degreased, and chromated or otherwise properly prepared in accordance with the sheeting manufacturer's recommendations. After treatment, clean cotton gloves shall be used in handling the sign blank until the reflective sheeting is applied. All fabrication except for cutting the lower ends of embedded posts shall be done in the shop. The aluminum panels shall be clean, dry, and free from oils, dust, grit, or any other contaminants that would adversely affect the adhesion of the Reflectorized and Non-Reflectorized sheeting.

C. Welding of aluminum shall consist of inert gas shielded metal arc welding with consumable electrodes. All welding of aluminum shall be performed in the shop. No field welding or aluminum shall be permitted. All welders shall be qualified in accordance with the qualification procedures of AWS D 1.2.

D. Necessary drilling of holes required for shop and field assembly after sheeting is applied shall be done such that the drill bit does not snag, rip, or damage the sheeting outside of the drill hole. Holes shall be deburred prior to assembly.

E. Exposed bolt heads on the face of the assembly sign shall be touched up with enamel paint of the same color as the sheeting surrounding the bolts.

PART 3. EXECUTION

3.01 INSTALLATION

A. Erect, cover, and remove signs as shown on the Basic Contract Drawing.

B. Side-of-road ground mounted signs shall be erected so that the sign face is truly vertical to the profile line and the intersection angle measured between the sign face and the centerline of the travel lane, which the sign serves shall be 93 degrees. Where lanes divide or curve, sign faces shall be oriented so as to be most effective both day and night, and to avoid the possibility of specular reflection.

C. All sign panels shall be securely fastened to their supports with bolts, nuts and washers of aluminum (2024-T4 alloy), hot-dip galvanized steel, or stainless steel conforming to 2.01 D, and 1.03 of this Section.

D. Horizontal and vertical sign clearances shall be as shown on the Basic Contract Drawing.

3.02 FIELD INSPECTION

A. Immediately prior to erection, all material will be inspected by the Engineer for damage that is attributable to improper transportation, handling or storage procedures.

B. An inspection of each completely erected sign shall be made in the daylight for proper location, line and grade of signs, vertical post alignment, condition, appearance and visibility. The completely erected signs may also be inspected at night by the Engineer.

C. As the Work progresses, the location, position and condition of all signs shall be monitored by the Contractor in accordance with the requirements of "Maintenance of Traffic and Work Area Protection" of Division 1 - GENERAL PROVISIONS.

D. Any deviation from the above-indicated procedure shall be approved by the Engineer.

END OF SECTION

SECTION 02851

ALUMINUM SIGN PANELS

APPENDIX "A"

SUBMITTALS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 – GENERAL PROVISIONS:

1. Detailed sign face layout for all sign panels showing letter height, width, brush stroke, spacing between letters, words, symbols and lines, border width, symbols details, and overall dimensions of the sign panels.

2. Shop drawings of sign panels showing the sizes of the members and their connection details including joining and anchorage, stiffening, and bracing.

3. Catalog cuts of all the materials to be used for sign faces.

B. Prior to fabrication, submit computations for the design of the sign panels and supports, as required in 1.03 of this Section, signed by a Professional Engineer licensed to practice in the State where the Work is to be performed.

C. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 3

SECTION 03100

CONCRETE FORMWORK

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for cast-in-place concrete formwork.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Concrete Institute (ACI)
ACI 347	Guide to Formwork for Concrete
ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 318	Building Code Requirements for Reinforced Concrete
	American Society for Testing and Materials (ASTM)
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)
	National Forest Products Association (NFPA)
	National Design Specifications for Wood Construction
	West Coast Lumber Inspection Bureau
	American Plywood Association (APA)
	Douglas Fir Plywood Association (DFPA)

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design calculations shall be prepared by a Professional Engineer licensed in the State where the Work is to be performed. Design calculations shall be made available to the Engineer to facilitate inspection.

B. For wood products furnished for the Work of this Section, the Contractor shall comply with the applicable provisions of "National Design Specifications for Wood Construction" of the National Forest Products Association (NFPA).

C. For all other products furnished for the Work of this section, the contractor shall comply with the reference standards of the local building code.

D. Shop Drawings

1. All formwork and shoring shop drawings shall be signed and sealed by a Professional Engineer licensed in the State where the Work is to be performed. Shop drawings shall be made available to the Engineer to facilitate inspection.

2. Shop drawings shall indicate:

a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports;

b. Means of leakage prevention for concrete exposed to view in the finished construction;

c. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift and height of drop during placement;

d. Vertical, horizontal and special loads in accordance with "Loads" of ACI 347 (Section 2.2) and camber diagrams, if applicable;

e. Notes to formwork erector showing size and location of conduits and pipes embedded in concrete according to ACI 318 (Section 6.3).

1.04 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.05 SUBMITTALS

For Submittals - see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. Earth Forms

Use only for footings where shown on the Basic Contract Drawing.

B. Lumber Forms

Use for edge forms and unexposed finish concrete. Boards shall be 6 inches or 8 inches in width, shiplapped or tongue and groove, "Standard" Grade Douglas Fir, conforming to the "Standard Grading and Dressing Rules No. 17", of the West Coast Lumber Inspection Bureau. Boards shall be four sides surfaced.

C. Plywood Forms

Use for exposed finish concrete. Forms shall conform to U.S. Product Standard PA 1-66. Each panel shall carry the grade trademark of the American Plywood Association along with the Douglas Fir Plywood Association (DFPA) Quality stamp and shall be full size (4-foot x 8-foot) panels.

1. Plywood for surfaces to receive membrane waterproofing shall be a minimum of 5/8 inch thick and shall be "B-B Plyform Class 1 Exterior" grade.

2. Plywood where "Smooth Finish" is required, as shown on the Basic Contract Drawing, shall be "HD Overlay Plyform Class 1 Exterior" grade, a minimum of 3/4 inch thick.

D. Prefabricated Forms

Prefabricated forms shall be as listed below and where shown on the Basic Contract Drawing:

1. Pan Type Void Forms

   Removable steel or reinforced plastic of sizes and profiles required to produce completed Work shown.

2. Tubular Column Type

   Metal, fiberglass-reinforced plastic, or spirally wound laminated fiber materials; inside surface treated with release agent; of sizes required to produce completed Work shown.

E. Steel Forms

Sheet steel, suitably reinforced and designed for the particular use shown on the Basic Contract Drawing.

F. Form Liners

Smooth, durable, grainless and non-staining hardboard, unless otherwise shown on the Basic Contract Drawing.

G. Framing, Studding, and Bracing

Stud or No. 3 Structural Light Framing grade.

H. Form Ties and Spreaders

Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. No wire ties, wood spreaders or through bolts will be permitted.

I. Form Anchors and Hangers

Anchors and hangers used for exposed concrete shall not leave exposed metal at surface. Hangers supporting forms from structural steel shall be symmetrically arranged on supporting members to minimize twisting or rotation of member. Penetration of structural steel members will not be permitted.

J. Form Coating Agent

Provide one of the following unless otherwise shown on the Basic Contract Drawing:

1. "Arcal-80"; Arcal Chemical Corporation
2. "Synthex"; Industrial Synthetics Company
3. "Nox-Crete Form Coating"; Nox-Crete Company

K. Vapor Retarder

Where shown on the Basic Contract Drawing, 8 mil thick poly-ethylene sheet

L. Bituminous Joint Filler: ASTM D 1751

PART 3. EXECUTION

3.01 PREPARATION

A. Earth Forms

Trench earth forms neatly and accurately and at least 2 inches wider than footing widths shown on the Basic Contract Drawing, unless otherwise indicated. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing. Form sides of footings where earth sloughs. Earth forms shall be tamped firm and cleaned of all debris and loose material before depositing concrete.

B. Formwork – General

Sloped surfaces steeper than 1.5 horizontal to 1 vertical should be provided with a top form to hold the shape of the concrete during placement, unless it can be demonstrated to the engineer that top forms can be omitted. Construct forms to the correct shape and dimensions, mortar tight, of sufficient strength, and so braced and tied together that the movement of men, equipment, materials or the placing and vibrating of the concrete shall not throw them out of line or position. Forms shall be strong enough to maintain their shape under all imposed loads. Camber where necessary to assure level finished soffits unless otherwise shown on the Basic Contract Drawing. Carefully verify the horizontal and vertical positions of forms and correct all inaccuracies to the satisfaction of the Engineer before placing concrete in any form. Complete all wedging and bracing before placing concrete.

C. Forms for "Smooth Finish" Concrete

Use steel, plywood or lined board forms. Plywood and form liners shall be clean, smooth, uniform in size and free from damaged edges and holes. Form lining shall have close-fitting square joints between separate sheets and shall not be sprung into place. Sheets of form liners and plywood shall be full size wherever possible and joints shall be taped to prevent protrusions in concrete. Use special care in forming and stripping wood forms to protect corners and edges. All horizontal joints shall be level and continuous. Wood forms shall be kept wet at all times until stripping.

D. Forms for Surfaces to Receive Membrane Waterproofing

Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

E. Framing, Studding and Bracing

Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood. Framing, bracing, centering and supporting members shall be of ample size and strength to carry safely, without deflection, all dead and live loads to which forms may be subjected, and shall be spaced sufficiently close to prevent any bulging or sagging of forms. Soffits of all beam forms shall be constructed of material a minimum of two inches thick. Concrete out of line, level or plumb will be cause for rejection by the Engineer of the whole Work affected. Distribute bracing loads over base area on which bracing is erected. When placed on ground, protect against undermining, settlement or accidental impact.

3.02 INSTALLATION

A. Tolerances

Formwork shall be constructed so that concrete surfaces shall be within construction tolerances specified in "Standard Specifications for Tolerance for Concrete Construction and Materials" of ACI 117. Tolerances not met will be corrected to the satisfaction of the Engineer at no cost to the Authority.

B. Chamfered Corners

As shown on the Basic Contract Drawing, provide moldings in forms for all chamfering required. Moldings shall be 45-degree right triangles in profile, of size required, milled from wood free from visible defects.

C. Forms Ties

Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading of the forms. Place ties at least one inch away from the finished surface of the concrete. Leave inner rods in concrete when forms are stripped. Space all form ties to be equidistant, and symmetrical and lined up both vertically and horizontally unless otherwise shown on the Basic Contract Drawing.

D. Cleanouts and Access Panels

Provide removable cleanout sections or access panels at the bottoms of all forms to permit inspection and effective cleaning of loose dirt, debris, and waste material. Clean all forms and surfaces against which concrete is to be placed of all chips, sawdust, and other debris and thoroughly blow out with compressed air just before concrete is placed.

E. Arrangement

Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

F. Construction Joints

Provide a surfaced pouring strip where construction joints intersect exposed surfaces to provide a straight line at joints. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage. Construction joints shall show no overlapping of concrete and shall, as closely as possible, present the same appearance as butted plywood joints. Joints in a continuous line shall be straight, true, and sharp.

G. Embedded Items

Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops and other features. No wood or uncoated aluminum shall be embedded in concrete. Obtain any required information pertaining to embedded items to be furnished for the Work specified in other Sections. Securely anchor all embedded items in correct location and alignment prior to placing concrete. Conduits and pipes, including those made of coated aluminum, must meet the requirements of ACI 318 (Section 6.3). Approved coatings for aluminum shall be as follows unless otherwise shown on the Basic Contract Drawing:

1. Conlux

   Primer - Bond Plex 46 or 66 (water borne urethane)
   Topcoat - Epolon Multi-Mil 39 (epoxy polyamide)

2. Sherwin Williams

   Topcoat - Heavy Duty Epoxy B67/B60B3 (epoxy polyamide)
   Note: self-priming

3. Benjamin Moore

   Primer - Epoxy Rust Inhibitive Primer (epoxy polyamide)
   Topcoat - Epoxy Enamel (epoxy polyamide)

H. Openings for Items Passing Through Concrete

Frame openings in concrete where shown on the Basic Contract Drawing. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections. Coordinate all Work of this nature in order that there shall be no unnecessary cutting and patching of concrete. Perform any cutting and repairing of concrete required as a result of failure to provide for such openings at no cost to the Authority.

I. Screeds

Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs. Slope slabs to drain where required or as shown on the Basic Contract Drawing. Before depositing concrete, remove all debris from the space to be occupied by the concrete and thoroughly wet all forms. Remove freestanding water.

J. Screed Supports

For concrete over waterproof membranes and vapor barrier membranes, use screed supports of a cradle, pad or base type which shall not puncture the membrane. Staking through the membrane will not be permitted.

K. Shores and Falsework

Provide shores and falsework of adequate strength to protect persons and adjacent structures. Falsework and supports shall be adequate in size and strength to resist the loads imposed upon them without deformation, deflection, or settlement. All members must be straight and true without twists or bends. Use wedges in pairs or jacks where required to bring forms, shoring, or falsework for beams, girders, slabs, and other parts of the structure to the necessary elevations and uniform bearing before placing concrete. Do not use single wedges. Vertical and lateral loads shall be carried to ground by the formwork system or by bracing. Where shores rest on ground, provide adequate mud sills or other bases. Construct forms to permit their removal without disturbing the original shoring. Ensure that there is no movement of shores, braces or other supports during placement of concrete.

L. Reuse and Coating of Forms

Thoroughly clean forms and reapply form coating before each reuse. For exposed Work, do not reuse any form which cannot be reconditioned to "like new" condition. Discard forms considered unsatisfactory by the Engineer. Apply form coating to all forms in accordance with the manufacturer's specifications, except where "Scored Finish" is required as shown on the Basic Contract Drawing. Do not coat forms for concrete that is to receive a "Scored Finish". Apply form coatings before placing reinforcing steel.

M. Inspection

Notify the Engineer after placement of reinforcing steel in the forms, but prior to placing any concrete, so that his inspection may be made.

3.03 REMOVAL OF FORMS AND SHORES

A. The forms and supporting shoring shall not be removed until the members have acquired sufficient strength to support their weight and the loads superimposed thereon safely and until the time and sequence of removal have been approved by the Engineer. Formwork shall be removed without damage to the concrete, in a sequence that does not allow the members to be subject to impact or loading eccentricities. Any repair required as a result of damage to the concrete shall be made to the satisfaction of the Engineer at no cost to the Authority.

B. Except when otherwise approved by the Engineer, or when minimum attained concrete strengths are specified on the Basic Contract Drawing, forms shall be left in place for not less than the total number of days as specified in ACI 347.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

SUBMITTALS

APPENDIX "A"

The following items shall be submitted to the Engineer for approval, except as otherwise noted.

A. Shop Drawings

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples";
2. Formwork and shoring shop drawings for areas accessible to the public and/or concrete exposed to view in the finished construction shall be submitted to the Engineer (as indicated in Section 1.03 D) at least 21 days prior to ordering any material or constructing any formwork;
3. Provide a layout of all embedded items, including electrical and telephone conduit and plumbing and drainage pipes, at least 15 days prior to concrete placement.

B. Catalog Cuts, Material Certification and Test Results

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples";
2. Material certifications, brand names and test results (where required) for all formwork materials. Submit at least 35 days prior to concrete placement.

C. Samples

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples";
2. Form ties and spreaders with manufacturer's specifications, submit at least 21 days prior to ordering any material;
3. Tapes for form joints with manufacturer's literature;
4. Waterstops and premolded expansion joint filler;
5. Form liners with manufacturer's specifications, submit at least 21 days prior to ordering any material;
6. Form coating agent with manufacturer's literature.

D. Design Computations

Design computations for areas accessible to the public and/or concrete exposed to view in the finished construction shall be submitted to the Engineer (as indicated in Section 1.03 A) at least 21 days prior to ordering any material or constructing any formwork.

E. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 3

SECTION 03200

CONCRETE REINFORCEMENT

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for furnishing and installing concrete reinforcement.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M32	Steel Wire, Plain, for Concrete Reinforcement
AASHTO M55	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
AASHTO M221	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
AASHTO M31	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
AASHTO M284	Epoxy-Coated Reinforcing Steel Bars

American Concrete Institute (ACI)

ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete

American Society for Testing and Materials (ASTM)

ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 497	Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 767	Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775	Epoxy-Coated Reinforcing Steel Bars

American Welding Society (AWS)

AWS D 1.4	Structural Welding Code - Reinforcing Steel

Concrete Reinforcing Steel Institute (CRSI)

Manual of Standard Practice Placing Reinforcing Bars

1.03 BRIDGE WORK

For Work of this Section involving bridges, the Contractor shall comply with the applicable provisions of "Standard Specifications for Highway Bridges" of the American Association of State Highway and Transportation Officials (AASHTO). Materials shall be in accordance with AASHTO designations where shown after the ASTM designation in parenthesis. Where not shown, comply with ASTM Designation.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver concrete reinforcement in bundles marked with metal tags indicating size, length and mark number.

B. Store and handle materials to prevent corrosion, damage to coating or contamination that could impair bond.

1.05 SUBMITTALS

For submittals see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars: ASTM A 615 (AASHTO M31), deformed, Grade 60, unless otherwise shown on the Basic Contract Drawings.

Coated bars where shown on the Basic Contract Drawings shall comply with the following:

1. Galvanized Reinforcing Bars

   ASTM A 767, Class-I hot-dip galvanized, after fabrication and bending.

   Repair sheared and cut ends and damaged coating with a zinc-rich formulation conforming to ASTM A 767 in accordance with the material manufacturers' recommendations.

2. Epoxy-coated Reinforcing Bars: ASTM A 775 (AASHTO M284)

   Repair sheared and cut ends and damaged coating with an epoxy patching material conforming to ASTM A 775 (AASHTO M284) in accordance with the patching material manufacturers recommendations.

B. Welded Wire Fabric

Types shall be as shown on the Basic Contract Drawings and shall comply with the following:

1. Plain, ASTM A 185 (AASHTO M55), flat sheets for size W5 and larger and coiled rolls for sizes below W5.

2. Deformed, ASTM A 497 (AASHTO M221), flat sheets for sizes D5 and larger and coiled rolls for sizes below D5.

C. Fabricated Steel Bar Mats

Fabricated steel bar mats shall be in accordance with ASTM A 184, when shown on the Basic Contract Drawings, and as follows:

1. Bar grade, size and spacing as shown on the Basic Contract Drawings.
2. Welded connections, unless otherwise shown on the Basic Contract Drawings.

D. Steel Wire

Steel wire shall comply with ASTM A 82 (AASHTO M32), plain finish, unless otherwise shown on the Basic Contract Drawings.

2.02 ACCESSORIES

A. Tie Wire

Provide minimum 16-gage, annealed type. Provide nylon, plastic or epoxy-coated wire for use with epoxy-coated and galvanized reinforcing bars, if any.

B. Supports for Reinforcement

Provide bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use galvanized steel wire bar type supports complying with CRSI standards and as follows:

1. For supporting epoxy-coated reinforcing bars, use plastic coated supports, or supports fabricated from or coated with a dielectric material.
2. For slabs-on-grade, use supports with horizontal plate runners.
3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, use supports with plastic capped legs (CRSI, Class 1).
4. Where architectural concrete is shown on the Basic Contract Drawings, use plastic side form spacers.

2.03 FABRICATION

A. Fabricate concrete reinforcement as shown on the Basic Contract Drawings and on approved shop drawings, in accordance with ACI 315 "Tolerances".

B. Bend all concrete reinforcement cold. Heating of bars or wire fabric is prohibited.

C. Where welding of concrete reinforcement is shown on the Basic Contract Drawings, weld in accordance with AWS Dl.4.

PART 3. EXECUTION

3.01 INSTALLATION

A. Place concrete reinforcement as shown on the Basic Contract Drawings and on approved shop drawings. Where not shown on the Basic Contract Drawings, comply with CRSI "Placing Reinforcing Bars".

B. Clean concrete reinforcement of loose rust, mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support and secure concrete reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support concrete reinforcement by chairs, runners, bolsters, spacers, and hangers in accordance with CRSI Manual of Standard Practice". Do not interfere with placement of embedded items.

D. When a vapor barrier is shown on the Basic Contract Drawings, do not cut or puncture during concrete reinforcement placement.

E. Place concrete reinforcement to obtain covers shown on the Basic Contract Drawings for concrete protection, or in accordance with ACI 318 "Concrete Protection for Reinforcement", if not shown on the Basic Contract Drawings. Arrange, space and securely tie bars and bar supports to hold concrete reinforcement in position during concrete placement operations. Set ties so ends are directed into concrete, not toward exposed concrete surfaces.

F. Install welded wire fabric in lengths as long as practical. Lap adjoining pieces at least one full mesh and lace splices with wire, but in no case shall lap be less than requirements of ACI 318 "Splices of Welded Deformed Wire Fabric in Tension" or "Splices of Welded Plain Wire Fabric in Tension". Offset end laps in adjacent widths to prevent continuous laps in either direction.

G. After concrete placement, do not field bend partially embedded concrete reinforcement except as shown on the Basic Contract Drawings.

H. Repair damaged bars and welds, if any, in accordance with 2.O1A.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

SUBMITTALS

APPENDIX "A"

The following items shall be submitted to the Engineer, except as otherwise noted.

A. Shop Drawings

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples".
2. Details indicating placement, cover, splice locations, lap lengths, mechanical splice hardware, grade, bar size, length, mark number, bending schedule, bending diagram, weld designations, type of coating, material used to repair coating, and types of chairs, spacers, hangers and tie wire for all concrete reinforcement.
3. All proposed changes to the size, spacing or arrangement of the reinforcing steel shown on the Basic Contract Drawings shall be clearly flagged as such on the shop drawings.

B. Catalog Cuts, Material Certification and Test Results

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples".
2. Catalog cuts for chairs, spacers, hangers and mechanical splices.
3. Certification from the applicator of epoxy that the epoxy-coated reinforcing bars meet the requirements of ASTM A 775 (AASHTO M284).
4. Test results and certification from the galvanizer that the weight, application and testing of zinc coating conforms with specifications and ASTM A 767.
5. Certified mill test reports for all concrete reinforcement.

C. Samples

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples".
2. Mechanical Splice Hardware.
3. Material used to repair coating.

D. Design Computations

1. Design computations for all proposed changes to the size, spacing or arrangement of the concrete reinforcement shown on the Basic Contract Drawings.

END OF APPENDIX "A"

DIVISION 3

SECTION 03301

PORTLAND CEMENT CONCRETE, LONG FORM

PART 1. GENERAL

1.01 SUMMARY

This Section and its appendices specify requirements for Portland Cement Concrete mix proportions, materials used in concrete mixes, placing, finishing (with the exception of concrete for pavements), curing, control joints, end result property requirements of the in-place concrete, and the evaluation of these properties through Quality Acceptance testing performed by the Authority for determining Adjustments to Contract Compensation. The Specifications herein establish minimum standards for concrete construction. This does not relieve the Contractor from following more stringent standards to achieve the quality acceptance limits for applicable performance parameters and their respective Percent Within Limit (PWL) measurements.

1.02 REFERENCES

The following is a listing of the publications, standards and codes referenced in this Section, of which the latest edition shall govern:

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO HB	Standard Specifications for Highway Bridges.
AASHTO M182	Burlap Cloth Made From Jute or Kenaf.
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete.
AASHTO T 277	Electrical Indication of Concrete's Ability to Resist Chloride.
AASHTO T 318	Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

American Concrete Institute (ACI)

ACI 207	Mass Concrete.
ACI 211	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
ACI 213	Guide for Structural Lightweight-Aggregate Concrete.
ACI 222R	Protection of Metals in Concrete Against Corrosion.
ACI 301	Specifications for Structural Concrete for Buildings.
ACI 302.1	Guide for Concrete Floor and Slab Construction.
ACI 303.1	Specification for Cast in Place Architectural Concrete.
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete. Chapter 8: Concrete Placed Under Water.
ACI 305R	Hot Weather Concreting.
ACI 306R	Cold Weather Concreting.

ACI 308	Standard Practice for Curing Concrete.
ACI 309R	Guide for Consolidation of Concrete.
ACI 318	Building Code Requirements for Structural Concrete.
ACI 548.4	Standard Specification for Latex-Modified Concrete (LMC) Overlays.
	ASTM International (ASTM)
ASTM C 31	Practice for Making and Curing Concrete Test Specimens in the Field.
ASTM C 33	Specification for Concrete Aggregates.
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 42	Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
ASTM C 78	Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
ASTM C 88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
ASTM C 94	Specification for Ready-Mixed Concrete.
ASTM C 114	Test Methods for Chemical Analysis of Hydraulic Cement.
ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C 136	Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM C 138	Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
ASTM C 143	Test Method for Slump of Hydraulic-Cement Concrete.
ASTM C 150	Specification for Portland Cement.
ASTM C 156	Test Method for Water Retention by Liquid Membrane-Forming Curing Compounds for Concrete.
ASTM C 157	Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
ASTM C 171	Specification for Sheet Materials for Curing Concrete.
ASTM C 172	Practice for Sampling Freshly Mixed Concrete.
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
ASTM C 174	Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
ASTM C 191	Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
ASTM C 227	Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete.
ASTM C 289	Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).

ASTM C 309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C 311	Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
ASTM C 330	Specification for Lightweight Aggregates for Structural Concrete.
ASTM C 494	Specification for Chemical Admixtures for Concrete.
ASTM C 535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C 566	Test Method for Total Evaporable Moisture Content of Aggregate by Drying.
ASTM C 567	Test Method for Determining Density of Structural Lightweight Concrete.
ASTM C 618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
ASTM C 979	Specification for Pigments for Integrally Colored Concrete.
ASTM C 989	Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
ASTM C 1064	Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete.
ASTM C 1116	Specification for Fiber-Reinforced Concrete.
ASTM C 1152	Test Method for Acid-Soluble Chloride in Mortar and Concrete.
ASTM C 1218	Test Method for Water-Soluble Chloride in Mortar and Concrete.
ASTM C 1240	Specification for Silica Fume Used in Cementitious Mixtures.
ASTM C 1260	Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
ASTM C 1399	Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete.
ASTM C 1583	Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials By Direct Tension (Pull-Off Method).
ASTM C 1611	Slump Flow of Self-Consolidating Concrete.
ASTM D 1751	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
ASTM D 1752	Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
ASTM D 3665	Practice for Random Sampling of Construction Materials.
ASTM D 4580	Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding.
ASTM D 4791	Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
ASTM D 4833	Test Method for Index Puncture Resistance of Geomembranes, and Related Products.
ASTM D 5199	Test Method for Measuring the Nominal Thickness of Geosynthetics.

ASTM E 965	Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique.
ASTM E 1347	Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry.

Federal Aviation Administration (FAA) Advisory Circular (AC)

FAA AC 150/ 5370, Item P-501-6	Standards for Specifying Construction of Airports - Portland Cement Concrete Pavement - Contractor Quality Control Program.

Federal Specifications

SS-S-1401	Sealants, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements.

New Jersey Department of Transportation (NJDOT)

Standard Specifications for Road and Bridge Construction 2007.

US Army Corps of Engineers (USACE)

Handbook of Concrete and Cement.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements

1. Cold weather concrete construction shall conform to ACI 306R.

2. Submit a Cold Weather Concrete Construction Plan, and have it approved prior to concrete placements when the ambient temperature falls below 50 deg F. This Plan shall conform to ACI 306R and shall include but not be limited to the demonstration of how the in situ concrete temperature will be maintained at 50 deg F and monitored, or at temperatures specified in ACI 306R, Table 3.1, whichever is more stringent. In addition, demonstrate that the specified concrete properties can be achieved within the time requirements specified while maintaining a minimum curing temperature of 50 deg F.

3. Do not mix or place concrete when the ambient temperature is below 35 deg F, or when conditions indicate that the temperature will fall below 35 deg F within 72 hours, unless the areas to receive fresh concrete are insulated or enclosed, and maintain the concrete temperature at 50 deg F or in accordance with Table 3.1 in ACI 306.

4. Reinforcement, forms and soils with which concrete will be in contact shall not be frozen and must be maintained completely frost-free. If required, apply heat to raise their temperature to a minimum of 35 deg F. The use of chemicals to eliminate frost will not be permitted.

B. Hot Weather Requirements

1. Hot weather concrete construction shall conform to ACI 305R.

2. Submit a Hot Weather Concrete Construction Plan and have it approved prior to concrete placements when the ambient temperature exceeds 80 deg F. This Plan shall conform to ACI 305R and shall include but not be limited to the demonstration of how the concrete temperature during batching and mixing will be kept below 90 deg F, how the concrete will be protected from rapid evaporation of surface moisture, the proper use of water reducing retarders with re-dosing charts and procedures and curing procedures.

3. Do not place concrete for pavements, overlays, bridge decks or ramps when the ambient temperature exceeds 85 deg F; schedule Work so that concrete can be placed during the coolest part of the day. Do not place concrete for structural decks, slabs or pavements when the rate of concrete surface evaporation exceeds 0.15 lbs/ft^2/hr, as defined in ACI 305R, Figure 2.1.5. If ambient conditions exceed this limit, demonstrate through the use of windscreens, fogging or other suitable means that the concrete evaporation rate is less than 0.15 lbs/ft^2/hr.

4. If the concrete temperature reaches 92 deg F as measured at the construction site in accordance with ASTM C 1064, it may be rejected.

1.04 QUALITY CONTROL

A. General

1. Maintain a level of Quality Control sufficient to consistently achieve the end result performance properties specified herein. In addition:

   a. Submit the approved mix proportions including an automated, time-date stamp on each delivery ticket indicating the batch weights of all batching constituents.

   b. Ensure that all plant mixing equipment and trucks are calibrated and approved by either the New Jersey or New York State Department of Transportation. Documentation of such conformance shall be available to the Engineer at all times.

   c. Ensure that all personnel performing concrete testing are certified ACI Grade I Concrete Laboratory Testing Technicians or Concrete Field Testing Technicians, as appropriate.

   d. When placing aeronautical pavement concrete, the quality control plan shall conform to the provisions of the Federal Aviation Administration Advisory Circular 150/5730-10D- Rigid Pavement Items P-501 Contractor Quality Control Program.

B. Quality Control Plan: Submit a Quality Control Plan a minimum of 10 days prior to the pre-concrete construction meeting described in 1.06. Do not start production before the Quality Control Plan has been approved by the Engineer. The Quality Control Plan shall include the following:

1. Quality Control Organization

   a. A chart showing all Quality Control personnel and a description of how these personnel integrate with and report to other management or field construction personnel. Include names, company name and each person's function, telephone number and fax number.

b. The quality control organization chart shall include a Program Administrator who shall ensure that all QA procedures are followed and enforced and who shall have a minimum of 5 years experience on projects of size and scope comparable to the Work of the Contract. The Program Administrator shall be a full-time employee of the Contractor or a consultant engaged by the Contractor. Additional qualifications shall include at least one of the following:

(1) Professional Engineer, Engineer-In-Training, Bachelor of Science in Civil Engineering, Civil Engineering Technology or five years experience with airport and/or highway concrete construction.

(2) Completed New Jersey ACI Chapter's "Concrete Construction Technology" course with 5 years of airport and/or highway concrete construction experience.

(3) Qualified as ACI Concrete Transportation Construction Inspector or possessing Concrete Construction Special Inspector certification with 5 years of airport and/or highway concrete construction experience.

2. Intended project progress schedule for each mix and application, including quantities and a submittal schedule.

3. Quality Control Testing Plan, including a list of testing standards and the frequency at which each test is to be performed.

a. Include gradation and moisture content testing for fine and coarse aggregates in accordance with ASTM C 136 and ASTM C 566, respectively. Perform both tests (1) prior to production, (2) every 3 hours during production or every 100 cubic yards of concrete produced (whichever is longer in time) and (3) when aggregates are used from a new stockpile that has not been tested for gradation or moisture content.

4. Documentation of Quality Control activities, including the location where recorded test results and other information such as mill test certificates for all cementitious material will be stored, which shall be made available to the Engineer at any time upon request.

5. Procedures for corrective action when QA and/or QC test results do not conform to the requirements of the Contract.

1.05 TRIAL BATCHING AND TEST POUR VERIFICATIONS

A. Trial Batching

1. The Engineer may prepare and test trial batches as specified herein and in accordance with ACI 318, Section 5.3. At the Engineer's request, submit representative samples of all materials in sufficient quantities to the Port Authority Materials Engineering Unit. In the event of a conflict between tests performed by the Engineer and tests performed by or for the Contractor, all tests performed by the Engineer shall control.

2. The Engineer may perform the following tests to verify trial batches submitted by the Contractor: compressive strength, flexural strength, permeability by the Coulomb test, air content, unit weight, water content of freshly mixed concrete using the microwave oven drying test, shrinkage, chloride ion concentration, corrosion inhibitor concentration, bond strength, slump, time of set, gradation of fine and coarse aggregates, and the fineness modulus of the fine aggregate.

B. Test Pours

1. Unless otherwise noted on the Basic Contract Drawings, perform a test pour a minimum of 14 calendar days prior to production pouring in order to demonstrate and verify proper workability, finishability, setting characteristics, consolidation and curing procedures and to confirm that specified physical properties are attained for the approved mix proportions. For tremie concrete applications, construct a mock-up to verify acceptable consolidation and that the specified compressive strength is achieved by testing three in-place cores taken from the test placement at locations designated by the Engineer. In addition, for architectural cast in place concrete, construct a full-scale mock-up in accordance with 2.03 C.3. If in the sole opinion of the Engineer the test pour is acceptable, follow the procedures established during the test pour during production.

2. Test Pour Size: For flatwork, the minimum test pour size shall be a length of 100 feet for the entire thickness of the pavement and width of the screed planned to be used. For all other concrete construction, the test pour size shall be full-size for the cross sectional area, including the location of all steel reinforcement. However, at the option of the Engineer, the length of the member may be reduced from its design size, provided it is adequate to demonstrate workability, finishability, setting characteristics, consolidation, finish and curing procedures, as determined solely by the Engineer. Perform all test pours using the same personnel, equipment, procedures and materials that will be used for full production.

3. The test section will be considered acceptable if, in the sole opinion of the Engineer, it meets the specifications for surface preparation, batching, mixing, placement, consolidation, curing, finish and applicable performance properties of the concrete. In addition, for architectural concrete, color and texture will be considered acceptable according to the sole opinion of the Engineer.

4. In the event that the Engineer deems the test section unsatisfactory, remove the test section and repeat the test at no cost to the Authority.

5. The test pour location will be determined by the Engineer at the pre-concrete construction meeting, and will be located close to, if not within, the area of Work, unless otherwise noted on the Basic Contract Drawings.

1.06 PRE-CONCRETE CONSTRUCTION MEETING

A. A pre concrete placement meeting will be conducted at the construction site by the Engineer a minimum of 20 days prior to the first pour to review the Contractor's submitted mix proportions, hot and cold weather concreting plans (as applicable), curing procedures plan and test pour and to discuss the methods and procedures to achieve the specified concrete quality. Notify the Engineer and send a pre-concrete meeting agenda to all attendees a minimum of 15 days prior to the scheduled date of the meeting indicating review subjects. At no additional cost to the Authority make arrangements for the Contractor's superintendent and a qualified representative from each segment of the concrete operations to be present, including, but not limited to the following:

1. Concrete supplier.

2. Laboratory representative responsible for the concrete proportion mix and Quality Control.

3. Contractor's Program Administrator for Quality Control.

4. Concrete subcontractor.

5. Admixtures and curing membrane suppliers.

6. Concrete pumping subcontractor.

7. Mobile mixer subcontractor.

8. Precast concrete fabricator and installer.

9. Joint sawing subcontractor.

10. The Engineer.

B. Record, type, and print meeting minutes and distribute them to all attendees of the meeting within 5 days of the date of the meeting.

C. Do not schedule the pre-concrete construction meeting until all of the following have been submitted and approved, as applicable to the Work of the Contract:

1. Mix Proportions.

2. Admixture dosage charts showing the effects of concrete temperatures from 50 deg F to 90 deg F.

3. Sample panels (12" x 12" x 2" for architectural concrete).

4. Hot and Cold Weather Concrete Construction Plans.

5. Independent testing laboratory AASHTO Accreditation Certification.

6. ACI Grade I certifications for concrete testing personnel.

7. Placement methods and procedures, including surface preparation.

8. Pumping Procedure Plan.

9. Curing Procedure Plan.

10. Joint Location Plan and Timing of Cuts.

11. Quality Control Plan.

12. Procedure for Curing Field Concrete Specimens.

1.07 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.08 SUBMITTALS

A. See Appendix "A" for submittal requirements.

B. Do not deliver any concrete to the construction site until all approvals have been obtained.

PART 2. PRODUCTS

2.01 MANUFACTURERS AND SOURCES OF SUPPLY

A. Use no cement, fly ash, slag, silica fume, metakaolin or fine or coarse aggregates that have not been approved by either the New Jersey or New York State Department of Transportation.

2.02 MATERIALS

A. Cement: Conforming to ASTM C 150, Type I and II, and Type III where early strength gain is required, or others specified on the Basic Contract Drawings.

B. Very High Early Strength Cement: Defined as cement used to produce concrete with the compressive strength shown on the Basic Contract Drawings within 12 hours or less and conforming to the following:

1. The compressive strength shall be greater than or equal to the specified strength at the curing time specified on the Basic Contract Drawings, when tested in accordance with ASTM C 39. During cold weather concrete construction, demonstrate that the specified compressive strength can be obtained at a curing temperature of 50 deg F.
2. Absolute drying shrinkage less than or equal to 0.04% at 28 days for the mix proportions containing the Very High Early Strength Cement in accordance with ASTM C 157 modified (Air Drying Method), where the initial reading shall be taken at 3 hours after the addition of the mixing water to the dry materials in the mix.
3. Setting time, determined in accordance with ASTM C 191, shall be sufficient to provide adequate workability, meet the specified strength requirement, and allow enough time in the field to finish and begin curing the concrete for its intended use.
4. The Very High Early Strength Cement shall meet the properties in 2.02 B.1, 2.02 B.2 and 2.02 B.3, for each Lot of cement not to exceed every 50,000 pounds. Submit certification from an independent testing laboratory employed by the Contractor and approved by the Engineer that the cement meets these properties.

C. Silica Fume: Shall conform to ASTM C 1240 and the following:

1. Silicon Dioxide Content: 90% minimum.
2. Loss On Ignition: 6% maximum.
3. Surface Area: (nitrogen absorption): 15,000 m2kg.
4. Crystallinity: Non-crystalline within limits of detection by XRD.
5. Oversize Foreign Materials (in fume): 5% maximum on 45-micron sieve (wet).

D. Metakaolin: Conforming to ASTM C 618, Class N. Use one of the following products, or approved equal:

1. "MetaMax", as manufactured by Engelhard, Iselin, New Jersey.
2. "PowerPozz", as manufactured by Advanced Cement Technologies, LLC, Blaine, Washington.

E. Fly Ash: Conforming to ASTM C 311 and ASTM C 618, Class F except the maximum loss on ignition shall be less than 4%.

F. Slag: Conforming to ASTM C 989, Grade 100 or 120.

G. Fine Aggregate: Conforming to ASTM C 33, ASTM C 227, ASTM C 289 and ASTM C 131 with a maximum percentage of wear of 30%.

H. Coarse Aggregate (Normal Weight Concrete): Conforming to ASTM C 33, ASTM C 227, ASTM C 289, ASTM C 535 with a maximum percentage of wear of 40%, and ASTM C 88 with a magnesium sulfate loss of not more than 12% for a five-cycle test period. Use trap rock or gneiss for all pavement wearing surfaces. The aggregate in any size group shall not contain more than 8% by weight of flat or elongated pieces, as tested in accordance with ASTM D 4791. A flat or elongated piece is one having a ratio between the maximum and minimum dimensions of a circumscribing rectangular prism exceeding 5 to 1. In accordance with ACI 318, Section 3.3.2, the nominal maximum size of coarse aggregate shall be not larger than: (1) one-fifth the narrowest dimension between sides of forms, (2) one-third the depth of slabs, or (3) three-quarters the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, or prestressing tendons or ducts. The nominal maximum size of coarse aggregate used shall be the largest size aggregate that conforms to ACI 318, Section 3.3.2, unless otherwise noted herein or shown on the Basic Contract Drawings.

1. For full depth pavement concretes unless otherwise shown on the Basic Contract Drawings the combined aggregate volume shall be a minimum of 70 percent. The combined gradation of the fine and coarse aggregate shall conform to the following, when tested in accordance with ASTM C 136:

	For Pavement 10 Inches or Greater in Thickness		For Pavement Less Than 10 Inches in Thickness	
Sieve Size % Passing	Min.	Max.	Min.	Max.
2-1/2"	100			
2"	90	98	100	
1-1/2"	76	88	89	98
1"	67	79	74	86
3/4"	65	77	64	76
3/8"	48	60	48	60
No. 4	30	42	30	42
No. 8	27	37	27	37
No. 16	20	30	20	30
No. 30	16	22	16	22
No. 50	4	10	4	10
No. 100	0	4	0	4

2. Pile Jackets: As a minimum, the mix proportion shall contain an ASTM C 33 Size No. 8 coarse aggregate. The ratio of coarse aggregate to fine aggregate by volume shall be not less than one to one.

3. Pipe Piles: Reduce the amount of coarse aggregate to minimize segregation. The volume of coarse aggregate shall not exceed 9.0 cubic feet per cubic yard of concrete. The maximum size coarse aggregate shall be ASTM C 33 Size No. 8.

4. Minimum Volume of Coarse Aggregate: All mixes shall contain a minimum of 39% coarse aggregate by volume, with the exception of 1) applications specified in Part 2.02 H.1-4, H.2), Performance Category VI applications, 3) bridge decks and 4) mixes containing ASTM C 33 Size No. 8 aggregate. Bridge deck concrete mixes shall contain a minimum of 41% coarse aggregate and total minimum aggregate volume of 67%. Mixes containing ASTM C 33 Size No. 8 stone not covered in 2.02 H.2-4 shall contain a minimum of 36% coarse aggregate by volume. These minimum requirements apply to all methods of placement, including pump mixes.

5. When requested by the Engineer, supply independent laboratory test results in accordance with ASTM C 1260 indicating the potential alkali reactivity of the aggregates and cementitious materials proposed for use. Expansion at 16 days shall be less than 0.10%.

I. Coarse Aggregate (Lightweight Concrete)

1. Expanded clay or shale produced by the rotary kiln process conforming to ASTM C 330 shall be graded in accordance with the requirements for 3/4" to No. 4 sieve sizes shown in Table I of that specification.

2. The oven dry unit weight of plant-tested, lightweight aggregate shall vary not more than +/- 3.0 pounds from the unit weight (pounds per cubic foot) determined from the sample quantity submitted in accordance with 1.05 A.1.

J. Water: Conforming to AASHTO T 26. Clean and potable for both mixing and curing concrete.

K. Formulated Latex Modifier: Latex modifier shall be modifier "A/NA", as manufactured by Dow Chemical, Midland, Michigan. Add latex emulsion at a rate of 3.5 gallons per 94 lbs. of cementitious material in the concrete mix.

L. Air Entraining Agent: Conforming to ASTM C 260.

M. Admixtures: All admixtures shall conform to ASTM C 494. They shall contain not more than 0.05% chloride ions, and shall be used in accordance with the manufacturer's recommendations. Submit dosage charts, including the effects of concrete temperatures from 50 deg F to 90 deg F, to the Engineer. All admixtures shall be manufactured by one of the following:

1. Euclid Chemical Company.

2. W.R. Grace & Company.

3. Master Builders Technologies.

4. Sika Corporation.

N. Polycarboxylate High Range Water Reducer: For use when self-compacting concrete is desired and approved by the Engineer. Conforming to ASTM C 494, Type F or Type G. Dosage rate shall be as recommended by the manufacturer to produce a spread of the concrete mixture measuring between 21 and 27 inches in diameter without segregation when released from a slump cone in accordance with ASTM C 1611. Use one of the following products, no substitutions:

1. "Plastol 5000" or "Plastol 341", as manufactured by The Euclid Chemical Company.

2. "ADVA Flow 530" or "ADVA Flow 540", as manufactured by W.R. Grace & Company.

3. "Glenium 3030 NS" or "Glenium 3200 HES", as manufactured by Master Builders Technologies.

O. Corrosion Inhibitors

1. Corrosion inhibitor shall be one of the following:

a. For cast in place or precast:

(1) "DCI-S", as manufactured by W.R. Grace & Company.

(2) "Eucon CIA", as manufactured by Euclid Chemical Company.

(3) An approved equal.

b. For precast applications only:

(1) "Sika CNI", as manufactured by Sika Corporation.

(2) "Rheocrete CNI", as manufactured by Master Builders Technologies.

(3) "DCI", as manufactured by W.R. Grace & Company.

2. The concentration of calcium nitrite shall be 30% +/- 2% by weight of solids per gallon.

3. The Engineer will sample the corrosion inhibitor for testing to verify the calcium nitrite solids content. The amount of calcium nitrite in fresh concrete may also be tested at any time, to verify if the proper quantity of the corrosion inhibitor is being batched in the mix.

4. Corrosion inhibitor admixtures shall not accelerate the setting time of the concrete mixture. Use a retarder and/or other admixtures to ensure that acceleration of setting time does not occur, while maintaining the applicable performance criteria, as stipulated in 2.04. Submit procedures for the placement of concrete mixes containing a corrosion inhibitor when a retarder is required for the range of concrete temperatures from 50 deg F to 90 deg F.

P. Viscosity Modifying and/or Self-Consolidating Admixtures: May be required for tremie concrete applications at the rate recommended by the manufacturer. Test concrete in accordance with CRD-C6189A US Army Corps of Engineers "Handbook of Concrete and Cement". Maximum percentage of washout weight loss shall not exceed 5% after three standard test drops in water.

Q. Pigments: Conforming to ASTM C 979.

R. Curing Materials

1. Curing compound shall be one of the following:

a. "DOT Resin Cure (Type II)", as manufactured by Conspec Marketing & Manufacturing Company, Inc.

b. "Euco Kurez Vox (White)", as manufactured by Euclid Chemical Company.

c. "1200 White", as manufactured by W.R. Meadows.

d. "AHT Type II Class B Cure", as manufactured by American Highway Technology, a Dayton Superior Company.

e. "Certi-Vex Envio Cure White-1000", as manufactured by Vexcon Chemicals Inc.

f. "Day-Chem White Pigmented Cure (J-10-W)", as manufactured by Dayton Superior.

g. Or an approved equal meeting the requirements specified in 2.02 R.2.

2. Liquid Membrane Forming Curing Compound conforming to the following:

a. For horizontal exterior applications, curing membranes are restricted to ASTM C 309 Type 2, Class B materials. ASTM C 309 Type 1-D, Class B membranes are acceptable for other exterior applications. ASTM C 309 Type 1, Class B membranes are acceptable for interior applications only.

b. Curing membranes shall be wax free when used on concrete where overlays, coatings, paints, sealers or any topping is to be applied, or where vehicular, pedestrian or aircraft traffic will pass over.

c. Membranes shall be volatile organic compound (VOC) compliant for the states of both New York and New Jersey. Submit certification of compliance to the Engineer upon request.

d. The membrane shall restrict the loss of water to not more than 0.40 kilograms per square meter in 72 hours at a coverage rate of 300 square feet per gallon per coat for Type I curing compounds, and 200 square feet per gallon per coat for Type 2 curing compounds when tested in accordance with ASTM C 156.

3. Burlap: Conforming to AASHTO M 182, Class 3, weighing approximately 9 oz./sq. yd. dry.

4. Sheet Material: Conforming to ASTM C 171.

a. Shall be White Burlap Polyethylene Sheet.

5. Cotton Mats: conforming to ASTM D 5199 with a minimum thickness of 40 mils, ASTM C 156 with a maximum water loss of 0.0065 oz./in.^{2}, ASTM D 4833 with a minimum puncture strength of 70 pounds and ASTM E 1347 with a minimum reflectance of 75%. The following cotton mats may be used in lieu of burlap for wet curing operations:

a. "Transguard 4000", as manufactured by Reef Industries, Inc., Houston, Texas, or

b. An approved equal conforming to the requirements specified in 2.02 R.5.

S. Evaporation Retardant: This material shall be used to retain moisture in the concrete during finishing operations. Use one of the following:

1. "Euco-Bar", as manufactured by Euclid Chemical Company.

2. "E-Con", as manufactured by L&M Construction Chemicals, Inc.

3. "Confilm", as manufactured by Master Builders Technologies.

4. "SikaFilm", as manufactured by Sika Corporation.

5. "Aquafilm", as manufactured by Conspec Marketing & Manufacturing Company, Inc.

T. Fiber Reinforcement:

1. Polypropylene Micro Fibers

a. Use one of the following products, subject to compliance with the Contract requirements:

(1) "Fiberstrand", as manufactured by Euclid Chemical Company.

(2) "Fibermesh", as manufactured by Fibermesh, Inc.

(3) "Forta", as manufactured by Forta Corporation.

(4) "Grace Fibers" or "Grace Microfibers", as manufactured by W.R. Grace & Company.

(5) "Durafiber", as manufactured by Industrial Systems, Ltd.

(6) Or an approved equal.

b. Additional requirements:

(1) Collated fibrillated materials: Dosage rate shall be a minimum of 1.5 lb./cu. yd.

(2) Multifilament fibers: Dosage rate shall be a minimum of 1 lb./cu. yd. The minimum length shall be 0.75 inches.

(3) Conformance with ASTM C 1116, designation Type III, 4.1.3.

(4) Conformance with a minimum plastic shrinkage crack reduction of 70 percent when tested in accordance with ICBO ES, Appendix B (7-92).

(5) Use of fibers shall not change the water requirements of the mix.

(6) Conform to the manufacturer's recommendations for the quantity of fiber, which shall be not less than the minimum requirements of 2.02 T.1.b.1 and 2.02 T.1.b.2.

(7) Arrange for the fiber manufacturer to provide the services of a qualified representative at the pre-concrete construction meeting and for the first two days of fibrous concrete placement production.

2. Structural Polypropylene/Polyethylene Macro Fibers

a. Use one of the following products, subject to compliance with the Contract requirements:

(1) "Tuf-Strand SF", as manufactured by Euclid Chemical Company.

(2) "Strux 90/40", as manufactured by W.R. Grace & Company.

(3) Or approved equal.

b. Additional requirements:

(1) Dosage rate shall be a minimum of 4.0 lb./cu. yd. Higher dosages may be noted on Basic Contract Drawings.

(2) The minimum length shall be 1.50 inches.

(3) Fiber shall have an Aspect Ratio of 50 to 90.

(4) Conformance with ASTM C 1116, designation Type III, 4.1.3.

(5) The structural macro fiber concrete shall have an average residual strength of 200 psi when tested in accordance with ASTM C 1399.

(6) Use of fibers shall not change the water requirements of the mix.

(7) Conform to the manufacturer's recommendations for the quantity of fiber, which shall be not less than the minimum requirements of 2.02 T.2.b.1.

(8) Arrange for the fiber manufacturer to provide the services of a qualified representative at the pre-concrete construction meeting and for the first two days of fibrous concrete placement production.

U. Expansion Joints (Except for Bridge Decks) and Contraction Joints (Except for Pavements)

1. Vinyl plastic water stops shall be of types and sizes shown on the Basic Contract Drawings and conforming to Corps of Engineers "Specifications for Polyvinylchloride Waterstop" (Designation: CRD-C 572-60, latest revision).

2. Premoulded expansion joint filler, when shown on the Basic Contract Drawings:

a. Cork type shall be ASTM D 1752, Type II.

b. Bituminous type shall be ASTM D 1751.

3. Joint Sealant when shown on Basic Contract Drawings: Federal Specification SS-S-1401, latest revision.

2.03 MIX PROPORTIONS

A. Develop mixes in accordance with the latest editions of ACI 211, ACI 301 and ACI 318 to achieve the proportion performance criteria in accordance with the Contract Documents, with a degree of excess as determined by Chapter 5 of ACI 318, and meet all of the applicable performance criteria as specified in the Contract Documents. In addition, all concrete placed underwater shall conform to ACI 304R, Chapter 8, and lightweight aggregate concrete shall conform to ACI 213. Submit an underwater concrete placement procedure that is in conformance with ACI 304R, Chapter 8. Prior to concrete construction and after approval of all materials to be used in the concrete, submit a mix proportion showing that all performance criteria have been met. Mix proportions submitted shall be based upon laboratory trial mix test results and/or mixes successfully used within the two years preceding the date of the submittal of the mix for the Work of this Section. The independent testing laboratory used to develop the mix proportions and to perform testing shall have AASHTO Accreditation for all test methods required to be performed and to develop the required mix. Submit proof of certification to the Engineer prior to the start of development of the mix proportions and testing. The mix proportions shall include copies of test reports, including test dates, and a complete list of materials, including type, brand and source. The trial mix design performed in the testing laboratory shall use the same materials, cement, pozzolons, aggregates and admixtures that will be used at the proposed batch plant. Show fineness modulus, gradations and absorptions of aggregates. If any of the approved mix constituents change in source, properties or proportion, submit a new mix. The mix proportions shall also conform to the following:

1. Substitute either fly ash or slag at the minimum rate of 20% by weight of cement. The maximum rates of substitution shall be 30% for fly ash and 40% for slag, unless otherwise approved by the Engineer. Fly ash and slag substitution in the same mix may be permitted upon approval by the Engineer.

2. For concrete placed underwater, the minimum cementitious material content shall be 700 pounds per cubic yard of concrete.

3. Compute water to cement ratio using the weight of cementitious material that is equal to the total weight of cement plus fly ash, slag and silica fume. Any admixtures which increase the water to cement ratio by 0.01 or greater shall be accounted for in the mix proportion to meet the specified water to cement ratio.

4. For Categories II, III and IV concrete applications, the mix water to cement ratio shall not exceed 0.40 and the absolute drying shrinkage at 28 days shall not exceed 0.04% in accordance with ASTM C 157 (Air Drying Method), modified to start measuring at 10 hours. In addition for Categories III and IV, the maximum Coulomb count at 28 days shall be 1,000 for mixes without calcium nitrite and 1,500 when the mix contains calcium nitrite. For mixes that do not have silica fume, latex or metakaolin but contain either fly ash or slag, the Coulomb count requirements shall remain the same; however, the test shall be performed at 90 days instead of 28 days. For concrete pavements and Categories I and V applications where the concrete will be exposed to freeze-thaw cycles and/or sulfates, the mix proportion water to cement ratio shall not exceed 0.40 and the absolute drying shrinkage at 28 days shall not exceed 0.04% in accordance with ASTM C 157 (Air Drying Method). For other concrete applications, the mix water to cement ratio shall not exceed 0.50, unless otherwise shown on the Basic Contract Drawings.

5. High Range Water Reducer shall not be added to the concrete mix at the plant. It shall be delivered to the construction site in a tank fixed to the truck that discharges directly into the mixing drum, or it may be added to the drum from a calibrated dispensing unit. A calibrated dispensing unit shall be defined as a manufactured dispenser with clear volume indications marked on the outside of the unit. It shall be available at all times during the concrete placement for re-dosing purposes. Submit a re-dosing chart showing the dosages necessary to increase the slump, in inches per cubic yard of concrete remaining in the drum, over the range of concrete temperatures from 50 deg F to 90 deg F. If re-dosing occurs, the re-dosing chart shall be used, but under no circumstances shall the total dosage exceed the maximum dosage recommended by the manufacturer. The truck shall mix the load for a minimum of an additional 5 minutes prior to releasing the load.

6. The percentage of air in the mix shall fall within the range of the Lower Quality Limit (LQL) and the Upper Quality Limit (UQL) as outlined in the table shown in 2.04 A.6 entitled "Air Content Target Range for Freshly Mixed Concrete". Air content shall be determined by testing in accordance with ASTM C 231 for normal and heavyweight concrete mixes and ASTM C 173 for porous, lightweight aggregate.

7. Make adjustments to the weight of coarse, lightweight aggregate in accordance with the following:

   a. Design lightweight concrete mix proportions not to exceed 123 pounds per cubic foot, unless otherwise specified.

b. Adjust the proportion of lightweight aggregate to compensate for the difference between the wet unit weight determined in 3.05 B.5 and the dry unit weight of the material submitted in accordance with 1.05 A.1 and the approved mix proportions.

c. For lightweight aggregate mixes, advise the batch plant 72 hours prior to pouring in order to saturate the aggregate. Presoak lightweight coarse aggregate a minimum of 72 hours prior to mixing of concrete. The lightweight aggregate shall reach an absorbed moisture content not less than the manufacturer's written recommendations or the concrete will be rejected.

B. Where Latex Modified Concrete is specified in the Contract Documents, conform to ACI 548.4. The mix maximum water to cement ratio shall not exceed 0.37. The minimum volume of coarse aggregate shall be not less than 7.6 cubic feet (absolute volume) per cubic yard.

C. Architectural Concrete

Concrete that will be permanently exposed to view and which therefore requires special care in selection of concrete ingredients including color, forming, placing, consolidating and finishing to obtain the desired architectural appearance is designated as "Architectural Concrete".

1. A minimum of 35 days prior to construction of a mock-up, submit mix proportions and two sample panels (a minimum of 12" x 12" x 2") for each mix to the Engineer for approval. The materials used for the sample panels shall be from the same sources of material supply for all constituents in the approved mix. When requested by the Engineer, submit samples of all constituents for trial batching to the Port Authority Materials Engineering Unit to verify that the physical property requirements are met. Obtain approval for both sample panels for color and texture, as well as for the mix proportions for physical properties prior to constructing a mock-up.

2. Pigments, in conformance with ASTM C 979, shall be used when matching the color of existing concrete or when a specific color of concrete is required by the Engineer.

3. Construct mock-up only after the Engineer has approved both the mix proportions for physical properties and the sample panels for color and texture. For cast in place concrete, a mock-up in accordance with ACI 303.1 Section 1.6 Quality Assurance will be required for approval by the Engineer. For walls, a mock-up shall include all details that will be encountered in a typical day's pour. The mock-up may be constructed at the construction site as part of the permanent Work at the sole risk of the Contractor. If the Engineer rejects the mock-up, it shall be removed and recast at the sole expense of the Contractor. For precast architectural concrete, the mock-up shall consist of a full member selected in advance by the Engineer. Keep the approved mock-up at the precast concrete production facility for the Engineer to compare with the production units for acceptance or rejection. Acceptance or rejection shall be determined solely by the Engineer.

4. Construct mock-ups only with all of the actual constituents of the approved mix proportions. Do not proceed with production until the mix proportions, sample panels, full-scale mock-up and shop drawings have been approved by the Engineer. Once production begins, do not change suppliers or sources of supply for any of the constituents in the approved mix for the duration of the Contract.

5. In addition to the mix proportions and sample panels, submit the following for approval: forms, form liners and form oil or release agents.

6. Architectural Concrete shall conform to the Quality Assurance performance criteria specified in 4.01 B, Table 2 for the appropriate placement application and the associated Quality Acceptance Limits specified in 2.04.

7. Noticeable differences in color and/or texture of the finished product, as determined solely by the Engineer, shall be corrected by means and materials approved by the Engineer.

D. Pipe Piles: The target range for slump shall be 4 to 6 inches.

2.04 QUALITY ACCEPTANCE LIMITS

A. Develop mixes to meet the following performance criteria Quality Acceptance Limits in accordance with the relevant application properties specified in 4.01.B., Table 2, unless otherwise noted on the Basic Contract Drawing:

1. Compressive Strength (ASTM C 39): The Lower Quality Limit, LQL, shall be the specified mix compressive strength at 28 days, unless otherwise noted on the Basic Contract Drawing.

2. Flexural Strength (ASTM C 78): The Lower Quality Limit, LQL, shall be 700 psi at 28 days, unless otherwise noted on the Basic Contract Drawing.

3. Permeability (AASHTO T 277): The Upper Quality Limit, UQL, shall be 1700 Coulombs for mixes not containing a corrosion inhibitor and 2200 Coulombs for mixes that do contain a corrosion inhibitor. Performance testing shall be performed at 28 days, except for mixes containing only fly ash and/or slag substitution for cement but no silica fume or metakaolin, which shall be evaluated at 90 days.

4. Bond Strength (ASTM C 1583): The Lower Quality Limit, LQL, shall be 150 psi at 28 days.

5. Water Content (AASHTO T 318): The Upper Quality Limit, UQL, for water content shall be the specified water to cementitious ratio specified in 2.03 A.4 plus 0.05.

6. Air Content (ASTM C 138, ASTM C 173 or ASTM C 231): Both the Lower Quality Limit, LQL, and the Upper Quality Limit, UQL, shall be as specified in the table below:

AIR CONTENT TARGET RANGE FOR FRESHLY MIXED CONCRETE

MAXIMUM SIZE AGGREGATE (SIZE #)	AIR CONTENT LQL	AIR CONTENT UQL
2" or above (# 467 and above)	3.5%	7.5%
1-1/2" (# 57)	4.0%	8.0%
1" (# 67)	4.5%	8.5%
1/2" (# 8)	5.5%	9.5%
3/8"	6.0%	10.0%
Latex modified concrete	2.5%	6.5%

Note: For a specified compressive strength greater than 5000 psi, the LQL and UQL for air content, as indicated above, shall both be reduced by 1.0%. For all concrete applications not exposed to freeze-thaw cycling or chlorides, no air entrainment is required.

7. Chloride Ion Concentration by Weight of Cementitious Material (ASTM C 1152, ASTM C 1218, ASTM C 114, ACI 222R): The acid soluble chloride ions by weight of cementitious material in the concrete mix shall be less than or equal to 0.10% for reinforced concrete and 0.08% for prestressed concrete, as per ACI 222R. The water soluble chloride ions by weight of cementitious material in the concrete mix shall be less than or equal to 0.08% for reinforced concrete and 0.06% for prestressed concrete, as per ACI 222R.

8. Pavement Thickness: The Lower Quality Limit, LQL, for pavement thickness shall be 97.0% of the thickness shown on the Basic Contract Drawing.

9. Delaminations: The total surface area tested for any given Lot of concrete shall indicate less than 5.00% delaminated area when tested using the chain drag in accordance with ASTM D 4580.

B. For concrete bridge decks where riding surface tolerances are required, as shown on the Basic Contract Drawing, the following requirements shall be met:

1. Surface smoothness deviations shall not exceed 1/4 inch in 16 feet.

2. Vertical deviation from the grade shown on the Basic Contract Drawing shall not exceed plus or minus 0.04 foot at any point.

C. For mass concrete as defined in ACI 207 or as specified on Basic Contract Drawing the temperature at the core of the in situ concrete shall not exceed 160 deg F nor shall the maximum difference in temperature between the core and the surface of the structure exceed 35 deg F at any time. The drop in temperature in the first 24 hours after the end of protection shall not exceed the limits of ACI 306R Table 3.1.

D. Unless otherwise specified on the Basic Contract Drawing, the above specified Quality Acceptance Limits will be used to calculate Adjustments to Contract Compensation in accordance with Part 4 of this Section.

PART 3. EXECUTION

3.01 SURFACE PREPARATION

A. Bonded Overlays and Patching Applications

1. Bond strength tests will be performed by the Engineer in accordance with ASTM C 1583, using 4-inch by 4-inch steel plates, to determine the adequacy of the surface preparation. A minimum average bond strength of 200 psi shall be attained, with no single test value less than 180 psi. If time does not permit the above test to be performed, as determined solely by the Engineer, the Engineer will measure the macrotexture depth in accordance with ASTM E 965. A minimum of four tests will be performed and the average macrotexture depth shall be a minimum of 0.06 inches. Prior to the placement of any overlay or patching material, obtain the Engineer's approval of the surface preparation.

B. Latex Modified Concrete and Silica Fume Concrete

1. The Engineer will sound the concrete surface to identify areas of unsound or deteriorated concrete. Areas so identified shall be removed to the limits and depths as ordered by the Engineer. Perform abrasive blasting of all exposed reinforcing steel that is to remain in place.

C. Construction Joints (excluding joints in pavements)

1. Number, locations and details shall be as shown on the approved shop drawings.
2. Planes of joints shall be normal to direction of pressure and shall include suitable keys and dowels.
3. Locate joints at points of minimum shear, unless otherwise shown on approved shop drawings or directed by the Engineer.
4. Avoid lips and other irregularities between adjoining sections of concrete. Secure forms tightly against previously placed concrete.

D. Expansion and Contraction Joints (excluding joints in pavements)

1. After curing concrete, clean grooves or saw cuts to receive joint sealant by scrubbing with a mechanical wire brush to loosen dirt and other foreign matter and blowing out loose matter with compressed air.
2. Install joint sealant to finish flush with concrete surface, except where otherwise shown on the Basic Contract Drawing.

E. Preparation for Placing Concrete (excluding pavements)

1. Straighten bent dowels, whether placed under this Contract or by others, using tools approved by the Engineer. Do not apply heat to dowels.
2. Clean all dowels and all steel, that will be embedded in concrete, of all loose rust, scale, paint, grease and other objectionable materials.
3. Examine coated reinforcement for integrity of coating. Repair all damaged areas in accordance with the requirements of Specification Section 03200 entitled "Concrete Reinforcement". Make the repair crew available at the time of examination.
4. Check all formwork locking devices to ensure that they are in place and properly secured.
5. Do not place concrete for piles, footings, pile caps or slabs supported on pile caps or piles until the pile survey has been completed and additional reinforcing steel, if necessary, has been added as directed by the Engineer.
6. For preparation of surfaces to receive concrete, conform to the Basic Contract Drawing for all procedures, equipment limitations and requirements to be performed prior to placing concrete.
7. Do not place concrete for slabs-on-grade, grade beams or footings until the subgrade has been inspected and approved by the Engineer, and until any base course or fill has been properly compacted in accordance with the Contract requirements.

8. Provide vent holes (1/4 inch diameter, minimum) edge angles or embedded plates at joints where vibrating alone will not ensure elimination of voids. Locate such holes at high points and with uniform spacing along joints for escape of air during concreting operations. Evidence of voids adjacent to embedments will be cause for rejection of work. Submit all vent holes and procedures for placement of concrete at joints with the shop drawings for review and approval.

9. Make provisions for the concrete to pass through the reinforcing steel without segregating during placement.

F. For preparations for placing concrete pavements, see Section 02513 entitled "PLACEMENT OF PORTLAND CEMENT CONCRETE PAVING (FAA)".

3.02 BATCHING AND MIXING CONCRETE

A. Measurement of Proportions

1. All concrete batching shall be in conformance with ASTM C 94 and ACI 304R.

2. For Very High Early Strength Concrete requiring 2000 psi or greater in 6 hours or less time, the method of batching will be restricted to a calibrated mobile mixer, or to a transit mixer that is loaded at the construction site with bulk bags of the Very High Early Strength Cement. Bulk bags shall contain sufficient Very High Early Strength Cement by weight to batch for a minimum of 3 cubic yards of concrete.

B. Mixing Concrete

1. Arrange for transit mix trucks to be inspected and approved annually by either the New Jersey or New York State Departments of Transportation.

   a. Mixers shall be equipped with a metal plate attached by the manufacturer, indicating the volume of mixed concrete the equipment is intended to produce. The quantities of materials transported and the volume of mixed concrete produced shall not exceed the mixer's rated capacity. In locations where the rate of depositing is slow, the Engineer may restrict the volume of concrete that may be mixed in a mixer to a volume less than the manufacturer's rated capacity of the mixer.

   b. Immediately repair or withdraw from use any mixer which is determined to be mechanically unsatisfactory.

2. If truck mixers are used, keep available a sufficient number to ensure continuous delivery of the concrete at the rate required for the proper handling, placing, finishing and curing of the concrete. If a plant at the construction site is used, it shall be of sufficient capacity to meet such requirements.

   a. Mixers shall be of the revolving-drum type, with drums suitably mounted and fitted with adequate blades capable of discharging the mixture without segregation. All truck mixers shall be equipped with an accurate, operable counter to measure the number of drum revolutions and an accurate, working water site gage or manometer to measure the volume of water introduced into the drum. Truck mixers without an accurately operating counter or water site gage shall be immediately withdrawn from use.

3. The Engineer may permit one re-tempering of the concrete subject to the following:

   a. When the measured water content in the batch is less than the water in the approved mix proportion.

   b. The redosage of high range water reducer shall conform to the Engineer-approved redosage chart and shall not exceed the manufacturer's recommended limitation, nor shall it retard the initial set of the concrete by more than 30 minutes.

   c. When air content is below the lower quality limit specified in 2.04 A.6.

4. The Engineer may reject concrete in the following instances:

   a. Concrete has not been placed within 90 minutes from the time the cement had first contact with water.

   b. Concrete temperature reaches 92 deg F.

   c. The mix appears to be segregated.

5. The Engineer will reject concrete subject to the following:

   a. Concrete that has partially hardened or has attained its initial set prior to placement.

   b. The water to cement ratio as determined by AASHTO T 318 exceeds that given in 2.03 A.4 by 25%.

6. Construction Site Mixing: Measure mix components in accordance with tolerances given in ASTM C 94. Weigh all non-liquid components and measure all liquid components immediately prior to batching. Use a calibrated flask with clear indication markings for ounces, pints, etc. when measuring liquid components. Measures without calibrated clear indication markings will not be permitted. Mix concrete materials in an approved drum-type batch machine mixer.

   a. For a mixer capacity of 1 cubic yard or less, continue mixing a minimum of 3 minutes, but not more than 5 minutes after ingredients are in the mixer and before any portion of the batch is released.

   b. For a mixer capacity of greater than 1 cubic yard, increase the mixing time by 1 minute for each additional 1 cubic yard.

   c. Provide a batch ticket to the Engineer for each batch discharged and used in the Work, indicating the Contract number and title, date, time, mix type, mixing time, quantity of each constituent, volume of concrete and amount of water added. Record a location of the deposit in the structure that can be easily identified.

C. Mobile Mixers: When application requires the use of a mobile mixer, it shall meet the following criteria:

1. Proportioning and Mixing Equipment

   a. Mixer shall be a self-contained, self-propelled, continuous mixing type capable of carrying sufficient unmixed dry cement, aggregates, water and admixtures to produce not less than 6 cubic yards of concrete. Maintain a calibrated back-up unit at the construction site ready for use.

b. Mixer shall be capable of positive measurement of cement being introduced into the mix. A recording meter, visible at all times and equipped with a ticket printout, shall indicate this quantity.

c. Mixer shall provide positive control of the flow of water and admixtures. Water flow shall be indicated by flow meter and shall be readily adjustable to accommodate minor variations in aggregate moisture.

d. Mixer shall be capable of being calibrated to automatically proportion and blend all components of indicated composition on continuous or intermittent basis as required by the finishing operation, and shall discharge mixed material through a chute directly in front of the finishing machine. Notify the Engineer a minimum of 48 hours prior to calibration of the mobile mixers. Before approving the calibration of the mobile mixer, the Engineer will witness the calibration of the mobile mixer. However, the Contractor is responsible for testing the mix produced. Allow the Engineer to test the concrete mix at any time.

e. Calibrate mixer to accurately proportion the specified mix. Certification of calibration by an Engineer approved testing agency will be accepted as evidence of this accuracy, provided such certification attests the yield to be true within the following tolerances (by weight):

Coarse Aggregate	+/- 2%
Fine Aggregate	+/- 2%
Cement	+/- 1%
Water	+/- 1%
Admixtures	+/- 3%
Latex	+/- 1%

f. Mix in accordance with the specified requirements for the equipment used. The concrete, as discharged from the mixer, shall be such that finishing operations can proceed at a steady pace with final finishing completed before the formation of the plastic surface film.

g. Repair mixers not functioning in a manner the Engineer considers acceptable. If repair is not practical, remove the mobile mixer from the construction site and replace it with one which functions properly.

h. Prior to production, test the moisture content of the fine aggregate and coarse aggregate. Adjust the water gage setting only in the presence of the Engineer, to produce the approved mix water to cement ratio. Test the moisture content of the fine aggregate and coarse aggregate every 3 hours during production, or when the mobile mixer is loaded with aggregates from a stockpile different from the one for which moisture content tests were performed, whichever occurs first. Make adjustments in the presence of the Engineer. For Latex Modified Concrete, the maximum permissible moisture content of fine aggregate and coarse aggregate shall be 6.0% and 3.0%, respectively, as determined in accordance with ASTM C 566. If these limits are exceeded, stop concreting operations until drier aggregates are obtained. Allow the Engineer to view and copy all records for moisture content testing at any time.

3.03 PLACEMENT FIELD REQUIREMENTS

A. During all concrete placements at the construction site, the Contractor shall have an individual in a supervisory capacity present with a valid certification from one of the following programs:

1. ACI Concrete Transportation Construction Inspector or Concrete Construction Special Inspector.
2. New Jersey ACI Chapter's "Concrete Construction Technology" course.

B. Prior to any construction site delivery of concrete, furnish, deliver and maintain insulated curing boxes of sufficient size and strength to contain all the specimens (cylinders and beams) made by the Engineer in any two (2) consecutive Work periods. Such boxes shall be equipped to regulate the temperature in the range of 60 deg F to 80 deg F or 68 deg F to 78 deg F when the design compressive strength is 6000 psi or greater, and to provide the moisture to maintain the curing conditions specified in ASTM C 31. During hot weather when the temperature is greater than 80 deg F, maintain the temperature of the concrete specimens in the required range by immersing them in a water bath. Cover the water bath to prevent direct sunlight from raising the water temperature. Completely remove and replace the water in the bath every day. Locate the boxes where directed by the Engineer. Protect boxes from vibration and other disturbances during specimen curing.

C. Keep this Specification and the following ACI publications available at all times at the construction site:

1. ACI 301.
2. ACI 302.1R.
3. ACI 305R.
4. ACI 306R.
5. ACI 308.
6. ACI 309R.
7. ACI 318.

D. Ensure that the concrete supplier keeps this Specification and the following ACI publications available at all times at the batching location:

1. ACI 211.
2. ACI 213.
3. ACI 304R.

E. Bonding New Concrete to Existing Concrete

Where new concrete will be placed against existing concrete surfaces:

1. Surface to receive concrete shall be soaked and kept wet with water for one (1) hour prior to placement of material. Puddles of standing water shall be removed immediately prior to placement.

2. A thin layer of material from the leading edge of the concrete being placed shall be broomed into the wetted surface. Care shall be exercised to ensure that all vertical as well as horizontal surfaces receive a thorough, even coating and that the rate of progress is controlled so that the broomed material does not dry before being covered with additional material as required for final grade.

F. Placing Concrete (excluding pavements)

1. Place concrete only in the presence of the Engineer and by methods approved by him.
2. For concrete cast against earth or an approved compacted subgrade, and for concrete overlays, place concrete against surfaces in a saturated surface dry condition.
3. Prior to placing concrete, remove all standing water or puddles.
4. Do not place concrete on or next to frozen surfaces.
5. Transfer concrete from mixer to place of deposit as rapidly as practical to prevent formation of cold joints.
6. Use equipment and methods for placing which permit rapid placement of concrete of the required consistency and which preclude segregation.
7. The method and equipment used to transfer concrete from mixer to forms will be subject to prior approval by the Engineer. Do not use any pipes, chutes or other equipment made of aluminum.
8. Subject to the foregoing requirements, convey concrete by approved conveyors, pipes, chutes or spouts to a point not more than five feet horizontally or vertically from its final position, unless otherwise approved by the Engineer.
9. Concrete for fill in steel reinforced pipe piles, steel shells or caissons shall be deposited using a metal (not aluminum) hopper and an elephant trunk. The hopper and elephant trunk shall be set above the top of piles, steel shells or caissons to permit the escape of air as the concrete is placed. Elephant trunks shall be removed in sections while filling piles, steel shells or caissons from bottom of reinforcing cage to top of piles, steel shells or caissons. Elephant trunks shall extend a minimum distance of 10 feet below top of pile, steel shell or caisson or to bottom of reinforcing cage, whichever is greater. The top 15 feet of the concrete poured from the top shall be vibrated or rodded. No cold joints will be permitted during concreting operations, unless otherwise noted on the Basic Contract Drawing.
10. Except where otherwise approved by the Engineer, consolidate concrete by internal mechanical vibration subject to the following:
    a. Type, number and method of application of vibrators will be subject to prior approval by the Engineer.
    b. Apply vibrators at points not more than 30 inches apart for time intervals of approximately 10 seconds.
    c. Do not use vibrators to move concrete horizontally.
    d. In locations where spading is approved in lieu of mechanical vibration, spade coarse aggregate away from the forms and into the plastic mass; rod concrete around embedded materials and into corners and spaces to be filled and use only approved equipment.

11. Prevent formation of laitance and accumulation of excessive water on surface of concrete as it is deposited. Remove any accumulated bleed water by approved means before placing other concrete.

12. Place concrete so as to require as little rehandling as possible. Place and spread concrete using an approved mechanical spreading device that prevents segregation of the materials. Place continuously between contraction joints. Perform necessary hand spreading with shovels, not rakes.

13. Deposit concrete as near to joints as possible without disturbing them but do not discharge onto a joint assembly unless placement is centered above the joint assembly.

14. Thoroughly consolidate concrete against and along the faces of all forms and previously placed concrete and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Do not permit vibrators to come in contact with a joint assembly, base course or a side form. In no case shall the vibrators be used to move the concrete.

15. Screed and float concrete for riding surfaces as it is placed and use an approved evaporation retardant or fog spray.

G. Concrete Placing and Finishing Equipment for Bridge Decks and other Riding Surfaces (except for FAA pavements)

1. For slab or overlays 8 inches or more thick use internal vibrators. Internal vibrators shall be gang-mounted and supplemented with manual vibrators subject to the following:

   a. Use manual, hand-held vibrators adjacent to joint assemblies and similar locations where gang-mounted vibrators are not practical.

   b. Check all vibrators prior to the start of Work and periodically during construction progress to verify that they are working properly.

2. For slab or overlays less than 8 inches thick, vibrating surface pans or screeds will be allowed.

3. Manual tools such as bull floats, trowels, brooms and other similar hand tools are acceptable.

H. For placement and finishing of concrete pavements, see Section 02513 entitled "PLACEMENT OF PORTLAND CEMENT CONCRETE PAVING (FAA)".

I. Consolidation and Finishing

1. Bridge Decks and other Riding Surfaces

   a. Machine finishing shall conform to NJDOT Standard Specifications for Road and Bridge Construction 2007 Subsection 1005.02, .03 and .04.

   b. Finishing at and adjacent to joints shall conform to NJDOT Standard Specifications for Road and Bridge Construction 2007 Subsection 405.03.02 Item C.

c. Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade; (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Concrete, as soon as placed, shall be struck off and screeded using an approved portable screed. Use a second screed shall for striking off the bottom layer of concrete when reinforcement is used.

The screed for the surface shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal (not aluminum) or of other suitable material covered with metal. Consolidation shall be achieved by the use of suitable vibrators.

d. After the concrete has been struck off and consolidated, it shall be further smoothed and trued by means of a longitudinal float using one of the following methods:

(1) Long-handled floats shall be not less than 12 feet in length and 6 inches in width, stiffened to prevent flexibility and warping. The float shall be operated from foot bridges spanning but not touching the concrete or from the edge of the pavement. Floating shall pass gradually from one side of the bridge deck to the other. Forward movement along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or laitance in excess of 1/8-inch thick shall be removed and wasted.

(2) The Contractor may use a machine composed of a cutting and smoothing float(s), suspended from and guided by a rigid frame and constantly in contact with, the side forms or underlying surface. If necessary, long-handled floats having blades not less than 5 feet in length and 6 inches in width may be used to smooth and fill in open-textured areas in the pavement. When the crown of the bridge deck will not permit the use of the mechanical float, the surface shall be floated transversely by means of a long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance in excess of 1/8-inch thick shall be removed and wasted. Successive drags shall be lapped one-half the length of the blade.

e. While the concrete is still in a workable condition, test it for trueness with a Contractor-furnished 16-foot straightedge swung from handles 3 feet (1 m) longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advance in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8-inch thick shall be removed from the surface of the bridge deck and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to ensure that the surface across joints meets the smoothness requirements set forth in 2.04 B. Straightedge testing and surface corrections shall continue until the entire surface is free from observable departures from the straightedge and until the slab conforms to the required grade and cross section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment. Test the surface across the joints with a 16-foot straightedge as the joints are finished and correct any irregularities in excess of 1/4 inch before the concrete has hardened.

2. Specified concrete finishes, as shown on the Basic Contract Drawing, shall be in accordance with the following requirements:

a. "Smooth Finish": A surface of concrete obtained by the use of special forms as specified in Division 3 Section entitled "Concrete Formwork". Remove all fins and other irregularities in the exposed surfaces of concrete by rubbing the irregularities with a carborundum brick and clean fresh water. Any mortar patches shall be rubbed with a carborundum brick as above specified.

b. "Scored Finish": A surface of concrete obtained by roughening in an approved manner or by etching with sharp-pointed steel tools to key or otherwise improve the mechanical bond of the surface. Such scoring shall roughen at least ten percent of the area so scored.

c. "Float Finish": A surface of concrete obtained by the use of a wood float. Apply float finish to horizontal surfaces immediately after screeding and before initial setting has begun.

d. "Trowel Finish": A surface of concrete obtained by the use of a steel trowel, after screeding and floating the surface of the concrete to produce a dense, smooth, even surface suitable for painting or the application of floor covering. The troweling shall not take place until the surfaces have set sufficiently to sustain knee boards without damage. Troweling shall eliminate all irregularities and leave the concrete surface with a smooth, hard finish, free from marks and blemishes to the satisfaction of the Engineer.

e. "Traction Finish": A monolithic layer of abrasive concrete having a minimum thickness of 3/4 inch and which shall be "Emericrete SH", as manufactured by the Sika Corporation, or approved equal. Prepare the base and install the monolithic finish in accordance with the recommendations of the manufacturer of the abrasive concrete. The surface shall be given a wood float finish. The sides and edges of pavement slabs shall be rounded with an approved edging tool to the minimum radius obtainable in the sole opinion of the Engineer.

f. "Burlap Finish": A surface of concrete obtained by the use of a burlap drag, after screeding and floating the surface of the concrete. Drag the burlap in one direction in a straight line before initial setting has begun and in such a manner that the full width of the slab being finished is dragged in one operation. Prepare the surface prior to dragging by working from a bridge that does not come in contact with the fresh concrete at any point. The use of any burlap that causes irregularities or grooves greater than 1/16 inch in depth in the concrete surface will not be permitted. Rinse or wash burlap as often as is necessary to prevent the presence of hardened particles and consequent scarring of the concrete.

g. Stair treads and platforms of steel stairs shall be filled with mortar mixed in the proportions of one part Portland cement to three parts of fine aggregate, mixed with water to a satisfactory consistency. Coat the surface of the mortar with three pounds of aluminum oxide crystals per square yard of surface, uniformly applied, and trowel the surface to a smooth hard finish. Aluminum oxide crystals shall be grade AL203 crystals ranging from No. 12 to No. 30 in size and shall contain not more than six percent of iron or other impurities.

h. "Broom Finish" shall be subject to the following:

(1) Finish the concrete when the water sheen has practically disappeared. Use push broom or floor brush type, not less than 18 inches wide and made of good quality bass or bassine fibers not more than 4-1/2 inches long and with handles longer than half the width of the slab.

(2) Use an adequate number of brooms to keep up with other operations. Achieve proper finish prior to initial set of the concrete.

(3) Wash and thoroughly dry brooms at frequent intervals and remove worn or damaged brooms from the construction site.

(4) Draw broom across previously finished surface from the centerline to each edge of the slab with a slight overlap of strokes.

(5) Corrugations made in surface shall be uniform, approximately 1/16 inch in depth, and not more than 1/8 inch in depth.

(6) Complete brooming before concrete reaches a condition that would result in the surface becoming torn or unduly roughened and before initial set of concrete.

(7) Immediately following brooming, carefully finish the edges of slab along sides and at joints with an approved edging tool to form a smooth rounded surface of required radius and subject to the following:

(a.) Where corners or edges of slabs have crumbled and at any areas which have leaked sufficient mortar to make proper finishing difficult, remove loose fragments and soupy mortar, fill solidly with a mixture of correct proportions and consistency and finish.

(b.) Edges shall be smooth, true to line and free of unnecessary tool marks.

i. "Saw Cut Grooved Surface" for deck slabs and overlays shall conform to the requirements of the NJDOT Standard Specifications, Division 500 Subsection 507.03.02, Item L.

j. Concrete Curbs and Sidewalks

(1) Give sidewalks a "Float Finish", tool edges and joints for a width of 2 inches and round corners to a radius of 1/4 inch with an approved edging tool.

(2) Install expansion joints at not more than 20-foot intervals in sidewalks with matching joints in curbs. Use 1/4-inch bituminous joint filler.

(3) Score sidewalks in squares as approved by the Engineer.

J. Pump Concrete

1. Grout used to prime the pump line shall not be included in the placement. Dispose of the grout at the end of the pump line off Authority property. Do not begin placement until concrete is visible at the end of the pump line.

2. Allow no water to enter the pump hopper at any time during placement operations.

3. Submit written procedures for pumping to the Engineer for approval. The procedures shall contain, but shall not be limited to, pumping scheme, pump description, line diameter, line length and the number of turns and line offsets.

K. Silica Fume Concrete and Fibrous Concrete

1. Arrange for qualified technical representatives from the silica fume and the fiber suppliers, who are experienced in the batching and placement of silica fume and fibrous concrete, to be present for the pre-concrete construction meeting, all test pours and the first two production pours.

L. Fog spray forms, steel reinforcement and subgrade with potable water immediately prior to the placement of fresh concrete. Maintain uniform moisture of the subgrade without standing water, soft spots or dry areas.

3.04 CURING

A. Carefully cure all concrete. Submit a curing procedure plan for approval by the Engineer prior to placing any fresh concrete. Perform curing in accordance with ACI 308 and the following specifications. Commence curing procedures immediately after fresh concrete has been placed.

1. Provide suitable means, such as insulating blankets or heated enclosures, for maintaining a concrete temperature of at least 50 deg F after placement. At the end of this period, remove protection in such a manner that the drop in temperature of any portion of concrete is gradual and does not exceed the following within the first 24 hours after removal of protection, in accordance with ACI 306R, Table 3.1: 50 deg F for applications with a minimum dimension less than 12 inches; 40 deg F for applications with a minimum dimension between 12 and 36 inches; 30 deg F for applications with a minimum dimension between 36 and 72 inches; and 20 deg F for applications with a minimum dimension greater than 72 inches.

2. Allow all concrete to attain 4,000 psi compressive strength before exposure to freeze-thaw cycles.

3. Choice of curing material and method shall be as approved by the Engineer.

B. Wet Curing

1. All pavement concrete and structural slabs: Immediately after screeding of the concrete, apply an evaporation retardant, or commence the operation of a fog spraying system to keep moisture in the atmosphere surrounding the concrete until all concrete finishing has been completed. Do not direct fogging at the fresh concrete and do not permit ponding of water on the fresh concrete surface.

2. Perform wet curing for the following concrete applications: overlays, deck slabs, ramps, any concrete mixes containing silica fume, Very High Early Strength Cement and formulated latex modifier.

3. Immediately after finishing concrete, cover the surfaces with wet burlap or cotton mats which have been presoaked for a minimum of 24 hours in potable water, so that no marring of the surface occurs. Keep the burlap or cotton mats continuously moist, 24 hours per day, through the use of a fog spraying system or soaker hoses arranged at the high points of the concrete pour. Burlap, which shall consist of two or more layers, or cotton mats shall overlap a minimum of one foot, and shall be at least one foot longer than necessary to cover the entire width and edges of the pavement lane. The burlap or cotton mats shall be weighted down to prevent displacement.

   a. Inspect sheet material before reuse. Repair all holes and tears with cemented patches, subject to approval by the Engineer.

4. Wet curing procedures may be stopped only (1) when the ambient temperature is expected to fall below 35 deg F within 24 hours, (2) when placing concrete for slabs directly adjacent to the fog spraying system or soaker hoses or (3) when concrete is to receive traffic.

   a. When the ambient temperature at the surface of placement is 35 deg F and falling, wet curing will not be permitted; instead, apply a liquid membrane forming curing compound in accordance with 2.02 R and 3.04 C.1.a.

   b. When wet curing is temporarily interrupted for an adjacent placement, remove all standing water in areas to receive fresh concrete prior to placement. Occasionally spray a fine mist of water over the wet curing areas. Do not puddle water on the surface of the fresh concrete. When the fresh concrete is finished and covered with burlap or cotton mats, reassemble the continuous fog spraying system or soaker hoses and continue wet curing immediately.

   c. Areas in which the concrete will be exposed to traffic shall be wet cured for as long as possible. Wet curing may stop only when there is just enough time to apply a liquid membrane forming curing compound over the entire area prior to reopening it to traffic. In this case, apply the liquid membrane forming curing compound when the surface has no standing water or puddles on the surface, but is in a damp condition.

5. Wet cure for 7 days, or until 75% of the design compressive strength is obtained, whichever is longer, when determined by strength tests performed on sample cylinders cast in the field and cured in the same manner as the concrete.

6. Immediately after wet curing procedures are completed, apply a liquid membrane forming curing compound in accordance with 2.02 R and 3.04 C.1.a.

7. Contain water within the area of work.

8. For latex modified concrete, wet cure for a maximum of 48 hours, unless otherwise directed by the Engineer.

C. Liquid Membrane Forming Curing Compounds and Sheet Materials for Curing

1. Immediately after placing or finishing, commence the curing process of concrete not covered by forms from loss of moisture. Use one of the curing materials listed in 2.02 R, which may be supplemented by initially using an evaporation retardant listed in 2.02 S, as long as wet curing is not required, subject to the following:

   a. Apply white pigmented liquid membrane forming curing compound as soon as surface moisture has evaporated by approved pressure spraying or distributing equipment in two uniform full applications perpendicular to each other as recommended by the manufacturer. Allow the first coat to become tacky before applying the second coat. Each application shall be the full quantity recommended by the manufacturer. The entire surface shall be white after the second application.

      (1) Recoat areas subjected to heavy rainfall within 3 hours after rain.

      (2) Follow manufacturer's recommendations for agitation during application and warming where necessary during cold weather. Do not use liquid membrane forming curing compound where the surface being cured is to receive a finish that will be bonded to the concrete surface or where a floor hardener is to be applied, unless a certification of compatibility and a minimum five-year performance record is submitted in advance to the Engineer for approval.

      (3) The Engineer will check for uniformity through random sampling and testing. Testing may include determination of membrane infrared spectrum, pH, specific gravity and solids content.

2. Removal of Forms

   Removal of forms shall be subject to the following:

   a. Remove forms in accordance with the requirements of Specification Section 03100 entitled "Concrete Formwork" or Section 02513 entitled "Placement of Portland Cement Concrete Paving (FAA)".

   b. After removal of forms, patch areas of concrete which in the opinion of the Engineer show excessive honeycomb by cutting out defective areas, keying and refilling them with a mortar of cement and sand in the same proportions as those in the approved concrete mix design and sufficient water to provide a workable mix.

   c. After forms are removed, cure sides of slabs greater than 12 inches in thickness in accordance with 3.04 C.

d. Immediately after removal of forms, holes and voids in the surfaces of concrete, resulting from bolts and ties, shall be wetted and filled with a mortar containing cement and fine aggregate in the same proportions as in the approved concrete mix design, and utilizing cement which shall produce mortar of the same color as the concrete. Exposed mortar surfaces shall then be finished smooth and even with a wood float, except that those surfaces exposed to view in the finished structure shall be finished with a steel trowel to match adjacent surfaces. All fins and other surface irregularities shall be removed promptly by chipping, grinding or other methods approved by the Engineer to give a uniform finish. Where no specific surface finish for formed concrete surfaces is indicated on the Basic Contract Drawing, no further finishing will be required.

e. Drop in concrete surface temperature over the first 24 hours shall be controlled in accordance with ACI 306.

3.05 QUALITY ASSURANCE TESTING, SAMPLING AND INSPECTIONS

A. The Engineer will perform Quality Assurance testing during mixing and placing of concrete on samples taken from the end of the pump line or at the point of discharge in accordance with ASTM C 172. The Engineer will take samples of concrete from each Lot during a single Work period based on random sampling procedures contained in ASTM D 3665. A Lot of concrete is defined as the production of a single Work period. For each Sublot, the Engineer will cast cylinders in accordance with ASTM C 31 when testing for compressive strength, as well as 4" x 8" cylinders when permeability is being tested and beams when flexural strength is being tested. The cylinders and beams will be tested in accordance with ASTM C 39 and ASTM C 78, respectively, for each Sublot to determine the compressive strength and flexural strength at the time requirements specified.

TABLE 1
LOTS AND SUBLOTS

Daily Placement Quantity (Cubic Yards)	Number of Lots	Number of Sublots
Less than 50	Note 1	Notes 1 and 3
50 – 100	1	3 equally divided
101 – 450	1	4 equally divided
Greater than 450	1	Note 2

Table 1 Notes:

1. If one Work period's placement of a given Class of concrete is less than 50 cubic yards, it will not constitute a Lot. It will be added either to the previous or the next Work period's Lot, whichever is closer in time, or until a minimum of 3 Sublots are completed constituting a Lot.

2. For concrete placements of 450 cubic yards or greater, a Sublot will be deemed to be one fourth of a Lot of concrete, or 150 cubic yards of concrete, whichever is less. For larger pours the Engineer may increase the number of cubic yards that constitute a Sublot.

3. If the total concrete quantity under the Contract for any type of mix is less than 50 cubic yards, it will constitute one Lot and will be divided into a minimum of 3 Sublots, regardless of the placement schedule.

B. Quality Assurance Testing Standards and Frequency of Testing: Some or all of the following procedures will be used by the Engineer to approve the concrete mix proportions and evaluate the in-place concrete for Adjustments to Contract Compensation:

1. Compressive Strength: In accordance with ASTM C 31 and ACI 318 Part 3, Chapter 5, Item 5.6, entitled "Evaluation and Acceptance of Concrete", except that the Engineer will take samples on a random basis and 4" x 8" cylinders will be used when the nominal maximum size of the coarse aggregate allows. Latex Modified Concrete samples will be wet cured by the Engineer for 1 day and dry cured for 27 days. The cylinders will be tested in accordance with ASTM C 39. The Engineer will calculate the average of two test specimens at the compressive strength time requirement. The average of the two test specimen result values for each Sublot will be considered the Sublot compressive strength value.

2. Flexural Strength: From each Sublot sample, cast beams in accordance with ASTM C 31. The Engineer will test the beams in accordance with ASTM C 78 and will calculate the average of two test specimens at the flexural strength time requirement. The average of the two test specimen result values for each Sublot will be considered the Sublot flexural strength value.

3. Slump Test: Performed by the Engineer at the point of delivery during the time of placement in accordance with ASTM C 143 or ASTM C 1611 when self-consolidating concrete is used. For Latex Modified Concrete, the Engineer will perform slump tests 5 minutes after sampling from the mixer. For pile concrete applications, the slump shall be no less than 4 inches and no greater than 6 inches.

4. Air Content Test: Performed during the placement in accordance with ASTM C 138, ASTM C 173 or ASTM C 231. The Engineer will perform one test for each Sublot, which will be considered the Sublot air content test value.

   a. When results for either two consecutive tests or three tests in one lot or one day's production indicate that the air content is outside the Quality Limits specified in 2.04 A.6 by +1.0 or –0.50% do not place the next load until it has first been tested and satisfactory test results have been obtained. If the air content for the next load is outside the Quality Limits specified in 2.04 A.6, it will be rejected. The Engineer will test subsequent loads until the air content is found to be within the specified limits of 2.04 A.6.

5. Unit Weight: The Engineer will determine the plastic unit weight of concrete (taken at the same frequency as specified in 3.05 B.4 according to ASTM C 138). For lightweight concrete, the plastic unit weight, as determined in accordance with ASTM C 567, shall not exceed 125 pounds per cubic foot, unless otherwise specified.

6. Water Content Test: The Engineer will test for water content during the placement using a Microwave Drying Oven, in accordance with AASHTO T 318. He may adjust drying times depending on the mix constituents to achieve a constant dry weight. Once the water content has been determined, it will be divided by the cementitious content in the mix design to determine the water to cement ratio. When the maximum aggregate size exceeds 1-1/2 inches, the Engineer will obtain a sample of approximately 5000 grams. This sample will be split and the Engineer will perform two separate analyses. The weighted average of the two separate analyses will be considered the Sublot water content value. Likewise, the Engineer will compute the sublot water cement ratio as given above.

a. When results for either two consecutive tests or three tests in one lot or one day's production indicate that the water content exceeds the limits given in 2.03 A.4 by 0.10, do not place the next load until it has first been tested and satisfactory test results have been obtained. If the water content for this load is greater than the Upper Limit given in 2.04 A.5, it will be rejected. The Engineer will test subsequent loads until the water content is found to be within the limit given in 2.04 A.5.

7. Coulomb Test: To evaluate the permeability of the concrete the Upper Quality Limit, UQL, shall be 1700 Coulombs for mixes without a corrosion inhibitor and 2200 Coulombs for mixes containing a corrosion inhibitor, as tested by the Engineer in accordance with AASHTO T 277 after a 28-day wet cure. For mixes containing only fly ash or slag (no silica fume or metakaolin) permeability will be evaluated at 90 days, using the same performance requirements stated above (1700 Coulombs for mixes without a corrosion inhibitor and 2200 Coulombs for mixes with a corrosion inhibitor). For Latex Modified Concrete applications, samples will be wet cured for 7 days and dry cured for 21 days. For each Sublot, the Engineer will cast two (2) 4" x 8" cylinder specimens for each Sublot. The Engineer will cut 2-inch thick samples from the center of each cylinder for testing. The average of the two test specimen result values for each Sublot will be considered the Sublot Coulomb test value.

8. Bond Strength: The bond strength between overlay concrete and parent concrete will be evaluated in accordance with ASTM C 1583. For each Sublot, the Engineer will perform three tests. Three 4-inch diameter cores will be cut 1/2 inch into the parent concrete to isolate the overlay concrete. The average of the three test result values for the Sublot will be considered the Sublot bond strength test value. The locations for each test will be randomly determined by the Engineer.

9. Chloride Ion Concentration by Weight of Cement: The Engineer may perform testing for both the acid soluble and water soluble chloride ion concentrations by weight of cementitious material, which will be evaluated as follows. Powder samples from 28-day concrete cylinders, cast from the concrete mix delivered to the construction site, will be tested to assess both the acid soluble and water soluble chloride ion concentrations by weight of cementitious material. Samples will be obtained using a rotary hammer drill from the mid-height of a minimum of two Sublot specimens from each Lot. The sample will be obtained from the inner three inches of the cylinder specimen, and must be a minimum of 40 grams in weight. The acid soluble and water soluble chloride ion concentrations by weight of cementitious material will be determined by the Materials Engineering Unit in accordance with preparatory standards ASTM C 1152 and ASTM C 1218, respectively, followed by ASTM C 114 (silver nitrate titration) for both the acid soluble and water soluble chloride ion analysis.

10. Pavement Thickness: The Engineer will perform acoustical testing using Impact Echo instrumentation to determine the pavement thickness. Areas indicating pavement thickness below the requirements shown on the Basic Contract Drawing will be cored for verification. The cores will be measured in accordance with ASTM C 174. The average of three test result values for the Sublot will be considered the Sublot test value.

11. Where specified the Engineer will place Remote Temperature Sensing Devices in the in situ concrete to record maximum core temperature and maximum drop of temperature for 24 hours after protection has been removed.

12. Test Cores for Tremie Concrete

a. The Engineer will drill test cores for every 100 cubic yards of concrete placed in mass pours, such as tremie seal, or one core for every 1000 square feet of surface of thin pours, such as bulkheads or wall facings. Cores will be obtained in accordance with ASTM C 42 and will be drilled full depth (or thickness) through the pour horizontally or vertically as applicable.

b. Recovery of less than 95 percent will be considered to indicate defective concrete requiring corrective action by the Contractor.

c. If the cores reveal voids, honeycombing, seams or other defects, the concrete will be subject to rejection for non-uniformity. Additional cores may be obtained by the Engineer for further investigation. The number and location of cores will be determined by the Engineer. All additional cores will be taken at the sole expense of the Contractor.

d. Fill all test core holes by pressure grouting from the bottom upward, or from the inside out, as the case may be.

e. Clean out and fill all voids, honeycombing, seams and other defects by pressure grouting with cement or sand-cement to the Engineer's satisfaction. At the Engineer's request and at the sole expense of the Contractor, drill additional cores to verify grouting.

C. In accordance with the Section of Division 1 entitled "Inspections and Rejections", provide labor and means for obtaining all samples required for trial batches and field testing performed by the Engineer. At no additional cost to the Authority, furnish and deliver the following when requested by the Engineer:

1. Provide a representative sample, in the quantity requested by the Engineer, of all cement, fly ash, slag, silica fume, fine and coarse aggregate, admixtures, corrosion inhibitor, latex, fibers, pigment, evaporation retardant and liquid membrane forming curing compound during any day of production the Engineer requests a sample. Take such samples in the presence of the Engineer at the point of storage used for the Work of this Contract. For cement, fly ash, slag and silica fume samples, only use a sampling port on the silo, or drop material in a loader bucket between loads, or take samples from the boot using a "Sample Thief" during loading. Notify the Engineer of aggregates being loaded at their source of supply at least 48 hours in advance of each loading.

2. Provide the cement, fly ash, slag, silica fume or metakaolin manufacturer's Mill Test Certificate and Bill of Lading, if such documents are requested by the Engineer.

3. Allow the Engineer to sample any mix proportion constituents at any time.

D. The Engineer may direct an inspection of the Contractor's concrete plant or precast concrete fabricator to observe operations and review the Quality Control procedures being implemented. Notify the Engineer, in writing, a minimum of 15 days prior to the commencement of production and submit a schedule and Quality Control Plan for all production for the Work of the Contract.

E. Precast Concrete: Obtain from the fabricator and submit to the Engineer a set of approved shop drawings for the Work of the Contract. Fabrication without shop drawings will not be permitted. Clearly mark all precast units with identification numbers for each unit. The Engineer will provide a manifest ticket to be attached to the driver's shipping ticket listing the approved unit identification numbers. Any units shipped to the construction site that are not approved or are not listed on the manifest will not be permitted to be unloaded at the construction site. Shipments not accompanied by a manifest upon delivery will not be permitted to be unloaded at the construction site.

F. For concrete where riding surface tolerances are required, other than pavements, as indicated on the Basic Contract Drawing, the following requirements must be met:

1. The Engineer will test the entire surface of the hardened concrete with a rolling straight edge for conformance to the smoothness requirements. Surface smoothness deviations must not exceed 1/4 inch in 16 feet. Tests will be made in both the longitudinal and transverse direction of the slab and shall span joints. Correct any deficiencies as specified in 4.01 G.1.H and at no cost to the Authority.

2. The Engineer will survey the slab surface for vertical deviation from grade. Vertical deviation from the grade shown on the Basic Contract Drawing must not exceed plus or minus 0.04 foot at any point.

3. The Engineer will determine finished grade by running levels at intervals of 25 feet longitudinally and transversely. Correct all deficiencies as specified in 4.01 G.1.H and at no cost to the Authority.

G. Specified concrete finishes, as shown on the Basic Contract Drawing, must conform to the requirements set forth in 3.03 H.2. Correct all deficiencies as specified in 4.01 G.1.I and at no cost to the Authority.

PART 4. ADJUSTMENTS TO CONTRACT COMPENSATION

4.01 GENERAL

A. Unless otherwise shown on the Basic Contract Drawing, acceptance of material will be based on the method of estimating Percentage of Lot Within Specification Limits (PWL), where the PWL will be determined in accordance with this Section. All Sublot test result values for a Lot, as defined in 3.05 A, Table 1, will be analyzed statistically to determine the total estimated Percent of the Lot that is Within specification Limits, as shown in 4.01 B. The PWL is computed using the Lot sample Average value, $\overline{X}$, as defined in 4.01 D.3 and the Lot sample standard deviation, S_N, as defined in 4.01 D.4, for the specified number of Sublots, n, and for the specification Quality Acceptance Limits, as defined in 2.04 A, where LQL represents the Lower Quality Limit, and UQL represents the Upper Quality Limit, as they apply to each particular acceptance parameter. From these values, the respective Quality Index(ices), Q_L for Lower Quality Index and/or Q_U for Upper Quality Index, is computed in accordance with 4.01 D.5 and 4.01 D.6. Then the PWL for the Lot for the specified number of Sublots, n, is determined from Table 4, "Percent of Lot Within Limits (PWL) (Standard Deviation Method)". The Adjustment to Contract Compensation for each Lot is then calculated using the formulas specified in 4.01 F.

B. Depending on the application, concrete will be tested for the properties shown below. The PWL of each Lot for each parameter will be determined as specified in 4.01 D. Payments will be based on the concrete application for a Lot and the criteria defined below.

Performance Parameters	Minimum PWL
Flexural Strength	95
Compressive Strength	95
Permeability	90
Bond Strength	80
Water to Cement Ratio	80
Air Content	70*
Pavement Thickness	90
Chloride Content	100**

*denotes that in addition to the minimum PWL, the air content will also be evaluated for the average of test results for a given Lot of concrete as per 3.05 B.4 and 4.01 J.

**denotes that the chloride content (acid soluble and water soluble) will be analyzed only for the average of test results for any given Lot of concrete, as per 3.05 B.9 and 4.01 G.1.b.

Table 2 defines the Quality Acceptance performance criteria to be evaluated for Adjustments to Contract Compensation for a given concrete application. In addition, all concrete shall conform to the requirements of 4.01 G. Any deficiencies found to exist as specified in 4.01 G will govern and the Contractor shall either:

1. Remove and replace the concrete in that particular Lot at no cost to the Authority, or

2. Accept a deduction of 50% of the Base Price per cubic yard, as indicated on the Basic Contract Drawing, for that particular Lot of concrete.

TABLE 2
PERFORMANCE CRITERIA PARAMETERS

Category/ Application	Water/Cement Ratio (W/C)	% Air	Permeability	Bond Strength	Compressive Strength	Flexural Strength	Pavement Thickness
Category I - Full Depth Pavements & Unbonded Overlays							
	I	I	---	---	---	P	
LQL:	---	*	---	---	---	700 psi	97%
UQL:	0.45	*	---	---	---	---	---
Category II - Bonded Pavement Overlays							
	I	I	---	P	I	---	---
LQL:	---	*	---	150 psi	***	---	---
UQL:	0.45	*	---	---	---	---	---
Category III - Elevated Structural Overlays							
	I	I	I	P	I	---	---
LQL:	---	*	---	150 psi	***	---	---
UQL:	0.45	*	**	---	---	---	---
Category IV - Structural (exposed to freeze-thaw and/or sulfates, in addition to chlorides or a marine environment)							
	I	I	P	---	I	---	---
LQL:	---	*	---	---	***	---	---
UQL:	0.45	*	**	---	---	---	---
Category V - Structural (exposed to freeze/thaw and/or sulfates only; no exposure to chlorides or a marine environment)							
	I	I	---	---	P	---	---
LQL:	---	*	---	---	***	---	---
SQL:	0.45	*	---	---	---	---	---
Category VI - Standard Structural (not exposed to freeze-thaw cycles) and Miscellaneous Applications (at-grade sidewalks, at-grade curbs, kerfs, foundations, footings, drainage structures, manholes, pipe pile fill and all concrete applications below grade)							
	---	---	---	---	P	---	---
LQL:	---	---	---	---	***	---	---
UQL:	---	---	---	---	---	---	---

* - Refer to 2.04 A.6.

** - 1700 Coulomb counts for mixes without a corrosion inhibitor and 2200 Coulomb counts for mixes with a corrosion inhibitor.

*** - The proportion compressive strength at 28 days or as specified on the Basic Contract Drawing.

P - Used to Calculate Pay Factor per cubic yard. It denotes the concrete property that will be used to calculate payment for a given concrete application. No incentive payments will be made if the performance criteria parameters labeled 'I' for a given application have a PWL less than specified in 4.01 B.

I - Used to Calculate Incentive only when the Pay Factor for the parameter labeled 'P' is greater than 0.00.

C. Full Depth Pavement and Unbonded Overlay (Category I) Final Pay Factor: The Pay Factor for Pavement Thickness will govern only when the Pay Factor for Pavement Thickness is less than the Pay Factor for Flexural Strength, with the exception of when the Pay Factor for Pavement Thickness is 0.00.

D. Method of Estimating Percentage of Material Within Limits (PWL)

1. Locate sampling positions on the Lot by use of random sampling procedures specified in 3.05 A.

2. Take a test sample and make the test specimens on the test sample in accordance with 3.05 A.

3. Determine the Lot sample Average value, $\overline{X}$, by calculating the average of all Sublot test values.

4. Find the Lot sample standard deviation, S_N, by using the following formula:

$$S_N = \sqrt{\frac{d_1^2+d_2^2+d_3^2+ +d_n^2}{n-1}}$$

Where:

S_N = standard deviation of the Sublot test values

$d_1, d_2....$ = deviation from the individual Sublot test values

$X_1, X_2, ...$from the Average value, $\overline{X}$, that is,

$d_1 = (X_1 - \overline{X}), d_2 = (X_2 - \overline{X}), ..., d_n = (X_n - \overline{X})$

n = number of Sublots

5. Find the Lower Quality Index, Q_L, by subtracting the Lower Quality Limit, LQL, from the Average value, $\overline{X}$, and dividing the result by S_N.

$$Q_L = \frac{\overline{X} - LQL}{S_N}$$

6. Find the Upper Quality Index, Q_U, by subtracting the Average value, $\overline{X}$, from the Upper Quality Limit, UQL, and dividing the result by S_N.

$$Q_U = \frac{UQL - \overline{X}}{S_N}$$

7. The percentage of material above lower tolerance limit, P_L, and the percentage of material below upper tolerance limit, P_U, will be found by referring to Table 4, "Percent of Lot Within Tolerance Limit (PWL) (Standard Deviation Method)". Locate Q_L and/or Q_U in the column appropriate to the total number of Sublots, n, and reading the number under the column heading "PWL".

8. For concrete properties with only an Upper Quality Limit (ratio of water to cementitious material, permeability), PWL equals P_U. For concrete properties with a Lower Quality Limit (bond strength, compressive strength, flexural strength, pavement thickness), PWL equals P_L. For concrete properties with both Upper and Lower Quality Limits (air content), first calculate of the Upper Quality Index, Q_U, and the Lower Quality Index, Q_L, by using the Upper Quality Limit, UQL, and the Lower Quality Limit, LQL, respectively, as stipulated in 2.03 A.6. Then determine PWL using the following formula:

$$PWL = (P_U + P_L) - 100$$

E. Pay Factors for each Lot will be computed in accordance with the formulas contained in 4.01 F, Table 3 entitled, "Adjustments to Contract Compensation", by entering the PWL value and performing the calculation indicated for the appropriate PWL range to determine the Pay Factor.

F. Adjustments to Contract Compensation shall be calculated as follows:

TABLE 3

ADJUSTMENTS TO CONTRACT COMPENSATION PER CUBIC YARD

Percent Within Limits (PWL)	Compressive Strength Pay Factor
98 - 100	0.02 (PWL-100) +0.06
95 - 97	0.0
55 - 94	(PWL-95)/100
0 - 54	-0.50

Percent Within Limits (PWL)	Permeability & Bond Strength Pay Factor
91 - 100	0.006 (PWL - 90)
80 - 90	0.0
55 - 79	$0.00017PWL^2 - 0.0105PWL - 0.30$
0 - 54	-0.50

Percent Within Limits (PWL)	Flexural Strength Pay Factor
95 - 100	(PWL-95/100)+.01
55 - 94	(PWL-95)/100
0 - 54	-0.50

Percent Within Limits (PWL)	Pavement Thickness Pay Factor
90 - 100	0.00
55 - 89	(PWL-90)/100
0 - 54	-0.50

Pay Factors are multiplied by the Base Price per cubic yard established in the table below, unless otherwise indicated on the Basic Contract Drawing. The result is the amount to be added or deducted from the compensation for that particular Lot of concrete.

Category	Base Prices for Adjustments to Contract Compensation Per Cubic Yd
I	$100
II	$90
III	$130
IV	$130
IV	$110 when silica fume or metakaolin are not included
V	$90
VI	$80

G. Correction or Cost Adjustments for Deficiencies

1. Remove and Replace Concrete: Remove and replace concrete in a manner approved by the Engineer and at no additional cost to the Authority if any of the following deficiencies exist, unless the Engineer elects to accept the concrete, at which time the Contractor will be compensated at 50% of the Base Price per cubic yard, regardless of the Pay Factors calculated in 4.01 F, Table 3:

   a. Percent Within Limits (PWL) for compressive strength, flexural strength, permeability, bond strength or pavement thickness is below 55.

   b. The average acid soluble chloride ions by weight of cementitious material test results for any given Lot of concrete exceed the limit of 0.10% (reinforced concrete) or 0.08% (prestressed concrete) weight of chloride ions by weight of cementitious material, in accordance with ASTM C 1152 and ASTM C 114, and the average water soluble chloride ions by weight of cementitious material test results for any given Lot of concrete exceed the limit of 0.08% (reinforced concrete) or 0.06% (prestressed concrete) weight of chloride ions by weight of cementitious material, in accordance with ASTM C 1218 and ASTM C 114. The Soxhlet test referenced in ACI 222R will not be considered for chloride evaluations.

   c. For all concrete applications, the cylinder compressive strength shall conform to the following:

      (1) The calculated average of any three consecutive compressive strength tests shall be equal to or shall exceed the specified compressive strength.

      (2) No individual compressive strength test result shall be below the specified compressive strength by more than 500 psi. When the required strength is 5000 psi or less, or by more than 0.10 of the specified strength when greater than 5000 psi is required.

      (3) If either or both of the requirements specified in 4.01 G.1.c.1 and 4.01 G.1.c.2 are not met, investigate the in-place compressive strength in accordance with ACI 318-02, Section 5.6.5, at no additional cost to the Authority. If the compressive strength test results of the in-place concrete fail to meet either or both of the requirements specified in 4.01 G.1.c.1 and 4.01 G.1.c.2, the concrete will be considered deficient, and 4.01 G.1 will apply.

d. Concrete slabs or structures that exhibit any cracks prior to opening to vehicular/aircraft operations or loading will be subject to the actions specified in 4.01 G.1. If the concrete is accepted by the Engineer, seal cracks in accordance with Specification Section 03734 entitled "Concrete Crack Repair" in a manner approved by the Engineer, and at no cost to the Authority.

e. Delamination Testing: The Engineer will check all concrete overlays using the chain drag method in accordance with ASTM D 4580. If more than 5.00% of the total surface area of the Lot is found to be delaminated, remove these areas and replace them at no cost to the Authority. The determination by the Engineer as to the existence of delaminations shall be final and binding.

f. Slabs showing high or low spots exceeding 1/2 inch when tested in accordance with 3.05 F.2.

H. Diamond Grinding and Partial Depth Removal

1. Cured riding surfaces, except pavements, that do not meet the smoothness or finished grade requirements set forth in 2.04 B shall be corrected, to obtain the specified smoothness deviation, as follows:

a. High spots between 1/4 inch and 1/2 inch and surfaces that exceed the finished grade requirements shall be identified and ground with diamond grinding equipment.

b. Low spots between 1/4 inch and 1/2inch and surfaces that are below the finished grade requirements shall be corrected by partial depth removal of the entire slab to 1 inch below rebars by hydrodemolition, or by hydromilling and constructing an overlay in conformance with this Specification.

2. The diamond grinding equipment shall be as approved by the Engineer and shall have a grinding head at least 36-inches wide.

3. Where grinding is required, grind the entire width of the riding surface by the length of defective area. In the sole opinion of the Engineer, if the deficiencies are closely spaced and grinding individual areas will adversely affect ride, grind the entire surface.

4. Dispose of slurry produced from grinding operations off Authority property.

5. Perform diamond grinding, partial depth removal and construction of an overlay, if required to correct deficiencies, at no additional cost to the Authority.

I. If concrete finishes do not meet the requirements set forth for the specified finishes, refinish the hardened concrete as directed by the Engineer, at no additional cost to the Authority.

J. If the average air content for a Lot exceeds either the LQL or the UQL by more than 1% (with the exception of concrete not exposed to freeze/thaw cycles) 10% of the Base Price per cubic yard will be deducted from the compensation for that particular Lot of concrete.

K. If the core temperature of the in situ concrete exceeds 160 deg F, the Engineer will evaluate concrete quality using cores taken from the concrete in question. The cores will be tested in accordance with ASTM C 42 and their compressive strength results will be used to calculate the PWL for payment adjustments.

TABLE 4

PERCENT OF LOT WITHIN TOLERANCE LIMIT (PWL)

(STANDARD DEVIATION METHOD)

Positive Values of Quality Index (QI)

(n = Number of Sublots in the Lot)

PWL	n=3	n=4	n=5	n=6	n=7	n=8
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4716
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630
87	1.0597	1.1100	1.1173	1.1191	1.1199	1.1204
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015
83	.9939	.9900	.9785	.9715	.9672	.9643
82	.9749	.9600	.9452	.9367	.9325	.9281
81	.9550	.9300	.9123	.9025	.8966	.8928
80	.9342	.9000	.8799	.8690	.8625	.8583
79	.9124	.8700	.8478	.8360	.8291	.8245
78	.8897	.8400	.8160	.8036	.7962	.7915
77	.8662	.8100	.7846	.7716	.7640	.7590
76	.8417	.7800	.7535	.7401	.7322	.7271
75	.8165	.7500	.7226	.7089	.7009	.6958
74	.7904	.7200	.6921	.6781	.6701	.6649
73	.7636	.6900	.6617	.6477	.6396	.6344
72	.7360	.6600	.6316	.6176	.6095	.6044
71	.7077	.6300	.6016	.5878	.5798	.5747
70	.6787	.6000	.5719	.5583	.5504	.5454
69	.6490	.5700	.5423	.5290	.5213	.5164
68	.6187	.5400	.5129	.4999	.4924	.4877
67	.5878	.5100	.4836	.4710	.4638	.4592
66	.5563	.4800	.4545	.4424	.4354	.4310
65	.5242	.4500	.4255	.4139	.4073	.4031
64	.4916	.4200	.3967	.3856	.3793	.3753
63	.4586	.3900	.3679	.3575	.3515	.3477
62	.4251	.3600	.3392	.3295	.3239	.3203
61	.3911	.3300	.3107	.3016	.2964	.2931
60	.3568	.3000	.2822	.2738	.2691	.2660
59	.3222	.2700	.2537	.2461	.2418	.2391
58	.2872	.2400	.2254	.2186	.2147	.2122
57	.2519	.2100	.1971	.1911	.1877	.1855
56	.2164	.1800	.1688	.1636	.1613	.1592
55	.1806	.1500	.1408	.1363	.1338	.1322
54	.1447	.1200	.1125	.1090	.1070	.1057

END OF SECTION

SECTION 03301

PORTLAND CEMENT CONCRETE, LONG FORM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. List of materials for Work of this Section.

B. Shop Drawings of forms and test pour details at least 15 calendar days before the test.

1. Proposed number, location and details of contraction, control, expansion and construction joints at least 15 days prior to concrete placement.

C. Catalog Cuts, Material Certification and Test Results

1. At least 35 calendar days prior to concrete placement, the following:

a. Name and address of proposed concrete supplier, type of plant, documentation of State Certification for plant and ready mix trucks, AASHTO Accreditation certification for the independent testing laboratory and certification for an on-site individual in a supervisory capacity from one of the programs specified in 3.03 A.

b. Material certifications, source, brand name and test results (where required) of cement, fine and coarse aggregate, fly ash, slag, silica fume, metakaolin and concrete admixtures following guidelines of Appendix "B". In addition, arrange for an independent testing laboratory to verify that Very High Early Strength Cement meets compressive strength, absolute drying shrinkage and setting time requirements specified in 2.02 B at the testing frequency specified therein.

c. Brand names and chemical compositions of form oil or release agents, evaporation retardant and liquid membrane curing compounds. For Architectural Concrete include this information also for forms, form liners and pigments.

d. Certification of compatibility and five-year performance record for liquid membrane forming curing compound, when used under conditions specified in 3.04 C, and the requirements of 2.02 R.2.

e. Test data and field use history for corrosion inhibitor admixtures (when specified on the Basic Contract Drawing) as per 2.02 O.4:

(1) Manufacturer's test method to determine the concentration of the active component of the inhibitor.

(2) Procedures for the production of concrete mixes containing a corrosion inhibitor for the range of concrete temperatures from 50 deg F to 90 deg F and a procedure for the placement of concrete when a retarder is being used.

f. Certification that admixtures conform to the requirements of 2.02 M submitted with Appendix "B" "Concrete Materials and Mix Proportion Data". Include dosing and re-dosing charts, which shall demonstrate the effects of concrete temperatures from 50 deg F and 90 deg F.

g. A chemical analysis report of the percent by weight of silica fume solids by an approved independent testing laboratory when a wet slurry type of silica fume is being used.

h. Source of expansion and/or contraction joints.

i. Type, number and method of application of concrete vibrators.

D. Samples

1. Concrete ingredients for trial batches including cement, stone, sand, fly ash, slag, silica fume, metakaolin, admixtures, corrosion inhibitor, fibers, latex, pigment and anti-washout agent. Furnish these to the Engineer in whatever quantities he may require at least 35 days prior to concrete placement. This applies to all mixes, including changes to an approved mix.

2. At the request of the Engineer, submit cement, fly ash, slag and/or silica fume samples to check the Mill Certification at any time in accordance with 3.05 C.

3. For architectural concrete, provide two (2) sample panels (12" x 12" x 2" minimum size) for each mix for approval of color and texture. Provide catalog cuts for forms, form liners and form oil or release agents.

E. Construction Procedures and Quality Control Documents and Plans

1. At least 35 calendar days prior to concrete placement, the following:

a. Contractor's Quality Control Plan in accordance with 1.04 B.

b. Precast concrete fabricator's planned schedule for all production and a Quality Control Plan a minimum of 15 days prior to the commencement of production.

c. Cold and Hot Weather Concreting Plans in accordance with 1.03 of the Specification. Materials and methods for protecting concrete from freezing.

d. Pumping Procedure Plan, including, at a minimum, the pumping scheme, pump description, line diameter, line length and the number of turns and line offsets.

e. Written placement procedures that are in conformance with ACI 304R, Chapter 8 if concrete is being placed underwater.

f. Method of adding concrete admixtures, high range water reducers, non chloride accelerators, corrosion inhibitors, anti-washout agent, latex, fibers, pigment, slag, fly ash and silica fume.

g. Mixing and placement procedures and methods, as well as catalog cuts of equipment for installation. For hand mixes, submit the methods of proportioning, mixing (including minimum time requirements), transferring and placing the concrete.

h. Method of concrete placement in pipe piles (including elephant trunk size, length and material type).

i. Method of concrete placement and consolidation adjacent to joint assemblies and embedded hardware.

j. Curing Procedure Plan in accordance with 3.04, including the method and materials for curing.

k. Control Joint Location Plan.

l. Materials and procedures for filling cracks and patching honeycombs and/or spalls.

2. Daily copy of batch records in accordance with 1.04 A.1.a.

F. Concrete Mix Proportions

1. Appendix "B" "Concrete Materials and Mix Proportion Data" at least 35 calendar days prior to concrete placement in accordance with 2.03 A of the Specification. To substantiate the mix proportions, submit all data and field results in accordance with 2.03 A.

2. ACI Grade I certification for all personnel performing concrete testing.

3. Written request to the Engineer for approval if a change in the weights of fine and coarse aggregate and cement is required in the approved mix proportions.

G. For Information Only

1. Pre-concrete construction meeting agenda a minimum of 15 days prior to the scheduled date of the meeting.

2. Minutes of the pre-concrete construction meeting within 5 days of the meeting.

H. Design Computations

1. If required by the Engineer or noted on the Basic Contract Drawing, have design computations signed and sealed by the Professional Engineer licensed in the state where Work is being done.

I. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

(1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

SECTION 03301

PORTLAND CEMENT CONCRETE, LONG FORM

APPENDIX "B"

CONCRETE MATERIALS AND MIX PROPORTION DATA

A. Materials:

1. Cement: Type.....Source/Brand.....
2. Sand: Fineness Modulus.....Source.....
3. Stone: Size.....Class.....Source.....
4. Fly Ash: Type.....Source.....
5. Slag: Grade.....Source.....
6. Microsilica (Silica Fume): Source/Brand.....
7. Metakaolin: Source/Brand.....
8. Admixtures (Source/Brand):

   Air Entraining Agent.....

   Non-Chloride Accelerator.....

   Retarder.....

   Water Reducer.....

   Water Reducer - Retarder.....

   High Range Water Reducer.....

   High Range Water Reducer - Retarder.....

   Polycarboxylate High Range Water Reducer

   Anti-Washout Admixture.....

   Corrosion Inhibitor.....

   Latex.....

   Pigment.....

B. Mix Proportions

1. Proposed method of placement:.....Tremie/Mobile

.....Mixer/Transit Mixer/Portable Mixer/

Pumping/Tube Diameter:.....

2. Proportion of Ingredients:

Cement.....lbs./cu. yd.

Fly Ash.....lbs./cu. yd.

Slag.....lbs./cu. yd.

Silica Fume.....lbs./cu. yd.

Metakaolin.....lbs./cu. yd.

Pigment.....lbs./cu. yd.

Stone.....lbs./cu. yd.

Sand.....lbs./cu. yd.

Water.....lbs./cu. yd.....gallons

Air Entraining Agent:.....ounces/cu. yd.

Admixtures (specify type and amount):

.....at.....ounces/cu. yd.

.....at.....ounces/cu. yd.

.....at.....ounces/cu. yd.

.....at.....ounces/cu. yd.

3. Mix Properties:

Compressive Strength: f'c =.....psi at.....days/hours

Flexural Strength:.....psi at.....days/hours

Permeability at 28 days:.....Coulombs

Slump:.....inches

Water to Cementitious Ratio:.....

Air Entrainment:.....%

Sand/Stone Ratio:

Combined aggregate gradation chart (% retained on each sieve)

Unit Weight:.....lbs./cu. ft.

C. Conformance with ACI 318

Attach a report on mix proportion and test/statistical data documenting conformance with ACI 318, Chapter 5, or ACI 304R, Chapter 8, as they apply to the Work of the Contract.

D. Concrete Supplier/Batch Plant

1. Name:.....
2. Address:.....
3. Contact Name:.....
4. Telephone number/Fax number/E-mail address:.....
5. Quality Control technician(s):.....

   Name(s):.....

   Telephone number(s):.....

END OF APPENDIX "B"

DIVISION 3

SECTION 03364

PLACEMENT OF PORTLAND CEMENT CONCRETE UNDERWATER

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for placing Portland cement concrete in underwater locations by the tremie method or by direct pumping. Placement using pre-placed aggregate is not included in this Section. For requirements for furnishing Portland cement concrete see Section 03301, entitled PORTLAND CEMENT CONCRETE.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Concrete Institute (ACI)

ACI 304.2R	Placing Concrete by Pumping Methods

Port Authority Standard Specification sections:

#03301	Portland Cement Concrete
#03200	Concrete Reinforcement
#03100	Concrete Formwork

1.03 ENVIRONMENTAL REOUIREMENTS

A. For Cold Weather Requirements see Section 03301, entitled PORTLAND CEMENT CONCRETE.

B. For Hot Weather Requirements see Section 03301, entitled PORTLAND CEMENT CONCRETE.

1.04 QUALITY ASSURANCE

A. The Contractor shall be responsible for the quality of the concrete and concrete construction. Quality of concrete will be evaluated by the Authority, based on conformance with the requirements of this Section.

B. The Contractor shall provide labor and means for obtaining all samples of concrete required for tests and for curing and protecting concrete cylinders at the construction site.

C. When required by the Basic Contract Drawings, the test placement shall be scheduled at least two weeks prior to production placement of concrete.

D. For formwork design and performance requirements see Section 03100 entitled Concrete Formwork.

1.05 SUBMITTALS

For submittals, see Appendix "A".

PART 2. PRODUCTS

2.01 MATERIALS

See Section 03301, entitled PORTLAND CEMENT CONCRETE.

PART 3. EXECUTION

3.01 PREPARATION

A. Forms

1. Form materials and design shall be subject to approval by the Authority and shall suit the requirements of the Work indicated on the Basic Contract Drawings. Ensure structural adequacy of the forms under the action of environmental forces as well as forces due to placement of concrete.

2. Form Ties and Spreaders

   Use standard, non-corrosive metal form clamp assembly of type acting as spreaders and leaving no metal within one inch of concrete face. No wire ties, wood spreaders or through bolts will be permitted, except for wales, blocking or other accommodations when approved by the Authority.

3. Form coating shall not be used.

4. Forms shall be mortar tight and shall provide a still water environment in the space to be filled with concrete. Side forms shall extend above top of concrete as required. A diver shall be engaged by the Contractor to monitor the placement of the concrete continuously and shall caulk any joints or leaks which show evidence of loss of mortar or cement such as in the form of a cloud of discoloration emanating from the form.

B. Standby Facilities

To ensure a continuous concrete placement, prior arrangements shall be made to have an alternate concrete plant on standby. Backup cranes, pumps and other equipment necessary to continue the placement shall be readily available on site. All standby facilities shall be subject to the same requirements as applicable to the primary facilities and shall be approved by the Authority.

C. Tube Details

The word "tube" in this Section shall refer to either tremie tube or the pipe line, except where specific reference is made to either the tremie tube or the pipe line. The following types of end sealable, watertight tubes will be permitted:

1. End Plate Sealed Tubes: Loss of seal occurs when the embedded end of this tube is removed from the fresh concrete. Therefore, a separate tube is required at each deposition point. Plate sealed tubes shall not be relocated or removed until completion of the concrete placement.

2. End Valve Sealed Tubes: The seal is maintained even when the embedded end of this type is removed from the fresh concrete. Therefore, the number of tubes will depend on the placement rate. The valve shall be closed with the tube at least partially full of concrete, before the valved sealed tube is carefully removed and relocated without loss of seal.

3. Use of a "Go-devil" or "Pig" in lieu of end plate sealed tube will be permitted. However, as for the end plate sealed tube, a separate tube will be required at each deposition point. Tubes shall not be relocated or removed until completion of the concrete placement.

4. A pipeline may consist of hard pipe or flexible hose, but in order to facilitate reinsertion into the fluid concrete, should a loss of seal occur, its end shall be a hard pipe of a length that can be inserted into the forms.

5. Tubes shall be steel pipe, <u>not</u> aluminum, and shall be minimum one-quarter inch wall thickness (or stronger, if the depth of placement requires). Flexible pipe lines may be any material having the strength to resist the incident pumping pressure and the stiffness to permit insertion into form, reinsertion should a loss of seal occur and the handling incident to the placement procedure.

6. Diameter of tube shall be sufficient to permit unimpeded, smooth flow of concrete through the tube into final position.

7. Each tube shall be clearly marked to show the depth of its outlet. Underwater joints shall be watertight and capable of being easily disconnected and reconnected in 5 minutes or less under project placement conditions. The Authority may require a demonstration of these requirements and shall be provided with a safe means of inspecting assembled tubes for watertightness prior to concrete placement.

8. A hopper or funnel of 1/2 cubic yard minimum capacity shall be provided to transfer concrete to the top of a tremie tube.

D. Pumping Equipment

Mixing and pumping equipment used in mixing and handling of pumped concrete shall be as approved by the Authority. All oil and other rust inhibitors shall be removed from the mixing drums, stirring mechanisms and other portions of the equipment that would be in contact with the concrete before the mixers are used.

E. Construction and Expansion Joints

1. Vertical construction joints are permitted in order to accommodate the methods of placement proposed by the Contractor and approved by the Authority. However, unless specifically permitted by the Authority, these joints shall not be spaced closer than 30 feet.

2. Number, locations and details of construction joints shall be as shown on the approved shop drawings and shall include suitable keys and dowels.

3. Expansion joints if required, shall be located and detailed as shown on the Basic Contract Drawings.

F. All dowels and steel which will be embedded in concrete shall be cleaned of all debris, marine growth, loose rust and oily deposits.

3.02 APPLICATION

A. General

Concrete placement shall be continuous and over the full height. Horizontal construction joints are not permitted, unless specifically shown on the Basic Contract Drawings.

Placement shall begin at the tube which has its outlet at the lowest elevation.

All vertical movement of the tube shall be carefully regulated to prevent loss of seal. Horizontal movement of the tube is not permitted. The mouth of the tube shall, at all times, remain sufficiently immersed in the concrete so as to exert the necessary resistance on the pump to prevent vacuum build-up from causing blockage in the pipe line.

B. Use of a "Go Devil" or "Pig": Any floatable object which will not collapse under incident pressure and which prevents direct contact between fresh concrete and water in the tube may be used for starting the flow of concrete into the tube. For shallow depths, a semi-solid floatable object may be used as a plug. After the object has been forced to the bottom by concrete, the tube shall be slowly lifted just enough to expel the object, and quickly lowered upon expulsion. Use of a Go-Devil or Pig will not be permitted for restarting an interrupted placement operation.

C. Initial Start: The tube with end seal or "Pig" or "Go-Devil" shall be lowered to bottom of the proposed pour; the hopper and tube charged with concrete and the flow of concrete started as follows:

When a tremie tube is used - slowly raise the tube until the concrete flows out of the tube.

When a pipe line is used - start pumping, slowly increasing the pumping pressure until concrete flows out of the pipe line.

D. Control the rate of flow of concrete by slowly raising or lowering tremie tube or by adjusting the valve on the pipe line.

1. A power hoist or other device permitting control of the level of the end of the tube within two inches of the desired level shall be used to support and provide uniform control of the vertical movement.

2. Use of a crane to regulate vertical position of the end of the tube will not be permitted.

3. The operation of handling the tube shall be done off a fixed platform, not a floating platform.

E. During placement, the end of the tube should be maintained with an embedment of 3 to 5 feet in fresh concrete. If a blockage or loss of seal occurs, concrete placement shall cease immediately; the tube shall be withdrawn and restart procedure executed. Restart procedure may also be required if placement is interrupted for an hour or more. If it is feasible to clear the blockage without removing the tube, that maybe permitted if approved by the Authority.

F. Restart Procedure: Same as for initial start except that the tube shall be sealed at the lower end; water evacuated and prevented from entering the tube and the initial placement of concrete shall be through an empty tube.

G. If concrete level in the tremie tube lowers to the vicinity of the bottom of the hopper, the concrete flow shall be slowed or stopped until the hopper is refilled except that where deep placement is involved, it will be permitted to maintain a concrete level below the hopper to prevent the weight from causing the tremie tube to penetrate the stiffening concrete below.

H. The tube may be raised and moved to another location if the mouth remains sealed and the tube at least partially filled with concrete.

I. Laitance Removal:

1. Remove laitance from top of submerged pour surfaces at horizontal construction joints (or cold joints) by use of waterjet and air lift or other device as may be dictated by the depth of water and approved by the Authority.

2. If the concrete is to function as a seal and the top surface is to be uncovered by dewatering, remove laitance after dewatering by a suitable method approved by the Authority.

J. Spacing of tubes: Unless tests are conducted which demonstrate that more liberal limits can be permitted with the specific mix and under the specific conditions which prevail, spacing of tubes in a concrete pour shall not exceed 15 ft. and the distance from the ends of the pour shall not exceed 7 ft. See Paragraph K below for special requirements.

K. Special procedures for placing concrete in facings for bulkheads or other walls:

1. Clean contact surfaces: Before installing forms, the surfaces of the existing wall, tie rods, anchorages and wales which will be in contract with the concrete shall be cleaned by a high pressure water jet or by brushing with a power operated wire brush to remove all grease, marine growth, loose wood splinters, deteriorated wood, loose concrete, or loose rust. Required jet velocity shall be sufficient to remove said materials.

2. Recleaning Contact Surfaces: After forms are in place, and just before placing concrete, clean interior of form by use of a rotating water jet. Overflow to remove displaced material.

3. Placing Concrete:

a. The concrete shall be placed by pumping using pipe lines of flexible hoses with hard pipe ends, with an air vent on the main supply line and under an air pressure sufficient to assure a smooth and continuous flow.

b. The discharge end of the pipe line shall be inserted into the form until the bottom is reached before any concrete is pumped into place. As the level of the concrete rises in the form, the discharge ends shall be slowly withdrawn, care being taken that the ends remain continuously immersed in the newly placed concrete. Kinking the hose or other possible causes of sudden surge in concrete flow shall be avoided. Concrete shall be placed in a smooth and continuous operation at a rate which will avoid damage to the forms and permit the concrete to flow along the length of the form to the adjacent discharge ends, and in such manner as to avoid segregation of the concrete. A manifold shall be provided on the hose leading from the concrete pump and sufficient number of hoses shall lead from the manifold into the form so that the discharge ends are spaced at intervals not to exceed 8 feet. Additional concrete pumps may be used in lieu of a manifold.

c. All concrete in place shall be free of voids, streaks, honeycombs, or other evidence of segregation for porous construction.

d. Build forms several inches higher than the required construction and with a removable top section to trap laitance. Scalp off the laitance after the concrete has set.

e. When appropriate during the placing of the concrete, the forms may be vibrated lightly on the outside to assure the complete filling of the form. The vibrating shall be done using equipment approved by the Authority. Use of vibrators inside the form is not permitted.

L. The allowable lapse of time between mixing and placing of concrete shall be predetermined with the approval of the Authority and carefully monitored during placement. The Authority, at his discretion, may reject any mixed concrete that has not been placed within the time limit.

3.03 FIELD TESTS

See Section 03301, entitled PORTLAND CEMENT CONCRETE.

END OF SECTION

SECTION 03364

PLACEMENT OF PORTLAND CEMENT CONCRETE UNDERWATER

SUBMITTALS

APPENDIX "A"

The following shall be submitted to the Authority, except as otherwise noted.

A. Shop Drawings

1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
2. Proposed locations and details of construction joints. Submit at least 15 days prior to concrete placement.
3. Formwork working drawings. Submit at least 21 days prior to ordering any material or constructing any formwork.
4. Test placement details. Submit at least 15 days before test placement.

B. Catalog Cuts

1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".

C. Samples

1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
2. Formwork ties and spreaders. Submit at least 21 days prior to ordering any material.

D. Construction Procedure and Quality Assurance Documents

Submit the following at least 15 days prior to concrete placement.

1. Qualifications of labor and supervisory personnel for concrete placement.
2. Cold and/or hot weather concreting procedures.
3. Details of plant, equipment, tremie pipe/pipe line and procedures for concrete placement.
4. Details of standby facilities for concrete production and placement.
5. Proposed method of sealing and resealing of tremie pipe or pipe line.
6. Method of removing laitance from construction joints.
7. Placement procedures that are in conformance with ACI 304R, Chapter 8.

E. Design Computations

1. Formwork design calculations and catalog cuts. Submit at least 21 days prior to ordering any material or constructing any formwork.

F. Concrete Mix Design

1. Submit Appendix "B" – "Concrete Materials and Mix Design Data of Section 03301, entitled PORTLAND CEMENT CONCRETE" at least 15 days prior to concrete placement.

END OF APPENDIX "A"

DIVISION 3

SECTION 03420

PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for structural precast prestressed concrete for building construction.

B. All concrete shall be cast in forms at plant before final placement at the construction site.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

2008 New York City Building Code, with latest supplement.

Prestressed Concrete Institute (PCI)

PCI MNL-116	Manual for Quality Control Plants and Production of Precast Prestressed Concrete Products

American Concrete Institute (ACI)

ACI 211	Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 214	Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 318	Building Code Requirements for Reinforced Concrete (Commentary Included)

American Society for Testing and Materials (ASTM)

ASTM A 82	Cold-Drawn Steel Wire for Concrete Reinforcement
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A 416	Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete
ASTM A 497	Welded Deformed Steel Wire for Concrete Reinforcement
ASTM A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 775	Epoxy-coated Reinforcing Steel Bars
ASTM A 884	Epoxy-coated Steel Wire and Welded Wire Fabric For Reinforcement

ASTM C 31	Method of Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Concrete Aggregates
ASTM C 42	Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)
ASTM C 138	Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete
ASTM C 143	Test Method for Slumped Portland Cement Concrete
ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete

American Welding Society (AWS)

AWS D1.1	Structural Welding Code - Steel
AWS D1.4	Structural Welding Code - Reinforcing Steel

American Association of State Highway Transportation Officials (AASHTO)

Division II, AASHTO Standard Specifications for Highway Bridges, Bearing Devices

Steel Structures Painting Council (SSPC)

SSPC SP10	Near-White Metal Blast Cleaning
SSPC-Vis1	Guide to Pictorial Surface Preparation Standards for Painting Steel Surfaces

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. General

1. All design and detailing required by the Contract Design Criteria and Basic Contract Drawing for precast prestressed concrete Work shall be in accordance with ACI 318, the Building Code and the criteria of Section 1.03 C.

B. Building Code

2008 New York City Building Code, with latest supplement, for minimum requirements.

C. Structural Design Criteria

Precast prestressed concrete components shall conform to Contract Design Criteria for East Garage Parking Structure.

In addition, precast prestressed concrete components shall be designed based upon the following minimum structural criteria:

1. Allow for expansion and or contraction, without over- stressing the precast unit and connections, or adjoining construction due to a temperature range of 100 degrees F and shrinkage stresses.
2. Withstand all forces generated by load transfer, anchorage, stripping, handling, transportation and erection stresses. Temporary forces generated by construction activity shall also be considered. No damage to members shall be permitted from forces due to these activities.

D. Working Drawings and Calculations

1. Prepare shop fabrication drawings showing prestressing steel profile, reinforcement, openings, embedded products, stirrups, studs, loop inserts, bearing shoes, connections, sleeves, confinement angles, shear ties, estimated camber, prestressing steel deflection on rollers, finishes, and portions of work for which complete details are not indicated; indicate method of supporting and securing those products. Indicate loads used in the design. Shop fabrication drawings shall be signed and sealed by a Professional Engineer licensed in the state of New York.
2. Prepare design calculations of the precast prestressed concrete units and connections prior to submission of shop drawings. Include design calculations for elastomeric bearing pads. Calculations shall be signed and sealed by a Professional Engineer with a minimum of five years experience in prestressed work, and licensed in the state of New York.
3. Prepare a complete description of erection procedures, including erection design calculation, drawings, methods of hoisting, shoring, jointing, temporary bracing, temporary connections and methods of erection, setting and installing. All erection design calculations and drawings including information related to erection procedures, temporary bracing, etc. shall be signed and sealed by a Professional Engineer with a minimum of five years experience in erection of prestressed work, and licensed in the state of New York.

E. Connections

Design, detail and provide anchors, dowels, bolts, steel welding inserts, and connecting plates as necessary in connection with the fabrication and erection of precast prestressed concrete members to be held in position rigidly to prevent displacement while concrete is being placed. All welding during manufacture and erection shall be in accordance with AWS D1.1 and AWS D1.4, as applicable. Refer to NYC Building Code Section 1910.4.1 for specific requirements on East Garage Parking Structure Shear Wall connections.

F. Reinforcing

Conform to requirements of ACI 318 and Contract Design Criteria. Reinforce all bearing areas against diagonal tension, splitting, rupture and flexure. Place adequate ties, stirrups and reinforcing bars at support points. Allow no bearing pressure in edges of unreinforced sections.

G. Concrete Mix Design

1. Precast Concrete for East Garage Parking Structure shall comply with Specification Section 03301C with Performance Category IV and minimum compressive strength of 5,000 psi at 28 days.

2. Precast Concrete for all other applications, such as catch basin and manhole structures, the precast concrete manufacturer shall design the concrete mix. The following criteria shall apply:
   a. f'c = 5,000 psi minimum.
   b. w/c = 0.4 max
   c. Air content Range: 5% ± 1%
   d. Slump: In accordance with ASTM C 143, but not more than 5 inches or 8 inches when using a high range water reducer.
   e. Aggregates: Size number 67 and in accordance with ACI 211.
3. The mix design shall be prepared in accordance with ACI 318. The mix design selected shall have been previously evaluated by the concrete producer using established methods of statistical quality control in conformance with ACI 318.

1.04 QUALITY ASSURANCE

A. Precast Concrete Manufacturer Qualifications

1. Precast Plant

   Precast prestressed concrete shall be the product of a manufacturer having a minimum of five years experience in casting units of the type shown on the Basic Contract Drawing, and having the capacity and facilities for producing units of the quality specified in this Section.

2. The Engineer will inspect the plant prior to production for production and quality control capabilities.

3. Manufacturer Qualifications

   The precast concrete manufacturing plant shall be currently certified by the Prestressed Concrete Institute Plant Certification Program.

4. The plant quality control and engineering shall be under the direction of a licensed Professional Engineer with at least five years experience in this field.

B. Precast Concrete Installer Qualifications

The entity performing installation of precast concrete shall have successfully completed at least two projects involving quantities and complexities similar to those required under this Contract or a minimum of five years experience in erecting structures of similar type as shown on the Basic Contract Drawing.

C. Allowable Tolerances

1. Tolerances prescribed by PCI MNL - 116 shall be complied with unless otherwise noted on the Basic Contract Drawing.

2. Accuracy of Tensioning Measurements per PCI MNL - 116.

D. Source Quality Control

1. Quality control, inspection and testing to comply with applicable sections of PCI MNL-116 and the additional requirements contained herein.

2. The Contractor shall be responsible for achieving the quality of concrete specified in this Section by controlling the concrete mixes, placing, finishing and curing. The concrete quality control technician shall be present in the plant when Work is in progress. The Contractor shall be responsible for mix adjustments, performing necessary tests, correcting deficiencies and taking all other actions necessary to assure quality control. The Contractor shall maintain control charts showing individual test results for aggregate gradation, slump, air content, cement content and compressive strength. Data for slump, air content and compressive strength will be supplied by the Engineer.

3. Only cement approved by either the New York Department of Transportation or the New Jersey Department of Transportation shall be used.

4. Compressive Strength Tests

   Provide a minimum of 6 cylinders for each 10 cubic yards of batched concrete of the same mix. Statistical evaluation shall be in accordance with ACI 214.

5. Detensioning Compression Tests

   Test cylinders shall be cast in accordance with ASTM C 31 and shall be cured in the same environment as the member containing the concrete from which the cylinders were taken until detensioning or stripping at which time cylinders will be cured by ASTM C 31. Detensioning shall not take place and forms shall not be stripped until the test cylinders show that the concrete has reached 75 percent of compressive strength.

6. Air Content

   Tests shall be made at the same time that specimens for compression tests are made. Tests shall be made in accordance with ASTM C 173 or ASTM C 231.

7. Slump

   Tests shall be made at the same time that specimens for compression tests are made. Tests shall be made in accordance with ASTM C 143.

8. Unit Weight

   Tests shall be made at the same time that specimens for compression tests are made. Tests shall be made in accordance with ASTM C 138.

9. Core Tests

   If the compressive strength tests fail to meet the above requirements, core testing shall be made in accordance with ASTM C 42. If the core tests prove unsatisfactory, the unit shall not be used. Core tests shall be performed at no additional cost to the Authority.

1.05 DELIVERY, STORAGE AND HANDLING

A. The manufacturer's instructions for handling and transportation of prestressed precast concrete units shall be followed.

B. Lift members at designated points only, using approved lifting inserts.

C. Do not place members in position which will cause overstress, warp, or twist.

D. Handle members to protect from dirt, damage and staining.

E. Place stored members so that identification marks are discernible.

F. Separate stacked members by battens across full width of each bearing point.

G. Stack members so that lifting inserts are accessible and undamaged.

H. For facade panels, in addition to the requirements above, place non-staining resilient spacers of even thickness between units and support units during shipment on non-staining shock absorbing material.

1.06 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.07 SUBMITTALS

A. For Submittals see Appendix A.

B. Do not deliver any precast prestressed members to the construction site until all approvals have been obtained.

PART 2. PRODUCTS

2.01 MATERIALS

A. Portland Cement

1. ASTM C 150, Type I or III standard light gray throughout unless otherwise shown on the Basic Contract Drawing.
2. Use same brand, type, and source of supply throughout.

B. Admixtures

1. Air Entraining Agent: ASTM C 260.
2. Water Reducers, Water Reducer - Retarders, High Range Water Reducers and High Range Water Reducer - Retarders shall conform to ASTM C 494. They shall not contain lignosulfonic acids or their salts. Any combination of admixtures used shall not result in the addition of chloride ions in excess of the equivalent of 0.25 pounds per cubic yard of calcium chloride nor shall any individual admixture contain more than 0.4% chloride ions.

C. Aggregates: ASTM C 33, size number 67 and in accordance with ACI 211.

D. Water: Potable and free from foreign materials in amounts harmful to concrete.

E. Reinforcing Bars:

1. For East Garage Parking Structure, all steel reinforcing bars shall be either epoxy-coated or hot-dip galvanized at Contractor's option.
2. Steel reinforcing bars shall be in conformance with Specifications Section 03200C.
3. Reinforcing bar coupler systems shall be compatible with the selected coating of reinforcing bars.

F. Steel Wire

1. ASTM A 82 - Cold Drawn Steel Wire
2. ASTM A 185 - Welded Steel Wire Fabric

3. ASTM A 497 - Welded Deformed Steel Wire

G. Tie Wires

Minimum 16-gage annealed type.

H. Tendons for Pretensioning: ASTM A 416, Grade 270.

I. Anchors, Inserts and Embedded Items

1. Conform to Contract Design Criteria.
2. Finish of steel hardware units.

   Steel hardware units shall be hot-dip galvanized per ASTM A 153, unless otherwise shown on the Basic Contract Drawing.

J. Curing Materials

1. Liquid Membrane Forming Compounds: ASTM C 309.
2. Sheet Materials: ASTM C 171.

K. Grout

A premix product (only water to be added at the construction site), containing shrinkage-compensating, non-metal portland cement based material, meeting the following requirements:

1. Compressive Strength

   When tested in accordance with ASTM C 109, the strength shall not be less than values shown on the Basic Contract Drawing.

   Shrinkage 3 and 7 days test specimens shall show complete shrinkage correction as compared with the original height of the specimen.

2. Setting Time

   The initial setting time shall be sufficiently long so as to permit time for thorough mixing and normal conveying, handling and placing for the type of grouting operation being considered. Materials that produce very rapid set, or flash set, such that the mortar would require tempering, are not acceptable.

L. Elastomeric Bearing Pads

Chloroprene (Neoprene)

Conform to Division II, Bearing Devices of AASHTO Standard Specifications for Highway Bridges.

M. Miscellaneous Materials

1. Shims: Hot-dipped galvanized steel per ASTM A 153 or plastic. ("Korolath" as manufactured by Korolath of New England, Hudson, Mass. or approved equal.)
2. Joint Fillers and Joint Sealants

   The manufacturer shall provide all required joint filler and joint sealant recess details and notches to insure a watertight installation. The manufacturer shall review the joint filler and joint sealant installation procedures and details to ensure compliance with the manufacturer's design intent. The form release agent shall be compatible with the joint sealant system.

2.02 FABRICATION

A. Fabrication shall be governed by the provisions of PCI MNL 116 and any additional requirements contained herein.

B. Formwork

1. Construct forms to withstand tensioning and detensioning operations.
2. Construct forms to maintain units within the tolerances specified in 1.04 C herein with radius or chamfer at corners.
3. Securely attach anchorage devices to formwork in locations not affecting position of main reinforcement or placing of concrete.
4. Forms shall be made of steel.

C. Reinforcement

1. Fabricate and place concrete reinforcement as shown on Basic Contract Drawing and on approved shop drawings in accordance with ACI 301.
2. Bend all concrete reinforcement cold. Heating of bars or steel wire is prohibited.
3. Clear concrete reinforcement of loose rust, mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
4. Additional reinforcing shall be provided to resist all tensile stresses incurred during initial prestressing, handling and erection.
5. Steel Wire Fabric: Supply in flattened sheets or mats.
6. Reinforcing Bar Accessories: Shall be of a non-corrosive type to suit the condition.
7. All reinforcement including steel wire fabric in precast concrete conform to Contract Design Criteria and the following requirements:
   a. Reinforcing steel shall be free from slivers, rust, grease and oil. Additionally, uncoated steel shall pass bend test (displaying freedom from cracks) prior to being accepted for coating application.
   b. The surface to be coated shall be blast cleaned in accordance with SSPC-SP10. After blasting, the cleaned surface of the bar shall be defined by SSPC-Vis-1, ASa 2-1/2 or CSa2-1/2, as applicable.
   c. Repair sheared and cut ends and damaged coating, in accordance with the patching material manufacturer's recommendation.

D. Casting

1. Place concrete in continuous operation to prevent formation of seams.
2. Where ends of strands will not be enclosed or covered, cut flush, power tool clean in accordance with coating manufacturer's recommendation and immediately paint tendon ends with two coats of epoxy mastic. Cover with a high strength mortar bonded with an epoxy resin, bonding agent.
3. Where units are to receive concrete topping for curbs or sidewalks, or where top of unit is recessed to receive concrete topping at locations such as drains, joints, and connections, provide raked finish for bonding with concrete topping in accordance with ACI. Liquid curing compounds shall not interfere with bonding.
4. Include cast-in weld plates where required for anchorage or lateral bracing to structural steel and adjacent precast members as shown on the Contract Design Criteria and Basic Contract Drawing.
5. Provide block-outs for openings as required.
6. Provide permanent markings in precast units to identify pickup points and location in structure.

7. Curing of precast concrete shall be in accordance with the approved curing procedures.

E. Prestressing

1. The tension to which the strand is to be prestressed shall be established by the jack pressure reading on a calibrated gauge of approved type and verified by measurement of strand elongation. Means shall be provided for measuring the elongation of the strand to at least the nearest 1/8-inch. When the gauge reading and elongation measurement disagree by more than 5 percent, the cause of the discrepancy shall be found and corrected.
2. Strands shall not be spliced within a member.

F. Finishes

1. Concrete finishes shall be as shown on the Contract Design Criteria, Basic Contract Drawing and shall conform to PCI MNL-116 with additional requirements as follows: Fill all air pockets and holes over 1/2 inch in diameter using a sand-cement paste. For exposed areas, form offsets or fins over 1/8 inch shall be ground smooth. Finished surfaces shall be smooth, even textured, uniform in color and free of surface defects or blemishes.
2. All exposed non-galvanized carbon steel anchors and plates shall be painted with two coats of zinc-rich epoxy polyamide paint. Finish coat shall be as directed by the Engineer.
3. Touch up exposed damaged galvanized surfaces with two coats of zinc-rich epoxy polyamide paint.

G. Cracks

Do not deliver any units which exhibit cracks in production at the plant unless approved otherwise by the Engineer. Units which are cracked by handling, shipping, erection and connecting operations shall be rejected and returned to the plant unless accepted otherwise by the Engineer. Acceptability of the units is at the sole discretion of the Engineer. Any remedial work ordered by the Engineer shall be at no additional cost to the Port Authority. The cause of the cracking shall be eliminated from the subsequent precast units.

PART 3. EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which precast prestressed concrete units are to be installed. Do not proceed with the Work until unsatisfactory conditions have been corrected to the satisfaction of the Engineer.

B. Inspect bearing surfaces of structure to ensure they are smooth, level and free of debris.

C. Verify that required inserts and anchors for connection to precast prestressed concrete units have been erected.

3.02 ERECTION

A. Coordinate erection of precast prestressed concrete units according to the shop drawings.

B. Coordinate and perform welding as required to suit connection design and structural requirements, complying with AWS D1.1 and AWS D1.4.

C. The Contractor shall provide that the precast concrete manufacturer have available at the construction site a trained representative of the said manufacturer, at no additional cost to the Authority.

D. Ensure that precast prestressed concrete units have been accurately set as shown on the Basic Contract Drawing and that members have been shored during erection where necessary to minimize camber between adjacent units.

E. Set precast prestressed concrete units on bearing pads specified in 2.01 L herein with bearing surface not less than that shown on the approved shop drawings.

F. Do not cut holes or install sleeves, without the written permission of the Engineer, larger than size permitted by precast prestressed concrete manufacturer for pipe, conduits duct or other penetrations after fabrication.

G. Do not cut reinforcing or prestressing strands without written approval of the manufacturer and as acceptable to the Engineer.

H. Field cut holes for openings, with the written permission of the Engineer, in slab only, that do not disturb prestressing strands in accordance with the manufacturer's instructions. No holes are to be cut through stems of tees.

3.03 REPAIRS

A. Make field repairs to damaged areas of the reinforcing bar coating. The material used for field repair shall be that supplied by the coating applicator in accordance with the patching material manufacturer's recommendation. Field repair shall be required wherever the area of coating damaged exceeds the cross-sectional area of the reinforcing bar. Field repair shall not be allowed on bars that have severely damaged coatings as determined by the Engineer. Replace the damaged reinforcing bars. A severely damaged coating is defined as a coating that has a total damaged area greater than 5 percent of surface of the reinforcing bar.

B. Correct precast prestressed concrete units that do not conform to the specified requirements, by whatever means and in whatever manner that may be directed by the Engineer, at no additional cost to the Authority.

C. Erected precast prestressed concrete units may be rejected, at the sole discretion of the Engineer for any of but not limited to the following reasons:

1. Exceeding the installation tolerances specified in 1.04 herein.
2. Damaged during installation operations.
3. Having exposed-to-view surfaces that develop surface finish deficiencies.
4. All rejected precast prestressed concrete units shall be removed and replaced.

END OF SECTION

SECTION 03420

PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION

APPENDIX "A"

SUBMITTALS

The following shall be submitted to the Engineer for approval except as otherwise noted:

A. Shop Drawings

1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
2. Submit shop fabrication drawings under 1.03 D.1.

B. Catalog Cuts, Material Certification and Test Results

1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".
2. Product Data: Submit the following, including name of manufacturer and supplier:
   a. Cements, each type
   b. Aggregates, each type. (Aggregates are to be from approved D.O.T. sources)
   c. Admixtures
   d. Reinforcing bars and prestressing steel
   e. Steel wire fabric reinforcement
   f. Concrete
   g. Welding electrodes
   h. Studs
   i. Embedments, inserts and anchors
   j. Elastomeric bearing pads
   k. Non-shrink grout
   l. Liquid curing compounds
   m. Joint fillers and joint sealants
   n. Rebar chairs and spacers.
   o. Mechanical splices.
3. Submit the following certifications and test reports:
   a. PCI Certification Program Certificate.
   b. Current certified calibrations for stressing jacks and compression testing machine.
   c. Material certifications, source, brand name and test results (where required) of cement, fine and coarse aggregate, and concrete admixtures following guidelines of Appendix "B". Provide certification of no detrimental Alkali Silica Reaction (ASR) between cement and fine and coarse aggregates.
   d. Certification of compatibility and five-year performance record for liquid membrane, if used under conditions specified in 2.02 D.
   e. Certification that Water Reducers, Water Reducer - Retarders, High Range Water Reducers and High Range Water Reducer - Retarders conform to the requirements of 2.01 B submitted with Appendix "B" "Concrete Materials and Mix Design Data".

f. Test reports and certification from an approved testing laboratory showing that all component materials including strands, steel, and bearing pads conform the requirements of this Section.

g. Certified mill test reports for metal reinforcement and wire fabric.

h. Certification from the applicator of epoxy that the epoxy coated reinforcing bars meet the requirements of ASTM A 775.

i. Certification from the applicator of epoxy that the epoxy coated steel wire fabric meets the requirements of ASTM A 884.

j. Test results and certification from the galvanizer that the weight, application and testing of zinc coating conforms with specifications and ASTM A 767.

k. Current certification of welders for welding reinforcement, shop and field connection in accordance with the requirements of AWS.

l. Brand name and chemical composition of form oil, and curing compounds (liquid membrane).

m. Q.C. Test records of all concrete placed.

n. Records of magnitude of prestressing pressures both by force and elongation.

o. Precast concrete manufacturer qualifications.

p. Precast concrete installer qualifications.

C. Samples

1. As per Division 1 "Shop Drawings, Catalog Cuts and Samples".

2. Concrete ingredients for trial batches. At the request of the Engineer furnish these to the Engineer in whatever quantities he may require at least 35 days prior to concrete placement.

3. At the request of the Engineer, submit cement samples to check the mill certification at any time.

D. Construction Procedures and Quality Control and Assurance Documents

1. Submit complete description of forming, positioning reinforcement, casting, prestressing, finishing, curing, detensioning, and lifting, including the following:

a. Details and locations of lifting devices.

b. Strand pattern and elevation view of each member.

c. Jack clearances and jacking procedures and procedure for measuring elongation, slippage, and abutment yield.

d. Method of measuring initial tensioning forces, final tensioning forces, and tension elongation.

e. Curing times and procedures.

f. Estimated elapsed time between all operations, and predicted deformation at all stages.

g. Minimum concrete compressive strengths at initial prestress and 28 days and the initial prestress to be applied.

h. Show location of precast prestressed sections with same identification marks used in fabrication.

i. Finishes.

j. Welding.

2. Submit erection drawings and procedures under 1.03 D.3.

3. Submit Quality Control and Quality Assurance Plan and Procedures.

E. Design Computations

Submit design calculations under 1.03 D.2 and erection calculations under 1.03 D.3.

F. Concrete Mix Design for East Garage Parking Structure

1. Comply with submittal requirements on Specification Section 03301C.

G. Concrete Mix Design for Applications other than East Garage Parking Structure

1. Submit Appendix "B" - "Concrete Materials and Mix Design Data" at least 35 days prior to concrete placement.
2. To substantiate mix design submit all data and field results in accordance with Appendix "B" "Concrete Materials and Mix Design Data" to the Manager of Materials with a copy to the Engineer.
3. Submit a written request to the Engineer for approval, if pumping is proposed as a method of concrete placement with proposed mix design in accordance with Appendix "B" "Concrete Materials and Mix Design Data". Submittal shall include pumping scheme, pump description, line diameter and line length.
4. Submit a written request to the Engineer for approval if a change in the weights of fine and coarse aggregate and cement is required in the approved mix design in accordance with Appendix "B" "Concrete Materials and Mix Design Data".

H. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:
   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:
      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.
   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

SECTION 03420

PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION

APPENDIX "B"

CONCRETE MATERIALS AND MIX DESIGN DATA

A. Materials

Cement: Type _____ Source/Brand _____

Sand: Fineness Modulus _____ Source _____

Coarse Aggregate: Size _____ Class _____ Source _____

Admixtures (Source/Brand): Air Entraining Agent _____

Non-Chloride Accelerator _____

Retarder _____

Water Reducer _____

Water Reducer – Retarder _____

High Range Water Reducer _____

High Range Water Reducer – Retarder

B. Mix Design

Proposed method of placement:

Proportion of Ingredients:

Cement _____ lbs./cu. yd.

Sand _____ lbs./cu. yd.

Coarse Aggregate _____ lbs./cu. yd.

Water _____ lbs./cu. yd.

Admixtures (specify): _____

Air Entraining Agent: _____ ozs./cu. yd.

Mix Properties:

Strength at 28 days: f'c= _____ psi

Slump _____ inches

Water/Cement ratio _____

Air Entrainment _____ %

Sand/Coarse Aggregate ratio _____

Unit Weight _____ lbs./cu. ft.

C. Conformance with ACI 318

Attach a report on mix design and test/statistical data documenting conformance with ACI 318, Chapter 5.

END OF APPENDIX "B"

07-18-13P03:35 RCVD

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
ANALYSIS OF BID
THIS IS NOT PART OF THE CONTRACT

PROJECT **LGA 124.201 - East Parking Garage** CONTRACT **LGA 124.201** w/A#1

CONTRACTOR Yonkers Contracting Company, Inc. DATE July 18, 2013

Unit No.	Descriptions (1)	Quantity	Unit (2)	Unit Price	Amount
1	General Conditions	1	LS	$6,693,000.00	$6,693,000.00
2	Civil				
3	Removals	1	LS	$250,000.00	$250,000.00
4	DGABC	1,299	CY	$75.00	$97,425.00
5	Asphalt Concrete (76-22)	2,161	TON	$140.00	$302,540.00
6	Concrete Sidewalk/Island	175	CY	$800.00	$140,000.00
7	Concrete Curb	1,030	LF	$40.00	$41,200.00
8	Select Fill	3,283.00	CY	$55.00	$180,565.00
9	Utilities	1	LS	$500,000.00	$500,000.00
10	Ornamental Fence	1	LS	$40,000.00	$40,000.00
11	Other Civil	1	LS	$100,000.00	$100,000.00
	(Continue to next page)				

(1) Separate and list all items or operations of work included in your estimate in accordance with Specifications.
When listing subcontracts, the prime contractor will have each subcontractor complete an analysis of bid form.

(2) Unit of measure, i.e., SF, CY, Bbls, Pcs, Ea., etc.

3. Include all charges, such as moving on site, removal, rental, etc.
4. In case of conflict between information hereon (whether supplied by the Authority or the bidder) and the terms or prices contained or inserted in the Contract Booklet or Contract Drawings, said Booklet and Drawings shall control.
5. The Analysis of Bid is not part of the contract. No information hereon (whether supplied by the Authority or the bidder) and no information deduced from information hereon, including quantities of materials or work, shall be deemed to vary, alter or modify and provision of the Contract, including provisions therein as to compensation and performance. The unit prices contained hereon serve the sole purpose of informing Port Authority as to components of the bidder's price quoted in the Contract. The items of materials or work contained hereon shall not deemed to be an exhaustive list of the items of materials or work required by the Contract Drawings and Specifications in their present form.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

ANALYSIS OF BID

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PROJECT **LGA 124.201 - East Parking Garage** CONTRACT **LGA 124.201**

CONTRACTOR Yonkers Contracting Company, Inc. DATE July 18, 2013

12	Geotechnical				
13	Concrete filled steel pipe piles or drilled concrete piers (Specify type and diameter)	40,825	LF	$125.00	$5,103,125.00
14	Excavation, Backfill and Disposal	1	LS	$500,000.00	$500,000.00
15	Dewatering	1	LS	$100,000.00	$100,000.00
16	Structural				
17	Pile Caps or Pier Caps (Includes Reinforcement, Concrete, Formwork, etc)	700	CY	$1,200.00	$840,000.00
18	Grade Beams (Includes Reinforcement, Concrete, Formwork, etc)	1,080	CY	$1,200.00	$1,296,000.00
19	Ground Level Slab (Includes Reinforcement, Concrete, Formwork, Vapor Barriers, etc.)	58,565	SF	$20.00	$1,171,300.00
20	Elevated Slabs/Ramp (Precast Concrete Double Tee, Concrete Topping, Connections and Bearings, Expansion Joints, Joint Sealants, etc.)	262,721	SF	$25.00	$6,568,025.00
21	Precast Concrete Shear Walls	15,720	SF	$65.00	$1,021,800.00
22	Precast Concrete Columns	1,834	LF	$550.00	$1,008,700.00
23	Elevator Shaft Steel Framings	1	LS	$150,000.00	$150,000.00
24	8" CMU Walls	12,500	SF	$40.00	$500,000.00
25	Steel Cable Railing Perimeter Barriers	1	LS	$400,000.00	$400,000.00
26	Interior Garage Bollards	418	EA	$1,000.00	$418,000.00

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

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PROJECT **LGA 124.201 - East Parking Garage** CONTRACT **LGA 124.201**

CONTRACTOR Yonkers Contracting Company, Inc. DATE July 18, 2013

27	Other Structural (Relocated Overhead Sign Structure Foundations, Equipments and Light Poles Foundations, Façade Subframing System, Sign Panels, Equipments and Piping Supports, Post-Installed Anchor Connections, Seismic Supports for Nonstructural Components, Precast Underground Concrete Utility Structures, etc.)	1	LS	$150,000.00	$150,000.00
28	Architectural				
29	Louver Screen Wall Including Framing - Aluminum Screen Panel	40,800	SF	$115.00	$4,692,000.00
30	Curtain Wall System	7,000	SF	$110.00	$770,000.00
31	Miscellaneous - (Metal Fence, Lockable Double Gate, Tension Cable Vehicular Barrier at Perimeter, Glass Wind Screen at Elevator)	1	LS	$100,000.00	$100,000.00
32	Roof Covering	2,800	SF	$55.00	$154,000.00
33	Metal Panel Canopy	700	SF	$215.00	$150,500.00
34	Hollow Metal Doors, Frames, Hardware - Exterior and Interior	1	LS	$60,000.00	$60,000.00
35	Stair Construction and Finishes - (Including Landing and Railing)	33	FLT	$25,000.00	$825,000.00
36	Finishes (Paint, Plaster, Slip Resistant Finish to Concrete, Stainless Steel Base at Elevator, etc)	1	LS	$500,000.00	$500,000.00
37	Elevators and Lifts				
38	Passenger Elevator - (4,000 #, 350 FPM)	3	EA	$165,000.00	$495,000.00

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

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PROJECT **LGA 124.201 - East Parking Garage** CONTRACT **LGA 124.201**

CONTRACTOR Yonkers Contracting Company, Inc. DATE July 18, 2013

39	Elevator Cab - Glass Elevator Cab- All Walls Are Standard 9/16" Laminated Glass, Stainless Steel Welded Frames	3	EA	$335,000.00	$1,005,000.00
40	Elevator Floor Finish	3	EA	$1,000.00	$3,000.00
41	Bird Management System - Bird Slides, Bird Wire, Bird Shock Track)	22,000	LF	$7.00	$154,000.00
42	Other Architectural	1	LS	$1,000,000.00	$1,000,000.00
43	Mechanical				
44	Distribution Systems, Terminal Package Units	1	LS	$400,000.00	$400,000.00
45	Controls and Instrumentation-BMS Controls	1	PTS	$10,000.00	$10,000.00
46	Testing and Balancing	1	LS	$25,000.00	$25,000.00
47	Other (Misc. Supports, Fuel Oil Piping, Fuel & Vent Piping, Fuel Oil Tank, Start Up & Commissioning, etc)	1	LS	$200,000.00	$200,000.00
48	Plumbing				
49	Plumbing Fixture and Accessories	1	LS	$100,000.00	$100,000.00
50	Domestic Water Distribution	1	LS	$200,000.00	$200,000.00
51	Sanitary Waste	1	LS	$300,000.00	$300,000.00
52	Rain Water Drainage	1	LS	$500,000.00	$500,000.00
53	Other Plumbing System (Curb Valve, Heat Tracing, Testing & Inspection, Core Drills,Sleeving & Sealing, etc)	1	LS	$100,000.00	$100,000.00
54	Fire Protection				

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

ANALYSIS OF BID

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PROJECT **LGA 124.201 - East Parking Garage** CONTRACT **LGA 124.201**

CONTRACTOR Yonkers Contracting Company, Inc. DATE July 18, 2013

55	Standpipes	1	LS	$250,000.00	$250,000.00
56	Fire Protection and Specialties	1	LS	$250,000.00	$250,000.00
57	Other Fire Protection System (Testing & Inspection, Core Drills,Sleeving & Sealing, etc)	1	LS	$25,000.00	$25,000.00
58	Electrical				
59	Electrical Service and Distribution				
60	Electrical Utilities Site Work Including Manhole	1	LS	$200,000.00	$200,000.00
61	4.33 KV Incoming Feeders	1	~~KF~~ LS	$20,000.00	$20,000.00
62	2X500 KVA 5KV to 480V Double-ended Substation	1	LS	$300,000.00	$300,000.00
63	30 KVA Transformer	1	EA	$150,000.00	$150,000.00
64	250 KW Emergency Generator with Enclosure	1	EA	$700,000.00	$700,000.00
65	Other (Panels, Electrical Panels, Remaining Transformer, UPS - for Communication & Security Equipment, Misc Electrical Gear, etc)	1	LS	$300,000.00	$300,000.00
66	Electrical Feeders	1	LS	$1,000,000.00	$1,000,000.00
67	Feeders/Connections to Mechanical Equipments	1	LS	$100,000.00	$100,000.00
68	Lighting and Branch Wiring	1	LS	$850,000.00	$850,000.00
69	Fire Alarm and Alarm Detection	1	LS	$500,000.00	$500,000.00
70	Public Addess System	1	LS	$500,000.00	$500,000.00
71	Communications System	1	LS	$500,000.00	$500,000.00
72	Security Systems				

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

ANALYSIS OF BID

THIS IS NOT PART OF THE CONTRACT

PROJECT **LGA 124.201 - East Parking Garage** CONTRACT **LGA 124.201**

CONTRACTOR Yonkers Contracting Company, Inc. DATE July 18, 2013

73	MDF & Telecom Room Build Out	1	LS	$400,000.00	$400,000.00
74	Electronic Ductbank & Maintenance Hole	1	LS	$300,000.00	$300,000.00
75	Security Cameras	1	EA	$750,000.00	$750,000.00
76	Emergency Phones/Intercom	1	EA	$150,000.00	$150,000.00
77	Cellular Repeater	1	EA	$150,000.00	$150,000.00
78	Remaining Security System	1	LS	$50,000.00	$50,000.00
79	Other Electrical Devices (Grounding, Lightning Protection, Snow Melting System, Heat Tracing, Enclosures to Outdoor Equipment, Testing and Commissioning, etc)	1	LS	$100,000.00	$100,000.00
80	Traffic				
81	Permanent Traffic				
82	Pavement Markings	20,296	SF	$5.00	$101,480.00
83	Garage Signage	1	LS	$400,000.00	$400,000.00
84	Other Signage	1	LS	$100,000.00	$100,000.00
85	Parking Guidance VMS - LED VMS Tower Signs	2	EA	$75,000.00	$150,000.00
86	Parking Guidance VMS - LED 2 Line VMS	5	EA	$75,000.00	$375,000.00
87	Floor Count Sign Counting Device and Other Parking Equipment	1	LS	$75,000.00	$75,000.00
88	Other Permanent Traffic	1	LS	$50,000.00	$50,000.00
89	Maintenance of Traffic	1	LS	$200,000.00	$200,000.00
90	**Total Lump Sum - Construction (items 1-89)**		**LS**		$48,311,660.00

07-18-13P03:35

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
3RD FLOOR
3 GATEWAY CENTER
NEWARK, NEW JERSEY 07102

May 15, 2013

NOTICE TO BIDDERS

TO ALL PROSPECTIVE BIDDERS FOR CONTRACT **LGA 124.201**.

The drawings that are Confidential contain the "CONFIDENTIAL" mark on them. As of now, the following are considered Confidential: ES101, ES102, ES103, ES106, ES201, ES202, ES203, ES204, ES301, ES302, ES501.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

July 15, 2013

ADDENDUM NO. 11

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA-124.201** – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

07-18-

CHANGES TO THE CONTRACT BOOK

Page viii - Delete the listing for Section 16935 without substitution.

Page 280 - Delete 17.A.7) and substitute therefor the following:

"7) Digital Metering Systems

a. Furnish and install the following Schneider Electric/Square D equipment, no substitution allowed:

(i) Meters type ION-7330 for both incoming 5KV switches within each switch cubicle,

(ii) NEMA 12 Ethernet enclosure with prewired Lantronix ION protocol converter, Ethernet switch, SC connectors and 120VAC 1-pole circuit breaker.

b. Provide the following services from Schneider Electric/Square D authorized representative. , no substitution allowed:

(i) In-office work for programming and modifying existing SCADA screens at Central Monitoring Station located at Hangar 11 to depict East Garage Substation loading data. Existing SCADA screens were developed by Schneider Electric/Square D under LGA-124.181 and LGA-124.198.

(ii) On-site start-up/commissioning work and integration of all SCADA components.

(iii) Technical assistance up to 2 days in verifying and troubleshooting communication from East Garage switchgear to existing SCADA Central Monitoring Station located at Hangar 11 utilizing existing airport-wide fiberoptic network.

(iv) As-built system documentation for program software and screen shots.

RECEIVED
JUL 16 2013
Yonkers Contracting Company
Estimating Department
VPS

07-18-13 RCVD

c. The following is the contact information of Schneider Electric/Square D authorized representatives:

(i) GRC Inc, 119 Rockland Ave, Nothvale, NJ 07647, tel. 201-767-6100

(ii) L.B. Electric Supply Co., 502 New Utrecht Ave, Brooklyn, NY 11219, tel. 718-438-4700, x-1082

(iii) Graybar Electric, 800 Huyler Street, Teterboro, NJ 07608, tel 201-596-2662"

Pages 1282 through 1310 Delete these pages in their entireties and substitute therefor "NOT USED".

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

Richard D. McGrath, VP
Yonkers Contracting Company, Inc.
Dated: July 17, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER, 3rd FLOOR
NEWARK, NJ 07102

July 15, 2013

NOTICE TO BIDDERS

TO PROSPECTIVE BIDDERS ON CONTRACT LGA-124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

Attached herewith is a copy of a letter from S&C Electric Company offering to quote prices for switchgear and related Work under this Contract.

The foregoing letter does not form a part of this Contract nor does the Authority represent to the bidders any conclusions to be drawn therefrom. It is made available to the bidders for the sole purpose of apprising them of the information furnished to the Authority. The cost of these items should be included in your Proposal.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

Richard D. McGrath, VP
Yonkers Contracting Company, Inc.
Dated: July 17, 2013

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Estimating Department
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THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

July 15, 2013

ADDENDUM NO. 10

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA-124.201** – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES TO THE CONTRACT BOOK

Page 1 - In the first paragraph, change the day and date for receipt of Proposals to "Thursday, July 18, 2013".

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

Richard D. McGrath, VP
Yonkers Contracting Company, Inc.
July 15, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

July 8, 2013

ADDENDUM NO. 9

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA-124.201** – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES TO THE CONTRACT BOOK

Page 1 - In the first paragraph, change the date for receipt of Proposals to "July 16, 2013".

Page 152 - Make the following change:

A. At the end of paragraph B.1) insert the following: "Updates shall include approved shop drawings pertaining to the physical changes in the constructed elements at an LOD 400."
B. Below paragraph B.2) insert the following: "3) The Contractor shall submit revised CAD and BIM files reflecting approved shop drawings based on the submittal schedule in the clause entitled SHOP DRAWINGS, CATALOG CUTS AND SAMPLES."

Pages 171 through 221 On the Room Data Sheet for rooms 102, 103, 106, 107, 109, 110, 111, 112, 202, 203, 206, 207, 209, 302, 303, 306, 307, 309, 402, 403, 406, 407, 409, 502, 503, 506, 507, 509, 602, 603, 606, 607 and 612, delete the ceiling finish designation of "Exposed Mtl. Deck" and substitute therefor "Sealed Conc."

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CHANGES TO THE CONTRACT DRAWINGS

Dwg FP501 In the lower center portion of the drawing insert the following:
"Notes:

1. THE PARKING STRUCTURE SHALL BE PROVIDED WITH CLASS I MANUAL DRY STANDPIPE SYSTEM, A 6-INCH FIRE WATER SUPPY, BACKFLOW PREVENTER AND ASSOCIATED EQUIPMENT WITH CURB VALVE BOX LOCATED OUTSIDE OF THE BUILDING.
2. A SINGLE CENTRALIZED FLOW SWITCH CAN BE PROVIDED FOR THE FIRE WATER MAIN PIPING IN LIEU OF PROVIDING ADDITIONAL FLOW SWITCH AT THE BASE OF EACH FIRE STANDPIPE RISER."

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: July 9, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

July 5, 2013

ADDENDUM NO. 8

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA-124.201** – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES TO THE CONTRACT BOOK

Page 238 - In the 3rd line of paragraph C.1) b). delete "be" and substitute therefor "match in color and sheen".

Page 243 - In paragraph 4.a., delete the 2nd, 3rd and 4th sentences and substitute therefor the following: "Refer to Geotechnical Subsurface Investigation Stage 1 Report for appropriate garage foundation system alternatives."

Page 246 - Delete the text of 4.o. in its entirety and substitute therefor "Not Used".

Pages 304 through 310 Delete these pages in their entireties and substitute therefor new pages 304 through 310, which are attached hereto and made a part hereof.

CHANGES TO THE REFERENCE DOCUMENTS

In the Reference Document entitled "LaGuardia Airport Redevelopment Program East Garage Code Analysis", on page 2 of the section entitled "Fire Protection and Life Safety Concept Report", in the 2nd line of the first paragraph under the heading "Exterior Walls", insert the word "future" immediately before "Central Heating".

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THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: July 8, 2013

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THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY W/5 DRAWINGS
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NEWARK, NJ 07102

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Estimating Department
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July 2, 2013

ADDENDUM NO. 7

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA-124.201** – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES TO THE CONTRACT BOOK

Page viii - Delete the listing for Section 16766 in its entirety.

REVISED CONTRACT DRAWINGS

Contract Drawings A201, A202, A311, A313, and A751 have been revised as of 7/1/2013. Destroy the drawings of these numbers now in your possession and substitute therefor the revised drawings.

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THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: July 8, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

June 27, 2013

ADDENDUM NO. 6

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA-124.201** – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

REVISED CONTRACT DRAWING

Contract Drawing T025 has been revised as of 06/25/2013. Destroy the drawings of this number now in your possession and substitute therefor the revised drawings.

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THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

w/1 dwg.

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Yonkers Contracting Company
Estimating Department

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INITIALLED BY THE BIDDER:

Richard D. McGrath

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 28, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

June 25, 2013

ADDENDUM NO. 5

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA – 124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE**

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES IN THE CONTRACT BOOKLET

Page 1 -	In the first paragraph, change the day and date for receipt of Proposals to "Tuesday, July 9, 2013".
Pages 879 - to 897	Delete these pages in their entireties and substitute therefor new pages 879 to 897, which are attached hereto and made a part hereof.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

Richard D. McGrath

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 26, 2013

w/ 1 dwg.
w/ NTB
w/ Reference Do

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

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Yonkers Contracting Company
Estimating Department
JPS

June 21, 2013

ADDENDUM NO. 4

TO PROSPECTIVE BIDDERS ON CONTRACT LGA – 124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES IN THE CONTRACT BOOKLET

Page 94 - Make the following changes:

A. Delete the title of clause 79 and substitute therefor "REFERENCE DOCUMENTS".

B. In the first line of the first paragraph of clause 79, change "Drawings" to "Documents".

C. In the fourth line of the first paragraph of clause 79, change "drawings" to "documents".

Page 96 Make the following changes:

A. In the listing for Reference Document B, delete "March, 2013" and substitute therefor "April 12, 2013".

B. In the first line of the last paragraph of clause 79, change "Drawings" to "Documents"

Page 308 Below paragraph 5) (1), insert the following:

"(2) Tower VMS shall be ground mounted. 2-line VMS shall be ceiling mounted at each level and ground mounted at the roof level."

Pages 347 - to 349 Delete these pages in their entireties and substitute therefor new pages 347 to 349, which are attached hereto and made a part hereof.

Page 655 Following this page, insert new pages 655A through 655C, which are

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attached hereto and made a part hereof.

Pages 1187 to 1200	Delete these pages in their entireties and substitute therefor new pages 1187 through 1200, which are attached hereto and made a part hereof.

REVISED REFERENCE DOCUMENTS

Reference Document drawing T019 (Reference Document A) has been revised as of 06/13/2013. Reference Document B "Laguardia Airport East Garage Code Analysis" has been revised as of April 12, 2013. Destroy the copies of this documents now in your possession and substitute therefor the revised documents.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 25, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER, 3rd FLOOR
NEWARK, NJ 07102

June 21, 2013

NOTICE TO BIDDERS

TO PROSPECTIVE BIDDERS ON CONTRACT LGA-124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

Attached herewith is a copy of a letter from Kratos Public Safety & Security Solutions, Inc. offering to quote prices for services and materials under this Contract.

The foregoing letter does not form a part of this Contract nor does the Authority represent to the bidders any conclusions to be drawn therefrom. It is made available to the bidders for the sole purpose of apprising them of the information furnished to the Authority. The cost of these items should be included in your Proposal.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

Attached to Appl

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JUN 24 2013
Yonkers Contracting Company
Estimating Department
UAS

RDM.
Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 25, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

June 14, 2013

ADDENDUM NO. 3

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA – 124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE**

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES IN THE CONTRACT BOOKLET

Pages 147 to 152	Delete these pages in their entireties and substitute therefor new pages 147 to 152, which are attached hereto and made a part hereof.
Page 155 -	At the end of Paragraph C, insert the following: "A LEEP-AP would be acceptable in this role."
Pages 235 to 248	Delete these pages in their entireties and substitute therefor new pages 235 to 248, which are attached hereto and made a part hereof.
Pages 641 to 650	Delete these pages in their entireties and substitute therefor new pages 641 to 650, which are attached hereto and made a part hereof.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

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INITIALLED BY THE BIDDER:

RDM

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 17, 2013

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Estimating Department
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NEWARK, NJ 07102

June 13, 2013

ADDENDUM NO. 2

TO PROSPECTIVE BIDDERS ON CONTRACT LGA – 124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

The following changes are hereby made in the Contract Documents for the subject Contract.

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In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES IN THE CONTRACT BOOKLET

Page 91 Make the following changes:

A. Below the listing for drawing P001, insert the following:

"P302 WATER SERVICE SUMP PUMP & JANITOR CLOSET LEVEL 1 PART PLAN Plumbing"

B. Below the listing for drawing P503, insert the following:

"P505 PLUMBING SCHEDULES Plumbing"

Page 95 Delete the listings for Reference Drawings P302 and P505, without substitution.

REVISED CONTRACT DRAWINGS

Contract Drawings G002, A504, A511, FP001, FP501, and P503 have been revised as of 06/06/2013. Destroy the drawings of these numbers now in your possession and substitute therefor the revised drawings.

REVISED REFERENCE DRAWINGS

Reference Drawing REF-G002 has been revised as of 06/06/2013. Destroy the drawing of this number now in your possession and substitute therefor the revised drawings.

ADDED CONTRACT DRAWINGS

Copies of new Contract Drawings P302 and P505 dated 6/06/2013, are forwarded herewith and are to be included in the set of Contract Drawings.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

RDM.

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 14, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

June 6, 2013

ADDENDUM NO. 1

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA – 124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE**

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialled by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Proposal will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES IN THE CONTRACT BOOKLET

Page 1 - In the first paragraph change the date for the receipt of Proposals to "June 27, 2013".

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

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INITIALLED BY THE BIDDER:

RDM.

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 7, 2013

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
THREE GATEWAY CENTER - 3rd FLOOR
NEWARK, NJ 07102

June 6, 2013

NOTICE TO BIDDERS

TO PROSPECTIVE BIDDERS ON CONTRACT **LGA – 124.201 – LAGUARDIA AIRPORT – DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE**

Attached herewith is the Analysis of Bid, which was previously omitted from the Contract Book. Place this Analysis of Bid at the back of the Contract Book and submit a completed Analysis of Bid with your Proposal, in accordance with the section of the Contract Book entitled PAPERS ACCOMPANYING PROPOSALS.

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

Peter J. Zipf, P.E.
Chief Engineer

INITIALLED BY THE BIDDER:

RDM

Richard D. McGrath, Vice President
Yonkers Contracting Company, Inc.
Dated: June 7, 2013

attached to A#1

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Yonkers Contracting Company, Inc.

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1

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PQL

F.F.
C.M.

LAGUARDIA AIRPORT

DESIGN AND CONSTRUCTION OF THE EAST PARKING GARAGE

CONTRACT LGA-124.201

VOLUME 2 OF 2

JUNE 2013

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02553	ASPHALT CONCRETE PAVING
02575	PAVEMENT MILLING
02580	THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS

SECTION	TITLE
02582	PREFORMED REMOVABLE RETRO-REFLECTIVE PAVEMENT MARKING TAPE
02588	TRAFFIC PAINT PAVEMENT MARKINGS
02610	EXTERIOR SANITARY SEWER GRAVITY SYSTEM
02665	EXTERIOR WATER SUPPLY SYSTEM - DUCTILE IRON PIPE FOR NEW YORK FACILITIES
02720	MANHOLES AND DRAINAGE STRUCTURES
02722	STORM DRAINAGE SYSTEM (INFILTRATION/EXFILTRATION TESTING NOT REQUIRED)
02730	EXTERIOR SANITARY SEWER PRESSURE SYSTEM
02832	METALLIC-COATED STEEL CHAIN LINK FENCE AND GATES
02841	W-BEAM AND THRIE-BEAM GUIDE RAIL
02842	TEMPORARY TRAFFIC BARRIERS
02844	TEMPORARY CONCRETE BARRIERS
02846	TEMPORARY WATER-FILLED BARRIER
02850	PLYWOOD SIGN PANELS AND WOOD SIGN POSTS
02851	ALUMINUM SIGN PANELS
	DIVISION 3 - CONCRETE
03100	CONCRETE FORMWORK
03200	CONCRETE REINFORCEMENT
03301	PORTLAND CEMENT CONCRETE, LONG FORM
03364	PLACEMENT OF PORTLAND CEMENT CONCRETE UNDERWATER
03420	PRECAST PRESTRESSED CONCRETE FOR BUILDING CONSTRUCTION
03602	GROUTING (NON-METALLIC)
	DIVISION 5 - METALS
05120	STRUCTURAL STEEL
05506	MISCELLANEOUS STEEL
05810	PREFABRICATED EXPANSION JOINT ASSEMBLIES
	DIVISION 7 - THERMAL AND MOISTURE PROTECTION
07410	METAL PANEL SYSTEMS
07910	COMPRESSION SEALS
07920	SEALANTS
	DIVISION 11 - EQUIPMENT
11151	PARKING GUIDANCE SIGNS
	DIVISION 13 - SPECIAL CONSTRUCTION

SECTION	TITLE
13710	VIDEO SURVEILLANCE SYSTEM - CAMERAS
	DIVISION 14 - CONVEYING SYSTEMS
14210	TRACTION ELEVATORS
	DIVISION 15 - MECHANICAL
15375	FIRE STANDPIPE SYSTEM PIPING & APPURTENANCES
15410	PLUMBING PIPING & APPURTENANCES
15453	SUBMERSIBLE SEWAGE EJECTORS
15503	FUEL OIL PIPING AND APPURTENANCES
15504	FUEL OIL PUMP AND TRANSFER SYSTEM
15505	RECTANGULAR PROTECTED/SECONDARILY CONTAINED ABOVEGROUND DIESEL TANK
15590	FUEL OIL EQUIPMENT AND APPURTENANCES
	DIVISION 16 - ELECTRICAL
16000	ELECTRICAL GENERAL REQUIREMENTS
16110	RACEWAYS
16114	CABLE TRAYS
16115	UNDERGROUND CONDUIT SYSTEMS
16120	WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)
16121	WIRES, CABLES, SPLICES, TERMINATIONS (MEDIUM VOLTAGE: 601 VOLTS TO 34,500 VOLTS, INCLUSIVE)
16126	OPTICAL FIBER CABLE
16127	CONTROL/SIGNAL TRANSMISSION MEDIA
16128	ARCPROOFING
16130	CONDUCTOR BARS
16133	CONTROL PANELS, ENCLOSURES/CABINETS, AND TERMINAL BOXES
16135	BOXES AND FITTINGS
16140	WIRING DEVICES
16150	MOTOR POWER AND CONTROL WIRING
16190	SUPPORTING DEVICES
16250	TRANSFER SWITCHES
16315	MEDIUM VOLTAGE LOAD INTERRUPTER SWITCHES
16320	DRY-TYPE TRANSFORMERS – GENERAL PURPOSE – 600 VOLTS OR LESS
16326	CAST COIL, DRY-TYPE TRANFORMERS (MEDIUM VOLTAGE)
16335	LOW VOLTAGE SWITCHGEAR

SECTION	TITLE
16450	GROUNDING
16470	PANELBOARDS
16475	OVERCURRENT PROTECTIVE DEVICES (600 VOLTS OR LESS)
16477	PROTECTIVE DEVICE COORDINATION STUDY
16510	LIGHTING SYSTEMS
16620	DIESEL-GENERATOR SET (WITH AUXILIARIES)
16670	LIGHTNING PROTECTION SYSTEM
16720	FIRE ALARM SYSTEMS
16729	ACCESS CONTROL SYSTEM
16766	TOLL BOOTH AM/FM RADIO
16784	TELEPHONES AND TELEPHONE SYSTEM EQUIPMENT
16785	DATA NETWORK EQUIPMENT
16790	EMERGENCY PHONES
16859	ELECTRIC HEATING CABLES (SELF-LIMITING TYPE)
16935	SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM (FOR POWER MONITORING APPLICATIONS)
16998	MEDIUM VOLTAGE SYSTEM COMMISSIONING TESTS

Prevailing Rate Schedule NY State (Non-FAA)

Notification of MBE/WBE On-Line Directory & Forms

Schedule A

Schedule B

Schedule C

Schedule D

Analysis of Bid

DIVISION 5

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SUMMARY

This Section specifies requirements for structural steel.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Association of State Highway and Transportation Officials (AASHTO)

Standard Specifications for Highway Bridges

American Institute of Steel Construction (AISC)

Code of Standard Practice for Steel Buildings and Bridges:
Sections 2; 6; 8; and 10, only (except that all references to the responsibility of the Owner and the Engineer will not apply.)
Specifications for Structural Steel Buildings
Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts
Quality Certification Program

American Society for Non-destructive Testing (ASNT)

SNT-TC-1A Recommended Practice

American Welding Society (AWS)

D 1.1 Structural Welding Code, Steel
D 1.5 AASHTO/AWS Bridge Welding Code
QC1 Certification of Welding Inspectors

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Connection Design and Detailing

1. Complete details shall be shown on the shop drawings. For all Work, other than structural steel for bridges, the Contractor shall complete the design of connections for any portion of the structures not shown on the Basic Contract Drawing or indicated in the Specifications.
2. For bridges, the design of connections for any portion of the structures not shown on the Basic Contract Drawing or specified in the Specifications will be provided by the Engineer.
3. Design and detailing for any alternative connections proposed by the Contractor and accepted by the Engineer shall be prepared by the Contractor. All connection design and detailing prepared by the Contractor shall be performed under the supervision of a Professional Engineer licensed in the state where the steel is to be installed. The calculations and shop drawings shall also bear the signature and seal of a Professional Engineer licensed in the state where the steel is to be installed.
4. In the case of conflict between the requirements of this Contract and the Codes and Standards contained in the AASHTO or AISC publications referenced in 1.02, the requirements of this Contract shall govern.

B. Shop Drawings

1. The shop drawings shall contain all dimensional and geometric information. Materials shall not be ordered, fabricated, or delivered to the construction site before the shop drawings have been approved.
2. Prior to review of the shop drawings by the Engineer, such shop drawings shall have been reviewed and approved by the Contractor and shall be stamped to indicate this by the Contractor. Such approval by the Contractor shall constitute the Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and has reviewed or coordinated each shop drawing with other shop drawings and samples and with the requirements of the Work and the Basic Contract Drawing and Specifications.
3. Shop drawings shall include layouts and details showing the type of steel for each member, sizes of members, connections, cuts, copes, cope reinforcing, bolts, welds and other pertinent data. Provisions for the connection of any other work shall be indicated on the shop drawings.
4. All welds shall be indicated by standard welding symbols as defined by AWS. Shop drawings shall show the size, length, and type of each weld.

5. Job standards for all typical connections for beams and girders, column splices, moment connections and wind bracing details shall be prepared by or under the supervision of a Professional Engineer, licensed in the state where the steel is to be installed and shall have the signature and seal of the Professional Engineer.
6. Shop drawings shall be submitted in complete packages so that individual parts and the assembled unit may be reviewed together. Index sheets shall be furnished with all beam, girder and column details at the same time the details are submitted for review.
7. The review of shop drawings by the Engineer shall not in any way relieve the Contractor from the responsibility for the adequacy of the design of the connections and all required detailing, the responsibility for the proper fitting of the Work in strict conformance with the Contractor requirements and from the necessity of furnishing material and workmanship required by Basic Contract Drawing and Specifications in addition to that indicated on the shop drawings
8. The Contractor shall supply a complete set of stamped, approved drawings to the Authority Quality Assurance representative at the fabrication shop prior to the commencement of any fabrication.

C. Erection Drawings

1. The erection drawings shall include plans showing exact locations of base and bearing plates, and/or bolts and other embedded items. All field-bolted connections, not specifically shown on shop drawings, shall be shown on erection drawings.

1.04 QUALITY CONTROL

A. Requirements

1. The entity performing the Work of this Section shall have a minimum of three years experience in structural steel work involving complexities similar to those required under this Contract and shall employ labor and supervisory personnel experienced in this type of Work.
2. When the total quantity of steel furnished under this contract exceeds 10 tons, the fabrication shop shall be certified under the AISC certification program as Category Sbd for conventional steel building structures or Sbr for simple steel bridges, unless a higher category is shown on the Basic Contract Drawing. A list of certified fabrication shops for each Category can be found on the following website:

   http://www.aisc.org/find/FindCertifiedCompany.aspx?id=5542

3. The Contractor's Quality Control Plan shall be submitted to the Engineer for review and approval. The Engineer may elect to inspect the fabrication shop to verify that the fabrication is performed in accordance with contract documents and that the shop is operated in accordance with the Quality Control Plan. At a minimum, the Quality Control Plan for fabrication shall address all the items listed in Appendix A, Part C.

B. The Contractor shall qualify welding processes and welding operators in accordance with the applicable AWS Welding Code and shall provide certification that welders to be employed in the Work have satisfactorily passed AWS qualification tests.

C. The Contractor shall maintain a Quality Control Program for both fabrication and erection of structural steel to assure that all installations conform to the requirements of the Basic Contract Drawing and Specifications. The Quality Control Program shall conform to the AISC Code of Standard Practice for Steel Buildings and Bridges, as well as the requirements in this Section for both shop and field inspection and testing. The Contractor shall employ non-destructive testing personnel that meet ASNT SNT-TC-1A Level II qualifications and an AWS Certified Welding Inspector (CWI).

For bridge work where "Fracture Critical Members" are shown on the Basic Contract Drawing, the contractor shall satisfy the requirements of the Fracture Control Plan as defined in the current AASHTO/AWS D1.5 Bridge Welding Code, including the Charpy Impact notch toughness requirements for Zone 2.

D. High Strength Bolts

1. Each shipment shall be accompanied by a mill certification report that shows mill test results for the included production lots. The Engineer reserves the right to sample and test bolts from any shipment.
2. Bolts may be sampled by the Engineer on site and tested by the Authority for wedge tensile and Rockwell hardness requirements in accordance with the appropriate American Society for Testing and Materials (ASTM) specifications. If any samples do not meet the test requirements, then the corresponding lot of bolts will be rejected for use. Any bolts already installed from a failed lot or heat number shall be removed and replaced at no additional cost to the Authority.
3. Sampling shall be performed using the "shipping lot method" in which the ASTM specified number of bolts shall be taken from each shipment of the same nominal bolt size and length. Bolt containers shall be clearly marked with the manufacturer's name, the production lot number, and the heat number of steel. After sampling, as indicated in 1.04 D.2., the containers shall be so labeled in a manner approved by the Engineer.

4. All bolts used for bridge construction and all galvanized bolts shall also meet the requirements for rotational capacity testing as specified in the appropriate AASHTO/ASTM specification (e.g. ASTM A325, ASTM A490, AASHTO Section 11.5.6.4.2).

E. In addition to performing field inspection, the Contractor shall inspect structural steel at the fabricating shop.

F. Welds shall be inspected and tested at the fabricating shop by the Contractor in accordance with AWS D1.1 (AWS D 1.5 for bridge members) and as follows:

1. All welds shall be visually inspected by an AWS Certified Welding Inspector (CWI).
2. All full penetration welds shall be non-destructively tested for 100 percent of the weld length by radiographic or ultrasonic methods, as approved by the Engineer, unless otherwise noted.
3. Areas of suspected defects found visually in partial penetration and fillet welds shall be non-destructively tested by magnetic particle or dye penetrant methods, as approved by the Engineer. However, for bridge members, test a minimum of 10 percent of the length of all partial penetration and fillet welds in accordance with AWS D1.5. If, in the opinion of the Engineer, the test results disclose unacceptable welds, then the percentage of welds required to be tested may be increased, as deemed necessary by the Engineer, up to 100%, without additional compensation.

G. The Contractor shall notify the Engineer in a timely manner to assure that all testing and inspection procedures required by the Engineer are properly provided.

H. The Authority will perform Quality Assurance testing to ensure quality workmanship. Inspection and testing will include, but not be limited to, visual inspections, ultrasonic, radiographic, magnetic particle or dye penetrant testing of the welding and cutting performed in the fabrication shop and in the field. The percentage and extent of testing will be no less than 25% of that required of the Contractor. The Contractor shall notify the Engineer and the Authority Materials Engineering Division 15 days prior to the start of fabrication.

I. The Contractor shall supply equipment and personnel, at no additional cost to the Authority, to assist in moving members as necessary for adequate access to properly perform Quality Assurance inspections and testing by the Authority. Coupons of material may also be requested and shall be cut in the presence of the Engineer at no additional cost to the Authority. The

Contractor shall also provide a desk and adequate workspace for the Authority shop inspector. Access to the use of telephones, fax machines and copy machines shall be provided at all times.

1.05 SHIPPING

A. All material that has been inspected and accepted by the Authority's Quality Assurance shop inspector will be stamped with the initials "PA" and a number near its piece mark. A stamped shipment report will also be provided and shall accompany each shipment. Any material that is shipped to the jobsite that is not stamped or included on the shipment report and noted as "Accepted" on said shipment report will immediately be rejected by the Engineer and shall not be unloaded at the jobsite. Application of the inspector's stamp will not imply that the material will not be rejected by the Authority if subsequently found to be damaged or defective.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the construction site at appropriate intervals so as to ensure uninterrupted progress of Work.

B. Material shall be stored in an area designated or approved by the Engineer. Structural steel shall be drained properly. Adequate shoring and protection shall be provided to prevent distortion and other damage. Structural steel shall be stored on timber and not on mud or cinders, and otherwise handled so as not to damage shop paint. All sections which are to be placed in ground storage shall be readily accessible for inspection.

1.07 SUBMITTALS

A. See Appendix "A" for submittals requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Steel

Structural steel shall mean structural steel as defined in Section 2 - Classification of Materials of the AISC "Code of Standard Practice for Steel Buildings and Bridges". Structural steel shall conform to types shown on the Basic Contract Drawing. The types are indicated by the ASTM or AASHTO designation for each. Each type shall conform to all of the requirements of the indicated ASTM or AASHTO specifications.

B. High Strength Bolts

High strength bolts, nuts and washers shall be of the types shown on the Basic Contract Drawing. Joints using high strength bolts shall conform to the provisions of the AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts". In the case of bridge Work, conform to AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.5.6.

C. Anchor Bolts

Anchor bolts shall conform to ASTM type shown on the Basic Contract Drawing and shall be the regular hexagon-bolt type.

D. Welding Electrodes: Comply with AWS D1.1 (D1.5 for bridge members).

E. Grout: In accordance with Section 03602 of the specifications entitled Grout (Non-Metallic).

F. Paint: In accordance with Section 09910 of the specifications entitled Painting.

2.02 FABRICATION

A. Fabrication will not begin without approvals for the following:
   1. Shop Drawings
   2. Quality Control Plan
   3. Welding Procedure Specifications
   4. Procedure Qualification Records (if applicable)
   5. Welder Qualifications
   6. Mill Test Reports
   7. Quality Control personnel, including an AWS Certified Welding Inspector (CWI), and non-destructive testing personnel that meet ASNT SNT-TC-1A Level II qualifications.

Any fabrication performed without prior approval of these items will not be accepted. In addition, a copy of all signed approvals, including the supporting documentation, shall be in the possession of the fabrication shop prior to the

commencement of fabrication and shall be made available to the Authority's Quality Assurance inspector at all times.

B. Fabricate and assemble structural assemblies in shop to greatest extent possible. Provide camber and fabricate items of structural steel in accordance with the standards and specifications referenced herein and as indicated on shop drawings approved by the Engineer.

C. Properly mark and match-mark materials for field assembly. Fabricate for a delivery sequence, which will expedite erection and minimize field handling of materials.

D. Where finishing is required, complete assembly, including welding of units, before the start of finishing operations. Provide finish surfaces of members, exposed in final structure, free of markings, burrs, and other defects.

E. For bridge members the following shall be in accordance with Division II, Section 11 of the AASHTO Standard Specifications for Highway Bridges:
   1. Workmanship, methods, standards, and accuracy of fabrication.
   2. Fitting, cutting, drilling, punching, reaming, bending, curving, finishing, straightening, and cambering of steel.
   3. Preparation, shop assembly, fitting and correction for misfits of connections.

2.03 SHOP PAINTING

A. Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on exposed portions and initial 2 inches of embedded areas only.
   1. For high strength bolted surfaces with friction type connections, paint with an approved slip critical zinc rich coating.

B. Unless otherwise shown on the Basic Contract Drawing, do not paint:
   1. surfaces which are to be welded;
   2. surfaces which are scheduled to receive sprayed-on fireproofing;
   3. surfaces of exposed, corrosion-resistant, high-strength, low-alloy steel members.

C. Apply an additional coat of paint to surfaces which are inaccessible after assembly or erection. Change color of additional coat to distinguish it from first. Where shop painting is required, paint erection marks on painted surfaces.

D. Type of paint and surface preparations, if any, shall be as shown on the Basic Contract Drawing, or as specified in Section 09910 of the Contract specifications entitled "Painting".

E. Notify the Authority Materials Engineering Division 10 days in advance of painting so arrangements can be made to inspect surface preparation prior to coating. In addition to inspecting surface preparation and coating the Authority will also perform tests to confirm blast profile, dry film thickness and adhesion. Samples of coatings may be selected for testing by the Engineer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Work Under Other Sections

Examine all Work prepared under other Sections of these Specifications to incorporate the Work of this Section and ensure any defects affecting installation are corrected. Prior to commencement of the Work under this Section, verify the dimensions and coordinate the structural steel Work with Work under other Sections.

B. Anchor Bolts

The Contractor shall ascertain by accurate survey the location, alignment and elevation of the anchor bolts embedded in the concrete under other Sections, at least 21 working days prior to the start of the structural steel erection. Any discrepancy between the Basic Contract Drawing and Specifications and the as-built conditions shall be corrected, as approved by the Engineer, prior to the start of steel erection.

3.02 ERECTION

A. Workmanship

All Work shall be erected plumb, square and true to lines and levels in strict accordance with Contract requirements and within tolerances of the AISC "Code of Standard Practice for Steel Buildings and Bridges" and in the case of bridges in accordance with AASHTO Specifications.

B. Temporary Shoring and Bracing

Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking

Provide temporary planking and working platforms as necessary to effectively complete Work.

D. Field Assembly

Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified AISC tolerances or more stringent tolerances when shown on the Basic Contract Drawing. Establish required leveling and plumbing measurements at mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature of structure when completed and in service.

E. Touch-up Painting

Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting in accordance with Section 09910 of the Contract specifications entitled "Painting".

F. Bolting with high strength bolts shall conform with AISC Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts, or in the case of bridge work, AASHTO Standard Specifications for Highway Bridges, Division II, Section 11.5.6.

G. Grouting shall be performed in accordance with section 03602 of the specifications entitled Grout (Non-Metallic).

3.03 FIELD TESTS

A. The Contractor shall perform inspections of the following items in accordance with the Codes and Standards contained in the AASHTO or AISC publications referenced in 1.02: connections; proper tensioning of bolts (the

Contractor shall furnish an approved calibrated torque wrench and assign two workers to assist the Engineer.); levels, plumbness and alignment of the framing; and field painting.

B. Field welding shall be inspected and tested by the Contractor in accordance with 1.04.F and the Contractor's Quality Control Plan for erection.

C. The Authority will perform Quality Assurance testing for field connections and welds in accordance with 1.04 H. The Contractor shall supply equipment and personnel needed to allow access for said testing, at no additional cost to the Authority.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

SUBMITTALS

APPENDIX "A"

The following items shall be submitted to the Engineer for approval except as otherwise noted.

A. Shop Drawings

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples."
2. Connection Design and Detailing as per 1.03 A. prior to submitting job standards.
3. Job standards as per 1.03 B.5. prior to submitting detailed shop drawings.
4. Prior to the commencement of fabrication, shop drawings for all structural steel as per 1.03 B.
5. Erection drawings as per 1.03 C.

B. Catalog Cuts, Material Certification, Welder Qualifications, Welding Procedure Specifications and Test Results

1. As per Division 1, "Shop Drawings, Catalog Cuts and Samples."
2. Catalog cuts and manufacturer's literature on paint and grout specified under this section.
3. Prior to commencing with fabrication of steel, certified copies of all mill reports covering the chemical and physical properties of all steel used in this Contract shall be submitted. Such certification shall be obtained from the mills producing the steel and shall certify that the steel meets the minimum requirements as to physical properties, inspection, marking, and tests for structural steel as defined by the American Society for Testing and Materials (ASTM) or in the case of bridges, AASHTO, for the type of steel shown on the Basic Contract Drawing.
4. Prior to commencing fabrication, mill certificates for high strength bolts as described in 1.04 D.1.
5. For bridge steel, submit results of Charpy Impact notch toughness tests showing suitability for use in zone 2 as defined in AASHTO prior to commencing fabrication.
6. Inspection and test results from fabrication shop as per 1.04 F within five calendar days of inspections and tests.
7. Inspection and test results from field tests as per 3.03 within five calendar days of inspections and tests.
8. Prior to commencing with fabrication of steel, welder qualifications and welding procedure specifications in accordance with 1.04 B.

C. Quality Control Documents

1. Copy of the fabriction shop's Quality Control Program as outlined in 1.04 C. The program, at a minimum, shall include the following:

A. A copy of AISC certification for the fabrication shop indicating the required Category as specified.

B. Organizational chart indicating specific names and titles of personnel clearly identifying the reporting structure of personnel and the qualifications of the individuals responsible for implementing the program.

C. Material traceability, indicating the procedure used to identify each individual piece mark and its components that can be traced to a specific heat number on mill test reports.

D. A procedure for handling nonconformance issues, including a sample worksheet for recording nonconformance issues. Include the name and title of the person responsible for final acceptance.

E. The certifications and qualifications for an AWS Certified Welding Inspector (CWI), Non-Destructive testing personnel qualified to ASNT SNT-TC-1A Level II requirements, and their respective employers. Include samples of inspection and testing forms to be used for the work of this Contract.

F. A detailed schedule for the duration of fabrication at each shop. The schedule shall show, at a minimum, the start and end dates for ordering material, cutting material, fabricating material, painting material, and shipping material. If the schedule changes, a revised schedule shall be submitted For Information Only.

G. A brief statement that explains the amount of steel, in tons, the shop is fabricating and the application(s) the fabrication is intended.

2. Copy of the Fracture Control Plan as per 1.04 C, if applicable.
3. Name and location of shop that will perform painting work along with the shop's Quality Control Plan in accordance with Section 09910 entitled "Painting".
4. Notification, in writing, 15 days prior to commencing fabrication of structural steel.
5. Notification, in writing, 15 days prior to commencing with surface preparation and painting.
6. Notification, in writing, 15 days prior to commencing field welding operations.

D. Design Computations

1. Calculations for connection design and detailing shall accompany submittal A.2. in this appendix.
2. Computations for job standards shall accompany submittal A.3. in this appendix.

END OF APPENDIX "A"

DIVISION 5

SECTION 05506

MISCELLANEOUS STEEL

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for metal fabrications, including but not limited to structural steel and iron shapes, plates, bars, tubes and pipe.

B. Items specified in this Section include but are not limited to the following, where shown on the Basic Contract Drawing:

1. Loose steel lintels.
2. Shelf angles.
3. Ladders and safety cages.
4. Floor plates.
5. Nosings and treads.
6. Pipe bollards.
7. Miscellaneous steel framing and supports.
8. Cable Guards

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI A 14.3	Safety Requirements for Fixed Ladders.
	American Society of Mechanical Engineers (ASME)
ASME B 18.2.1	Square and Hex Bolts and Screws, Inch Series.
ASME B 18.6.1	Wood Screws (Inch Series).
ASME B 18.6.3	Machine Screws and Machine Screw Nuts.
ASME B 18.21.1	Lock Washers (Inch Series).
ASME B 18.22.1	Plain Washers.
	American Society for Testing and Materials (ASTM)
ASTM A 27	Specification for Steel Castings, Carbon, for General Application.
ASTM A 36	Specification for Carbon Structural Steel.
ASTM A 47	Specification for Ferritic Malleable Iron Castings.
ASTM A 48	Specification for Gray Iron Castings.
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A 123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A 153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
ASTM A 500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
ASTM A 501	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
ASTM A 563	Specification for Carbon and Alloy Steel Nuts.
ASTM A 780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
ASTM A 786	Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
ASTM A 1011	Specification for Sheet, Steel and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
ASTM B 633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
ASTM C 1028	Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
ASTM C 1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
ASTM D 1187	Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
ASTM E 488	Test Method for Strength of Anchors in Concrete and Masonry Elements.
ASTM E 935	Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
ASTM F 568M	Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.
ASTM F 593	Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ASTM F 594	Specification for Stainless Steel Nuts.
	American Welding Society, Inc. (AWS)
AWS D1.1	Structural Welding Code – Steel.
AWS D1.3	Structural Welding Code – Sheet Steel.
	Code of Federal Regulations (CFR)
29 CFR Part 1910, Subpart D	Fixed Ladders.
	The Society for Protective Coatings (SSPC)
SSPC-Paint 20	Paint Specification No. 20 – Zinc Rich Primers (Type I, Inorganic, and Type II, Organic).
SSPC-PA 1	Shop, Field and Maintenance Painting of Steel.
SSPC-SP 3	Surface Preparation Specification No. 3 – Power Tool Cleaning.
SSPC-SP 6	Surface Preparation Specification No. 6 – Commercial Blast Cleaning.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Ladders

When installed, if any, shall comply with the following minimum requirements for structural performance, unless otherwise shown on the Basic Contract Drawing:

1. Treads and Platforms

   Capable of withstanding a uniform load of 100 lbs. per sq. ft. and a concentrated load of 300 lbs., so located as to produce maximum stress conditions.

2. Handrails and Toprails

   Capable of withstanding the following loads applied as indicated below:

   a. Uniform load of 50 lbs. per linear ft. applied simultaneously in both vertical and horizontal directions.

   b. Concentrated load of 200 lbs. applied at any point in any direction when tested per ASTM E 935.

   c. Uniform and concentrated loads above need not be assumed to act concurrently.

3. Guards

   Intermediate rail balusters and panel fillers capable of withstanding a horizontal uniform load of 50 lbs. per sq. ft. of gross area of guard, including open areas of which they are part, of fabrication required or as shown on the Basic Contract Drawing.

1.04 QUALITY ASSURANCE

A. When required by Appendix "A", submit design calculations for ladders, signed and sealed by a Professional Engineer licensed in the state in which Work is to be performed, indicating compliance with these Design and Performance Requirements.

B. Fabricator Qualifications

Firm experienced in producing metal fabrications similar to those indicated for Work of this Contract with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.

C. Engineer Qualifications

A professional engineer who is legally qualified to practice in jurisdiction where construction site is located and who is experienced in providing engineering services required for applications shown on the Basic Contract Drawing.

D. Welding Standards

Comply with applicable provisions of AWS D1.1 *Structural Welding Code – Steel* and AWS D1.3 *Structural Welding Code – Sheet Steel.*

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

E. Field Measurements

Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabricating. Show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Ferrous Metals

1. Metal Surfaces: For fabrication of Work exposed to view, use materials that are smooth and free of surface blemishes including pitting, roughness, seam marks, roller marks and rolled trade names.
2. Steel Plates, Shapes and Bars: ASTM A 36.
3. Rolled Steel Floor Plates: ASTM A 786.
4. Steel Bar Grating: ASTM A 1011 or ASTM A 36.
5. Steel Tubing: ASTM A 500, cold-formed; or ASTM A 501, hot-rolled; for exterior installations. Steel tubing shall be hot-dip galvanized coated per ASTM A 53.
6. Steel Pipe: ASTM A 53; type and grade (if applicable) as selected by fabricator and as required for design loading; Schedule 40 (standard weight), unless otherwise shown on the Basic Contract Drawing; black finish, unless galvanized coating is shown on the Basic Contract Drawing.
7. Brackets, Flanges and Fittings: Cast or formed metal of the same type material and finish as supported construction.
8. Gray Iron Castings: ASTM A 48, Class 30.
9. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47 Grade 32510, or cast steel, ASTM A 27. Furnish bolts, washers and shims as required, hot-dip galvanized per ASTM A 153.

B. Fasteners

1. General

   Zinc-Plated: ASTM B 633, Class Fe/Zn 25 (Service Condition 4–very severe) for exterior use and Class Fe/Zn 8 (Service Condition 2–moderate) where built into exterior walls. Select fasteners for type, grade and class required for application shown on the Basic Contract Drawing.
2. Bolts and Nuts: Regular hexagon head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563, and where indicated, flat washers.
3. Machine Screws: ASME B18.6.3.
4. Lag Bolts: ASME B18.2.1.
5. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
6. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.

7. Plain Washers: Round, carbon steel, ASME B18.22.1.

8. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

   a. Interior Locations: Carbon steel components zinc-plated complying with ASTM B 633, Class Fe/Zn 8.

   b. Exterior Locations: Alloy Group 1 stainless steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

C. Paint

1. Shop Primer for Ferrous Metal

   Zinc-rich primer, complying with SSPC-Paint 20, compatible with substrates and finish paint systems shown on the Basic Contract Drawing. Comply with applicable requirements of Division 9 Section on Painting.

2. Galvanizing Repair Paint

   High zinc dust content paint for regalvanizing welds in galvanized steel with dry film containing minimum 94 percent zinc dust content, complying with SSPC-Paint 20.

3. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Grout

Pre-mixed, factory-packaged, nonshrink type, complying with ASTM C 1107, as manufactured by one of the following, or approved equal, for specified application:

1. Non-Metallic:

   "Five Star Grout", Five Star Products, Inc., Fairfield, CT
   "Masterflow 713 Plus", Master Builders, Inc. (Degussa), Cleveland, OH
   "NS Grout", Euclid Chemical Co., Cleveland, OH

2. Metallic:

   "Embeco 636 Plus", Master Builders, Inc. (Degussa), Cleveland, OH
   "Five Star Metallic Grout", Five Star Products, Inc., Fairfield, CT
   "NS Metallic Grout", Euclid Chemical Co., Cleveland, OH

3. Use metallic grout in concealed locations where not exposed to moisture. Use non-metallic nonstaining grout in exposed, wet and exterior locations, unless otherwise shown on the Basic Contract Drawing.

2.02 FABRICATION

A. General

Fabricate items to sizes, shapes, profiles and dimensions required for application shown on the Basic Contract Drawing or approved Shop Drawings, using proven details of fabrication and support. Use materials of type and thickness shown on the Basic Contract Drawing or specified in this Section for various components of Work or, if not shown, as required to produce strength and durability in finished product for intended use.

1. Shop Assembly: Preassemble items in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly match mark units for reassembly and coordinated installation.
2. Form exposed Work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of 1/32 inch, unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
3. Weld corners and seams continuously, complying with AWS D1.1 and D1.3 recommendations as applicable. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
4. Form exposed connections with hairline joints flush and smooth, using concealed fasteners wherever possible. Exposed fasteners, where used, shall be of type as shown on the Basic Contract Drawing or, if not shown, Phillips flathead (countersunk) screws or bolts.
5. Fabricate joints that will be exposed to weather in a manner to exclude water, or with weep holes where water may accumulate.
6. Cut, drill and tap units to receive anchorage, hardware and similar items.
7. Furnish anchorage of type shown on the Basic Contract Drawing, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use and for design loads. Furnish steel washers, except that where heads and nuts bear on wood structural connections, furnish malleable-iron washers.
8. Galvanizing

   Zinc coating by the hot-dip process for items shown on the Basic Contract Drawing or specified in this Section to be galvanized. Coating thickness shall be as specified in the referenced standards.

   a. Rolled, pressed and forged iron and steel shapes, castings, plates, bars and strip 1/8 inch thick and heavier and assembled fabrications: ASTM A 123.
   b. Iron and steel hardware: ASTM A 153.

B. Steel Ladders

1. Fabricate ladders for locations shown on the Basic Contract Drawing, with dimensions, spacings, details and anchorages as shown. Comply with requirements of ANSI A 14.3 or OSHA 29 CFR 1910, whichever is more stringent.
   a. Side rails shall be 1/2 inch by 2-1/2 inches continuous structural steel flat bar with eased edges, spaced 18 inches apart, unless otherwise shown.

b. Bar rungs shall be 3/4-inch diameter solid structural steel, spaced 12 inches on center.

2. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

3. Top surface of each rung shall be non-slip; either coat the rung with aluminum oxide (corundum) granules set in epoxy resin adhesive or use a type of manufactured rung that is filled with aluminum oxide grout.

4. Support each ladder at top and bottom and at equally spaced intermediate points, so that no unsupported length of ladder shall exceed 5 feet. Use welded or bolted steel brackets, designed for adequate support and anchorage and to hold ladder clear of the wall surface with a minimum 7-inch clearance from wall to centerline of rungs.

5. Extend rails 42 inches above top rung and return rails to wall or structure, unless other secure handholds are furnished. If the adjacent structure does not extend above the top rung, gooseneck the extended rails back to the structure for secure ladder access.

6. Galvanize ladders, brackets and fasteners.

7. Ship's Ladders, if any

   Fabricate of open type construction with structural steel channel or steel plate stringers, pipe handrails and open steel grating treads, unless otherwise shown on the Basic Contract Drawing. Furnish brackets and fittings necessary for installation.

C. Ladder Safety Cages

Fabricate from structural steel flat bars, assembled by welding. Comply with requirements of ANSI A 14.3 or OSHA 29 CFR 1910, whichever is more stringent.

1. Top and bottom primary hoops shall be 5/16 inch by 4-inch bar. For cages longer than 20 feet, space intermediate hoops not more than 4 feet on center from 5/16 inch by 2-inch bar between the primary hoops. Vertical flat bars 5/16 inch by 2 inches shall be secured to each hoop at maximum 9-1/2 inches on center, unless otherwise shown on the Basic Contract Drawing. Secure assembled safety cage to ladder rails and adjacent construction shown.

2. Galvanize ladder safety cages and fasteners.

D. Loose Bearing and Leveling Plates

For steel items bearing on masonry or concrete construction, flat, free from warps or twists and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

E. Loose Steel Lintels

1. Fabricate from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

2. Weld adjoining members together to form a single unit where shown on the Basic Contract Drawing.

3. Size loose steel lintels for equal bearing of 1 inch per foot of clear span, but not less than 8 inches bearing at each side of openings, unless otherwise shown on the Basic Contract Drawing.

4. Galvanize loose steel lintels located in exterior walls.

F. Shelf and Relieving Angles

1. Fabricate from steel angles of sizes indicated and for attachment to concrete framing. Fabricate with slotted holes to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches on center, unless otherwise shown on the Basic Contract Drawing.
2. Miter and weld corners. Provide open joints at expansion and control joints. Joint width shall be 2 inches larger than expansion or control joint.
3. Galvanize shelf and relieving angles located in exterior walls.

G. Miscellaneous Framing and Supports

1. Furnish miscellaneous steel framing and supports not part of structural steel framework, as required by the Basic Contract Drawing to complete the Work.
2. Fabricate miscellaneous units as shown on the Basic Contract Drawing or, if not shown, of required dimensions to receive adjacent other Work to be retained by framing. Fabricate from structural steel shapes, plates and bars of welded construction using mitered joints for field connection, except as otherwise shown on the Basic Contract Drawing.
3. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Space anchors 24 inches on center and furnish minimum anchor units of 1-1/4 inch by 1/4 inch by 8 inch steel straps, except as otherwise shown on the Basic Contract Drawing.
4. Fabricate support for suspended toilet partitions as follows:
   a. Beams

      Continuous steel shapes of size required to limit deflection to L/360 between hangers, but use not less than C8 by 11.5 channels or another shape with equivalent structural properties.
   b. Hangers

      Steel rods, 1/2-inch minimum diameter, spaced not more than 36 inches on center. Thread rods to receive anchor and stop nuts. Fit hangers with wedge-shaped washers for full bearing on sloping flanges of support beam.
   c. Braces and Angles

      Steel angles of size required for rigid support of beam and for secure anchorage.
5. Galvanize miscellaneous framing and supports at exterior locations and where shown on the Basic Contract Drawing.

H. Miscellaneous Steel Trim

1. Fabricate units from structural steel shapes, plates and bars, with continuously welded joints and smooth exposed edges, unless otherwise shown on the Basic Contract Drawing. Miter corners and use concealed field splices wherever possible. Furnish cutouts, fittings and anchorages as required for coordination of assembly and installation with other Work.
2. Galvanize miscellaneous steel trim at exterior locations. Galvanize miscellaneous steel trim at interior locations where shown on the Basic Contract Drawing.

I. Floor Plate

1. Fabricate raised-pattern floor plates from rolled-steel floor plate of thickness and in pattern shown on the Basic Contract Drawing.
2. Abrasive-Surface: Manufacturer's standard abrasive granules rolled into surface of steel plate where shown on the Basic Contract Drawing. Coefficient of friction (COF) shall be 0.6 or higher when tested according to ASTM C 1028.
3. Include steel angle stiffeners and fixed and removable sections with steel bar drop handles for lifting as indicated.

J. Extruded Nosings and Treads

1. Fabricate of material, color, sizes and configurations shown on the Basic Contract Drawing. If not shown, fabricate cast-iron units with an integral abrasive finish. Lengths shall be as required to accurately fit each opening or conditions.
   a. Integral abrasive filler shall consist of aluminum oxide (corundum), silicon carbide or a combination of both, in an epoxy resin binder.
   b. Solid abrasive type units without ribs.
2. Available Manufacturers

   Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

   American Safety Tread Co., Inc., Helena, AL
   Balco Inc., Wichita, KS
   Safe-T-Metal Co., Inc., Mineola, NY
   Wooster Products Inc., Wooster, OH
3. Drill for mechanical anchors with countersunk holes located not more than 4 inches from ends and not more than 12 inches on center, evenly spaced between ends, unless otherwise shown on the Basic Contract Drawing. Use closer spacing if recommended by the manufacturer.

K. Cast Nosings, Treads and Thresholds

1. Fabricate units of material, color, sizes and configurations shown on the Basic Contract Drawing. If not shown, furnish cast-iron units with an integral abrasive finish. Lengths shall be as required to accurately fit each opening or conditions.
   a. Cast units with an integral abrasive grit consisting of aluminum oxide (corundum), silicon carbide or a combination of both.
   b. Plain surface texture, except where fluted or cross-hatched surfaces are shown on the Basic Contract Drawing.
2. Available Manufacturers

   Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

   American Safety Tread Co., Inc., Helena, AL
   Balco Inc., Wichita, KS
   Safe-T-Metal Co., Inc., Mineola, NY
   Wooster Products Inc., Wooster, OH
3. Furnish anchors for embedding units in concrete, either integral or applied to units, as standard with the manufacturer.

4. Drill for mechanical anchors with countersunk holes located not more than 4 inches from ends and not more than 12 inches on center, evenly spaced between ends, unless otherwise shown on the Basic Contract Drawing. Use closer spacing if recommended by the manufacturer.

L. Corner Guards

Fabricate from steel angles of sizes as shown on the Basic Contract Drawing, but not less than 3 by 3 by 5/16 inch extending from floor to 42 inches above floor. Fabricate with 3/8 inch steel base plates for bolting to floor and with 1/4 by 2 inch steel strap braces at top. Furnish at least 2 vertical angles at each location along the length of the ladder where connections are made (except at internal corners), with strap extended between angles and from each angle to wall or column.

M. Wheel Guards

Fabricate from 3/4-inch thick, hollow-core, gray-iron castings of size and shape shown on the Basic Contract Drawing. Fabricate with holes for countersunk anchor bolts and grouting.

N. Pipe Bollards

1. Fabricate from Schedule 40 black steel pipe, unless otherwise shown on the Basic Contract Drawing. Prime and finish with two coats of paint as specified in Division 9 Section on Painting. Cap bollards with 1/4-inch minimum steel plate finished to match pipe, unless indicated to be concrete filled.
2. Fabricate sleeves for bollard anchorage from steel pipe, matching shape and configuration of bollard and with outside dimensions not less than 3/4 inch greater than outside dimensions of bollard. Weld 1/4-inch thick steel plate closures to bottoms of sleeves. Plate closures shall be 1 inch greater in length and width than outside dimensions of sleeves.
3. Reflective marking tape, if any, shall be in color shown and as specified in Division 2 Section on removable retro-reflective pavement marking tape.

O. Cable Guards

1. Provide system as indicated on the Drawings installing cables in straight lines and at true heights.
2. Cables, anchors, tensioning, grouting, etc. shall conform with Section 03 30 21, "Unbonded Mono-Strand Post-Tensioning System," except as follows:

   a. Provide black vinyl plastic coating on cables or provide galvanized steel cables. Do not apply grease to cables with vinyl plastic coating.
   b. Tension Cables and Back Stress cables to seat wedges as shown on the Drawings.
   c. Burn off excess length of cable and apply two coats of galvanizing compound.
   d. Fill pockets in columns with non-shrink grout.

2.03 SHOP PAINTING

A. Surface Preparation

Prepare ferrous metal surfaces to comply with requirements for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications as follows:

1. Exterior: SSPC-SP 6.
2. Interior: SSPC-SP 3.

B. Apply shop primer to surfaces of metal fabrications, except those that are galvanized or shown on the Basic Contract Drawing to be embedded in concrete or masonry, in compliance with requirements of SSPC-PA 1 for shop painting.

PART 3. EXECUTION

3.01 PREPARATION

Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the construction site in time for installation.

3.02 INSTALLATION

A. Furnish and install anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

B. Cutting, Fitting and Placement

Perform cutting, drilling and fitting required for installation of metal fabrications. Set Work accurately in location, alignment and elevation plus level, true and free of rack, measured from established lines and levels. Furnish and install temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

C. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

D. Field Welding

Comply with AWS D1.1 and D1.3 for procedures of manual shielded metal-arc welding, appearance and quality of welds made and methods used in correcting welding Work.

E. Setting Loose Plates

1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of bearing plates or surfaces.

2. Set loose leveling and bearing plates on wedges or other adjustable devices. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.

F. Miscellaneous Framing and Supports

Install framing and supports in compliance with requirements of items being supported, including manufacturer's written instructions and requirements.

G. Supports for Toilet Partitions

Anchor supports securely to and rigidly brace from overhead building structure.

H. Nosings, Treads and Thresholds

1. Install with anchorage system indicated complying with manufacturer's recommendations.
2. Apply black bituminous coating to concealed bottoms, sides and edges of cast-iron units set into concrete.
3. Seal thresholds exposed to exterior with elastomeric sealant, complying with the applicable Division 7 Section on Sealants, for a watertight installation.

I. Wheel Guards

Anchor wheel guards to concrete or masonry construction complying with manufacturer's instructions. Fill cores solidly with concrete.

J. Bollards

1. Install bollards vertical to line and grade shown on the Basic Contract Drawing.
2. Anchor bollards with 4 bolts through bottom plate with minimum 4 inch embedment into concrete, by core-drilling and grouting into concrete or by anchoring in place with concrete footings, as shown on the Basic Contract Drawing.
3. Vibrate and tamp concrete to consolidate. Support and brace bollard until concrete has cured.
4. Seal joint between concrete footings and surrounding pavement and sidewalk in accordance with Division 2 Section on Pavement Joint Sealing.

3.03 ADJUSTING

A. Touch-Up Painting

1. Shop Painted Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces. Apply by brush or spray in a minimum dry film thickness of 2.0 mils.
2. Galvanized Surfaces: Immediately after erection, clean field welds, bolted connections and abraded areas. Apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 05506

MISCELLANEOUS STEEL

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's technical information, specifications, anchor details and installation instructions for miscellaneous steel products used, including grout and paint products.

B. Shop Drawings

For fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Furnish templates for anchor and bolt installation under other Sections if required.

C. Samples

Representative samples of materials, color, texture or design of finished products for nosings, treads and thresholds, if any.

D. Design Calculations

Submit design calculations signed and sealed by a professional engineer licensed in the state in which Work is to be performed, showing compliance with Design and Performance Requirements loading criteria.

E. Qualifications

1. Professional Engineer: Include experience qualifications.
2. Fabricator: Experience, in-service performance and capability qualifications.
3. Welder: Evidence of current AWS certification.

END OF APPENDIX "A"

DIVISION 5

SECTION 05810

PREFABRICATED EXPANSION JOINT ASSEMBLIES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for interior and exterior prefabricated expansion joint assemblies, including seismic type, fire barriers and moisture barriers.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Architectural Manufacturers Association (AAMA)

AAMA 611	Specification for Anodized Architectural Aluminum.
AAMA 2605	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

American National Standards Institute (ANSI)/Underwriters Laboratories Inc. (UL)

ANSI/UL 2079	Tests for Fire Resistance of Building Joint Systems.

American Society for Testing and Materials (ASTM)

ASTM A 666	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
ASTM B 36	Specification for Brass Plate, Sheet, Strip, and Rolled Bar.
ASTM B 209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
ASTM B 221	Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ASTM B 455	Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.
ASTM E 1399	Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.

American Society for Testing and Materials (ASTM)/Society of Automotive Engineers (SAE)

UNS	Unified Numbering System for Metals and Alloys.

National Association of Architectural Metal Manufacturers (NAAMM)

Metal Finishes Manual for Architectural and Metal Products.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. General

Expansion joint assemblies shall permit unrestrained movement of joint without disengagement of cover. Expansion joint assemblies shall also, where shown on the Basic Contract Drawing and as required to suit project requirements, maintain fire-resistance ratings, maintain integrity of smoke barrier, prevent air infiltration, prevent moisture and water penetration, serve as finished architecural joint closures and remain in place upon exposure to seismic activity.

B. Loading Characteristics

Joints in floor, sidewalk, pavement, plaza deck and other similar horizontal surfaces shall withstand loading as established by product types shown, without damage or permanent deformation to the expansion joint assembly.

C. Fire Performance Characteristics

Where indicated on the Basic Contract Drawing, expansion joint assemblies shall incorporate fire barriers identical to those of assemblies whose fire resistance has been determined per ANSI/UL 2079, including hose stream test at full-rated period, by a nationally recognized testing and inspection organization.

1. Fire Rating: Not less than the rating of adjacent construction.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

Arrange for expansion joint assemblies specified in this Section to be furnished by a manufacturer with minimum 5 years experience in the fabrication of expansion joint assemblies involving quantities and complexities equal to or greater than those required by this Contract.

B. Installer Qualifications

Arrange for expansion joint assemblies specified in this Section to be installed by an entity with minimum 5 years experience in the installation of assemblies involving quantities and complexities at least equal to those required by this Contract.

C. Single Source Responsibility

Obtain expansion joint assemblies furnished and installed under this Section from a single manufacturer.

D. Coordination

Ensure that prefabricated expansion joint assemblies furnished and installed under this Section are compatible with expansion joint assemblies specified in other Sections.

1.05 DELIVERY, STORAGE, AND HANDLING

Handle expansion joint assemblies in manner to protect surfaces and to prevent distortion and other types of damage. Store under cover and off ground. Protect from weather and construction activities until installed and accepted.

1.06 WARRANTY

Submit written warranty executed by the Contractor, installer and the manufacturer, agreeing to provide materials and labor to repair or replace expansion joint assemblies that fail in materials or workmanship within 5 years after date of issuance of the Certificate of Final Completion. This warranty shall not limit other rights the Authority may have under the Contract.

1.07 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements:

1. The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria:

1. All field-applied adhesives, sealants, paints and coatings relating to Work of this Section shall meet the requirements of Division 1 - GENERAL PROVISIONS.

1.08 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, furnish and install products of one of the following, or approved equal:

Architectural Art Mfg., Inc., Wichita, KS
Balco Inc., Wichita, KS
Construction Specialties, Inc., Cranford, NJ
MM Systems Corp., Pendergrass, GA
Watson Bowman Acme Corp. (subsidiary of Degussa Corp.), Amherst, NY

2.02 MATERIALS

A. Aluminum

ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6 for sheet and plate; mill finish, unless otherwise shown on the Basic Contract Drawing.

1. Protect aluminum surfaces in contact with cementitious materials with zinc chromate primer or chromate conversion coating.

B. Stainless Steel

ASTM A 666, Type 304 for plates, sheet, and strip; No. 2B finish, unless otherwise shown on the Basic Contract Drawing.

C. Copper Alloys

1. Brass: ASTM B 36, UNS alloy C26000 for half hard sheet and coil.
2. Bronze: ASTM B 455, alloy UNS No. C38500 (architectural bronze) for extrusions; ASTM B 36, alloy UNS No. C28000 (Muntz metal, 60 percent copper) for plates.

D. Preformed Seals

Single or multicellular extruded elastomeric profiles, designed with or without continuous, longitudinal, internal baffles for use as primary and secondary seals. Formed to fit compatible frames or with anchored flanges, in color shown on the Basic Contract Drawing or, if not shown, as selected by Engineer from manufacturer's standard colors.

E. Seismic Seals

Two single-layered elastomeric profiles, one interior and one exterior; retained in a set of compatible frames, in color shown on the Basic Contract Drawing or, if not shown, as selected by Engineer from manufacturer's standard colors.

F. Fire Barriers

1. Manufacturer's standard fire barrier materials for use with fire-resistant expansion joint assemblies, resisting passage of flame and hot gases through the joint without material degradation or fatigue when tested after cycling per ASTM E 1399; tested in maximum joint width condition with a field splice as a component of the expansion joint assembly per performance requirements of 1.03 C.
2. Include manufacturer's standard fire caulks, sealants and hardware for the required hourly fire rating. Fire barrier materials shall be asbestos-free.

G. Moisture/Water Barriers

Manufacturer's standard flexible elastomeric material for use as an inner expansion joint seal: minimum 45 mils thick EPDM or minimum 30 mils thick PVC.

2.03 ACCESSORIES

A. Manufacturer's standard anchors, fasteners, set screws, spacers, flexible vapor seal, filler materials, gutters, drain tubes, adhesives, sealants, grout and other accessories compatible with material in contact, and as shown on the Basic Contract Drawing for complete installations.

2.04 FABRICATION

A. General

Expansion joint assemblies shall be of design, basic profile, materials and operation shown on the Basic Contract Drawing. Furnish units equal to those shown on the Basic Contract Drawing, as required to suit joint size, to accommodate variations in adjacent surfaces and to absorb structural movement.

1. Furnish units in longest available lengths to minimize number of end joints, with hairline mitered corners where joint changes directions or abuts other materials. Include closure materials, transition pieces, tee-joints, corners, curbs, cross-connections, centering bars, pantograph mechanisms, gaskets, splice covers and other accessories as required for continuous joint assemblies.
2. Cover plates shall be extruded aluminum, stainless steel, bronze or brass as shown on the Basic Contract Drawing, with surface design options as shown on the Basic Contract Drawing. Fasten cover plate to anchor member per manufacturer's instructions, lapping each side of joint opening, permitting free movement of joint and maintaining close contact with adjacent finished surfaces.
3. Include manufacturer's continuous standard flexible moisture seals under covers at locations shown on the Basic Contract Drawing.
4. Protect concealed metal surfaces that will be in contact with concrete and masonry surfaces when installed, by applying a shop coat of the manufacturer's standard primer to contact surfaces in minimum dry film thickness of 2.0 mils.

B. Floor Joint Assemblies

Furnish continuous extruded metal seating members of profile shown on the Basic Contract Drawing with raised floor rim and concealed bolt and steel anchors for embedment in concrete. Assemblies shall be formed to receive cover plates of design shown on the Basic Contract Drawing and to receive abrasive-resistant filler materials, if any, for space between raised rim of seating member and edge of cover plate. Depth and configuration shall suit type of construction and ensure that top surface of exposed extrusions, filler material and cover plate fits flush with adjoining finish floor surface.

C. Interior Joint Assemblies

Assemblies for floor-to-floor, floor-to-wall, wall-to-wall and joints in ceilings and soffits shall be as shown on the Basic Contract Drawing.

D. Exterior Joint Assemblies

Assemblies shall be capable of resisting moisture penetration and air infiltration, as shown on the Basic Contract Drawing.

2.05 SHOP FINISHING

A. General

Comply with NAAMM's Metal Finishes Manual for Architectural and Metal Products for finish designations and application recommendations. Apply finishes in factory after products are fabricated. Protect finishes on exposed surfaces with a strippable, temporary protective covering prior to shipment.

B. Aluminum Finishes

1. Class I Clear Anodic

AA M12-C22-A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: clear film, 0.7 mil or thicker), complying with AAMA 611.

2. Class I Color Anodic

AA M12-C22-A42 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: integrally colored coating, 0.7 mil or thicker), complying with AAMA 611. Color shall be as shown on the Basic Contract Drawing or, if not shown, as selected by the Engineer from the manufacturer's standard colors.

3. High Performance Organic Coating

AA C12-C42-R1x (Chemical Finish: cleaned with inhibited chemicals, prepared with an acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Ensure that coating is applied in strict accordance with coating manufacturer's instructions by an applicator authorized by the coating manufacturer.

a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer, 0.2 mil minimum dry film thickness and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight, in a dry film thickness of 1.0 mil minimum, complying with AAMA 2605.

b. Resin Manufacturers

Subject to compliance with requirements, fluoropolymer coating systems shall contain resins produced by Arkema Group ("Kynar 500") or by Solvay Solexis, Inc. ("Hylar 5000").

c. Color shall be as shown on the Basic Contract Drawing or, if not shown, as selected by the Engineer from the manufacturer's custom colors.

C. Stainless Steel Finishes

1. Bright, Cold-Rolled Unpolished Finish: AISI No. 2B finish.

2. Bright, Directional Polish: AISI No. 3 finish.

3. Bright, Directional Polish: AISI No. 4 finish.

4. Satin, Directional Polish: AISI No. 6 finish.

5. Satin, Reflective, Directional Polish: AISI No. 7 finish.

6. Mirror-Like Reflective, Nondirectional Polish: AISI No. 8 finish.

7. Non-Directional Finish: #BJNDF-60 finish, as manufactured by Milgo Industrial, Inc., Brooklyn, NY, or approved equal.

D. Copper Alloy Finishes (Brass and Bronze)

Natural Satin Finish: CDA M32 (Mechanical finish: directional textured, medium satin).

PART 3. EXECUTION

3.01 EXAMINATION

Verify dimensions and conditions in field for Work fabricated to fit project conditions.

3.02 PREPARATION

A. Prepare substrates according to expansion joint assembly manufacturer's instructions, including cutting, cleaning, priming, repair and surfacing.

B. Coordinate with Work of related trades, such as for installation of items embedded in concrete or masonry.

C. Furnish templates as required to related trades for location of embedded support and anchorage items.

D. Repair and grout block-outs as required with manufacturer's recommended material, to provide a level support beneath side frames of floor covers and to correct oversize block-outs. Do not use shims.

E. Fastening to In-Place Construction

Furnish and install anchorage devices and fasteners as required for securing expansion joint assemblies to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Metal fasteners shall be of the type and size required to suit type of construction shown on the Basic Contract Drawing and to ensure secure attachment of expansion joint assemblies.

3.03 INSTALLATION

A. Comply with manufacturer's written instructions for handling and installation of expansion joint assemblies, unless more stringent requirements are indicated.

B. Install factory-fabricated transitions between building expansion joint assemblies and roof expansion joint assemblies specified elsewhere, if any.

C. Terminate exposed ends of exterior expansion joint assemblies with factory-fabricated termination pieces to maintain watertight integrity.

D. Cutting Fitting and Placement

Perform cutting, drilling, patching and fitting required for installation of expansion joint assemblies. Install expansion joint assemblies in true alignment and proper relationship to adjoining finished surfaces measured from established lines and levels. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling. Set floor assemblies, with countersunk fasteners, at elevations to be flush with adjacent finished floor materials. Locate wall, ceiling, soffit and fascia assemblies where shown on the Basic Contract Drawing, in continuous contact with adjacent surfaces. Attach in place securely with required accessories.

E. Joinery and Continuity

Maintain continuity of expansion joint assemblies with end joints held to a minimum and metal members aligned mechanically using joint splices. Cut and fit ends to produce hairline joints and to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to seating member with adhesive or pressure-sensitive tape as recommended by the manufacturer.

F. Anchorage

Anchor extrusions to adjacent substrates, continuously, at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches on center. Set anchorage extrusions in continuous bed of sealant per manufacturer's recommendations; prevent slippage of vertical seal anchorages. Sealant type shall be compatible with sealants of adjacent construction.

G. Preformed Seals

Install seals with minimum number of end joints; straight sections shall be in continuous lengths. Vulcanize or heat-weld field splice joints watertight, using manufacturer's recommended procedures. Apply manufacturer's approved adhesive, epoxy or lubricant-adhesive to both frame interfaces before installing preformed seal material. Seal transitions and end joints according to manufacturer's instructions.

H. Seismic Seals

Install interior seal in continuous lengths. Install outer seal in standard lengths and vulcanize or heat-weld field splice joints watertight, using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's instructions.

I. Fire Barriers

Install fire barriers, including transitions and end joints, in accordance with manufacturer's recommended procedures so that fire-resistant construction is continuous and uninterrupted.

J. Moisture/Water Barriers

Install water barriers at exterior joints and where shown on the Basic Contract Drawing, in accordance with manufacturer's recommended procedures. Include drainage system where shown.

3.04 CLEANING

Remove strippable protective material after Work in adjacent areas is complete. When protective material is removed, clean exposed metal surfaces in accordance with manufacturer's instructions.

3.05 PROTECTION

Protect the installation from damage by other Work. Remove and store cover plates and exposed seals as required to protect from damage from construction traffic. Install temporary protection over joints, and reinstall covers and seals prior to issuance of the Certificate of Partial or Final Completion.

END OF SECTION

SECTION 05810

PREFABRICATED EXPANSION JOINT ASSEMBLIES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's product data, material and finish descriptions, installation instructions and general recommendations for each type of expansion joint assembly shown on the Basic Contract Drawing.

B. Shop Drawings

Show full extent of expansion joint assemblies; include large scale details of each type indicating profiles, splice joints between sections, joinery with other joint types including intersections, corner joints and tees, special end conditions, anchorages, fasteners, block-out locations and requirements, and relationship to adjoining Work and finishes.

1. Include isometric drawings, if required to fully describe assemblies, depicting the continuity of their route and their intersections.

C. Samples

1. Metal Finish: 6 inch long sample of metal finish shown on the Basic Contract Drawing, on metal of same thickness and alloy to be used in the Work. Where normal color and texture variations are to be expected, include two or more units in each set of samples showing limit variations.

2. Preformed Seals: 6 inch long samples of each type of flexible seal material to be used in the Work. Include manufacturer's standard color charts showing full range of colors and textures available for each type of flexible seal material for selection by the Engineer.

3. For Verification: Full-size units 6 inches long of each type of joint system to be used in the Work, including all system components and showing finish, color, texture, patterns and full range of variations expected for these characteristics.

D. Certifications

Fire Performance: Where fire-rated expansion joint assemblies are shown, submit test data to indicate conformance with 1.03 C and 2.02 F.

E. Qualifications

Submit proof of manufacturer and installer experience qualifications.

F. Sustainable Design Submittal Requirements:

The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

   a. Cost breakdowns for the materials included in the Contractor's Work. Cost breakdowns shall include total cost plus itemized material costs.

   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:

      (1) The amount of post-consumer and/or post-industrial recycled content in the supplied product(s).

      (2) The manufacturing location of the supplied product(s).

      (3) The location (source) of the raw materials used to manufacture the supplied product(s).

      (4) The VOC content of all adhesives, sealants, paints, and coatings applied on site as part of this Work.

2. Published product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.

3. Product cut sheets for materials that meet the SDMCF.

4. Material Safety Data Sheets (MSDS), for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).

5. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

SECTION 07410

METAL PANEL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. General: Provide metal panel systems in accordance with requirements of the Basic Contract Documents. The Work of this section, includes, but is not limited to the following:

1. Resinous coated aluminum plate panels and surrounds.

2. Panel mounting systems including anchorages, shims, furring, fasteners, gaskets and sealants, related flashing and accessories (as required) for a complete watertight installation.

B. The Contractor shall be responsible for the engineering, detailing, fabrication and erection of the complete metal panel systems including cladding door and frame systems. The Work shall include all labor, materials, tools, equipment, protection, testing and engineering services required to manufacture, deliver, furnish and install all items necessary for the proper execution and completion of the Work, as shown on the Drawings and as specified herein and/or as otherwise required to provide a complete, code-complying and warranted installation. The extent of panel system work is indicated on the drawings. The Contractor shall supply metal panels and all accessories for cladding exterior surfaces of hollow metal doors and frames.

FINS

1.02 REFERENCES

A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Basic Contract Documents. Where a recommendation or suggestion occurs in the referenced standards, such recommendation or suggestion shall be considered mandatory. In the event of conflict between referenced standards, this specification or within themselves, the more stringent standard or requirement shall govern.

1. American Welding Society AWS

   a. AWS D1.1 "Structural Welding Code - Steel".

   b. AWS D1.2 "Structural Welding Code - Aluminum".

   c. AWS D1.3 "Structural Welding Code - Sheet Steel".

2. National Association of Architectural Metal Manufacturers (NAAMM):

   a. NAAMM "Metal Finishes Manual".

3. Industrial Fasteners Institute "Fastener Standards Book".

4. American Architectural Manufacturers Association (AAMA):

   a. AAMA "Curtain Wall and Design Guide Manual ".

   b. AAMA 2605 "Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels".

5. The Port Authority of New York & New Jersey (PANYNJ) "Sustainable Building Guidelines".

6. United States Green Building Council (USGBC): Leadership in Energy & Environmental Design (LEED®): Green Building Rating System for New Construction & Major Renovations (NC) Version 2.1 www.usgbc.org

   a. The Sustainable Building Guidelines take into account the US Green Building Council's LEEDTM 2.1 Rating System, New York State Executive Order 111 and the New York State Green Building Tax Credit. The Port Authority does not require that new buildings be LEED® certified. By adhering to the guidelines, however, new buildings could obtain certification.

1.03 SYSTEM DESCRIPTION

A. General

1. Metal Panel Systems: The exterior wall metal panel systems are comprised of a resinous coated 1/8 in. thick aluminum plate system both with concealed gasketed sealed joints secured to a concealed backup system together with anchors, fasteners, trim and other required components used to secure the system to the building structure and provide a watertight, airtight installation.

2. Detailing: The method of erecting, installing and anchoring of metal panels indicated on the drawings is diagrammatic only and shall be used for the purposes of tendering. The Contractor shall be responsible for the design, engineering, fabrication, erection and warranty of the structural backup support, the permanent anchorage and the integrity of metal panel cladding Work. Alternate methods of detailing, proposed by the Contractor, will be considered provided it complies with aesthetic design shown and performance criteria specified. Design the installation to allow for expansion, contraction and differential deflection of supporting floors of the building structure.

B. Performance Requirements

1. Wind Loading Requirements: Design, fabricate and install component parts so that the completed metal panel systems will withstand the inward and outward pressures normal to the plane of the wall as determined and calculated by the 2008 NYCBC Section BC 1609 and BC 2404 At corners and other changes in plane, both surfaces shall be assumed to experience the most severe combinations of negative and positive pressures simultaneously.

2. Soffit Loading Criteria, Exterior Soffit: The installed exterior metal panel soffit systems shall withstand an upward and downward wind pressure of 30 psf normal to the plane of the soffit without displacement, structural failure, permanent distortion or other damage. Permanent distortion or displacement is defined as values exceeding 50% of specified installation tolerances.

   a. Deflection, Support Framing Aluminum Metal Panel Soffits: Not withstanding above requirements, aluminum metal panel soffit system shall be designed for deflection not to exceed l/360 of the distance between supports.

3. Thermal Movements: Provide factory fabricated backup system and metal panel cladding system that allows for thermal movements resulting from maximum change (range) in ambient and surface temperatures by preventing displacement of metal panels, opening of joints, overstressing of components, failure of joint sealants and connections, and other detrimental effects.

4. Building Movement: Design, fabricate and install metal panel system work system to withstand building movements including loading deflections, shrinkage, creep, seismic and similar movements.

5. Critical Dimensions: The following critical dimensions shall be utilized without modification.

   a. Wall Assembly Depth: Provide a complete metal panel wall cladding system as shown and specified with components and systems located within the area from the exterior face as shown to the face of column, beam or edge of slab shown, without encroachment or displacement of the interior construction and finishes shown.

b. Structural Tolerances: The metal panels systems design shall accommodate variation in location of surrounding and supporting work. Assume steel erection tolerances no less than permitted by the American Institute of Steel Construction (AISC). Assume concrete erection tolerances no less than permitted by ACI 117 "Standard Tolerances for Concrete Construction and Materials".

6. Deflections: Submit engineering calculations to show maximum deflections based on full panel loads, uniformly distributed, building deflections, thermal stresses, and erection tolerances. Sealants adjacent to metal panels systems and interior finishes shall not be included to contribute to strength, stiffness or lateral stability. Maximum full load deflections, normal to the wall plane, for any wall member or component shall not exceed the following:

   a. Exterior Metal Panels, Fascias, Metal Covers or Other Fabricated Metal Items: L/120 of its clear span or 3/4 in whichever is less. Deflection shall be measured relative to the horizontal and vertical support members with the allowable deflection being determined by the lesser dimension.

   b. Flatwork Tolerances: Metals panels, fascias, sills and other sheet or plate fabricated items shall be flat and free of bow or "oil canning" or "read thru" of stiffeners, welds under all lighting conditions. Exposed metal faces shall be of such flatness that the maximum uniform bow in 2 ft. shall not exceed 1/32 in. and the maximum overall variation in plane between high and low point within a panel shall not exceed 1/16 in. . Notwithstanding the aforementioned criteria, the visual appearance of such elements shall be judged exclusively by the Engineer who reserves the right to reject any visually objectionable flatwork

   c. Metal Panel Supports Systems: Design metal panel wall support systems holding metal panels work to limit deflection within the system and within the metal panels units to values which allow the metal panels units to sustain imposed loads, for each combination of metal panels anchors and/or support framing configurations and variations, intended for use on the project, within the specified design limits and factors of safety; but not greater than 1/360 of its clear span or 1/8 in.; whichever is less.

7. Anchorage:

   a. Anchorage disengagement or breakage shall not occur when an installed unit is subjected to a force equal to 2.5 times the design load.

   b. Anchorage shall be properly braced in three orthogonal directions (vertical, transverse, and longitudinal) to resist specified loadings from any direction (both positive and negative pressure).

c. Anchors and supports shall be designed and located so as to allow a uniform distribution of anticipated wind loads, and shall not impart any unauthorized torsional loading to spandrel beams, cause excessive stress on the structure, cause excessive deflection, inhibit thermal movement or conflict with clearances for equipment. Eccentric loads imposed into the building structural elements by the metal panel system anchorage are not allowed. Eccentric loads created by the anchorage of the metal panel system shall be neutralized by the addition of bracing or other means required.

8. Permanent deformation, weld or fastener failure, component disengagement or breakage shall not occur under loading equal to 1.5 times the design load pressures (positive and negative) specified. Permanent deformation is defined as deflection without recovery exceeding length/1000.

9. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of metal panels, joint materials or contiguous materials.

10. Surface Appearance: Provide the Work so that the completed system presents a uniform and smooth appearance with exposed surfaces free from bowing, dimpling, oil canning, sagging, pillowing, rippling, warp, abrupt transitions and other visual deformation or irregularity.

11. Unacceptable Conditions: Vibration harmonics, wind whistles, noise or vibration created by thermal movement, structural movement, or wind; thermal movement transferred to building structure; loosening, weakening or failure of fasteners, attachments or other components.

12. Design Modifications: Make design modifications of work shown only as may be necessary to meet performance requirements and coordinate the work. Variations in details and materials which do not adversely affect appearance, durability or strength shall be submitted to the Engineer for review. Maintain the general exterior design concept without altering profiles and alignments shown.

C. Green Building Performance Criteria: Comply with The Port Authority of New York & New Jersey (PANYNJ) "Sustainable Building Guidelines" and in general the following:

1. Green Building Performance Criteria: The Contractor shall implement practices and procedures to meet the Project's GREEN BUILDING requirements. The Contractor shall ensure that the requirements related to these goals, as defined in This project's written Criteria, and as specified in this Section, are implemented to the fullest extent. Substitutions or other changes to the work shall not be proposed by the Contractor or their sub-contractors if such changes compromise the stated GREEN BUILDING Performance Criteria.

2. Regional Materials: Project goal is to provide minimum of 20% of building materials (by cost) that are manufactured and extracted/harvested within a 500 mile radius of the project site, exclusive of labor and delivery costs and not including mechanical, electrical, or plumbing equipment. The Contractor will make all attempts to maximize the procurement of materials within this specified 500 mile radius. Utilize GPS straight-line distance calculator, found at: www.gpsvisualizer.com/calculators to verify distance. Made In NYC can be referenced via www.madeinnyc.org or 212-404-6990 for sourcing locally-manufactured materials.

3. Recycled Content of Materials: The pre-consumer (a.k.a. post-industrial) and/or post-consumer recycled content (by weight) of the products and materials shall be identified and documented. The Contractor will make all attempts to maximize the procurement of materials with recycled content.

4. LEED Performance Requirements

   a. LEED Focus Materials (LFMs) for this Section:

      1) Metal framing

      2) Aluminum panels and trim

      3) Metal reinforcing

      4) Targeted products containing Volatile Organic Compounds (Targeted VOC Products)

5. Recycled content of materials shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims," 16 CFR 260.7 (e): www.ftc.gov/bcp/grnrule/guides980427.htm, and claims should be certified by an independent third party when possible. Recycled content thresholds for this project are largely derived from EPA's Comprehensive Procurement Guidelines and the NYC Department of Design and Construction's Guide Sustainable Specifications.

   a. The following materials must contain at least the minimum recycled content, with post and/or pre-consumer allocations as indicated (combined = total%age of pre-consumer + post-consumer):

      1) Aluminum Wall Products: A minimum 25% recycled content by weight.

      2) Miscellaneous Steel Products: A minimum 25% recycled content by weight.

      3) Miscellaneous Aluminum Products: A minimum 25% recycled content by weight.

      4) Steel Support System for Wall Panels: A minimum 25% recycled content by weight.

6. VOC Limits: All field-applied adhesives, sealants, primers, paints and coatings used on the interior of the building shall meet the volatile organic compound (VOC) and chemical component limitations as defined in this project's wriiten Criteria, VOC contents shall be identified and documented.

1.04 SUBMITTALS

A. See Appendix "A" for submittal requirements.

1.05 QUALITY ASSURANCE

A. Basis of design: when particular manufacturers' materials, products or processes are specified for an item of work, any one is acceptable for the contractor to choose. An alternative material, product or process will be considered if the contractor submits a written substitution request together with such information as may be necessary to assist the Engineer in determining whether the proposed substitution is acceptable; the burden of proof rests solely upon the contractor.

B. Single Source Responsibility: Obtain metal panel systems from one source of a single manufacturer for each type of system. Obtain accessory products used in conjunction with the work from the metal wall panel manufacturer/fabricator or from sources acceptable to the metal wall panel manufacturer/fabricator. The manufacturer shall furnish evidence that the specified materials have been manufactured by the same source and successfully utilized on a yearly basis for a minimum of 5 years on projects of a similar scope to that shown and specified for this Project.

1. Hollow Metal Door Metal Panel Cladding: The -contractor shall furnish matching resinous coated aluminum metal cladding panels for hollow metal doors complete with specified finish and all required accessories and trim for a complete installation matching metal panels including specified finish.

C. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

D. Professional Engineer Qualifications: Engage the services of a professional engineer who is legally qualified to practice in the State of New York and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal panel systems that are similar to those indicated for this Project in material, design, and extent.

E. Visual Mock-Up(s)

1. Visual Mock-Up(s): Provide a visual mock-up of metal wall panel system, complete with framing system and related accessories representing the elements which will be used in the final work. Provide features as will be used in the final Work.

2. Size of mock-up for each type system shall be shown or if not shown shall include four (4) full size panels with reveal joints and complete with coping and with one (1) resinous coated aluminum clad hollow metal door and hardware.

3. Replace unsatisfactory Work as required to obtain approval of the Engineer. The approved visual mock-up will become the standard of workmanship for the project. The approval of the visual mock-up does not relieve the Contractor of it's obligation to perform the work in accordance with the Basic Contract Documents.

F. Pre-Installation Meetings: Prior to the start of the Work meet at the Project site to review methods and sequence of metal panel installation, special details and conditions, standard of workmanship, testing and quality control requirements, job organization and other pertinent topics related to the Work.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, the Contractor shall guarantee dimensions and metal panel fabrication shall without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

B. Protection of Finishes: Protect exposed surfaces from physical damage during and after erection with factory applied plastic film. Protections shall be durable enough to preclude minor accidental scratching of interior surfaces by trade workers involved in activities subsequent to the metal panels installation but shall be readily removable (without damage to underlying finishes) upon the direction of the Construction Manager.

1.07 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging with labels to show name, brand, type, and grade. Store materials in protected dry location off ground in accordance with manufacturer's instructions. Do not open packaging nor remove labels until time for installation.

B. Removable Protective Coverings: Provide finished panels and accessories with manufacturer's recommended temporary protective covering. Maintain covering on materials until installation. Covering shall not to affect factory finish coating nor leave residue or other deleterious matter on surface.

1.08 WARRANTY

A. Warranties specified in this Article shall not deprive the PANYNJ of other rights the PANYNJ may have under other provisions of the Basic Contract Documents and are in addition to and run concurrent with other warranties made by the Contractor under requirements of the Basic Contract Documents.

1. Special Warranty for Metal Panels Systems: Submit a five (5) year written warranty executed by the manufacturer/fabricators and the single firm awarded the metal panel Work and addressed to the PANYNJ, agreeing to repair or replace components of the metal panels systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to,:

   a. Failure of the metal panel systems to meet performance requirements including but not limited to excessive deflection, racking and/or warpage.

   b. Deterioration, fading, excessive non-uniformity, pitting, cracking, peeling, crazing or discoloration of finishes and other materials beyond normal weathering.

   c. Noise or vibration created by thermal and structural movement and wind.

   d. Loosening or weakening of fasteners, attachments, and other components.

   e. Sealant failure.

2. Special Warranty, Resinous Coatings: Provide a written warranty, from the manufacturer (formulator) of resinous coating system and the finisher and addressed to the PANYNJ, for a period of twenty (20) years, warranting against the loss of film integrity, chalking, fading, non-uniformity, corrosion and the overall performance of color of the resinous coatings. Upon notification of such defects, within the warranty period, make the necessary replacements at the convenience of the PANYNJ.

   a. Color retention not to exceed 5Δ E Units (Hunter) color change as calculated in accordance with ASTM D2244 on exposed surfaces cleaned with clean water and a soft cloth.

   b. Degree of chalking not to exceed rating No. 8 for colors and No. 6 for whites when measured in accordance with ASTM D4214 Test Method, Test Method A on exposed unwashed surfaces.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.

   1. Sheet and Plate: ASTM B 209.

   2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.

   3. Welding Rods and Bare Electrodes: AWS A5.10.

B. Aluminum Angles, Plates, Bars, and other Aluminum Members Required to Join or Reinforce Assembly of Aluminum Components: Alloys recommended by manufacturer or fabricator to develop required strength of assembly.

C. Steel

1. Structural Steel Shapes: ASTM A36.

2. Steel Plates: ASTM A283 , Grade C.

3. Steel Tubing: ASTM A500; Cold-formed, welded or seamless process. For exterior use and other locations noted, provide hot-dip galvanized (minimum spangle) tubing in accordance with ASTM A153 .

D. Fasteners: Stainless steel type 300 series nonstaining, non-bleeding fasteners selected to prevent galvanic action with the components fastened and compatible with adjacent materials. Where exposed in finished surfaces, use oval-head countersunk Philips heads colored to match adjacent surfaces. Where fasteners screw-anchor into aluminum less than 1/8 in. thick reinforce the interior surface with aluminum or non-magnetic type stainless steel to receive screw threw threads or provide manufacturer's standard non-corrosive pressed-in splined grommet nuts. All screwed connections shall be drilled. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

E. Anchors: 3-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

F. Concealed Flashing: Dead-soft, 0.018-in. - thick stainless steel, complying with ASTM A 666, of type selected by manufacturer for compatibility with system.

G. Weep Baffles: PVC coated, reticulated, flexible open cell reticulated polyurethane foam; 30-40 pores per in. or as recommended by the fabricator. PVC coating shall have a bacteriostat addictive added to the formulation

H. Sealants, Fillers and Specialty Gaskets.

I. Panel stiffeners shall be concealed from view, structurally fastened or restrained at the ends and shall be secured to the rear face of the panels with structural silicone adhesive of sufficient size and strength to maintain panel flatness. Stiffener material shall match base material of panel and be compatible with the silicone.

2.02 METAL PANEL SYSTEMS

A. General: The schedule of metal panel systems contains all metal panel types scheduled for the entire project. Refer to paragraphs "Related Work Specified Elsewhere" and paragraphs herein for information as to locations and additional requirements.

B. Aluminum Plate Panel System: Aluminum panels utilizing minimum 1/8 in. thick aluminum plate to the shapes and profiles shown with concealed reinforcing as required. Provide panel dimensions allowing for field adjustments and thermal movement. Panel lines, breaks and reveals shall be sharp, smooth and free of warps, oil canning or buckling. Provide **Type MTL01** resinous coated PVDF finish.

2.03 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Finishes: Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

1. **Metal Type (MTL01):** Fluoropolymer PVDF Coating 3 Coat System: Standard 3-coat, thermocured system composed of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluorocarbon topcoat complying with AAMA 2605 and AA-C12C42R1x in custom colors and gloss as selected, using 70% minimum polyvinylidene fluoride resin by weight either "Kynar 500 or Hylar 5000 Fluorocarbon Resin" (Arkema Inc. or Solvay Solexis, Inc.), applied to a total dry film thickness of 1.6 mils.

a. Metal Fins and Anchors: Color and sheen to match "UC70579XL Duranar XL Bright Silver" (PPG) or approved equal.

b. Screen Support Frame, Aluminum Perimeter Frame and Steel Outriggers: Color and sheen to match "UC1067071XL Duranar XL Silver Shadow"(PPG) or approved equal.

2.04 FABRICATION

A. Supplementary Parts: Include supplementary parts necessary to complete metal fabrications work though not definitely shown or specified. Such parts include, but are not limited to, interface components necessary for the installation or anchorage to Work.

B. Verification of Measurements and Dimensions and Coordination and Schedule of Work: Verify measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades (with particular attention given to the installation of items embedded in concrete and masonry).

C. Formation of Exposed Work: Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 in. , unless otherwise shown. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Formation of Exposed Connections: Form exposed connections with hairline joints, flush and smooth; using concealed fasteners where possible. Exposed threaded portion of bolts and screws shall be cut off flush with adjacent metal. Cut, drill, punch and tap as required for the installation and attachment of other work to metal fabrications work. Shear and punch metals cleanly and accurately. Remove burrs. Remove sharp or rough areas on exposed traffic surfaces.

E. Formation of Metal Work: Form metal work built in with concrete or masonry for anchorage, or provide suitable anchors, expansion shields, or other anchoring devices shown or required to provide support for intended use. Furnish metal work in ample time for setting and securing in place.

F. Procedures for Joints and Welds: Make joints as strong and rigid as adjoining sections. Make welds continuous along entire line of contact, except where spot welding is indicated. Grind exposed welds flush and smooth to match and blend with adjoining surfaces. Welded connections may be used where bolted connections are shown. Fabricate joints exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

1. Make up threaded connections tight so that threads are entirely concealed. Shoulder and head, dowel and pin abutting bars. Provide bolt and screw heads flat and countersunk in exposed work. Carefully machine, fit and secure removable members by means of Allen-head set screws of proper size and spacing.

G. Galvanizing

1. ASTM A153, Classes A and B, for galvanizing iron and steel hardware.

2. ASTM A123, for galvanizing rolled, pressed and forged steel shapes, plates, bars, strip 1/8 in. thick and heavier and for assembled steel products.

3. Items to be Galvanized: Galvanize ferrous metal utilized on the exterior and items embedded in concrete whether interior or exterior, unless otherwise specified. Galvanize other items where specified or shown.

H. Preassembly of Items: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Following trial fit, disassemble units only as necessary for shipping and handling. Clearly mark units for reassembly. Provide alignment and splice plates for accurate field fit.

2.05 FABRICATION METAL PANELS

A. General: Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Metal Wall Panels: Fabricate panels with panel stiffeners as required to comply with deflection limits. Weld and grind panel corners smooth. Fabricate panels to the following dimensional tolerances:

1. Length and Width: +/- 0.032 in. up to 48 in. ; 0.064 in. more than 48 in.

2. Diagonal: Plus or minus 0.1875 in.

3. Panel Bow: Not more than 0.2% of panel width or length up to 0.1875 in. maximum.

4. Thickness: Plus or minus 0.008 in.

5. Squareness: 0.1875-in. difference between diagonal measurements.

6. Camber: 0.032 in.

D. Aluminum Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal plate wall panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal plate wall panel manufacturer for application, but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.01 GENERAL

A. Manufacturer's Instructions: Prepare substrates and install the work of this Section, including equipment, components, and accessories in accordance with the manufacturer's instructions, except where more stringent requirements are shown or specified, and where project conditions require extra precautions or provisions to ensure satisfactory performance of the Work.

3.02 EXAMINATION

A. Verification of Conditions: Examine the areas to receive the Work and the conditions under which the Work would be performed. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

B. Verify dimensions of supporting structure by field measurements so that metal panel system work will be accurately designed, fabricated and fitted to the structure. Tolerances for supporting structure are specified in other Sections.

3.03 PREPARATION

A. Substrate Acceptability: Commencement of installation shall constitute acceptance of substrate conditions by the Installer.

B. Coordination: Coordinate metal panel system work with the adjacent work of other sections. Provide items to be placed during the installation of other work at the proper time to avoid delays. Coordinate placement of items, including inserts and anchors, accurately in relation to the final location of metal panel system work.

C. Provide resinous coated aluminum panels to manufacturer/fabricators of hollow metal doors and frames and exterior single-fold loading dock door in a timely manner so as to allow for fabrication, approval and installation of their systems.

3.04 INSTALLATION: GENERAL

A. Dimensions shown on Drawings are based on an assumed design temperature of 70 deg. F. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.

B. Procedures: Perform cutting, drilling and fitting required. Install work in locations shown, plumb, level and in line with adjacent materials where required. Provide fastenings as shown on shop drawings, and as necessary for a rigid, secure and permanent installation. Make provisions for removable items.

1. Fasten to metal with bolts or machine screws threaded full length of the shank, with lock nuts on bolts.

2. Fasten to inserts in concrete or solid masonry, or use expansion bolts. Fasten to hollow masonry units with toggle bolts. Drill holes for bolts no larger than shank diameter.

C. Formation of Joints: Form tight joints with exposed connections accurately and uniformly fitted together. Do not cut or abrade finishes which cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing.

D. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of specified dielectric separator.

E. Installation: Closures And Trim: Form closures and trim members from matching base metal with matching finish of type and minimum nominal thickness as indicated or specified. Incorporate components required for support and installation of closures and trim. Fabricate closures and trim to tightly close with adjoining construction.

F. Provide concealed fasteners at all locations. Size fasteners to support work, with fasteners spaced to prevent buckling or waviness in finished surfaces. Drill and tap holes required for securing work to other surfaces.

G. Support joints with concealed stiffeners as required to hold exposed faces of adjoining units in flush alignment. Miter or cope trim members at corners to form tight joint.

3.05 INSTALLATION

A. Erection: Set metal panel work accurately in location, alignment and elevation, plumb, level and true, within tolerances indicated by accepted shop drawings and mock-up, as measured from established building lines and from other work already in place. Fit components accurately together to form tight joints. Provide for thermal expansion and contraction of the Work.

B. Fitting: Cut and trim component parts during installation only with the approval of the manufacturer and in accordance with his recommendations. Restore finishes completely to protect the material and remove evidence of cutting or trimming. Remove and replace members where cutting and trimming has impaired strength or appearance.

C. Joint Sealing: Provide sealant within metal wall panel system components at locations shown on the Drawings and where required for a complete watertight and airtight installation.

D. Ensure that weep holes and drainage channels are unobstructed and free of dirt and sealants and that weep baffles are permanently attached behind weep holes and drainage channels we.

3.06 ADJUSTING

A. Touch-Up Painting: Field paint marred or abraded shop paint and welds after cleaning these areas. Separate dissimilar metals and metals in contact with concrete or masonry with dielectric separator or gaskets. Do not extend coatings onto exposed surfaces.

3.07 PROTECTION

A. Protection: Upon completion of installation clean exposed metal surfaces as recommended by manufacturer and install protection. Protect finished surfaces against damage during subsequent construction operations and remove protection at time of substantial completion.

END OF SECTION

SECTION 07410

METAL PANEL SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data: Submit for Engineer's action. Submit manufacturer's literature and specifications describing the general properties of each material and accessory to be used in the Work including a material list with technical data documenting the location and primary function, quality, and performance of each material component or system to be used in the Work, including other primary characteristics as required by the Basic Contract Documents.

B. Shop Drawings: Submit for Engineer's action. Furnish shop drawings for the fabrication and installation of the Work. Show typical details of the conditions for every member, joint, anchorage and support in the system. Show systems for water drainage and weepage for each of the systems. Submit shop drawings for the fabrication and erection of metal panel work. Include plans and elevations at not less than 1/2 in. = 1 ft. scale, and include details of sections and connections at not less than 3 in. = 1 ft. scale. Distinguish between factory and field assembly work. Coordinate all components which are specified elsewhere, which comprise the system or are contiguous to the system.

C. Samples: Submit for Engineer's action. Label samples to indicate product, characteristics, and locations in the Work. Samples will be reviewed for color and appearance only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Submit for Engineer's action. Submit 3 sets of samples of the following:

1. Furnish 24 in. x 24 in. samples of each type panel system, showing maximum range or variation in color and shade, to match colors selected by Engineer. Include representative closures, joint sealant, copings and sills, and other exposed trim items.

2. Corner section of each type of metal panel system , 12 in. square, including two adjoining finished edges, the other edges cut to show internal components, including gaskets, girts, and fasteners.

3. Each type of trim for panel system: 12 in. long.

D. Structural Calculations: Submit for Engineer's information. Furnish engineering calculations to show that maximum stresses and deflections do not exceed specified performance requirements under full design loading. Calculations shall be prepared and sealed by a qualified Structural Engineer licensed in the State of New York.

E. Quality Control Submittals: Submit for Engineer's information.

1. Certifications

a. Document Review: Before commencing work, submit a written statement signed by the Contractor and the Applicator certifying that the Contract Documents, shop drawings and product data have been reviewed with material manufacturers' qualified technical representatives and that they agree the selected materials are proper, compatible with contiguous materials and adequate for the application shown.

b. Manufacturer's and fabricator's certification indicating that the resinous coating system complies with the Contract Documents.

F. Sustainable Design Submittals Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

G. Closeout Submittals: Submit for PANYNJ's documentation.

1. Warranties: Special warranties as specified.

2. Maintenance Manuals: Furnish two (2) copies of a bound maintenance manual, describing the materials, and procedures for cleaning and maintaining the metal panel system assemblies. Include manufacturer's data describing the materials and finishes used in the work.

END OF APPENDIX "A"

DIVISION 7

SECTION 07910

COMPRESSION SEALS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for compression seals – preformed hollow elastomeric extrusions.

B. Related Work specified in other Sections includes the following:

1. Division 3 Section on concrete formwork for block-outs.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM D 2628	Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
ASTM D 4070	Specification for Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures.
ASTM E 1612	Specification for Preformed Architectural Compression Seals for Buildings and Parking Structures.

1.03 ENVIRONMENTAL REQUIREMENTS

Do not proceed with installation of compression seals under the following conditions:

A. When ambient and substrate temperature conditions are outside the limits permitted by compression seal manufacturer.

B. When joint substrates are wet due to rain, frost, condensation or other causes.

C. When joint widths are greater than or less than the permissible widths allowed by compression seal manufacturer for application shown on the Basic Contract Drawing.

1.04 QUALITY ASSURANCE

A. Installer Qualifications

Engage an experienced installer who has completed installation of compression seals similar in material, design and extent to that required for Work of this Contract and with a record of successful in-service performance.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened containers or bundles with labels indicating the manufacturer, product name and color.

B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.06 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainable Design General Requirements

1. The Authority requires the contractor to implement practices and procedures to meet the sustainable design requirements. The contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS, are implemented to the fullest extent. Substitutions or other changes to the work proposed by the contractor will not be allowed if such changes compromise the stated sustainable design performance criteria.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, furnish and install products of one of the following, or approved equal:

Conspec Systems, Inc., Muncy, PA
D.S. Brown Co., North Baltimore, OH
Watson Bowman Acme Corp., (subsidiary of Degussa Corp.), Amherst, NY

2.02 MATERIALS

A. General

1. Compatability

Compression seals, adhesives and other related materials and accessories shall be compatible with one another and with joint substrates, as shown on the Basic Contract Drawing.

2. Color

Compression seals shall be of color shown on the Basic Contract Drawing or, if not shown, as selected by the Engineer from manufacturer's custom colors. Compression seals in joints of masonry or stone shall match mortar color unless otherwise shown on the Basic Contract Drawing.

3. Furnish compression seals in longest available lengths to minimize number of end splices.

B. Compression Seals

Preformed elastomeric extrusions of the open-cell compression type, with continuous longitudinal internal baffle system throughout, complying with ASTM E 1612 and with requirements shown on the Basic Contract Drawing for size, profile and cross-sectional design, of one of the following materials:

1. Polychloroprene ("Neoprene"): ASTM D 2628.

2. Thermoplastic Vulcanizate ("Santoprene"): Thermoplastic rubber compound, Shore A hardness Grade 55 or 64.

C. Lubricant Adhesive: ASTM D 4070 or as recommended by compression seal manufacturer.

D. Accessories: Manufacturer's standard anchors, fasteners and other compatible materials as indicated or required for a complete installation.

PART 3. EXECUTION

3.01 EXAMINATION

Inspect joints shown on the Basic Contract Drawing to receive compression seals for compliance with requirements for joint configuration, installation tolerances and other conditions affecting compression seal performance. Do not perform Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordinate block-outs at joint edges as required and as shown on the Basic Contract Drawing. Comply with manufacturer's instructions applicable to substrate removals and preparation to accommodate seal installation.

B. Surface Cleaning of Joints

Clean out joints immediately before installing compression seals, in compliance with recommendations of compression seal manufacturer and the following:

1. Remove foreign material from joint substrates which could interfere with installation of compression seal, including but not limited to: dust; paints (except for permanent protective coatings tested and approved for seal compatibility by compression seal manufacturer); oil; grease; waterproofing; water repellants; water; surface dirt and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces either by brushing, grinding, blast cleaning, mechanical abrading, acid washing or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with compression seal. Remove loose particles remaining from cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form release agents from concrete.

4. Clean nonporous surfaces using chemical cleaners or other means that are not harmful to substrates or which leave residues capable of interfering with installation of compression seals.

3.03 INSTALLATION

A. General

Comply with compression seal manufacturer's printed installation instructions applicable to products and applications shown on the Basic Contract Drawing.

B. Prior to seal placement, apply manufacturer's recommended lubricant adhesive to joint substrates.

C. Install seal with minimum number of end splices using manufacturer's recommended installation tools. For straight sections install seals in continuous lengths; where splices and changes in direction occur, weld ("Santoprene") or adhesively splice ("Neoprene") compression seal together to create a watertight joint. Recess seal below adjoining joint surfaces by 1/8 to 1/4 inch, unless otherwise shown on the Basic Contract Drawing.

END OF SECTION

SECTION 07910

COMPRESSION SEALS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's technical data and details for each type of compression seal shown, including relevant product dimensions and instructions for joint preparation and installation.

B. Samples

6 inch long sample strips of each type of compression seal, in the colors required or with manufacturer's color chart for selection and 1 pint sample of lubricant adhesive.

C. Qualifications

Submit proof of installer qualifications. Include lists of completed projects with names and addresses of projects, architects and owners.

D. Sustainable Design Submittal Requirements:

1. The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

   a. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

      (1) Cost breakdowns for the materials included in the Contractor's work. Cost breakdowns shall include total cost plus itemized material costs.

   b. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX "A"

DIVISION 7

SECTION 07920

SEALANTS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies interior and exterior cold liquid-applied sealants, as shown on the Basic Contract Drawing with the following designations:

1. ES-1: One-part non-acid curing silicone.
2. ES-2: One-part acid curing, mildew-resistant silicone.
3. ES-3: One-part or two-part non-sag polyurethane.
4. ES-4: One-part or two-part pourable polyurethane.
5. ES-5: Latex sealant for interior locations.
6. ES-6: One-part non-sag silyl-terminated polyether.

B. Horizontal joint sealants in concrete and asphalt roads and sidewalks (hot and cold liquid-applied) are specified in Division 2 Section on pavement joint sealing.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Architectural Manufacturers Association (AAMA)
AAMA CW-13	Structural Sealant Glazing Systems.
	American Society for Testing and Materials (ASTM)
ASTM C 834	Specification for Latex Sealants.
ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM C 1021	Practice for Laboratories Engaged in Testing of Building Sealants.
ASTM C 1193	Guide for Use of Joint Sealants.
ASTM C 1330	Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
ASTM D 1056	Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Elastomeric joint sealants designated as ES-1 through ES-4, and E-6 shall establish and maintain watertight and airtight continuous seals without staining or deteriorating joint substrates when installed.

B. Nonelastomeric joint sealants designated as ES-5 shall establish and maintain airtight continuous seals that are water-resistant without staining or deteriorating joint substrates when installed.

C. Adhesion Test

When directed by the Engineer, perform preconstruction field adhesion test of each sealant per AAMA CW-13. Perform such tests in the presence of the Engineer and a qualified technical representative of the sealant manufacturer.

1. Notify Engineer and sealant manufacturer 7 days in advance of the dates and times when field adhesion tests are to occur.
2. Produce written report on test results.
3. Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with the above requirements, will be considered satisfactory. Sealants that fail to adhere to joint substrates during testing shall not be used in the Work.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not proceed with the Work of this Section under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by sealant manufacturer.
2. When joint substrates are wet due to rain, frost, condensation or other causes.
3. Where joint widths are less than or greater than widths allowed by sealant manufacturer for applications shown on the Basic Contract Drawing.
4. When contaminants capable of interfering with sealant adhesion are present on joint substrates.

1.05 QUALITY ASSURANCE

A. Installer Qualifications

Verify that the entity performing sealant installation has successfully completed within the last 3 years at least 3 joint sealant installations involving quantities and complexities at least equal to those required for Work of this Section.

B. Testing Laboratory Qualifications

Use an independent testing laboratory that demonstrates to Engineer's satisfaction, based on evaluation of laboratory submitted criteria conforming to ASTM C 1021, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying progress of the Work.

C. Single Source Responsibility

Obtain sealant and primer materials from a single manufacturer for each different required product.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to construction site in original unopened containers or bundles with labels clearly identifying the manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multicomponent materials.

B. Store and handle materials to prevent deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.07 Sustainable Design General Requirements:

A. Sustainable Design General Requirements:

1. The Authority requires the Contractor to implement practices and procedures to meet the sustainable design requirements. The Contractor shall ensure that the requirements related to these goals, as defined in Division 1 - GENERAL PROVISIONS and the articles below, are implemented to the fullest extent. Substitutions, or other changes to the Work proposed by the Contractor, will not be allowed if such changes compromise the stated Sustainable Design Performance Criteria.

B. Sustainable Design Performance Criteria:

1. All field-applied adhesives, sealants, paints and coatings relating to Work of this Section shall meet the requirements of Division 1 - GENERAL PROVISIONS.

1.08 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, furnish and install products of the following manufacturers, or approved equal:

A. ES-1 (One-part non-acid curing silicone)

Dow Corning 795; Dow Corning Corp., Midland, MI
SilPruf NB SCS9000; GE Sealants & Adhesives, Waterford, NY
Bondaflex 295; May National Associates, Inc., Clifton, NJ
Spectrem 2; Tremco Inc., Beechwood, OH

B. ES-2 (One-part acid curing, mildew-resistant silicone)

Dow Corning 786; Dow Corning Corp., Midland, MI
Sanitary SCS1700; GE Sealants & Adhesives, Waterford, NY
Bondaflex Sil 100 WF; May National Associates, Inc., Clifton, NJ
Proglaze; Tremco Inc., Beechwood, OH

C. ES-3 (One-part or two-part non-sag polyurethane)

Dynatrol I-XL or II; Pecora Corp., Harleysville, PA
Sikaflex 15LM or Sikaflex 2c NS; Sika Corp., Lyndhurst, NJ
Vulkem 921 or Dymeric 240; Tremco Inc., Beechwood, OH

D. ES-4 (One-part or two-part pourable polyurethane)

Sonolastic SL 1 or SL 2; Degussa Building Systems, Shakopee, MN
Urexpan NR-201 or NR-200; Pecora Corp., Harleysville, PA
Vulkem 45 or 245; Tremco Inc., Beechwood, OH

E. ES-5 (Latex sealant for interior locations)

AC-20 FTR; Pecora Corp., Harleysville, PA
Tremflex 834; Tremco Inc., Beachwood, OH
SHEETROCK Acoustical Sealant; United States Gypsum Co., Chicago, IL

F. ES-6 (One-part non-sag silyl-terminated polyether)

Sonolastic 150; Degussa Building Systems, Shakopee, MN
Bondaflex STP 25; May National Associates, Inc., Clifton, NJ
Pro-Sil[sct] 1; Pecora Corp., Harleysville, PA
Sikaflex-721 UV; Sika Corp., Lyndhurst, NJ

2.02 MATERIALS

A. Sealants (except designation ES-5)

1. Cold-applied elastomeric joint sealants shall conform to the following requirements of ASTM C 920:

   a. Type: S, except Type S or M for sealant designations ES-3 and ES-4.

   b. Grade: NS, except Grade P for sealant designation ES-4.

   c. Movement Class: 25 for sealant designations ES-2 and ES-4; 50 for sealant designations ES-1 and ES-3. Not applicable for sealant designation ES-5.

   d. Use: T, NT, M, G, A or O as applicable to joint substrate type shown on the Basic Contract Drawing.

2. Sealant designation ES-5: Cold-applied nonelastomeric joint sealant; ASTM C 834.

3. Color

   a. At stone or masonry joints: Sealant color shall match adjacent mortar color, unless otherwise shown on the Basic Contract Drawing, subject to Engineer's approval.

   b. At other locations: As shown on the Basic Contract Drawing, or if not shown, as selected by the Engineer from manufacturer's standard colors.

B. Sealant Backing

Furnish sealant backings of material and type which are nonstaining and are compatible with joint substrates, sealants, primers and other joint filler materials. Sealant backing shall be as approved by sealant manufacturer, based on field experience and laboratory testing, for applications shown on the Basic Contract Drawing and shall be one of the following types:

1. Cylindrical Foam Sealant Backing (backer rod): ASTM C 1330; preformed, compressible, resilient, non-exuding lengths of polyethylene or polyolefin foam of size and density required to control sealant depth and contribute to producing optimum sealant performance.

   a. Type B (bi-cellular) or Type C (closed cell), non-gassing foam, as recommended by sealant manufacturer for use with each sealant type and location.

2. Elastomeric Tubing Sealant Backing: Neoprene, butyl or EPDM tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to minus 26 degrees F. Furnish products with low compression set and of size and shape to provide a secondary seal, to control sealant depth and contribute to producing optimum sealant performance.

2.03 ACCESSORIES

A. Primer

Types recommended and furnished by joint sealant manufacturer and as required based on results of preconstruction field adhesion testing for adhesion of sealant to joint substrates shown on the Basic Contract Drawing.

B. Bond Breaker Tape

Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and joint filler or other materials at back (third) surface of joints. Furnish self-adhesive tape where applicable. Duct tape is not acceptable.

C. Masking Tape

Removable, nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

D. Cleaners for Nonporous Surfaces

Nonstaining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials that is not harmful to substrates and adjacent nonporous materials.

E. Vent Tubes (Weep Holes)

Heat-bendable clear acrylic or polypropylene tubes, of proper diameter and approved by the sealant manufacturer, where shown on the Basic Contract Drawing and as required to direct moisture to the outside of the building.

PART 3. EXECUTION

3.01 EXAMINATION

Inspect joints shown on the Basic Contract Drawing to receive joint sealants for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Do not allow joint sealant Work to proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints

Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), oil, grease, waterproofing, water repellents, water, surface dirt and frost.
2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with joint sealants. Remove loose particles remaining after cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form oil or release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile and similar nonporous joint substrate surfaces with chemical cleaners or by other means that are not harmful to substrates and that do not leave residue capable of interfering with adhesion of joint sealants.

B. Joint Priming

Prime joint substrates where recommended by joint sealant manufacturer and where required based on results of preconstruction field adhesion testing. Apply primer and allow to cure in compliance with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking

Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION

A. General

Comply with joint sealant manufacturer's printed installation instructions and recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions shown on the Basic Contract Drawing.

B. Sealant Backings

1. Install sealant backing of type shown on the Basic Contract Drawing, or if not shown, in accordance 3.03 A, for support of sealants during application. Install sealant backing in position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths to allow optimum sealant movement capability.

   a. Do not leave gaps between ends of sealant backings.

   b. Do not stretch, twist, puncture or tear sealant backings.

   c. Remove absorbent sealant backings that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants and sealant backings, joint fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.

3. Install compressible seals serving as sealant backings to comply with requirements of 3.03 B.1 for sealant backings.

C. Sealants

Follow sealant manufacturer's installation instructions so that installed sealants directly contact and fully wet joint substrates, completely fill recesses provided for each joint configuration and provide uniform, cross-sectional shapes and depths relative to joint widths to allow optimum sealant movement capability.

D. Tooling

1. Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads, to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint.

2. Do not use tooling agents that discolor sealants or adjacent surfaces, or tooling agents that are not approved by sealant manufacturer.

3. Joint Configuration: Concave per ASTM C 1193, Figure 8A, unless otherwise shown on the Basic Contract Drawing to be flush per Figure 8B or to be recessed per Figure 8C.

   a. Recessed joint depth shall be as shown on the Basic Contract Drawing. Use masking tape to protect adjacent surfaces of recessed, tooled joints.

E. Clean off excess sealants or sealant smears adjacent to joints immediately as Work progresses by methods and with cleaning materials approved by manufacturer of joint sealant.

3.04 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of issuance of the Certificate of Final Completion.

B. If despite such protection, damage or deterioration occurs, including bubbling, cut out and remove damaged or deteriorated joint sealants and backings immediately and reseal joints with new materials to produce joint sealant installations with repaired areas indistinguishable from original Work, at no cost to the Authority.

END OF SECTION

SECTION 07920

SEALANTS

SUBMITTALS

APPENDIX "A"

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Product Data

Manufacturer's product data for each joint sealant product, sealant backing, primer and accessory required, and instructions for joint preparation and sealant application.

B. Samples

When color sealant is required, submit two separate bead sample strips of manufacturer's standard colors showing full range of colors available and sample strips of colors to match adjacent mortar color, for each product exposed to view.

C. Certifications

From joint sealant manufacturer attesting that its sealant products comply with 1.03 A-B and 2.02 A.1 and 2 as applicable, and that their sealant products are suitable for the use shown on the Basic Contract Drawing.

D. Test Reports

1. Preconstruction field adhesion test report results per 1.03 C when field adhesion tests are directed by the Engineer.
2. Compatibility and adhesion test reports from sealant manufacturer indicating that materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance, and sealant manufacturer's recommendations for primers and substrate preparation needed to obtain adhesion.

E. Qualifications

Evidence of installer's experience and capabilities. Include lists of completed projects with project names and addresses, names and addresses of architects and owners and other information specified.

F. Sustainable Design Submittal Requirements:

The Contractor shall submit the Sustainable Design certification items listed herein. Sustainable Design submittals shall include the following:

1. A completed Sustainable Design Materials Certification Form (SDMCF), appended to Division 1 - GENERAL PROVISIONS. Information to be supplied for this form shall include:

   a. Cost breakdowns for the materials included in the Contractor's Work. Cost breakdowns shall include total cost plus itemized material costs.

   b. Where required by the Sustainable Design Performance Criteria of this Section, the following information shall also be supplied:

      (1) The amount of post-consumer and/or post-industrial recycled content in the supplied product(s).

      (2) The manufacturing location of the supplied product(s).

      (3) The location (source) of the raw materials used to manufacture the supplied product(s).

      (4) The VOC content of all adhesives, sealants, paints, and coatings applied on site as part of this Work.

2. Published product literature or letters of Certification, provided from the product manufacturer on the manufacturer's letterhead, to verify the product information supplied for the SDMCF.

3. Product cut sheets for materials that meet the SDMCF.

4. Material Safety Data Sheets (MSDS), for applicable products. Applicable products include, but are not limited to field-applied adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compound (VOC) limits of products submitted (If an MSDS does not include a product's VOC limits, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).

5. The Sustainable Design submittal information shall be assembled into one (1) package per Section or trade, and sent to the Engineer.

END OF APPENDIX

SECTION 11151

PARKING GUIDANCE SIGNS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies requirements for a Parking Guidance Signs for the La Guardia Airport (LGA). The PGS shall be used to provide motor vehicle operators an indication of available of parking, and to manually control the Variable Message Signs being furnished as part of these Specifications.

B. The PGS shall be composed of the following subsystems:

1. Variable Message Signs (VMS) controlled by the software that provide motor vehicle operators the information concerning the availability of parking on each level of the garage.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Unless otherwise specified on the Contract Drawings or in this Section, the PGS as manufactured, supplied, and installed, shall conform to the requirements of NFPA 70, all local codes having jurisdiction, and all other publications referenced in this Section.

B. The electrical and electronic hardware, structural materials, equipment housings and software, required for a fully operational, integrated, real-time system shall operate on a 24 hour-per-day, seven days-per-week basis with high system reliability of 99.98 percent, and shall conform to the requirements of this Section. The Mean Time Between Failures (MTBF) for each category of system component shall be not less than 80,000 hours.

C. Furnish and install a complete and fully functional system. Include all equipment and software required to provide a complete system, whether the equipment is specifically listed in this specification or not. The design is functional in nature with specific product references.

D. The PGS Communications shall be based on National Transportation Communications for Intelligent Transportation System Protocol (NTCIP).

E. System Operation:

1. The PGS shall provide the operators of the LGA the ability to manually change the parking availability status on any level of the garages.

2. The occupancy of each zone will be determined manually. The counts will be performed at intervals determined by the operations staff. The system will provide an indication to the motor vehicle operators that a zone has parking spaces available or that it is full. This information will be provided to the motorist on VMS signs that indicate the status of each zone or level.

3. The system software, in addition to the tracking the status of each zone or level, shall provide reports on the status of the parking system. The reports shall be based on the data fields selected by the LGA operator. It shall also be able to generate custom reports on a time of day basis.

4. The PGS shall control the Variable Message Signs (VMS) throughout the facility, to provide additional information to the motor vehicle operators. The PGS shall allow messages to be preprogrammed in advance to allow LGA operators to select the messages to be displayed by initiating pre-defined scenarios.

F. The PGS shall be fully software configurable and shall allow future system expansion, such as the addition of more parking zones or VMS, as well as the addition of entire new parking areas, merely through system configuration, with no hard coding or source-code changes required or the procurement of additional software or licenses.

1. The PGS shall support expansion of twenty times the initial number of zones or levels, workstations and VMS at a minimum.

G. The PGS software shall at a minimum run on an SQL database.

H. The PGS software shall operate on a Windows 7 Professional, Windows 2008 R2 Server or latest version of Microsoft Windows operating systems supported by the Authority. Non-Microsoft Windows based PGS software and systems shall not be acceptable.

I. All System components, hardware, software, firmware and equipment furnished shall be in a "state of common usage".

1. All hardware and software used shall be industry standard and conform to established open architecture standards. This shall include established programming languages, industry standard and general use database management system and operating systems.

2. All computer software shall consist of all system, application and utility software required to meet the requirements of the Specifications and Contract Drawings. All off-the-shelf software used shall be industry standard and available from multiple sources. Unless otherwise indicated, furnish and install the latest commercially available release version of the software product in general use at the time of Contract award.

3. Operating system software shall be industry standard, in general use and supplied in the same form in which it is distributed, modified only to meet integration and recording of system errors requirements.

4. All application software and firmware shall be a standard off-the-shelf product. Any custom application software required to meet the requirements of the Specifications and Contract Drawings shall be written in a programming language which is in general use and fully supported from multiple sources. The application software shall be modular, commented, documented and structured to facilitate software maintenance by the Authority.

5. All equipment hardware, firmware, software, and network upgradeable system components shall be the latest commercial version available.

1.03 RELATED SECTIONS

A. Section 16110 – Raceways

B. Section 16120 – Wires Cables Splices Terminations (600 Volts or Less)

C. Section 16126 – Optical Fiber Cable

D. Section 16127 – Control/Signal Transmission Media

E. Section 16133 – Control Panels, Enclosures/Cabinets, and Terminal Boxes

F. Section 16135 – Boxes and Fittings

G. Section 16450 – Grounding

H. Section 16576 – Short Viewing Distance Application Light Emitting Diode Variable Message Signs

I. Section 16610 – Static Uninterruptible Power Supply

J. Section 16744 – Data Network Testing, Startup and Administration

K. Section 16785 – Data Network Equipment

1.04 REFERENCES

A. ANSI International / Telecommunications Industry Association / Electronic Components Industry Association (ANSI / TIA / ECIA)

1. 232-F - Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
2. 310-D – Cabinets, Racks, Panels, and Associated Equipment
3. 485-A – Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems
4. 568-B.2 - Commercial Building Telecommunications Cabling Standards - Part 2: Balanced Twisted Pair Cabling Components
5. 569 – Commercial Building Standards for Telecommunications Pathways and Spaces

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

1. 802.3 - IEEE Standard for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks--Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
2. 802.11 - IEEE Standard for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC)

and Physical Layer (PHY) Specifications. (Including all associated amendments)

C. National Electrical Manufacturers Association (NEMA)

1. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
2. TS 2-2003 v02.06 - Traffic Controller Assemblies with NTCIP Requirements

D. National Fire Protection Association (NFPA)

1. 70 – National Electrical Code

E. New York City Electrical Code

F. National Transportation Communications for Intelligent Transportation System Protocol

1. 1203 - NTCIP Object Definitions for Dynamic Message Signs (DMS)

G. World Wide Web Consortium (W3C)

1. Extensible Markup Language (XML)
2. The Extensible Stylesheet Language Family (XSL)

H. Underwriters Laboratories (UL)

1. 486A – Standard for Safety for Wire Connectors

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Not Applicable

1.06 QUALITY ASSURANCE

A. Contractor's Quality Control Responsibilities

1. Contractor is solely responsible for quality control of the Work.
2. All products shall be made accessible to the Engineer for quality control inspection at any time during regular shop hours.

B. The Manufacturer of the PGS System shall meet the following requirements:

1. Be regularly engaged in the business of manufacturing fully integrated parking systems, with a North America-based service and support facility for a minimum of three years.
2. Have maintenance services and related technical assistance available in the New York City Metropolitan Area and an established maintenance facility within the Port District, as evidenced by existing contracts to provide maintenance for fully integrated parking systems and all associated control equipment and electronics comparable to the system to be furnished and installed under this Contract. The PGS manufacturer's maintenance staff shall consist of a sufficient number of qualified journeymen, technicians and other technical

personnel qualified to perform complete maintenance of the PGS and all associated control equipment and electronics.

3. The PGS and all associated control equipment and electronics equipment of the type furnished under this Contract, shall have been satisfactorily installed and operational in at least three different sites with similar environmental conditions similar to those of the construction site and in applications of complexity similar or equivalent complexity to that specified in this Contract, for a period of not less than two years.

4. Submit proof of manufacturer's compliance with the experience requirements. This includes, but is not limited to, a list of installations with photographs and names, addresses and telephone numbers of operating personnel who can be contacted regarding the systems. If requested by the Engineer, arrange for a demonstration of an installed PGS from the proposed manufacturer.

C. System Integrator Qualifications

1. Retain the services of a System Integrator responsible for the configuration and integration of the equipment described in this Section and the Contract Drawings.

2. The System Integrator shall have a minimum of three years' experience configuring and integrating systems of comparable size and complexity comparable to the system described in this Section using the same PGS hardware components and software utilized for the Work of this Contract.

3. Experience shall include at least two installed systems of similar size and complexity similar to the system described in this Section in continuous satisfactory operation for at least one year.

4. The Integrator shall also be a factory-authorized sales and service representative of the PGS Manufacturer.

D. Installer Qualifications

1. Retain the services of an experienced Installer with a minimum of three years of experience and who is a factory-authorized sales and service representative of the PGS manufacturer to perform the work described in this Section and the Contract Drawings.

1.07 SUBMITTALS

A. Qualifications:

1. Submit name and address of PGS Manufacturer, System Integrator and Installer with documentation to show proof of compliance with 1.06 of this Section.

2. Qualifications must be approved prior to transmittal of any other submittals of this Section.

B. Product Data:

1. Submit manufacturer's data on the PGS components, including, but not limited to:

Complete schedule and bill of materials for the equipment to be furnished and installed under this Section

Catalog Cuts for all hardware and software

Electrical and mechanical specifications to show compliance with 2.02 of this Section.

Documentation and manuals describing features and operation of PGS software. Indicate all software modules and features furnished.

2. Compatibility Certification

Submit written certification from the PGS manufacturer that the proposed PGS software has been successfully used in the past with, and is fully compatible with, the VMS that are provided under these Specifications.

3. Requirements Matrix

The requirements matrix shall contain each and every design requirement, listing Contract specification reference number and shall identify the logical processes and physical system or subsystem components that will satisfy the requirement.

The matrix shall identify the specific location in the design submittals where each of the design requirements and any approved design changes will be implemented by the proposed logical processes and physical components. Upon approval of any design changes, submit an updated requirements matrix.

C. Shop Drawings:

1. Hardware and equipment location plans: Show locations of all hardware including VMS, Servers and Workstations.

2. Installation Plans: Floor plans indicating hardware installation details, raceways, wiring and other system components to be used in the installation of all PGS equipment. Identify all power, control and communications raceways and wiring. Any deviation from the Contract Drawings requires prior written approval from the Engineer.

3. Wiring Diagrams: Point-to-point wiring diagrams detailing cabling for network, power, signal and control. Differentiate clearly between manufacturer installed wiring and field-installed wiring. Identify terminal numbers and wiring color codes to facilitate installation, operation, and maintenance.

4. Rack drawings: Drawings showing the placement of equipment within the racks, including electronics, power strips, relays, switches, vents, etc. Include front and rear elevations showing all labeling.

D. System Description

1. Submit System Description overview documentation providing a technical overview of the hardware, software and communications architecture of the PGS. The intent of this submittal is to give a basic overview of the System and to present the overall system design. Include the following information:

Executive Summary

1) Provide a summary of the documentation material provided in the deliverable, an overview of the operation and special features of the PGS System.

Functional Description

2) Provide a functional description of the major components of the PGS and their operation.

System Architecture

3) Provide a graphic representation of hardware components and their interconnections. This includes identification of the interfaces between each device and each computer and the interfaces to all other systems.

Communications Overview

4) Identify how all of the major hardware components are interconnected and communicate with each other and the outside world. Identify all communications protocols utilized and the information and data flow hierarchy.

Application Program and Human Machine Interface (HMI) Overview

5) Provide a description of the PGS software.
6) Indicate version, revision/build level.
7) Identify all software modules provided. Describe each program's processing functions and features.
8) Provide an overview of the HMI and how data is presented to users. Explain functions and features available through the HMI.
9) Provide a description of the database and the overall organization of the database including access methods, record/file structures and tables. Include diagrams depicting the database organization and hierarchies. If a commercial product is used, include information about it.

Custom Programming and Logic Applications

10) Identify any custom programs, logic routines or applications that will be utilized for the System. Describe what functions will be performed with custom logic and applications and how these will be integrated into the overall PGS software.

Security Features

11) Describe all security features, both software and physical, designed into the PGS to control and monitor access to the system and its components (e.g. hardware, software and data). Include a description of controls employed to protect the PGS from computer viruses and unauthorized use.

System Performance Analysis

12) Address the capability of the PGS to meet the performance requirements, including system availability and reliability calculations.

2. Prior to submission of the System Description documentation, schedule with the Engineer to conduct a formal System Overview presentation at which time the Contractor will elaborate on the contents of the System Description documentation and answer any questions on any or all portions of the design. Upon incorporation of presentation comments, formally submit the System Description documentation.

E. System Configuration

1. Submit diagrams and documentation indicating the system configuration and default settings for the PGS hardware and software.

F. Installation Staging Plan

1. Submit Installation Staging Plan in accordance with 3.01D of this Section.

G. Manuals

1. Submit, consolidated comprehensive, separate, Maintenance and User's Manuals for the complete PGS, and all associated equipment, hardware, and software in accordance with 3.06 and 3.07 of this Section. Include in the form of instruction manual information for products furnished under this Section, which will be used as the basis for the Users and Maintenance training courses, to be conducted by the Contractor. User and Maintenance manuals shall be specifically written for this installation. Pages from the original equipment manufacturers standard operations and maintenance manuals may referenced in the manuals written for this Contract, provided all of the referenced items are included in the manuals.

2. Bind all 8.5 inches by 11 inches documentation, except standard spiral bound materials, in logical groupings in 3-ring loose-leaf binders. Each bound grouping of documentation shall be permanently and appropriately labeled. Documentation that exceeds 8.5 inches by 11 inches shall be 11inches by 17 inches in size and fan-folded to 8.5 inches by 11 inches size. No documentation shall be smaller than 8.5 inches by 11 inches. Document pages shall be numbered sequentially.

H. Factory Inspection and Testing Plan:

1. Submit to the Engineer for approval a Factory Inspection and Testing plan, which includes:

A summary statement of the purpose and goal of each portion of the test plan

The method of testing

A description of the overall test environment including diagrams showing the total test environment, relevant equipment interconnection and test equipment hook up.

Specification of the hardware and software required for the test including the number and type of devices to be used during the test or the method of simulation.

Detailed recommended test procedures which:

1) Demonstrate that every feature and function to be provided in the furnished hardware and software conforms to the requirements of the Contract
2) Identify the:
   - Steps for each test to be performed
   - Test purpose
   - Conditions that exist at the start of each test procedure
   - Conditions/results expected at the conclusion of each test procedure
   - The specification requirement that will be demonstrated by the test procedure
3) Include a space for recording of the actual test results, check boxes for the test outcome (pass or fail), dated signatures of both the person performing the test and the Engineer witnessing the test and for comments of the test witness(es)
4) Describe the documents to be submitted to the Engineer to validate the test results (reports, database listings, statistical analyses, message displays, etc.)

2. Submit to the Engineer for approval, a request to conduct the Factory Inspection and Test. Include the estimated length of time required to complete the inspection and testing and a test schedule.

3. Upon the completion of the Factory Inspection and Test, submit copies of the signed Factory Inspection and Test document, including all annotations and notes from the actual tests and all failed test reports. The test document shall state the test results and indicate the nature of any failure(s), the reasons for the failure(s), what corrective actions were taken and on which units the corrections were made, and a list of any outstanding items. These reports shall become part of the Factory Inspection and Test document.

   In the event of any device or component fails a test, halt the test and have the system manufacturer shall make the necessary repairs or adjustments. The test shall then be repeated.

   Unless permitted by the Engineer, subsequent test steps shall not begin until the test failure is satisfactorily corrected.

   If, in the judgment of the Engineer, a repair or adjustment jeopardizes the integrity of previously completed tests, the Engineer may direct the contractor to fully or partially repeat the previous tests.

   The Engineer may direct testing to begin on a different unit while repairs or modifications are made to correct a failure.

   If, in the judgment of the Engineer, there are an excessive number of test failures, the Factory Inspection and Test shall be terminated. Reschedule the Factory Inspection and Test for a later date.

If the test is terminated, before commencing of the re-test (schedule at a later date), submit written verification that the problem causing the termination has been repaired and the system has passed an internal testing procedure, as per the testing requirements. Only after this document has been received by the Engineer shall a re-test be scheduled.

I. Field Quality Control Test Reports

1. Submit Field Quality Control Test Reports in accordance with 3.04D of this Section.

J. Field Acceptance Testing Plan:

1. Submit to the Engineer for approval a Field Acceptance Testing plan, which follows the same format and requirements of the Factory Acceptance Testing plan described in 1.07H of this Section. The test plan shall include, at a minimum, all tests and procedures incorporated in the Factory Inspection and Testing that were approved by the Engineer and any additional tests to demonstrate that the installed equipment operates as specified.

2. Upon completion of the Field Acceptance Testing, submit the signed Field Acceptance Test document, including all annotations and notes from the actual tests and all failed test reports. The test report shall state the test results and indicate the nature of any failure(s), the reasons for the failure(s), what corrective actions were taken and on which units the corrections were made, and a list of any outstanding items. These reports shall become part of the Field Test document.

K. 30-Day Operational Acceptance Test Results

1. Upon completion of the 30-Day Operational Testing, submit report documenting the results of the test. Identify all equipment, software and components adjusted, repaired or replaced during the 30-day test.

L. Training Plan:

1. Submit to the Engineer for approval, copies of the Training Plan that includes, but is not limited to the following for each training class:

   Detailed description of the proposed course curriculum;

   Draft copies of the course material including but not limited to manuals, study guides, workbooks, technical reference material, etc.;

   Comprehensive schedule for the delivery of all training classes;

   The dates, times and exact locations for the training courses. The training courses shall be held at an Authority facility, designated by the Engineer. The dates and times shall be coordinated with and approved by the Engineer.

2. Prior to the start of the Operations, Maintenance and Supervisor Training Courses, submit copies of the approved Operations, System Administration, Maintenance, and Communications Protocol manuals, in the quantities

indicated. These manuals will be used by the Authority personnel during the training courses.

3. After completion of all Operations, Maintenance and Supervisor Training Courses, submit the following:

   One unbound, reproducible master set of all Operations, Maintenance, System Administrator and Communications Protocol manual documents and a copy of each manual in a digital format that may be edited using Microsoft Word 2000 or later. These master sets shall include a written non-disclosure and copyright waiver allowing the Authority to make unlimited copies, for its own use, of any copyrighted material within, royalty free, for a period of 99 years.

   Video recordings of each instructional class on DVD for the Authority's future use. Also submit video instructions for operation of each item of equipment supplied. These video recordings shall include a written non-disclosure and copyright waiver allowing the Authority to make unlimited copies, for its own use, of any copyrighted material within, royalty free, for a period of 99 years.

M. As-Built Drawings

1. Submit as-built drawings indicating location of equipment installed in the field. After approval of the "As Built" drawings, submit prints and one complete reproducible set on Mylar (polyester film). All Mylar's shall be black-line, double-matte, reverse reading, 34 inches by 22 inches in size and not folded or creased.

N. Spare Parts

1. Submit a complete list of proposed spare parts, including part descriptions, part numbers, quantity used in the system and proposed quantity of spares to be furnished.

2. After approval, furnish the spare parts in accordance with the approved list. Spare parts shall be furnished to the Authority prior to the start of the 30-Day Operational Test.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect all equipment against damage during transit and storage. All equipment shall be shimmed, braced, blocked and tied down to prevent distortion or other damage during transportation.

B. Deliver all materials in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract and Work Order Number (as applicable), storage requirements and any other special handling instructions.

C. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, weather, temperature, corrosion, contaminants, dirt, vandalism and other causes.

D. Deliver all equipment to the placement and installation Work sites. If equipment is delivered to an off-site location prior to placement and installation at the Work site, the Contractor shall be responsible for all movement of the equipment from the off-site storage facility to the Work site as well as for proper storage and handling and security of the equipment at the off-site storage location.

E. After delivery at the Work site, make a field inspection of the equipment in the presence of the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements hereof, the Contractor , upon notification in writing, shall replace the equipment at his own cost even though this equipment may have been previously inspected and approved for shipment. After such satisfactory replacement and subsequent Engineer's written approval, the equipment shall be installed by the Contractor.

F. Handle all equipment in a manner to prevent damage. Replace damaged equipment at no cost to the Authority.

G. Where possible, furnish and install protective coverings to prevent equipment damage. Coverings shall remain in place until final acceptance testing and be removed as part of final clean-up.

H. Touch up damage to finishes to match adjacent surfaces, including re-coating of galvanized or plated surfaces where damaged, cut, or drilled.

1.09 SPARE PARTS

A. Furnish the following items for use by the Authority in the quantities indicated:

1. Tower LED Modules - 15
2. Tower Controllers – 2
3. Informational Sign LED Modules - 25
4. Informational Sign Controllers - 2

B. Prepare a complete list of proposed spare parts for approval, including part descriptions, part numbers, quantity used in the system and proposed quantity of spares to be furnished. After approval, furnish the spare parts in accordance with the approved list prior to the start of the 30-Day Operational Test.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Zone/Level Availability Tower Display, and Informational Signs

1. Daktronics, Inc. Brookings, S.D.
2. American Signal Company, Atlanta, GA
3. Vultron Incorporated, Rochester Hills, MI

4. Approved equal

B. PGS Software:

1. CUR-Systemtechnik GmbH, Zum Sitters 12, D-66787 Wadgassen, Germany
2. CTR Parking Systems, Inc., Thornhill Industrial Park, 555 Keystone Drive, Warrendale, PA 15086
3. TCS International, Inc., 55 Union Ave., Sudbury, MA 01776
4. Approved equal

C. Servers

1. IBM (no substitutions)

D. Computer Workstations and Monitors

1. Lenovo/IBM (no substitutions)

2.02 MATERIALS

A. Variable Message Signs

1. The Variable Message Signs for the PGS shall be of three types; Roadway Informational Signs, Zone/Level Availability Tower Display, and Informational Signs. Each sign shall have distinct characteristics. The Roadway Informational will be controlled by the system but are not part of this contract

I. Zone/Level Availability Tower Display and Informational Signs shall conform to the following:

1) REFERENCES

a) Standard for Electric Signs, UL® listed
b) Standard for Control Centers for Changing Message Type Signs
c) Federal Communications Commission Regulation, Part 15
d) National Electrical Code®

2) SUBMITTAL

a) In addition to the documentation required in 1.07 submit:
- All LED display manufacturer qualifications, as specified herein.
- LED shop drawing, including an illustration of the recommended installation method.
- LED display riser diagram.
- Power requirements, including legs and amps per leg.
- Major LED display schematics, including AC power distribution, DC power distribution, and control signal distribution.

3) QUALIFICATIONS

a) LED display manufacturer shall:

- Have been in the business of manufacturing permanently mounted outdoor displays that are used in transportation applications for a minimum period of five (5) years prior to the contract bid date. An LED display contains pixels constructed solely of high-intensity discrete LEDs.
- Have in operation a minimum of one hundred (100) outdoor permanently mounted LED displays as defined above. Each of these LED displays shall have operated successfully for a minimum period of one (1) year prior to the contract bid date.
- Have in operation, as of the contract bid date, a minimum of five (5) outdoor LED display systems. These LED display systems shall communicate over direct wire dial-up telephone, cellular telephone, spread spectrum radio, or fiber-optic backbones. Each of the five (5) systems shall contain a minimum of two (2) permanently mounted displays. All systems shall be owned and operated by five (5) different agencies.
- Have been in business under the same corporate name for a period of no less than five (5) years prior to the contract bid date.
- Utilize a documented in-house quality management procedure that has been in place for no less than five (5) years prior to the contract bid date.
- Provide a toll-free help desk number that shall be manned during normal business hours.

b) Documentation that proves the LED display manufacturer complies with these requirements shall be provided with the LED display manufacturer's pre-build technical submittal. This submittal shall also include references and project information for all five (5) of the systems referenced above:

- Equipment owner/operator agency name
- Contact person name, telephone number, fax number, and email address
- Display system name and location of operations control center (project name/number)
- Display quantity
- Display commissioning date (first date of successful on-site operation)
- LED display size (pixel rows by pixel columns) and type (full LED display, line LED display, or discrete character)
- Display housing access
- Type of communications backbone (telephone, fiber-optic, direct, etc.)

c) Experience with manufacturing the following types of electronic sign products shall not satisfy the requirements of this LED display specification:

- Indoor displays of any size or type
- Backlit displays
- Split-flap displays
- Any type of display that is not pixilated
- Displays that have a pixel technology comprised of something other than high-intensity LEDs. Examples of unacceptable technologies are incandescent lamp, liquid crystal, fiber-optic, flip disk, flip-fiber combination, and flip-LED combination.
- Outdoor electronic displays that are used for purposes other than transportation management

4) QUALITY ASSURANCE

a) Source Limitations: Obtain electronics displays and equipment through one source from a single manufacturer.
b) UL-listed for safety compliance
c) NEC compliant
d) FCC Class A Compliant
e) Designed to NEMA 3R standards

5) WARRANTY/SERVICE PLAN

a) There shall be one (1) year parts coverage of electronic components.
b) There shall be an exchange program that provides replacement parts for components that fail during the one (1)-year coverage. To minimize downtime, the exchange parts shall ship on the same day the order is received or on the following day. The manufacturer shall also enclose an air bill for return of the defective components.
c) A help desk staffed by experienced technicians and coordinators thoroughly familiar with the display shall be available for technical support. This staff is available at no cost to the Authority.

2. Zone/Level Availability Tower Display and Informational Signs

CABINET CONSTRUCTION

1) General specifications. The Zone/Level Availability Tower Displays shall be two types. A 7 in letter size for outside the parking structure and a 5 inch letter size for inside the parking structure they shall as a minimum conform to the following;

Description	Digit Height (in / mm)	# of Levels	Cabinet Height (in / mm)	Cabinet Length (in / mm)	Cabinet Depth (in / mm)	Weight (lbs / kg)	Max Power (W)	Voltage AC Single Phase
Inside Structure	5 / 127	7	57 / 1,435	29 / 734	6 / 160	76 / 35	237	120
Outside Structure	7 / 178	7	78.5 / 1,994	39.7 / 1,008	6 / 160	114 / 52	276	120

2) General specifications. The Informational Sign letter size shall vary from 2.1" to 14" and the number of lines will vary from 1 to 6 depending on character size. They shall as a minimum conform to the following;

Description	Digit Height (in / mm)	Cabinet Height (in / mm)	Cabinet Length (in / mm)	Cabinet Depth (in / mm)	Weight (lbs / kg)	Max Power (W)	Voltage AC Single Phase
Informational Sign	5 / 127	19 / 482.6	77 / 1955.8	5 / 127	85 / 38.55	344	120

3) The display housings shall:

   a) Protect internal components from external contaminates including rain, ice, and corrosive elements.
   b) Be tested to NEMA 3R standards.

4) Display shall operate in a minimum ambient temperature range of -20 to +120F (-30 to + 50C).

5) Internal display component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the signage application.

6) Electrical display components shall be 100% solid-state.

7) The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair performance of the display system. The display system shall not radiate electromagnetic signals that adversely affect any other electronic device

8) Cabinet enclosure

a) The basic cabinet enclosure and display door shall be constructed of 0.063-inch thick aluminum and shall house all internal components.
b) To meet the anti-corrosive, degradation, and oxidation requirements, the display cabinet enclosure shall be made from aluminum sheet quality and shall be no less than the properties of alloy 5052-H32.
c) The rear mounting brackets shall be made of 0.090-inch thick aluminum and shall be able to support the weight of the sign.

9) Exterior finish

a) The LED display cabinet and shall be coated with flat black Prism® automotive-grade acrylic urethane paint with an outdoor expected life of ten (10) years.

10) Front face construction

a) To meet the display readability requirements, the front face must be constructed in such a manner as to provide high contrast, low sunlight reflection, and durability in all weather and site conditions.
b) Surface materials in the LED active area such as metal, plastic, or other materials shall be designed for low sunlight reflectivity.
c) Minimum features of front face shall:
   - Utilize 0.060-inch colorless, non-glare, outdoor grade polycarbonate.
   - Provide water shedding ability.
   - Use black aluminum mask for high contrast.
   - Withstand all general weather conditions.
   - Utilize a tamper resistant captivated TORX® 25 entry system.
   - Achieve water-tightness through the use of gaskets on the front face panel.

11) Serviceability

a) The display housing shall provide safe and convenient service access for all modular assemblies, components, wiring, and other materials located within the housing.
b) All internal components shall be removable and replaceable by a single technician using basic hand tools.
c) Service access shall be easily obtained by unlocking a vertically hinged front face panel.
d) Removal of a module shall not be required to access the internal components of the display.
e) Displays shall be designed with service features that minimize potential bodily harm.

DISPLAY COMPONENTS

1) LED display modules shall be constructed for good readability, long life, and ease of service. Modules shall mount to an internal aluminum frame using hardware that requires basic hand tools for removal and replacement. Each display module shall be constructed as follows:

   a) An LED module shall consist of four (4) LED digits per module.
   b) Red and Green LEDs shall be auto-placed to maintain quality and uniformity of the LEDs within each LED module.
   c) All PCBs shall be wave-soldered to ensure uniformity, quality, and durability of all solder joints.
   d) All PCBs shall be cleaned in a manner so as not to contain more than two (2) parts per million contaminants.
   e) All internal assemblies, including all PCBs, transformers, sign controller(s), and modules, shall be conformal coated to protect electronics against corrosion.
   f) LED display module signal and electrical connections shall be of the quick-disconnect locking connector type. Removal of a display module from the display shall not require a de-soldering operation.
   g) All LED display modules in a single display shall be identical in construction and be interchangeable throughout the display.
   h) Module LED uniformity shall be consistent to the point that modules can be interchanged between displays without a noticeable difference in appearance.
   i) All modules shall be located behind non-glare clear polycarbonate for sunlight shading and enhanced contrast.
   j) Modules shall be attached to a hinged front door for ease of maintenance.
   k) Removal of one or more modules shall not affect the display's structural integrity.
   l) The failure of a single LED segment shall not cause failure of any other LED segments in the display.
   m) All modules shall have a minimum of 70-degree vertical and 110-degree horizontal half-intensity viewing angles.
   n) The transition of the viewing intensity shall be consistent throughout the viewing cone.

1) LED segments shall be constructed with discrete LEDs, which shall conform to the following specifications:

   a) LEDs shall be through-hole, ultra-bright, solid-state light emitting diodes.
   b) The LED lens diameter shall be 5 mm oval.
   c) LEDs shall emit either red light that has a peak wavelength of 626 ± 4nm or emit green light with a peak wavelength of 525 ± 4nm
   d) LED half-life shall be a minimum of 100,000 hours.
   e) All LEDs shall have a minimum-viewing angle of 40 degrees vertically and 100 degrees horizontally.

2) Power transformers shall power the LED modules and shall protect the LED segments, LED display, and driver circuitry in the event of power spikes or surges.

   a) Power transformers shall conform to the following specifications:
      - Have a maximum current rating of 6.25 A.

- Have an operating input voltage range of +85 to +264 VAC and an input voltage of 115 V/ 230 VAC.
- Be UL recognized.

3) Internal wiring

   a) Wiring for LED display modules and other internal components shall be installed in the housing in a neat and professional manner.
   b) Wiring shall not impede the removal of display modules, power supplies, or other display components.
   c) Wires shall not make contact with or be bent around sharp metal edges.
   d) LED display module power and signal wiring shall be cut to a length, labeled, and installed so it is not possible to connect a module to the wrong set of wires.
   e) All wiring shall conform to the National Electrical Code.

DISPLAY PERFORMANCE

1) Display capability

   a) The display shall contain four (4) seven (7)-segment LEDs measuring a minimum of 5 or 7 inches in height by 6 levels in height depending on the location of the sign.
   b) Each display pixel shall be comprised of an individual red and green monochrome LEDs. Other pixel technologies, such as fiber-optic, flip disk, combination flip disk fiber-optic, combination flip disk LED, liquid crystal, and incandescent lamp will not be accepted.
   c) The seven (7)-segment LED height should measure either 5 inches or 7 inches as indicated on the design plans.
   d) The LED display shall be capable of displaying 0-9999, FULL, OPEN, or CLSD in either red or green text.
   e) Displays shall be legible under the following conditions:

2) 24 hours per day and in most normally encountered weather conditions.

3) During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is directly behind (silhouetting) the display.

4) Controller

   a) Communication protocol shall support other products from the vendor such as other outdoor or indoor displays of varying sizes and/or colors.
   b) The controller shall be able to be operated via serial or Ethernet communication.
   c) A controller shall be connected to a light sensor allowing the LED display to automatically adjust to a minimum of 64 levels of brightness according to display direction and lighting conditions.

5) Communications

   a) The LED controller shall be able to receive instructions from and provide information to a computer containing control software using the following communication modes:
      - RS232 / RS422: Via direct RS232 connection or using an RS232 signal converter. The RS422 signal converter shall provide signal

optical isolation between the display and the control computer and/or network.

- Ethernet: Via one (1) direct 10base-T, 10baseFX or 100base-T, Ethernet connection.

6) Display communication and protocol

a) All communications between the display control software and display(s) shall be accomplished using a protocol meeting the NTCIP Standards.

B. Servers

1. Servers, shall be IBM System x3650 M4 series or approved IBM equal for rack mounted applications with the following minimum configuration:

Pentium 4 two Intel Xeon Processor 2.8 GHz, minimum

756 MB ECC RDRAM, 1 MB cache, minimum.

24X, minimum, CDRW/DVD

716TB, minimum, SATA 7200 rpm hard drive, hot swappable

Gigabit Ethernet communication

USB, serial data and video ports

101 key USB keyboard

Two button USB optical mouse with scroll wheel

Operating System: Microsoft Windows Server 2003 (or latest release supported by the Authority).

2. Each server shall have an LCD flat panel monitor, Lenovo/IBM (no substitutions) ThinkVision LT2252p wide 22in LED Monitor with the following features:

Native resolution of 1680x1050

White LED backlight

Aspect ratio: 16:10

Brightness: 250 cd/m2 (typical)

Contrast ratio: 1000:1 (typical)

View angles (Horizontal/Vertical, @CR=10:1): 170 degrees / 160 degrees

Respond time: 5ms (on/off, typical)

Lift, Tilt swivel and pivot stand

VGA, DVI-D, Display Port connections

Compliance with ENERGY STAR 5.1 requirements

TCO certified Edge 1.1

Mercury / Arsenic free Glass

Kensington Lock slot support for security

Meets 100mm VESA standard(1) for mounting

Backlight Technology LED

3. Servers shall be fully configured with all required software. Furnish and install servers where directed.

C. Workstations

1. Workstations shall be Lenovo/IBM ThinkCentre M57 PADT5700-APU, (or latest Port Authority standard configuration) with the following minimum configuration:

   Intel Core i5 i5-3570 processor operating at 3.4 GHz

   4GB DDR2 RAM

   4MB L2 Cache Memory

   1TB, 8MB Cache, 7200RPM SATA Hard Drive

   1 Serial ATA DVD-Write optical disk drive

   Intel GMA 3100 Integrated Graphics

   1 – 10/100/1000 MBps Ethernet Port

   8 – USB 2.0 Ports

   3 Button Optical Mouse with scroll wheel

   USB 104-key keyboard

   Tower type chassis with power supply

   Operating System: Windows 7Professional (or latest release supported by the Authority)

2. Each workstation shall have an LCD flat panel monitor, Lenovo/IBM (no substitutions) ThinkVision LT2252p wide 22in LED Monitor as specified above.

3. Each workstation shall be fully configured with all required software. Furnish and install workstations where directed.

D. PGS Software

1. The PGS software shall be a standard commercial off the shelf product designed for transportation and parking guidance applications. The software shall be configurable for any parking facility that includes open lots or parking structures.

2. The software will allow an operator to graphically place a parking zone or garage level on a graphic background.

   The software shall be modular in design and permit user flexibility to purchase only the modules and components necessary for the user's application, and expandable to allow the purchase of additional modules to add functionality for future expansion and changing operational needs.

   The software shall have a scalable architecture such that the user can start with a small application and later expand the system and database to any size without upgrading the license.

   The software shall be fully compatible with the Variable Message Signs as described in these Specifications.

   The software shall provide a user-friendly multi-color graphical user interface.

   The software shall contain an on-line help system that includes documentation for every screen and function.

3. The software shall be a native 64-bit Windows program, created using Microsoft-certified software development tools, running on Microsoft Windows 2008 R2 Server and Windows 7 Professional operating systems (or latest maintained by the Authority) and shall be based on Microsoft user interface standards.

   The software shall support and take advantage of multiple core processor architecture.

   The software shall support and utilize multiple threads within the CPU. The multi-threading shall aid in multi-tasking for CPU optimization.

   The software shall integrate Microsoft standards including:

   a) Microsoft Access
   b) Microsoft SQL Server
   c) Microsoft Data Engine (MSDE)
   d) Open Database Connectivity (OBDC)
   e) ADO, OLE-DB for Database Interface
   f) Object Linking and Embedding (OLE)
   g) Active X Technologies
   h) Visual Basic for Applications (VBA)

4. The software shall utilize and be fully compliant with the National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) for communications between the software and field devices, to allow

the software to monitor, control and fully exchange data with any NTCIP compliant device.

5. Operator Graphical Interface

The PGS shall support the display of information as map displays including the following:

a) The ability to access the client-supplied files for map backgrounds, including aerial photographs and computer aided drafting (CAD) drawings.
b) The ability to show the geographical location of all devices on the map display. The appearance of devices on a particular map view shall be controlled by a combination of zoom control and map display.
c) When a device is moved on a map display, the device shall indicate its actual geo-location with a line (a "rubber band") from the device icon to the actual location.
d) The overall look and feel of the map display interface shall make it possible for an operator to navigate around the maps, and select devices, based on their position, and then navigate to that device's status and control screen using mouse clicks.
e) The map display shall include the capability for showing multiple levels of parking, availability, congestion, and VMS message display with graphical widgets that respond to real-time data returned from field devices.

The map view shall replicate the actual plan view of the parking area, including an accurate view of the bay layouts to help operators recognize the exact area being viewed.

The map view shall be an accurate real-time representation of the parking area, providing a real-time over view of the current parking status in the facility. Each parking zone shall have a color indicator, which represents in real-time the status of the parking area in the parking facility. The map will provide the operator with numeric count of the vehicles that has been manually input in that area and the available spaces shown real-time on the user interface in the appropriate color.

The PGS software shall have a user configurable dashboard view showing the overall parking status in all parking areas as well as 24-hour parking trends. This Dashboard shall be configurable to show multiple parking areas. The Dashboard shall also give an overview of the overall system and field hardware health and status.

6. Variable Message Sign Monitoring and Control

The PGS software shall include an integrated module for monitoring and controlling Variable Message Signs (VMS) via the NTCIP protocol, regardless of the sign manufacturer. The software shall support all NTCIP mandatory and optional object definitions for Dynamic Message Signs. The software shall be configurable to enable or disable support for any standard or optional NTCIP objects.

The VMS functions shall be fully integrated into the PGS software. Operators shall not be required to start or open a separate application or program for VMS functions.

The PGS shall be capable of fully monitoring and operating the VMS furnished as Work of these Specifications.

The software shall provide a user interface that presents the system's VMS in both list and graphical formats. The software shall allow the VMS to be grouped as needed by users. The VMS list and map interfaces shall include only the signs for the group currently selected.

List and Map Interfaces: The VMS list shall clearly display the following information for each VMS:

1) VMS ID number
2) VMS name, in a descriptive text format
3) Name and priority level of message file being displayed
4) Date and time of last communication between the control software and the VMS sign controller
5) Error and warning status, including pixel errors, power failures, communication error, etc.

The graphical interface shall include the following:

6) Configurable bitmaps that may be used to show all or parts of the parking facility and approach roadways geographically
7) Icons for each sign that may be placed anywhere on the map display
8) Icon color changes to indicate the status of the VMS (i.e., yellow for warnings or red for errors)
9) Icon flashes if a message is running on the VMS
10) Sign name is visible if mouse is placed over a VMS icon

Polling

11) The software shall have a feature to poll all or any set of VMS at predefined intervals or at a specific time-of-day. During this poll, the software shall retrieve the most recent status information from the sign and present it to the user as appropriate in the list and map interfaces.

The PGS shall have the ability to select any one of the available VMS and control it through the use of a user-interface that performs the following functions:

12) Current data for the sign selected displayed on the interface.
13) All the available pre-programmed or changeable messages displayed, depending on which message type is selected.
14) Ability to check the content of these messages, change them and/or download them to the sign for future or current display.

The VMS Signs user-interface shall include the ability to:

15) Send and activate stored messages from sign libraries
16) Create ad-hoc messages, including graphic elements for signs that support graphic display, that are created immediately and not loaded from a library, and display them on the VMS.
17) Create new sign message libraries and edit existing message libraries and download the libraries to the signs.
18) Preview the message that is being edited in a WYSIWYG (what you see is what you get) format.
19) Change a message on multiple signs at the same time. (Sign groups).
20) View current messages displayed on signs and in a signs message queue
21) Blank a sign.
22) Set the priority and duration for sign messages.
23) Limit the words used on a sign to those available on a pre-determined approved word list.
24) Sequence more than one message on a sign and set the display rate for each page
25) Retrieve messages and schedules from a sign.
26) Perform diagnostics of signs and their subsystems
27) Perform pixel tests
28) Monitor the signs event log

When a message is edited, the following options shall be available:

29) Font selection (a minimum of 4 choices)
30) Line Justification
31) Page Centering (Top, Bottom, Middle)
32) Page Breaks
33) Flashing
34) Timers
35) Background / Foreground Color
36) Moving Text
37) Graphics (for signs with graphics capability)
38) Insert date and time information
39) Word checking capabilities including the ability to offer an approved list of words and/or a disapproved list of words.

The PGS shall enable an authorized user to modify the list of signs and the selected message(s) prior to display. A mechanism shall also be included to terminate a message and restore the next-highest priority message that was previously displayed until the duration time of said message expires. The opportunity to select a different message shall also be provided.

The PGS shall display the highest priority message when multiple messages are being requested for display on the same sign at the same time. The message shall continue to be displayed until a higher priority message is requested, the message is terminated or the message duration time expires.

40) Prior to expiration of the message duration time, the PGS system shall notify the user of the imminent expiration of the message duration time and allow the user to extend the message display or extinguish the message.

41) The PGS shall retain the current message up to 10 minutes beyond the expiration of the message duration time while waiting for the operator's response before extinguishing a message with an expired duration time or sooner if the operator indicates that the message may be extinguished.
42) Once the operator terminates the message or when it is overridden by a higher-priority message, the PGS shall display the highest-priority message competing for display on the sign.

The PGS shall include the ability to create scenarios or "Amber Alerts" that can be activated immediately on one or more signs or that can be scheduled at pre-determined dates / times. Scenarios or alerts include:

43) Pre-prepared procedures that can be implemented.
44) Permissions for the administrator to set up the pre-prepared procedures so that operators are able to activate the intended messages on the intended signs for any given scenario.
45) Selecting messages from those prepared using the Sign interface.
46) Capacity to verify a scenario before activating it.
47) Ability to cancel a scenario.
48) Capability to add any number of Standard Operating Procedures as part of the scenarios
49) Creation of a log of the scenario actions.

Sign Configuration

50) The software shall allow authorized users with correct security access right, to configure VMS parameters and functions. The basic sets of configurable settings shall include the following:

Sign models and individual signs
Communication networks
System error/warning alarms
User security rights
System maps and sign icon placement
Default system option settings
Default message parameters
Message priority settings

51) The software shall allow configuration of the following parameters for each VMS:

Sign viewing area height and width (for full-matrix signs)
Number of lines and each line's height and width (for line-matrix signs)
Color capabilities (i.e., amber, tricolor, full-color, etc.)
Site name
VMS ID number
Network address
Communication parameters

52) Communication network configuration shall include the ability to configure and modify the following communications parameters for each VMS:

Network type (i.e., Ethernet, direct serial, dial-up)
IP address
Communication port (i.e., COM4)
Baud rate (ranging from 1200 to 115,200) – for direct serial links only
Hardware handshaking
NTCIP subnetwork and transport protocols
Communication retries and timeouts

53) Configurable alarm settings shall allow authorized users to determine which of the following events will trigger an audio and visual (on-screen) alarm:

Communication failure
Priority status conflict
Sign restart
Power supply failure
Door open

7. Software Security and User Privilege Levels

The PGS Software shall support a minimum of five privilege levels. The system administrator shall be able to configure access restrictions for each user level.

Users shall have to log on the system by entering a user name and password, which shall be verified by the PGS server.

Only the system administrator shall have rights to add and delete users, modify user rights and access user names and passwords.

The system administrator shall be able to restrict a user's rights to any aspect of the software, including specific zones, specific devices and read or write permissions.

The system administrator shall be able to define rights for single users and groups of users.

A Multi-level password control system shall be provided that establishes an individual password account for each individual. Each feature of the system shall be individually assignable and limited to each individual. The password system shall maintain a program log of the last 500 logins to the system. This log shall include the individual, date, time and type of actions taken.

Passwords shall conform to the following requirements:

1) User Passwords Required
2) Force Periodic Password Changes every 90 days
3) Users Have Ability to Change Passwords
4) Maximum three grace logins allowed

5) Password Minimum Length six Characters
6) Require Unique Passwords When Changed
7) Remember Previous 5 Passwords
8) Hide the last user to Login

The system shall monitor the following

9) Intruder Detection
10) Three Failed Logins Prior to Lockout
11) Maximum bad login retention period shall be one Day
12) Minimum Login Account Lockout Time Period shall be seven Days
13) Parse Error Log for Login Violations

The setup log shall log all password server activity. The password control system shall allow assignment of users to user groups for restricted access to appropriate functions and areas.

8. Event Logging Requirements

The system shall provide complete logging for the following types of system activity:

1) Setup Log – This feature shall record all log in and out activity by time and date and shall record event descriptions for each, including changes made to the system setup.
2) System Activity Log – This feature shall record all events in the system including all announcements and messages that play. This includes the user password, type of announcement or message, time and date, originating location, destination location and length.
3) Fault Log – This feature shall log all system faults, including type and location of fault, time and date of fault, time and date of restoration and applicable test data.

The PGS shall support the polling of devices, to monitor their status, value and health, including:

4) The ability to configure the logging period for each device.
5) The ability to configure, for each Device Type, NTCIP objects that are logged into the database at each poll.
6) The ability to configure, for each Device Type, the length of the logs that are to be kept in the database, before the oldest logs are overwritten.

9. Alarms

Alarms shall have the ability to notify users if the system is not operating properly when the status is measured. The alarms feature shall include:

1) User-defined alarm parameters, used by the system to determine when alarm indications are to be displayed to the operator, for example; low battery voltage warning for installations with backup power systems, parking full, etc.

2) A diagnostic display (grid) shall be opened for each sign showing current failures and/or current status etc.
3) Alarms shall be generated if a fault is detected by the system during the polling process and the fault shall be displayed on the grid in red, with an audible warning, to alert the operator.
4) Diagnostic alarms shall also be reported by e-mail to designated users on the system.

10. Reports

PGS shall support user-configurable reports, as follows:

1) This report writer shall be Microsoft Access, or equivalent, and shall support connection to the main PGS SQL Server database.
2) The report writer shall support the display of tables, graphs and any other data that is located in the PGS database.
3) The PGS shall feature standard filters for date ranges, device types, devices and users so that any or all reports can be filtered with these parameters.

Parking System Reports: These reports shall reflect the status and health of the system over time, including the following standard reports:

4) Communication Statistics Summary by Date By Device (key performance indicator for the overall health of the communication system)
5) Communication Statistics By Date By Device
6) Operator Activity by Date (an operator audit trail report)
7) Current Operators
8) Offline History by Device By Date

Parking Data Reports: These reports shall reflect the current and historical parking activity. Current reports shall be able to be viewed and printed. Historical reports shall be able to be used for trend analysis.

9) Current Parking Utilization by Zone
10) Parking Utilization Summary by Zone by Date
11) Parking Utilization Detail by Zone by day, Week, Month, and Year
12) Current Reservations by Zone
13) Current Reservation Overstay Violation by Zone

11. Communications

The PGS software shall use a variety of communication sub-systems to monitor and control the VMS. These include network, and serial connections. The PGS shall support as a minimum the following communication channels:

1) Ethernet connections, using both TCP/IP and UDP/IP transport, including support for IEEE 802.11 wireless networks
2) Serial connections, using PMPP transport.
3) Ethernet connections, with PMPP serial embedded within either TCP/IP or UDP/IP.

The PGS shall maintain communication statistics for each device, so that the number of dropped packets and other communication errors can be readily determined.

The communication parameters shall be settable in the software for time to establish a connection; time for a device to reply and the number of re-tries the server makes before raising a timeout error. These parameters shall be individually adjustable for each communication channel.

It shall be possible to establish log polling to each device, with the following parameters configurable:

4) The frequency of polling shall be adjustable. It shall also be possible to disable log polling of selected devices.
5) The user, for each device type, shall be able to select NTCIP objects to be included in each log poll.
6) The system shall log the results of each poll in the database, and make it available for inspection and report.
7) As part of the polling process, it shall be possible to cause the PGS to synchronize the time in the device controller to the server time of the PGS.

It shall be possible to establish real-time polling to each device, with the following parameters configurable:

8) The frequency of polling shall be adjustable.
9) The user, for each device type, shall be able to select NTCIP objects to be included in each real-time poll.
10) It shall be possible to configure NTCIP SNMP (Dynamic Objects) for real-time polling, and the PGS shall automatically manage the refresh of these objects to ensure correct SNMP operation.

Thresholds shall be measured as to whether a level or limit has been either exceeded or fell below a certain point. These thresholds shall be configurable by using:

11) Comparative measures such as greater than, less than or equal to, as well as comparing two values.
12) Binary comparatives

E. Equipment Enclosures

1. All PGS components, communications and networking equipment shall be installed in enclosures. All equipment located in outdoor, wet, or damp locations shall be installed in a NEMA 4X enclosures. All equipment installed in communications or computer type rooms shall be housed in NEMA 1 enclosures. NEMA 12 enclosures shall be provided in all other locations.

2. All servers shall be rack mountable and installed in standard EIA 310 racks.

3. All equipment cabinets and racks shall be fabricated in accordance with the requirements of Specification Section 16133.

4. All enclosures, cabinets and racks shall have lockable, hinged doors.

5. The environment of the areas where equipment is to be installed varies by location. Some areas locations are environmentally controlled and others are not. Include any enclosure ventilation and supplemental heating or cooling required to ensure that the equipment within is maintained within the manufacturers specified operational temperature range.

   Enclosures with internal ventilation fans shall have replaceable filters. Internal ventilation fans, heating or cooling shall be thermostatically controlled to provide airflow and keep the internal enclosure temperature within the rated temperature of the internal components.

   If a NEMA 4X stainless steel enclosure/cabinet is utilized and the internal components within require supplemental heating, cooling or ventilation, install stainless steel air louver kits provided by the enclosure manufacturer to allow for proper air flow.

   Prepare and submit heating, cooling and ventilation calculations to show that the internal temperature within the enclosure will remain within the various component equipment manufactures operating specifications.

6. In addition to any receptacles required for device power, provide one additional NEMA 5-15R GFCI convenience outlet in each cabinet for maintenance purposes.

F. Cable

1. All cabling shall conform to the requirements of Specification Section 16120 for general purpose power and control, Section 16127 for Category 5e, twisted-pair and coaxial cabling and Section 16126 for Optical Fiber cabling.

2. Category 5e

   Category 5e cable shall be used to provide Ethernet communications between the workstations, servers, electronic displays, and the common communications network backbone. Refer to Section 16127 for details.

3. Optical Fiber Cable

   Optical Fiber Cable, if utilized, shall conform to the requirements of Specification Section 16126 and the optical and physical characteristic listed on the Contract Drawings.

4. Signage Cables

   Requirements for cables running from the PGS to electronic displays are specified in Section 16576.

5. Power and Control Cables

   All power and control cables shall be type XHHW II in accordance with Section 16120.

2.03 COMMERCIAL OFF THE SHELF AND 3RD PARTY SOFTWARE

A. Virus Protection Software:

1. All servers and workstations shall have virus protection software installed and properly configured with the latest updates and virus profiles.
2. Virus protection software shall be Network Associates McAfee VirusScan Enterprise, without substitution. Utilize the latest software release supported by the Authority.

B. Web Browser

1. All servers and workstations shall have Microsoft Internet Explorer, version 7, (or latest release supported by the Authority) installed.

C. Document Viewers

1. All servers and workstations shall have the latest version of Adobe Acrobat Viewer installed.
2. All servers and workstations shall have the latest version of Autodesk Drawing Web Format (DWF) Viewer installed.

D. Utility Programs

1. All servers and workstations shall have the latest version of the following utility programs supported by the Authority:

   DVD Player: InterVideo WinDVD Player v8.0 or latest release supported by the Authority.

   CD Recording: IBM RecordNow 7.3, or latest release supported by the Authority.

   File Compression Utility: WinZip 17.0, or latest release supported by the Authority.

2. All workstations shall have the latest version of the following utility programs supported by the Authority:

   Media Player: Microsoft Media Player, latest release.

   Media Player: Apple Quicktime Player, latest release.

   Flash Player: Adobe Macromedia Flash player, latest release

2.04 SECURITY ADMINISTRATION

A. Create and maintain a secure system environment in keeping with the guidelines outlined in this Section until final turnover of the system and equipment to the Authority.

B. Maintain an updated list of personnel who are granted access to the PGS System and its equipment. Periodically review this list with the Engineer. All personnel who have been

terminated or are no longer involved with the Work of this Contract shall immediately be removed as users from all systems.

C. Depending on the application, security shall be able to be administered at the application, database, module, screen, data field, and/or transaction level. Prior to system implementation, review the capabilities of the application with the Engineer to assure implementation of the appropriate security levels. When in production, the Contractor's System Administrator shall maintain the selected security profiles.

D. The Contractor's System Administrator shall create and maintain accounts for all users authorized to access the PGS system. Access privileges granted to all users shall be regularly re-evaluated to ensure only currently authorized users have access.

E. Re-evaluate all users and their access privileges at six-month intervals, or at a period appropriate for the level of security and sensitivity of information stored on the system. Provide the Engineer with a report of this information weekly for review. The report shall indicate the applications that each user is authorized to use. Keep the list up-to-date as users are added or removed and no longer authorized, particularly during system installation, startup, testing, training, acceptance and turnover.

F. Limiting Network Access

1. Once the system is installed and connected to the common shared LGA Data Network, the Authority's System Administrator shall limit access to the LGA Data Network by doing the following:

   Create logon IDs for only authorized persons.

   Periodically reconcile the list of users with the list of authorized persons.

   Establish controls over supervisor, or other privileged account, passwords, or other special passwords, so that their use is documented and approved.

   Research sign-on violations to determine if a pattern is evident and report findings to the Engineer, as necessary.

G. Logically secure all Microsoft Windows servers from unauthorized access, until such time as system administration functions are turned over to the Authority. To aid in the creation of a secure computing environment, the following steps shall be taken at a minimum:

1. User accounts are not to be created locally on Windows servers if at all possible. Local security groups containing global user groups are the methods of rights management in Active Directory.

2. Limit access to Network Monitor. Access to Network Monitor enables the capturing of packets and potentially compromising passwords and security.

3. Secure backup media. Store backup media offsite in fireproof cabinets. Unrestricted access to encrypted backup media can compromise data and system security.

4. Physically secure Emergency Repair Disks. Emergency Repair Disks are critical in restoring a damaged Microsoft Windows server, but contain a copy of

the password database. Physically securing the disks minimizes the potential of unauthorized access to the password database.

5. Use NT File System (NTFS) for the boot partition. Microsoft Windows manages security only on NTFS file system partitions and not on FAT partitions. Use of NTFS partitions adds another layer of security for the system.

6. Separate the boot partition from user data. This helps ensure that user files are not affected by service packs or upgrades and prevents user access to critical system files.

7. Enable weak password filtering. Modify the Notification Packages value in the registry to require that all passwords are at least six characters in length, contain characters from at least three of four groupings (lower case, upper case, numbers and non-alphanumeric characters) and that passwords do not contain the user name or any part of the user's full name.

8. Enforce the requirement that passwords be changed upon initial logon and no less often than every 90 days thereafter.

9. Control access to the command scheduler. Users should not have permission to schedule services or jobs, or to list previously scheduled jobs.

10. Enable Administrator account lockout and rename the Administrator account. Configure the Administrator account to lockout after repeated failed access attempts over the network. The account shall still be accessible from the system console. In addition, rename the Administrator account it is not as easily accessible to unauthorized individuals.

11. Establish separate accounts for System Administrators. Administrators shall use privileged accounts only when necessary for system administration. At all other times they shall use individual user accounts, which limit the possibility that unauthorized individuals can access administrator accounts.

12. Default Guest Account shall be renamed and disabled. In addition, a strong account password shall be in place and all rights shall be removed from the account.

13. Null session shall be disabled if not required by the system.

14. Secure and manage event logs. NTFS permissions shall be set on the event log files to allow only Administrators and System access. In addition, auditing shall be enabled on event log files to detect when they have been copied or viewed.

15. Encrypt the Security Account Manager (SAM) password database with 128-bit encryption. This minimizes the possibility that passwords can be cracked and used by unauthorized individuals.

16. Disable remote registry access. Modify the appropriate registry entry to disable access to the server's registry over the network. This minimizes unauthorized access to the server.

17. Monitor for security patches and updates.

2.05 VIRUS PROTECTION

A. Virus protection shall be implemented, including the following:

1. Provide boot disk protection.
2. Perform deleted file purges immediately after or no later than 6 days after file deletion.
3. Scan servers and workstations for viruses on a daily basis.
4. Scan for viruses all workstations upon the first daily network log-in.
5. Scan for viruses all incoming data from users, server peripherals diskette, CD-ROM, tape drives, other servers, and the Internet.
6. Advise users to save all mission critical files to the server each day, because the server is backed by a second server located in a physically separate area, but the operator workstations and notebooks are not protected in the same way.
7. Perform daily incremental backups and full backups weekly.
8. Store all backups off-site at a secure location.

B. Update all servers and workstations with the latest virus signature file as they become available from the virus software manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Configure and program all equipment supplied for the PGS in accordance with the manufacturer's recommendations and the Authority's requirements. This includes PGS device and VMS address nomenclature, user access rights and privileges, initial library of messages, and any other required customizations to the PGS or COTS software products.

1. Prior to configuration, submit documentation that describes the configuration in full detail for Engineer's approval. The configuration shall reflect the requirements described in this Section and the Contract Drawings.

B. Coordination of the Work of this Section with Work by other Sections:

1. Coordinate the locations of all raceways and cable routings with all other affected trades.
2. Where the Work of this Section utilizes common raceways shared with other systems, coordinate with the raceway system installer, if a different entity that the installer of the Work of this Section, to ensure proper provision and raceway capacity is being provided to support any cable installations or additional raceway connections required for the Work of this Section.
3. Where cabling and distribution are installed within architectural and structural elements coordinate the requirements with the entities manufacturing and installing the architectural and structural elements to ensure proper provisions are made for the PGS equipment installation.

4. Coordinate the interface, testing and installation of the system with the Variable Message Signs being furnished under this specification to ensure a seamless integration.

5. Coordinate all data networking requirements with the data network designer and administrator retained under Specification Section 16744. Ensure that all equipment requiring connection to the data networks is reviewed with the network designer and administrator. Ensure the network designer and administrator provides IP addresses for all equipment. Ensure that any special network protocols, bandwidth, throughput and recovery requirements are coordinated with and provided for by the network designer and administrator.

6. Coordinate the phasing of the system installation, testing and acceptance with the data network designer and administrator retained under Section 16744. Ensure that all required data networks are available to support the system installation, testing and acceptance for each phase. Ensure that all testing is coordinated with the data network administrator to ensure that the testing required for the Work of this Section does not impact network performance or availability or the operation of any other systems that may be utilizing the data network.

7. Coordinate the work of this section with the selection of the Data Networking equipment furnished and installed under Section 16785. Ensure that all switches and equipment are compatible with and will fully support the required operation, availability and performance of the Work of this Section.

8. Coordinate all system and equipment power requirements with the Electrical installation. Ensure that all required power circuits are provided and wired to the PGS equipment. For any equipment indicated on the Contract Drawings to be backed by Uninterruptible Power Supplies (UPS), coordinate the power requirements with the entities furnishing and installing the UPS under the Work of Section 16610. Ensure that UPS are properly sized to support the equipment loads for the specified backup time(s).

C. Coordinate all device and equipment installation and power requirements with the equipment installer.

D. Prepare and submit an Installation Staging Plan that describes all activities and tasks associated with the development, installation, integration, configuration, preparation and commissioning of the PGS.

1. The Installation Staging Plan shall include the identification and description of all activities, tasks and stages of construction to be used in bringing the PGS to a fully operational state. Elements of the plan shall include but are not limited to:

Installation plan drawings.

Product installation guides and literature.

Details of construction sequencing to allow the system to be installed in a staged manner and operated through the construction period as areas become available for passenger use.

Schedule and plan for the installation of devices, cable, wires, computer hardware, software development, software loading, training.

3.02 CONDUIT AND WIRING

A. All equipment shall be grounded in accordance with local codes, manufacturer's recommendations and in accordance with Specification Section 16450.

B. All conduit and raceways shall be in accordance with the requirements of Specification Section 16110.

C. All 120VAC power wiring shall be in accordance with Specification Section 16120.

D. Furnish and install all wiring to all equipment connections required for a complete and fully operational system conforming to the requirements of this Section and the Contract Drawings. Advise the Engineer of any required conduit or wiring modifications from those shown on the Contract Drawings, prior to installation, including size, routing, back boxes, junction boxes, pull boxes, to achieve complete coordination with the work of all other trades.

E. Test and certify all cables in accordance with the requirements of Specification Sections 16126 and 16127 and submit test reports for approval.

F. Ensure cabling shield does not touch terminal connections. Unless otherwise recommended by equipment manufacturer, ground all shielded cables at one end only using drain wires at control panels, power supplies, or head end equipment. Insulate shield at device end with shrink tubing to completely cover shield and drain wire. Where multiple devices are served by the same shielded cable, shield continuity shall be maintained and properly insulated to eliminate intermittent grounding. At control panels, power supplies or head-end equipment, furnish and install separate instrumentation ground. Do not connect shield grounds directly to building electrical ground. Carefully follow manufacturer's instructions. Coordinate with Specification Section 16450-Grounding.

G. Lay out conduit and cable runs prior to installation. Wherever possible, maintain 1 foot-0 inches clearance from parallel runs with 120 VAC or larger voltage conduit and wiring

H. All wires shall be color-coded to provide separate identification to differentiate signal, power, data or any other system function. Wires shall be similarly coded for each system serviced throughout the entire installation.

I. No intermediate cable splices are allowed.

J. All cabling shall be labeled with self-laminating, thermal transfer printable, permanent adhesive backed tags using indelible marking at the camera and control end with corresponding numbers, such as Tyco self-laminating polyester labels, or approved equal. Patch cords between equipment shall be labeled, wherever possible, with field equipment label designations, to create as uniform a tagging system as possible.

1. All 24 VAC power circuits shall be tagged at each device and 24 VAC power supply fused terminal strip with 12 VDC and 24VAC panel and fused circuit number.

2. Transformers and power supplies shall be identified, along with their cable, at both transformer and load-fed end of cable.

K. Furnish and install all wiring in enclosures, equipment cabinets and terminal boxes in accordance with Specification Section 16133. All wiring in panels shall be neatly dressed, run parallel wherever possible, and provided with adequate slack for future maintenance and service terminations.

L. All "unused" wire conductors shall be capped to eliminate shorts and grounds, tagged with their terminal points and identified as "spare" at each end with a unique spare cable tag-identification system.

M. Deviations to wire runs shown on the Contract Drawings may be required when site conditions affect the equipment's operation, performance, or purpose. All such relocations will be approved by the Engineer. All relocations required shall be made without additional cost to the Authority.

N. All wiring or cable shall be tested for, and be free of, opens and shorts. All wiring shall test free of grounds with the exception of circuits that are intended to be connected to the ground side of protective circuits.

O. All wire and cables entering equipment cabinets and enclosures shall be grouped and tied inside the enclosures on 6-inch centers with self-locking nylon cable ties. All wiring shall be grouped in an orderly fashion. The use of adhesive tapes (electrical or other) is not permitted as a substitute for cable ties or wire management.

P. All stranded wiring that is connected to equipment that has terminal strips or screw lugs shall be terminated with either nylon-insulated crimp-on spade lugs, equal to Thomas & Betts STA-KON fork tongue locking type or equivalent, sized for correct wire and screw sizes or shall be solid bare wire attached to screw terminals. Where compression screws are used to cap stranded wiring, wiring shall be tinned to eliminate de-stranding and consequent poor connection. Each wire shall be documented on the Shop Drawing wiring diagrams.

Q. All wiring that is connected to equipment with solder lug connectors shall terminate wire to lug in a solder joint. The solder joint, lug and any bare wire shall be covered with heat shrink tubing. Multi-conductor bare wire ends shall be soldered to prevent de-stranding.

R. Wiring and cables that are installed shall maintain color-coding from origination point to termination point. Where paired cable is used, the pairs in the cable shall be maintained in the run. Pairs shall not be separated to form pairs different than those in the original cable. Color-coding shall be maintained within the system. Maintaining color-coding applies to all type circuits in the system.

S. Review with factory/technical representatives all approved installation Shop Drawings for wiring type, scheme and tagging for all systems prior to installation, with factory/technical representatives. Advise the Engineer of any required modifications prior to wire procurement and installation and obtain approval. Review the system's wiring

with the factory's representatives and supply the cables which meet their requirements. Use heavier gauge cables as directed by the Engineer to provide enhanced performance reliability, durability or future capacity unless prohibited by the Manufacturer. Where cable gauges must be increased, due to length of runs in the field, furnish and install the increased gauges at no additional cost to the Authority.

T. Paralleling of multi-conductor cables to "create" a cable of larger wire gauge is prohibited.

U. Prepare and submit wiring diagrams in all signal and power panels along with cable schedules, in a clear plastic envelope, for future use in system maintenance and service.

V. Wherever possible, maintain a minimum of 6-foot clearance from variable speed drives, transformers, 480V and higher electrical service, and other known sources of RF and EMI. Wherever possible, maintain 2-foot clearance from fluorescent ballasts.

W. Heat shrinking tubing shall be shrunk to cover the external connection to amplifier/passive components only after system alignment and acceptance has been completed.

3.03 INSTALLATION

A. Installation of all Parking Guidance System equipment and materials shall be in accordance with the manufacturer's recommendations, the approved Shop Drawings and the requirements of this Section and the Contract Drawings.

1. Locate all equipment which must be serviced, operated or maintained in fully accessible positions, especially when located in concealed locations.

2. Minor equipment location deviations from the Contract Drawings may be made to allow for better accessibility, but have all such deviations approved by the Engineer prior to any work being performed.

3. Minimum clearances in front of or around equipment shall conform to the latest applicable Manufacturer's requirements for inspection and testing and to all local codes for control panel and junction box access. Treat all control panels, power supplies for access, as though they were 120 VAC leaving a minimum of 3 feet-0 inches clear in front of same, floor to ceiling as required by NFPA 70.

4. All equipment, except wiring and conduit, shall be completely accessible without the requirement to remove any portion of building structure or other system component, except an appropriately sized access door or ceiling tile.

5. Enclosure access doors shall be hinged and arranged to allow full swing open and complete access to all enclosure components and wiring.

6. Furnish and install all fittings, conduit associated with panel-to-panel and panel-to-trough connections, trough, wireways, boxes, hangers, wiring devices, enclosures, signage, fasteners, connections, control panels, relays, cable trays and miscellaneous accessories necessary for the complete installation of the PGS and final connections.

7. Contract Drawings are schematic for systems equipment as exact roughing requirements vary slightly with different manufacturers and job conditions. The

Contract Drawings represent a schematic, depiction of the conduit, cable tray and wire network layout for the system equipment specified. Final conduit, cable tray and wire quantity, size and arrangement, as well as final routing and placement shall be based on system equipment, manufacturer's engineering requirements, field coordination with other trade work, existing building conditions and on dimensions and locations of other trade equipment that must be connected to. Submit exact installation details on shop drawings for the Engineer's approval. Coordinate all Work of this Section with the work of all other trades.

8. Carefully coordinate the Work of this Section with all affected trades to prevent conflict with the work of other trades or delays to the schedule.

9. See the Contract Drawings for overall scope and configuration of PGS cable, control, and monitoring requirements.

10. Coordinate all cable, conduit and device identifiers with the Engineer. Ensure uniformity and inter-relation of identifiers. Avoid duplication of identification.

B. Install all equipment racks as indicated on the Contract Drawings and in accordance with approved Shop Drawings.

C. Connect and make operable all required system interfaces to third party systems.

D. Installation of Roadway informational Signs is not part of the Work of this Section. Conduit and all wiring to Variable Message Signs furnished and installed within the garage structure are part of the Work.

E. Ground equipment following the requirements of UL Standard 486A and in accordance with Section 16450.

3.04 TESTING

A. Test Equipment

1. The Contractor shall provide all equipment and instrumentation required for testing. All test instruments utilized shall have been calibrated within 1 year of use.

B. Testing shall be performed in the following distinct phases:

1. Factory Inspection and Testing
2. Field Quality Control Testing
3. Field Acceptance Testing
4. 30 Day Operational Acceptance Testing

C. Factory Inspection and Testing

1. The Factory Inspection and Testing shall demonstrate that the equipment furnished is in conformance with the Specifications and Contract Drawings. The test shall demonstrate every feature and function of the hardware, software and firmware components under test.

2. When the manufacture of all PGS components and associated hardware, control equipment, and electronics to be furnished is complete, notify the Engineer, and request a Factory Inspection and Testing of said equipment.

3. Testing shall be performed by the Contractor and witnessed by the Engineer using the test plan submitted by the Contractor and approved by the Engineer. Each item of the PGS and all its associated hardware, control equipment, and electronics shall be tested in its entirety with the use of simulated inputs and simulated outputs, as required in the event that the actual field equipment or conditions cannot be replicated in the factory. All simulation equipment required for the test shall be furnished by the Contractor.

4. The Factory Testing of the PGS shall include demonstration of successful integration with the VMS furnished as Work. The Contractor shall arrange for the manufacturer of the VMS, if a separate entity from the manufacturer or integrator of the PGS, to furnish a minimum of one complete and fully operational VMS for the PGS Factory Testing.

   With the approval of the Engineer, the Contractor may elect to conduct the Factory Inspection and Testing of the PGS at the same location as the Factory Inspection and Testing of the VMS.

5. In the event of a test failure, make all repairs or modifications required for passing the test. Repeat the failed test until the results are satisfactory to the Engineer. Any subsequent planned tests that, in the opinion of the Engineer, are dependent on the satisfactory passing of the failed test shall not be performed until the failed test is repeated and satisfactorily passed.

6. To demonstrate a satisfactory resolution of a failed test, the Engineer may require that additional tests be performed by the Contractor, or that tests be performed on all PGS components, even if it was originally planned to test only a sample of the units. Perform these additional tests at no cost to the Authority.

7. If in the opinion of the Engineer, there are an excessive number of failed tests, the Factory Inspection and Testing shall be halted and the Contractor shall repeat all or part of the Factory Testing at a later date.

8. Shipment of PGS components and associated hardware, control equipment, electronics and software shall start only after such inspection and testing have been satisfactorily completed and all PGS components, hardware, control equipment, electronics and software have been approved for shipment by the Engineer. Neither the witnessing of a test by the Engineer, or the waiving of a right to witness a test shall relieve the Contractor of his responsibility to furnish a system that is in compliance with the Specifications and Contract Drawings. The witnessing of any tests by the Engineer or the approval for shipment of PGS components and associated hardware, control equipment, electronics and software shall not be deemed as acceptance of the system and associated hardware, control equipment, electronics and software.

9. These tests shall include, but not be limited to, the following:

   A system set-up that demonstrates the use of each required component. The simulated set-up shall include a minimum of two VMS of each type.

   Component compatibility test to verify compatibility of all equipment.

Environmental tests to ensure proper operation at the most extreme environments in which the equipment will be installed.

Tests for each component and software function as well as a test of the integrated system including monitoring and control of the VMS furnished as Work of these Specifications.

Operational Test: Perform an operational system test to verify conformance of system to these specifications.

Electronic Signage Test: Verify that the systems can perform all required operations on Variable Message Signs that were furnished and installed.

Demonstration of remote set-up and diagnostics for the VMS using the PGS software.

D. Field Quality Control Testing

1. Maintain a competent supervisor and supporting technical personnel, subject to the Engineer's approval during the entire installation. Change of supervisor during the project is not acceptable without prior written approval from the Engineer.

2. Before connecting any equipment to AC power outlets, measure and record the AC voltages between hot, neutral, and ground and verify correct AC power. Verify, test and document correct and safe function of isolated ground power systems.

3. Before connecting to any data networks, verify proper operation of all data networking hardware, complete end to end connectivity between host and field device ports, proper provisioning of data network equipment and proper IP addressing. Coordinate with the Contractors Data Network Integrator performing the Work of Specification Section 16744.

4. Determine the proper sequence of energizing systems to minimize the risk of damage.

5. After successfully energizing the systems, make all preliminary adjustments and calibrations, document the setting of all controls, parameters of all networks, voltages at key system interconnection points, gains and losses, as applicable. Tabulate all data along with an inventory of test equipment, a description of testing conditions, and a list of test personnel as itemized below. Copies of preliminary test data shall accompany copies of performance testing data as part of the Field Testing documentation submittal.

6. Verify the performance parameters of the individual systems following manufacturers recommended procedures, in addition to those specified herein.

7. Document all acceptance testing, calibration and correction procedures described herein using the included documents at the end of these Specifications. Include the following information:

   Performance date of the given procedure.

   Condition of performance of procedure.

Type of procedure, and description.

Parameters measured and their values, including values measured prior to calibration or correction, as applicable.

Parameters associated with calibration or corrective networks, components, or devices.

The names of personnel conducting the procedure.

The equipment used to conduct the procedure

8. Upon completion of initial tests and adjustments, submit written report of tests along with all documents, diagrams, and record drawings required herein. Report shall include date of each test, pertinent conditions such as control settings, etc., test circuit, and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for Field Acceptance Testing.

E. Field Acceptance Testing

1. Perform Field Acceptance Testing for all installed components. The PGS Field Acceptance Testing shall include full integration with the VMS furnished and installed as Work of these Specifications. PGS Field Acceptance Testing shall be performed concurrently with the Field Testing of the VMS.

2. The Field Acceptance Testing shall demonstrate that the all components of the PGS work properly together. The test shall demonstrate end-to-end functionality. The Field Acceptance Testing shall include:

Testing all cables, wires, components and software installed in the field.

Verification of the proper operation of all installed components, including but not limited to:

1) Tests to verify the PGS accurately reflects the number in each zone of vehicles parked in the facility from the manual counts.
2) Tests to verify that the correct and up-to-date information is available to all users on all workstations.
3) Full monitoring, control and diagnostics tests of each VMS using the PGS software.
4) Verification that messages are properly transmitted to and displayed on each VMS.
5) Tests to verify that the operation and performance of all PGS software functions and features.

3. Submit detailed test procedures for each component and subsystem.

The detailed component test procedures may be adapted from FAT if applicable, using actual installed equipment instead of simulations. Where the FAT may have tested one type of device as a typical sample, the Field Tests shall test all devices.

4. Submit a schedule of testing for the Field Acceptance test.

   The schedule shall describe when each component and subsystem will be installed and the schedule for field acceptance testing.

   The schedule shall describe the complement of test procedures to be utilized for each test.

   The schedule for each day of testing shall be described in detail. No single test shall last for more than eight hours.

5. Submit a list of equipment that will be used to perform the Field Acceptance Testing. The Contractor shall furnish all vehicles and drivers required for testing of parking guidance system.

6. All retesting required due to Field Acceptance Test failures or results unsatisfactory to the Engineer shall be performed at no additional cost to the Authority.

7. Upon completion of Field Acceptance Testing, submit written report of test results along with all documents, diagrams, and record drawings required herein. Report shall include date of each test, pertinent conditions such as control settings, etc., test circuit, and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for 30 Day Operational Acceptance Testing

F. 30-Day Operational Acceptance Testing

1. Following the satisfactory completion of Field Acceptance Testing, a 30-Day Operational Test shall be performed. The 30 Day Operational Testing shall be performed concurrently and in coordination with the 30 Day Operational Testing of the VMS being furnished and installed as Work of these Specifications. The testing shall demonstrate that the PGS and VMS operate as a fully integrated system.

2. At the satisfactory conclusion of 30 Day Operational Testing, the Authority will issue to the Contractor a Certificate of Partial Completion for the PGS and the warranty/maintenance period shall begin for the installed equipment.

3. During the 30 Day test period, the Authority will operate the system as specified using the fully configured software and hardware and all applicable manuals, printed guides and procedures submitted by the Contractor. This shall include operation of the VMS using the PGS software. During the 30-Day test period, operators will use the system to provide complete 24-hour a day, 7-days a week Parking Management. The Contractor shall correct all malfunctions encountered during 30 Day Operational Testing at no additional cost to the Authority. Said malfunctions include, but are not limited to, equipment failure or failure of the PGS to comply with the requirements of this Section. Major failure is defined for this purpose as any failure of any software or item of the equipment.

4. Prepare a list of any diagnostic routines (if any) that are to be performed by Authority operators during the operation of the system to validate the system performance and operation, and submit to the Engineer for approval.

5. After the Contractor corrects a malfunction, the 30-Day Operational test shall restart at day one, and shall continue until the results meet the conditions and terms of the performance period and the system has operated continuously for 30 consecutive days without error or malfunction. During the 30-Day Operational Test phase, the Authority will determine the PGS performance.

6. All retesting required due to test failures or results unsatisfactory to the Engineer shall be performed at no additional cost to the Authority.

7. Performance Period: The Performance Period for operational testing shall begin on the date of notification of the Contractor by the Engineer to commence operational testing and shall end when the PGS has met the Standard of Performance for the number of consecutive days required, by operating in conformity with Specifications at the required PGS Availability Level.

8. Failure to Complete Operational Testing Successfully

   In the event the PGS is deemed not to have successfully completed Operational Testing within 90 days of the scheduled completion, then the Authority may, in its sole discretion, elect one of the following options, the election of which shall be effective upon written notification of the Contractor by the Authority:

   1) The Authority may require the Contractor to furnish and install, within such time period as may be mutually agreed in writing by the Authority and Contractor, a direct substitute of equipment or components to meet the applicable period of the Acceptance Testing. The Contractor shall use due care in the removal and substitution of such equipment or components. Such substitutions shall be subject to Operational Testing as provided in this Section and, in the event such substitute component fails to successfully complete Operational Testing by the agreed-upon date, the provisions of this paragraph shall again be applicable.
   2) The Authority may permit the Contractor to continue to attempt to successfully complete the Operational Testing ; provided, however, that the Authority may revoke its election of this alternative at any time upon not less than five days prior written notice to the Contractor, in which event the Authority may, in its sole discretion, elect any one of the other options specified in this paragraph, the further election of which shall be effective upon written notification of the Contractor by the Authority.
   3) The Authority may pursue any other remedy available under this Contract or available at law or in equity or seek to enforce any damages, in addition to those provided in the section entitled "Liquidated Damages" of Division 1 herein.

9. During the Field and 30-Day Operational Testing, perform any re-calibration, re-configuration or re-programming of the PGS hardware and software required as part of the normal operational configuration and to correct any system bug or errors encountered to insure that the system performs in accordance with the Specifications and required sequences of operation. Fully document all changes performed during Field Acceptance and 30-Day Operational Testing including date of the Engineer's prior approval, without which change shall not be implemented.

10. Prior to the commencement of Operational Testing, bring on site, one complete set of "working" As-Built shop drawings and wiring diagrams for use by the Engineer and the Contractor's field technicians during the test process.

G. Following satisfactory completion of the 30-Day Operational Testing, the Authority will issue to the Contractor a Certificate of Completion for the PGS, and the final warranty period shall begin.

3.05 POST-INSTALLATION SERVICES

A. Warranty

1. Notwithstanding the Contract Documents, any inspection or approval by the Authority of the equipment or its installation, or the existence of any patent or trade name, the Contractor nevertheless warrants and represents that all equipment and the other items including the software, firmware and other items supplied to the Authority and all workmanship shall be in accordance with this Contract, shall be fully fit for performance and shall operate in accordance with the requirements of the Contract Documents. The Contractor warrants that all equipment and other items furnished and/or installed meet original manufacturers' specifications. The Contractor warrants all equipment and other items furnished and/or installed and workmanship against defects or failures in workmanship and materials, excepting to the extent of defects or failures which the Contractor demonstrates to the satisfaction of the Engineer have arisen by reason of accident, abuse or negligence or fault of the Authority, its agents, employees, Licensees or invitees and not due to fault on the Contractor's part. In the event of defects or failures in said equipment, or other items, or workmanship or any part thereof, then upon receipt of notice thereof from the Authority, the Contractor's warranty obligations for the PGS shall be to repair or replace and make operational all PGS components within 24 hours of being notified of the condition at no cost to the Authority.

2. The Warranty shall include the procurement and installation of all recommended and required software upgrades and patches.

3. The Warranty shall include routine scheduled and recommended maintenance procedures. Routine and recommended maintenance shall be coordinated with the Engineer.

4. The Warranty shall include system administration and configuration.

5. Warranty Period

   The obligations of Contractor to remedy defects shall extend through a date one year after issuance of Certificate of Final Completion for All Work Excluding Maintenance.

6. Adjustments

   When requested by the Engineer within one year of date of Final Completion, provide on-site assistance. Provide up to three visits to the site for this purpose.

B. Guarantee

1. Notwithstanding the specifications forming a part of this Contract, any inspection or approval of the Work by the Authority, or the existence of any patent or trade name, the Contractor nevertheless unconditionally guarantees that the equipment and workmanship furnished and installed hereunder shall be of the best quality and shall be fully fit for the purpose for which it is intended. The Contractor shall unconditionally guarantee all equipment and workmanship against defects or failures of any kind, including defects or failures in design, workmanship and materials, for a period extending to a date one year after issuance of Certificate of Final Completion for All Work Excluding Maintenance. Guarantee shall be for the Authority's benefit and shall grant the Authority a direct right of action against the Manufacturer.

C. Maintenance

1. The maintenance period shall begin immediately following successful completion of 30-day Operational Testing and shall conclude 365 calendar days after date of issuance of the Certificate of Completion for the PGS.

2. The maintenance services shall include as a minimum the following:

   Correction and repair of all errors and malfunctions.

   Repair of failed hardware and components furnished as Work of this Contract.

   Procurement and installation of all recommended and required software upgrades and patches required to operate the system during construction.

   Routine scheduled and recommended maintenance procedures required for the installed components to operate in a construction environment. All routine and recommended maintenance shall be coordinated with the Engineer.

   System administration and configuration

3. Maintenance of the VMS shall be performed as part of the Work of these Specifications.

D. Maintenance Response Time

1. The Contractor shall respond to a service call and arrive at the Work site within four hours of the call, 24 hours per day, seven days per week, including holidays.

E. Use Spare Parts for Maintenance:

1. The spares parts furnished to the Authority under 1.09 of this Section may be utilized for the performance of system maintenance under the condition that the Contractor immediately replaces all such spares. The Contractor shall continuously restock all Authority spare parts utilized in performance of maintenance at no cost to the Authority.

2. All spare parts shall remain the property of the Authority.

3. Maintain an inventory list of all Authority spare parts. Note approved quantities, quantities in stock and record the serial numbers of all parts (where available). Record which parts were utilized and when and when they were replaced. Spare part inventory is subject to inspection and audit by the Authority at any time and without prior notice to the Contractor.

4. Upon conclusion of Contractor's maintenance services, the Contractor shall ensure that the Authority has a complete inventory of spare parts in accordance with the quantities listed in the approved spare parts list described in 1.09 of this Section.

3.06 MAINTENANCE MANUALS

A. The maintenance manuals shall provide complete documentation of the PGS for the purpose of system maintenance and operation by the Authority. It is intended that the operation and maintenance manuals be exhaustive in the coverage of the system to the extent they may be used as the sole guide to troubleshooting, identification and repair of defective parts.

B. Submit complete drawings and maintenance and operation manuals of the completed system. These manuals shall include basic wiring diagrams, schematics and functional details such that all components, wires and pieces of equipment in the system may be easily identified by going to the actual equipment and making reference to this manual. It is required that everything in the system be neatly labeled and easily identifiable. The serial number identification scheme shall be included in the maintenance and operation manuals. Prepare and submit one set of all drawings as reproducible and one set of electronic files in AutoCAD format. Prepare and submit one set of all schedules and tables in an electronic file format. The maintenance manual requirement of this section is in addition to shop drawing requirements. Maintenance manuals and drawing sets shall be compiled after system fabrication and testing, and shall incorporate all changes made after shop drawing submittal. The maintenance manuals and drawing books shall be permanently bound in hard plastic covers. Prepare and submit one set of all manuals in PDF format.

C. Include all original manufacturer manuals and literature.

1. Submit manufacturer's standard literature for each piece of equipment included in the system. The maintenance manuals shall contain specifications, adjustment procedures, circuit schematics, component location diagrams and replacement parts identification.

D. Include drawing books to guide maintainers through troubleshooting, routine and remedial maintenance.

1. All drawings developed specifically for this Section shall be reduced to "B" size and bound with hard plastic covers. Provide component identification and cross reference on the drawings to allow the maintenance department to understand the function of each item (the block diagram), find the room where the device is mounted (contract document as-built drawings), find its location in a rack (rack drawings), find how it is wired (one line and wiring diagrams), its detailed specifications (vendor data sheets) and how to repair it (spare parts

lists). Include the following updated and revised drawings as identified in the "Submittals" section as a minimum

Product Data

Shop Drawings

Test Documentation, including list of equipment and result records

Spare Parts List

Tools List

E. The Maintenance Manual shall include, but not be limited to, all sections covering the operation of the hardware, diagnostics, maintenance, troubleshooting and repair including but not limited to:

1. An Introduction that includes a theory of operations and bill of materials.
2. General description of normal maintenance procedures.
3. Detailed description of all PGS applications including all of the functional capabilities.
4. Detailed description of procedures for modifying the PGS software configuration settings.
5. Detailed description of operating and troubleshooting procedures for each subsystem. This shall include step-by-step field and bench troubleshooting procedures to isolate and repair faults, as well as normal waveforms and test voltages.
6. Procedures to backup and restore message libraries and schedules, VMS configurations, error and event logs.
7. Detailed description of procedures to back up and restore the PGS configuration including all parameters, thresholds, libraries and tables.
8. As-installed color-coded interconnection wiring diagrams, both "factory" and "field".
9. Equipment wiring and all circuit board schematic diagrams indicating "factory" and "field" wiring. This shall include drawings showing the physical location of each component, as well as logic diagrams and stage-by-stage explanation of the circuit theory for each circuit board.
10. Complete nomenclature and commercial number of replacement parts, including current prices, listing of spare parts initially provided, and a second source of supply where applicable, cross referenced to a component designation.
11. Each manufacturer's product data sheet annotated to clearly identify product or part.
12. Each manufacturer's printed operating and maintenance instructions.
13. List of recommended cleaning agents, maintenance procedures and schedules.

14. List of recommended test equipment including manufacturer's name, address, and model number.

3.07 USER'S MANUALS

A. The User's Manuals shall be provided as a guide to users of the PGS. The manuals shall enable a novice user to login and utilize the system. The manual shall be written for beginner personal computer users who are not familiar with detailed computer operations and terms. It shall contain step-by-step procedures with screenshots and graphics to explain overall concepts.

B. At a minimum, the manual shall provide detailed instructions on the following:

1. Detailed description of system operation for all of the access privileges normally associated with the intended audience.
2. Detailed description of system operations and procedures. The manual shall clearly describe all functions supported by the PGS and implemented through the user interface.
3. Start-up and shutdown procedures including log-in.
4. Navigating the application.
5. Using the library of messages. The extent of these instructions may vary by type of operational manual.
6. Creation, execution and explanation of System reports.

C. The manual shall include a separate section for System Administrator functions including detailed descriptions of the following:

1. Managing user profiles, including adding, deleting and editing users. This includes entering and editing user attributes, such as user level, name, etc. This shall include detailed description and procedures for password management and changing user passwords and password expiration.
2. Configuring priority levels.
3. Adding VMS.
4. Software configuration of field hardware
5. Identifying malfunctions.
6. Using the diagnostic and troubleshooting tools.
7. Conducting backup and restoration of databases, configuration, libraries, schedules, etc.
8. General description of normal software maintenance procedures.
9. Using the diagnostic and troubleshooting tools.
10. Navigating and using the system fault logs.

3.08 TRAINING

A. Conduct training courses to familiarize users with the PGS.

1. Three courses shall be provided:

   Operators/User's

   System Administrators

   Maintenance Training

B. Conduct the training courses at a Port Authority facility location to be coordinated with the Engineer.

C. Submit to the Engineer no less than 30 days prior to the intended start date for training copies of the Training Plan, which includes but is not limited to the following for each training class:

1. Detailed description of the course curriculum.
2. Draft copies of the course material including but not limited to manuals, study guides, workbooks, technical reference material.
3. Comprehensive schedule for the delivery of all training classes.
4. The dates, times and exact locations for the training courses. The training courses shall be held at an Authority facility, designated by the Engineer. The dates and times shall be coordinated with and approved by the Engineer.
5. Post-training and or on-the-job technical reference guides.

D. After completion of the Training Courses, submit the following:

1. One unbound, reproducible master set of all manuals. These sets shall include a written non-disclosure and copyright waiver allowing the Authority to make unlimited copies for its own use, of any copyrighted material within, royalty free, for a period of 99 years.
2. One set of all manuals in electronic form (PDF). These sets shall include a written non-disclosure and copyright waiver allowing the Authority to make unlimited copies for its own use, of any copyrighted material within, royalty free, for a period of 99 years.
3. Copies of each instructional class on DVD to the Engineer for Authority's future use. Video instructions for operation of each item of equipment supplied shall also be provided. These DVDs shall include a written non-disclosure and copyright waiver allowing the Authority to make unlimited copies for its own use, royalty free, for a period of 99 years.
4. Conduct two independent sets of training classes for each course at the scheduled times and locations designated by the Engineer consistent with the approved Training Plan. Training shall be conducted around the clock to coincide with the normal shifts of the operations, supervisory and maintenance personnel as directed by the Engineer. Class sizes shall contain no more than 15 students and classes shall include hands-on training for all class participants.

Each class shall be conducted in a maximum of one, four-hour session on any given day to permit the students to perform their regular duties in addition to attending the instructional class. Class sessions shall be conducted on consecutive days when possible. The full complement of training courses shall be conducted over a period time specified by the Engineer to accommodate shift personnel, vacations and make up sessions. Training shall include, but not be limited to, the courses for the following groupings and number of staff (student population is shown below).

Staff Category	Number of Staff	Minimum Class Time
Operations	30	8 hours
Supervisory/ Administrator	15	12 hours
Maintenance Technicians	15	24 hours

5. One set of training courses, Operations, Supervisory, and Maintenance shall be held for staff working the day shift. A complete second set of training courses, Operations, Supervisory, and Maintenance, shall be held for staff working an alternate shift.

3.09 TURNOVER TO THE AUTHORITY

A. Prior to turnover of any servers and workstations furnished as Work of this Section to the Authority:

1. Ensure all hardware has proper configurations and IP addresses, as approved by the Network Administrator retained under Section 16744 and the Authority. Ensure there is no duplication of IP addresses.
2. Ensure all security configuration requirements have been met. Where exceptions have been made due to system requirements, identify all such exceptions to the Engineer.
3. Review all user accounts with the Authority. Delete all non-Authority authorized user accounts. Also delete all temporary and Contractor user accounts and associated access privileges. Coordinate with the Authority for any Contractor personnel who will still require user accounts and access privileges after turnover to the Authority (e.g. for performing Contract Maintenance services).
4. Ensure all software updates and patches have been installed and are up to date with the latest Authority requirements.
5. Ensure all anti-virus software is properly installed and configured and that the latest virus definition files have been installed.

B. For each server and workstation, assemble and submit original hardware registrations and commercial off-the-shelf standard software license agreements. All hardware and software shall be registered or licensed to the Authority.

C. For each server and workstation, submit:

1. Configuration documentation. Indicate:

Server/workstation/notebook local machine name,

IP address

List of local users and corresponding access privileges

Complete list of software installed. Indicate software manufacturer, product name and version/release number. Prepare separate lists for Authority-supported and non-Authority-supported software. For non-Authority-supported software, also indicate the function/purpose of each non-supported application

Location of hardware (i.e., where it was installed).

2. Original media for all software installed on each machine.
3. Rescue disks.
4. Complete drive backup.

END OF SECTION

SECTION 13710

VIDEO SURVEILLANCE SYSTEM – CAMERAS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies requirements for Video Cameras. The Work includes furnishing and installation of all equipment and accessories including, but not limited to:

1. Cameras,
2. Lenses,
3. Housings,
4. Mounting hardware,
5. And all other accessories and equipment necessary for a complete camera installation.

1.02 PERFORMANCE REQUIREMENTS

A. The Work specified in this Section shall furnish and install cameras and associated equipment for the purpose of video surveillance as required and as shown on Contract Drawings.

B. Unless otherwise specified on the Contract Drawings or in this Section, the components, manufactured, supplied and installed shall conform to the requirements of NFPA 70, all local codes, all other publications referenced in this Section.

C. All system equipment and components shall be submitted to the Engineer for approval.

D. Equipment Environmental Conditions: The equipment specified in this Section shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 32 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosure.
2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, non-condensing. Use NEMA 250, Type 3R enclosures.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 105 mph (137 km/h) Use Type 4X enclosures.

1.03 REFERENCES

A. ANSI International/Electronic Industries Alliance/Telecommunications Industries Alliance (ANSI/EIA/TIA)

1. 232 - Interface between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange
2. 250-C Electrical Performance for Television Transmission Systems
3. 422B - Electrical Characteristics of Balanced Voltage Digital Interface Circuits

B. Institute of Electronic and Electrical Engineers (IEEE)

1. 802.3 Information Technology, Telecommunications and Information Exchange Between Systems

C. International Standards Organization (ISO)

1. 14496-14:2003 Information technology -- Coding of audio-visual objects -- Part 14: MP4 File Format

D. National Electrical Manufacturers Association (NEMA)

1. Enclosures for Electrical Equipment (1000 volts Maximum)

E. National Fire Protection Association (NFPA)

1. 70 - National Electrical Code
2. 130 - Standard for Fixed Guideway Transit System

F. Society of Motion Picture and Television Engineers (SMPTE)

1. 170 - Television - Composite Analog Video Signal - NTSC for Studio Applications (2004)

1.04 SUSTAINABLE DESIGN REQUIREMENTS

A. Not Applicable

1.05 QUALITY ASSURANCE

A. Qualifications

1. Retain the services of an experienced Systems Integrator and Installer who can demonstrate a minimum of 7 years of continuous experience and technical expertise in performing work comparable in size and complexity, and whose installation and integration work was performed skillfully in a satisfactory manner and on time.

   a. The Systems Integrator and Installer shall furnish all specified components, shall be of established reputation and experience in the field of Video Surveillance Systems, and shall be qualified by the manufacturers of the proposed equipment to install, service and maintain each manufacturer's equipment.

b. The Systems Integrator and Installer shall serve as the single point of responsibility for the work described in this Section.

2. Retain the services of personnel certified by the equipment manufacturer to: assist in the installation of the equipment; check the installation before the equipment is placed into operation; assist in the performance of field tests; assist in the hardware configuration, and train the Authority operations and maintenance staff in the care, operation, troubleshooting and maintenance of the equipment.

   a. Unless otherwise authorized by the Engineer, the certified personnel shall have at least 7 years experience and an in-depth knowledge of the equipment to be used in the installation, testing, and start-up of the equipment under this Section. The Manufacturer's sales and marketing personnel will not be accepted as Manufacturer's Representatives.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect all equipment against damage during transit and storage. All equipment shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage during transportation.

B. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer. Product name, Port Authority Contract and Work Order Number (as applicable), storage requirements and any other special handling instructions.

C. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, weather, temperature, corrosion, contaminants, dirt, vandalism or other causes.

D. Deliver all equipment to the placement and installation Work sites. If equipment is delivered to an off-site location prior to placement and installation at the Work site, the Contractor shall be responsible for all movement of the equipment form the off-site storage facility to the Work site as well as proper storage, handling and security of the equipment at the off-site storage location.

E. After delivery at the work site, a field inspection of the equipment will be made by the Contractor in the presence of the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements hereof, the Contractor shall be notified in writing, and he shall replace the equipment at his own cost even though this equipment may have been previously inspected and approved for shipment. After such satisfactory replacement and subsequent Engineer written approval, the equipment shall be installed by the Contractor.

1.07 SUBMITTALS

A. See Appendix A of this section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Refer to Camera Contract Drawings for camera description and associated equipment.

2.02 GENERAL REQUIREMENTS

A. Video signal format shall comply with the NTSC standard composite video, interlaced. Composite video signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

C. Tamper Protection: Tamper switches on camera housings and camera enclosures shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

D. Cables

1. Station areas are under the jurisdiction of NFPA 130. All cable jacketing shall be of the low smoke, zero halogen type. PVC insulation and jacketing shall not be utilized.
2. Refer to Contract Drawings for Cable Manufacturers.
3. Refer to Specification Section 16127 for video, control and communication cable requirements.

2.03 CAMERAS

A. IP Camera – Day/Night Fixed Dome – Packaged Indoor

1. Manufacturer
   a. Refer to Contract Drawings.
2. Minimum Video Requirements:
   a. ¼" Progressive Scan RGB CMOS
   b. Available compression rates of H.264
   c. 1280 x 800 resolution
   d. 30FPS @ both compression rates and in all resolutions.
   e. Multiple, individually configurable streams in H.264 and Motion JPEG
   f. Controllable frame rate and bandwidth
3. Minimum Lens Requirements
   a. Varifocal: auto focus, automatic day/night
   b. Focal Length, Zoom Ratio and F stop to facilitate Field of View as defined on Contract Drawings
4. Minimum Network and Data Requirements
   a. Security provided through Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control and user access logs

b. Supported Protocols to include: IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS.
c. Shall be provided with an Open API for software integration.
d. Processor and Memory of 128 MB RAM, 128 MB Flash

5. Minimum Mechanical Requirements

a. Acrylic smoke tinted dome having less than .5LUX light loss.

6. Minimum Electrical Requirements

a. Power over Ethernet IEEE 802.3af Class 2
b. RJ-45 10BASE-T/100BASE-TX PoE Connection.

7. Minimum Environmental Requirements

a. Operating temperature of 32°F to 122°F.

B. IP Camera – Day/Night Fixed Dome – Packaged Outdoor

1. Manufacturer

a. Refer to Contract Drawings.

2. Minimum Video Requirements:

a. ¼" Progressive Scan RGB CMOS
b. Available compression rates of H.264
c. 800 x 600 resolution
d. 30FPS @ both compression rates and in all resolutions.
e. Multiple, individually configurable streams in H.264
f. Controllable frame rate and bandwidth

3. Minimum Lens Requirements

a. Varifocal: auto focus, automatic day/night
b. Focal Length, Zoom Ratio and F stop to facilitate Field of View as defined on Contract Drawings

4. Minimum Network and Data Requirements

a. Security provided through Password protection, IP address filtering, digest authentication, user access log, IEEE 802.1X network access control, HTTPS encryption
b. Supported Protocols to include: IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
c. Shall be provided with an Open API for software integration.
d. Processor and Memory of 128 MB RAM, 128 MB Flash

5. Minimum Mechanical Requirements

a. Aluminum housing w/ White finish
b. Acrylic smoke tinted dome having less than .5LUX light loss.

6. Minimum Electrical Requirements

a. Power over Ethernet IEEE 802.3af Class 2
b. RJ-45 10BASE-T/100BASE-TX PoE Connection.

7. Minimum Environmental Requirements

a. Operating temperature of -40°F to 131°F.
b. Meets NEMA Type 4X

2.04 HOUSINGS

A. Housing and Mount Assembly – Indoor – Recessed Fixed Dome

1. Manufacturer

   a. To match camera selected to meet 2.03 A of this Section

2. Requirements:

   a. The housing shall be a recessed ceiling housing designed and engineered for the standard body 1/3" cameras as selected to meet the criteria in Section 2.03-A. The back box shall be constructed from 18- and 20-gauge steel and be capable of being installed in its entirety from below the ceiling. The lower acrylic dome will be free-blown using cell-cast tinted acrylic. An opaque liner shall hide the direction of the camera in both the tinted and clear dome. The lower dome shall be held in place by a 19-gauge steel trim ring (white powdercoat finish). The housing shall be designed to be installed in either sheetrock or drop ceilings. Housings shall come in either White or Black.The support arms shall allow for adjustment to the ceiling material thickness.

B. Housing and Mount Assembly – Indoor – Surface Fixed Dome

1. Manufacturer

   a. To match camera selected to meet 2.03 A of this Section

2. Requirements

   a. The housing shall be a dome style surface mount ceiling housing designed and engineered for the standard body 1/3 cameras as selected to meet the criteria in Section 2.03-A. A minimum 12" dome shall accommodate standard body fixed camera up to 8" in length. The housing shall be constructed of black ABS high impact plastic. The housing shall have an optically clear acrylic tinted lower dome, and a liner colored to match the housing.

C. Housing and Mount Assembly – Indoor – Recessed Vandal Resistant Fixed Dome

1. Manufacturer

   a. To match camera selected to meet 2.03 A of this Section

2. Requirements

   a. The housing shall be a vandal resistant recessed ceiling housing designed and engineered for the standard body 1/3" cameras as selected to meet the criteria in Section 2.03-A.. The back box shall be constructed from .08" thick aluminum and be capable of being installed in its entirety from below the ceiling. The lower injection molded Polycarbonate dome shall be available in clear or smoked material. The housing shall include either a smoked lower dome or a clear lower dome as required by Contract Drawings. The lower dome shall be made from injection molded Polycarbonate, and held in place by a heavy-duty aluminum trim ring. The product shall be designed to be installed in either sheetrock or drop ceilings. Three spring clips will allow for adjustment to the ceiling material thickness.

D. Housing and Mount Assembly – Indoor/Outdoor – Fixed Standard Housing

1. Manufacturer

a. To match camera selected to meet 2.03 A of this Section

2. Requirements

a. The indoor/outdoor extruded aluminum camera housing shall be designed and engineered for the standard body 1/3" cameras as selected to meet the criteria in Section 2.03-A. The housing shall be compatible for use with a 1/3" fixed focal or varifocal (manual zoom) lens. The housing shall be compatible for use with a heater and blower components as required by Contract Drawings, both 24VAC. The housing shall include a side hinge for ease of access for focus adjusting and servicing. The housing shall be suitable for use with a sun shield as required by Contract Drawings. The housing shall be compatible for use with wall mounts; pole mounts, and corner mounts as required by Contract Drawings. The power source shall be 24VAC, 60Hz.

E. Housing and Mount Assembly – Outdoor – Fixed Dome Housing

1. Manufacturer

a. To match camera selected to meet 2.03 A of this Section

2. Requirements

a. The outdoor dome camera housing shall be shall be designed and engineered for the standard body 1/3" cameras as selected to meet the criteria in Section 2.03-A. The housing shall be available as either a pendant, pole or a wall mount housing as required by Contract Drawings. The enclosure shall be equipped with 24 VAC input blowers and thermostatically controlled heaters. The housing shall be manufactured from a high-impact engineered plastic, UV protected, with a UL flame rating of 94V0. The dome shall be made from an injection molded, optically clear, polycarbonate blend material. The dome shall be held in place with minimum of (3) fasteners, and a safety cable shall be provided to hold the dome while servicing. Access to the enclosure shall be from below with captive fasteners used to press the dome against a sealing O-ring. A twist-off feature shall allow for the final removal of the dome. On pendant models all incoming wires will enter the unit through the top of the housing. A 1" NPT quick-release coupling shall be provided at the top of the unit for ease of installation and quick removal of the unit. On wall and pole mount models all incoming wires will enter through the back of the bracket mount and run up into the housing. An access door located at the bottom of the wall/pole mount will allow for easy hook up of all incoming wire connections. The housing shall include a camera mounting bracket that integrates a heater, blower, video and power surge protector capable of clamping differential node voltage between 240-300V and common mode voltage from 27-36V. The housing shall be powered with 24VAC (60Hz) and have a power consumption not to exceed 70W including the Camera. The blower shall draw no greater than 2Wcontinuous power. The heater shall turn on at 40°F (5°C) and turn off at 60°F (15°C) and draw no more than 50W. The housing shall support a temperature range of -40°to 120°F (-40°C to +50°C).

F. Housing and Mount Assembly – Outdoor – Fixed Pressurized Housing

1. Manufacturer

a. To match camera selected to meet 2.03 A of this Section

2. Requirements

a. The outdoor pressurized camera housing shall be designed and engineered for the standard body 1/3" cameras as selected to meet the criteria in Section 2.03-A. The housings shall be of all aluminum construction, with stainless steel housing bracket straps. End caps shall be sealed with lubricated O-rings and held in place with flat retaining rings. Front window shall be tempered glass. All electrical and video connections shall be made through the rear end cap, using an MS style pressure connector. The housing shall utilize a Schraeder valve and a 20-psi pressure relief valve. The housing shall be compatible for use with wall mounts; pole mounts or corner mounts as required by Contract Drawings

2.05 SIGNAL TRANSMISSION COMPONENTS

A. Comply with requirements in Section 16127 "Control / Signal Transmission Media" and Section 16126 "Fiber Optic Systems" for provision and installation of communications wiring and cable.

2.06 CAMERA SYSTEMS ACCESSORIES

A. Comply with the requirements of Specification Section 13725 "Video Surveillance System – Support Components" for provision and installation of communications and video system accessories as required by the contract drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. CCTV equipment installation shall include:

1. Conduit and raceways
2. Wiring and cabling
3. Verification of equipment power requirements
4. Equipment and device circuiting
5. Anchoring and securing of equipment
6. Restoration of finishes incidental to the installations

B. CCTV Camera Installation

1. Install, all cameras in accordance with approved Shop Drawings.
2. Furnish and install dedicated individually fused, homerun power circuits and video cables to each camera location shown on the Contract Drawings, and connect power to specified cameras at each location.
3. Verify all finish surface dimensions and materials and coordinate junction and/or mounting box type and cover with camera mounting bracket accordingly. Review camera mounting back boxes/brackets and concealed cable feeds to camera housing with the Engineer, prior to installation of camera back box, to ensure adequate blocking is provided for structurally sound installation and appropriate bracket/dome housing mounting.
4. Aim, adjust, align, focus and perform all necessary system set-ups to achieve required viewing image performance.
5. Ensure that no conductive path exists between the shield of the video cable and the chassis of the associated video equipment. Configure all cable connections and video equipment mounting to eliminate ground loop distortion. Add differential ground loop correctors, clamper amplifiers, or other suitable equipment, as required to achieve distortion-free imaging and recording.

C. Miscellaneous CCTV Installation Requirements

1. All hardware, such as shields, nuts, bolts, washers, shims, etc., shall be stainless steel, minimum Type 304
2. Leave adequate cable slack at camera outlets and at equipment racks and cabinets to allow proper servicing of equipment.

3.02 TESTING:

A. Manufacturer's Field Service: Engage a factory-authorized Installer to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Acceptance Testing shall be divided into three distinct phases as follows:

1. Factory Testing

   a. Factory Acceptance Testing: Conduct a factory test for the components encompassing the specified system a minimum of 30 days in advance of the earliest, approved, scheduled submission date. Submitted test results shall clearly demonstrate the system components are meeting the requirements of this Section.

2. Final Testing

   a. Final Testing: Conduct an onsite inspection and test immediately following the complete installation of the system, to demonstrate compliance with the requirements of this Section. Test shall be performed in presence of the Engineer in order to clearly demonstrate the system is meeting the requirements of this Section.

3. 30 Day Operational Testing

   a. 30 Day Operational Test: Conduct a 30 day operational or "burn in" test immediately following the successful completion of the final test, to demonstrate compliance with the requirements of this Section. Test shall clearly demonstrate the system is meeting the requirements of this Section.

D. Prepare and submit a comprehensive Acceptance Test Plan, for each test phase, that describes all the activities and tasks associated with testing of the system in accordance with the requirements of this Section. The test plan shall include a comprehensive description of the testing. At a minimum, the Comprehensive Acceptance Test Plan shall contain the following elements:

1. Summary of each test phase (Factory, Final and Operational)
2. A schedule for the accomplishment of each test and identification of the interim milestones.
3. Identification of all components, including the number and type of field devices, to be used during the test.
4. Schematic drawings showing interconnection and types of simulation equipment employed.
5. A description of the hardware and software involved and/or required for the test.
6. A statement of the purpose and goal of each test case and the method of testing.
7. A full step-by-step description of the tests performed including test conditions at the start and end of each test, expected test results with Pass/Fail criteria, and actual test results.
8. A description of the conditions that shall exist at the start of the test, the action and or function to be tested, and the conditions/results expected to exist at the conclusion of the test.
9. A description of the procedures to be used to control and resolve all failures encountered during the performance of each test.
10. A plan and schedule to conduct the next iteration of the test phase or a statement that the phase was completed successfully.
11. Each test procedure shall include a sheet for sign off and date by both the person performing the test and the test witness. Space for tester and witness comments shall also be included.

E. Factory Acceptance Testing:

1. Prepare and submit a comprehensive Factory Acceptance Test Plan that describes all the activities and tasks associated with testing in accordance with the requirements of this Section. The Factory Acceptance Test Plan must be submitted to the Engineer a minimum of 60 calendar days prior to the start of the witnessed Factory Acceptance Testing.

2. The Factory Acceptance Testing shall include:

   a. Physical inspection of all equipment panels and cabinets for conformance with approved shop drawings.
   b. Sample screenshots and camera operation
   c. Sample monitoring and control.

F. Final Acceptance Testing

1. Within 30 days after successful completion of the Factory Acceptance Test, submit detailed Final Acceptance Test Plans that describes all the activities and tasks associated with the Final Acceptance testing of all elements and functions of the System in accordance with the requirements in these Specifications and the Contract Drawings.

2. After installation and agreement by the Engineer to initiate Final testing, the System shall be tested in compliance with the approved Test Plan. The Final Acceptance Test shall be conducted with all devices and components installed through a specific construction phase, integrated as a system at the site with simulation only used to perform stress and performance testing. The test scripts to be used shall include, but not be limited to, those test scripts used for the Factory Acceptance Test, and any additions as required to encompass all devices, such as local processors and network components.

3. The Final Test submittals shall be in the same general format as the Factory Acceptance Test Documentation. Because the Final Acceptance Testing will be on the installed equipment, properly connected, configured and interfaced to the actual field devices, the test procedures shall be in correspondingly greater detail than the Factory Acceptance Test and shall demonstrate the full and complete system functionality.

4. Final Testing shall include:

   a. Command, control and monitoring of all field interface equipment both locally and over the network where required by contract drawings.

5. Preliminary as-built drawings shall be available during the Final Testing so their accuracy can be verified by the Engineer in the field. Additional requirements for the testing of the equipment are as follows:

   a. Furnish instruments, ladders, scaffolding, lifts, testing equipment and labor required for all tests shall be furnished by the Contractor.
   b. Upon completion of the installation and testing, prior to acceptance, thoroughly clean (internally and externally) all equipment furnished and/or installed under this Section.
   c. Restore systems to full operating capacity and operating capability after testing.
   d. Notify the Engineer in writing of all scheduled tests within the prescribed time in advance, so that he may witness same. Unwitnessed tests shall be performed again at no additional expense to the Authority.

G. 30 Day Operational Acceptance Testing

1. Prior to the commencement of Operational Acceptance Testing the Contractor shall furnish one complete set of the approved equipment shop drawings and wiring diagrams for use by the Engineer during the test process.

2. Operation Acceptance Testing shall commence following notification by the Engineer that the results of the Field Acceptance Testing are satisfactory and following receipt by the Engineer of the Contractor's certification that the system is ready for 30 Day Operational Acceptance testing. The Operational Acceptance Tests shall be performed by the Authority with the advice and assistance of the Contractor during a 30 consecutive day period.

3. During the Operational Test period, the Authority will operate the system as specified using the fully configured software and hardware and all applicable manual, printed guides and procedures submitted by the Contractor. The Contractor shall correct any major failure of malfunction of material significance during the period as it occurs. Said malfunctions include, but are not limited to, equipment failure or failure of the System to comply with this Section. Major failure is defined for this purpose as any failure of any item of the equipment or software, or both, that prevents the Authority from performing meaningful work based upon the Authority's business needs.

4. All malfunction encountered during operational Acceptance Testing shall be corrected by the Contractor at no additional cost to the Authority. After correction the Operational Test shall restart at day one, and shall continue until the results meet the conditions and terms of the performance period and the System has operated continuously for 30 consecutive days without error or malfunction.

5. A 30 Day Operational Test shall follow the completion if the Field Acceptance Test for each of the installation phases. At the end of the last installation phase the final 30 Day Operational Test shall be on the completed fully installed System.

H. During the Field and Operational Testing, the Contractor shall perform any re- calibration, re-configuration or re-programming of the System hardware and software required as part of the normal operational configuration and to correct any system bug or errors encountered to insure that the system performs in accordance with the Specifications and required sequences of operation. All changes performed during field and Operational Testing shall be fully documented by the Contractor and shall not be implemented without prior approval by the Engineer.

I. Certified Completed Test Reports:

1. Acceptance Test Reports: Following the completion of each test period, prepare and submit a Final Test Report that describes the results of the test period and the next steps to be taken. The Engineer will review the report and respond, indicating its approval or noting changes required either in the performance of the work or in the report. The Contractor shall make changes or perform additional work as the Engineer may direct prior to the start of the next test phase. No test phase shall be considered complete, nor may the Contractor proceed to the next phase of testing until the Engineer has approved, in writing, the Contractor's test report for the previous phase. The report shall contain, but not be limited to:

   a. Summary of the test period results including a statistical analysis of test results.
   b. Descriptive narrative of individual test objective(s)
   c. Data dictionary of test database
   d. System status prior to testing and after testing

e. Expected test results
f. Actual test results
g. Exception condition report (when applicable)
h. Explanation of exception conditions and Contractor corrections
i. Before and after database listings
j. All applicable screen printouts, reports, interim processing dumps and other audit trail physical evidence to validate the test activity for each iteration of the test conducted.
k. Completed Tester and Sign-off Sheets

2. Factory Acceptance Test Results: Submit certified Factory Acceptance Test Result documentation no later than 30 days after successful completion of the Factory Acceptance Testing.

3. Final Acceptance Test Results: Submit certified Final Acceptance Test Result documentation no later than 30 days after successful completion of each Field Acceptance Test.

4. Final 30 Day Operational Test Results: Upon completion of the final 30 Day Operational Test, submit documentation showing the entire system has successfully completed operational testing.

3.03 OPERATIONS AND MAINTENANCE MANUALS

A. Prepare and submit System operation and maintenance manuals. If standard manufacturer's reference manuals are used, they shall be enhanced with a site specific introduction and detailed narratives preceding each section to explain how individual section contents relate to the System as installed and configured for operation as Work of this Contract. These manuals shall be made available and used during the Factory Acceptance Testing as a means of checking their accuracy and completeness.

B. Prepare separate Operations and Maintenance manuals.

C. Operations Manual: The Operations Manual shall contain custom test, photographs, and drawings for the installed System, with detailed instructions on how to perform day-to-day operational tasks. Include:

1. Overview of installed system architecture

2. Detailed description of normal system operation

3. System Start up and Shutdown Procedures

D. Maintenance Manual: The Maintenance Manual shall contain custom text, photographs, and drawings for the installed, with detailed instructions on how to perform diagnostics, regular preventive maintenance and replacement on all components. Include:

1. Detailed description of installed system architecture.

2. Hardware description, including description of all equipment and nameplate date. Include catalog cuts.

3. Drawings showing all equipment locations.

4. Photographs of typical equipment locations with individual rack or enclosure identified.

5. Functional block diagrams.

6. Drawings showing interconnection of all equipment.

7. Operating Procedures

8. System start-up and restoration procedures.

9. Diagnostic and test procedures for system and all hardware.

10. Comprehensive factory service manuals shall be provided for individual equipment types showing theory of operation, wiring diagrams, voltages, parts lists, including diagnostics, adjustment and configuration procedures.

11. Recommended service and test procedures including hardware replacement, card replacement, adjustments, and preventive maintenance procedures and materials, routine operations, guide to troubleshooting, description of sequence of operation. Include manufacturer's product data with each sheet annotated to clearly identify the data applicable to the installation and delete references to inapplicable information.

12. Recommended routine maintenance procedures and schedules (e.g. daily, weekly, monthly, etc.).

13. Special maintenance requirements (if any).

14. Hardware configuration information, including device naming, model numbers and serial numbers of equipment, MAC addresses, IP addresses and port assignments.

15. Special configuration requirements

16. Include copy of each manufacturer's warranty and give information sheet for proper procedures in the event of failure and instances, which may affect the validity of warranties.

3.04 WARRANTY

A. Furnish a minimum 1 year manufacturer's replacement warranty for all devices and equipment. All devices shall have a warranty against defects in materials and workmanship for a one-year period commencing on the Base Date and ending on the first anniversary of the Base Date. (Base Date is defined to be the day of Authority's acceptance of the completion of the 30-day Operational Testing specified herein). The warranty shall cover all components, parts, installations, and assemblies. The warranty shall cover labor to trouble shoot, repair, reprogram, replace defective components, and travel to and from the location where the equipment resides.

END OF SECTION

SECTION 13710

VIDEO SURVEILLANCE SYSTEM – CAMERAS

APPENDIX "A"

SUBMITTALS

Submittals for the Work of this Section shall be separate and distinct from the submittals of other Sections.

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

1. Qualifications Package
   a. Furnish the name and address of the System Installer and Integrator.
   b. Submit a list of a minimum of three installations, at least one of which shall be located in the United States, which shall have included work, comparable in type, size and complexity. Said installations shall be in satisfactory operation for the last three consecutive years, at minimum. Furnish references and current contact information for each project.
   c. Furnish references and current contact information for each project.
   d. Furnish the resumes of all key project management, integration and installation personnel.
   e. Furnish certifications of training of key personnel in the installation and maintenance of the major equipment manufacturers
   f. Approval of qualification information is required prior to transmittal of any further submittals of this Section.
2. Catalog Cuts
   a. CCTV Cameras
   b. CCTV Camera Mounts
   c. CCTV Camera Lenses
   d. CCTV Camera Power Supplies
   e. Wire, Cable and connectors associated with the installation of the system
3. Shop Drawings
   a. Bill of Materials as per the approved catalog cuts
   b. System Block Diagram
   c. Detailed System Wiring Diagrams, indicating all field terminal block numbers
   d. Point Schedules
   e. Device matrices
   f. Complete, comprehensive, single-line diagrams, including all equipment, devices and cabling completely identified.
   g. All "red line" drawings.
   h. Wire, cable, conduit and connectors
   i. Enclosure and device installation details
   j. Terminal block connection diagrams for all system components.
   k. Detail drawings, which clearly illustrate the typical mounting configuration of each major equipment item. While some drawing details may be "typical," the drawings shall illustrate the installation detail of each unique application.

l. Detailed schematic drawings of all custom work, circuitry, and interfaces to equipment or systems not in Contract Work.
m. Fabrication shop drawings for all custom equipment.
n. Elevation drawings showing all CCTV related equipment locations and dimensions. These drawings shall also include wiring and power requirements.
o. Detailed information and/or drawings concerning grounding and lightning and surge suppression.
p. Engineering calculations concerning wire sizes to ensure that the proper cable sizes have been provided.
q. Equipment Schedules and or details which define all of the equipment used within the System.

4. Operations and Maintenance Manuals

   a. Complete sets of system manuals shall be submitted explaining all system capabilities and options, including but not limited to the installation, set-up, operation and maintenance of all equipment furnished as Work of this Section, in accordance with this Section. Submittal shall be furnished in both hardcopy and digital format.

5. Prepare and submit requests for programming information relating to response instructions, device numbers, and any/all special programming information.

   a. The request shall be in writing to the Engineer a minimum of four weeks prior to commencement of programming the system. As part of the request, the Programmer shall provide descriptive information of what is to be reported by the System for each device, and identify all required questions which require a response in order to complete the System's programming.

6. A list of all IP addressable equipment at least 60 days before the start of equipment addressing, to be coordinated with the Engineer.

7. System Configuration Submittals

   a. A minimum of 30 days before the start of the system programming submit complete system configuration information for the approval of the Engineer including, but not limited to, tables, schedules device matrices, screen shots and similar documentation and information to include, but not be limited to: cameras, encoders, decoders interfaces with the MAC System, in respect to incorporation of intrusion alarm, intercom and access point information. Include information on standard operating and alarm coupled frame rates and resolution of the encoders and decoder video streaming configuration, other MAC System set up coordination information, and all additional system operation and configuration information necessary for the completion of the integration and full system operation.

8. Disaster Recovery Procedures

   a. Prepare and submit Disaster Recovery Procedures describing how, upon completion of the first Operational Acceptance test, the System will be restored to a previous state of functionality with minimal loss of System operational capability, in the event that modifications to the System during subsequent installation phases result in System errors or faults.

9. Acceptance Testing

   a. Submit comprehensive Acceptance Test Plans that describe all the activities and tasks associated with testing of the System in accordance with the requirements

of this Section. The test plan shall include a comprehensive description of the Factory Acceptance, Field Acceptance testing to be performed.

b. Furnish the following:
   1) Preliminary Test Reports
   2) Factory Acceptance Test Plan
   3) Factory Acceptance Test Results
   4) Final Acceptance Test Plan
   5) Final Acceptance Test Results

c. Upon completion of 30 day Operational Acceptance Testing submit
   1) As-Built Drawings and Shop Drawings, which reflect actual locations and actual wiring details of system equipment and all revisions to the Work of this Section. One set shall be printed on reproducible mylar.
   2) Hardware Documentation shall be provided in hard copy and digital format.
   3) A hard copy back-up of all database and configuration settings.
   4) Electronic backup of all software, database and configuration settings to allow for system recovery and restoration.
   5) A detailed outline of the training information as described in this Section.

10. The following additional items shall be included as part of the required submittals

a. A report documenting the presence on the Work Site of the Manufacturer's certified personnel.

b. A report, completed by the person(s) certified by the equipment Manufacturer, documenting the findings of equipment unloading processes.

c. A test and certification reports for all twisted pair ethernet and fiber optic cables installed as Work of this Section.

SECTION 14210

TRACTION ELEVATORS

PART 1 GENERAL

1.1 DESCRIPTION

A. Work included: Provide engineering, materials, labor, and services necessary for complete installation of three new APTA compliant Machine Room-Less traction elevators – identified as elevator 1 - 3 as shown and specified.

B. Related work specified elsewhere:

1. Hoistways, pits and control room.
2. Smoke holes and secured gratings.
3. Louvers and screens.
4. Lighting and ventilation of pits, hoistways and machine room.
5. Access doors including guardrails.
6. Access ladders and guards.
7. Supports for guide rail brackets, buffers and entrance installation.
8. Buffer ladders and gratings.
9. Rope sleeves in concrete platforms.
10. Electric feeders to disconnect switches or circuit breakers to elevator starter or control panels.
11. 120 volt 15 amp disconnect switch or circuit breaker for each elevator including feeder wiring to control panels for car lights.
12. Electric feeders to disconnect switches or circuit breakers to freight elevator door control panels
13. Conduit to remote locations for elevator intercommunication and alarm systems.
14. Indicated or required chases and openings.
15. Finish painting except as noted.
16. Guarding and protecting hoistway during construction.

17. Storage space for tools and materials.

18. Electric power for testing and adjusting equipment.

19. Telephone wiring to control panels.

20. Telephone jacks furnished by others and installed by the elevator contractor.

21. Sump pits with removable gratings. Including sump pump or drain.

22. Grouting under entrance sills.

23. Signal from fire alarm system.

1.2 REFERENCES

A. Applicable Codes

1. American Society of Mechanical Engineers, Safety Code for Elevators and Escalators (ASME A17.1).

2. American Society of Mechanical Engineers, Guide for Inspection of Elevators, Escalators, and Moving Walks (ASME A17.2).

3. New York City Building Code Chapter 30.

4. New York City Building Code Appendix K &Appendix K2.

5. New York City Building Code Chapter 11.

6. New York City Electrical Code.

7. American Disabilities Act - ADAAG published in Federal Register.

8. APTA Heavy Duty Transportation System Elevator Design Guidelines.

9. APTA Mid to High Rise Heavy Duty Transportation System Elevator Design Guidelines.

10. APTA Heavy Duty Machine Room Less Elevator Design Guidelines.

11. Authorities having jurisdiction.

1.3 SUBMITTALS

A. Shop Drawings and Samples:

1. Shop Drawings: Provide complete shop drawings, to scale. Include layouts of pits, control rooms, overhead requirements, power and heat data for all equipment, static and impact loads, reaction points and required clearances.

2. Shop drawings: Six (6) copies of the shop drawings shall be provided by the Installer. Submit approval layout drawings to scale. Drawings shall include, but not be limited to the following:

   a. Car, guide rails, buffers and other components in hoistway

   b. Maximum rail bracket spacing.

   c. Maximum loads imposed on guide rails requiring load transfer to the building structure

   d. Loads on hoisting beams.

   e. Clearances and travel of car and counterweight run-by.

   f. Clear inside hoistway and pit dimensions.

   g. Location and sizes of access doors, hoistway entrances and frames.

   h. Car & Hall signal and operating fixtures.

   i. Remote wiring layouts for each elevator.

   j. Refuge space on top of car and pit.

   k. Control room, machine area, pit and hoistway layout.

   l. Cab design, dimensions and layout.

   m. Hoistway-door and frame details

3. Complete assembly detail of machine, machine mounting, machine beam assembly, dead end hitch and beam assemblies, governors, safeties, counterweights, with all load calculations.

4. Samples: Materials and finishes exposed to public view, 6" by 6" panels or 12" lengths as applicable.

   a. Cab Flooring

   b. Ceiling, including surface material, supporting frame and light fixture

   c. Cab Interior including car door, front return, wall finish etc

   d. Fixture faceplate

B. Equipment Brochure and Service Manuals:

1. Before acceptance of work, furnish three sets of manufacturer's equipment brochures and service manuals. Assemble manuals in chronological order

according to the specification alphanumerical system. Provide manufacturer's standard binders consisting of:

a. Equipment and components, descriptive literature.

b. Performance data, model number.

c. Installation instructions.

d. Operating instructions.

e. Maintenance and repair instructions.

f. Spare parts lists.

g. Lubrication instructions.

h. Detailed, record and as-built layout drawings.

i. Detailed, simplified, one line, wiring diagrams. Provide one complete set per manual.

j. Field test reports.

C. Control Room Prints: Provide one complete set of "as- built" field wiring and straight line wiring diagrams showing all electrical circuits in the hoistway as well as the machine room. These diagrams shall be laminated and bound in an 8½ inch by 11 inch binder and located in the elevator machine room as directed.

1.4 DEFINITIONS

A. The following definitions apply to work of this Section:

1. "Provide": to furnish and install, complete for safe operation, unless specifically indicated otherwise.

2. "Install": to erect, mount and connect complete with related accessories.

3. "Supply": to purchase, procure, acquire and deliver complete with related accessories.

4. "Work": labor and materials required for proper and complete installation.

5. "Wiring": raceway, fittings, wire, boxes, and related items.

6. "Concealed": embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosures.

7. "Exposed": not installed underground or "concealed" as defined above.

8. "Indicated", "shown", or "noted": as indicated, shown or noted on Drawings or as specified.

9. "Similar", or "equal": of base bid manufacturer, equal in materials, weight, size, design and efficiency of specified product, conforming with "Acceptable manufacturers."

10. "Reviewed", "satisfactory", "accepted", or "directed': as reviewed, satisfactory, accepted or directed, by or to Owner.

1.5 OPERATION PERFORMANCE

A. The control system shall provide smooth acceleration and deceleration with 1/8" leveling accuracy at all landings, from no load to full rated load in the elevator, under normal or unloading conditions. The self leveling shall, within its zone, be entirely automatic and independent of the operating device and shall correct for overtravel and undertravel. The car shall remain at the landing irrespective of load. Clearance between the car sill and the hoistway landing shall not exceed 1¼ inch.

B. The floor-to-floor performance time under the above criteria shall be 10.0 seconds (floor-to-floor time is measured from the start of door close at one floor to ¾ open at the next floor).

C. The door open time shall be 2.0 seconds from start of door open to fully open.

D. The door close time shall be based on the Code requirements with a door delay feature. The door delay is the minimum acceptable time from notification that a car is answering a call (lantern and audible signal) until the doors of the car start to close. Time shall be calculated by the following equation:

1. T = D/(1.5ft/s).

2. T = Total time in seconds.

3. D = Distance from a point in the lobby 60 inches directly in front of the hall station to the centerline of the door opening.

4. For cars with in car lanterns, T begins when the lantern is visible from the vicinity of the hall call station and the audible signal is sounded.

E. Car Call: The minimum acceptable time for doors to remain fully open shall not be less than 5 seconds.

F. The speed of the elevator shall not vary +/- 5% under loading conditions.

G. Prior to final acceptance and prior to the termination of the maintenance period, the elevators shall be adjusted as required to meet these performance requirements.

1.6 QUALITY ASSURANCE

A. Quality and gauges of materials:

1. New, best of their respective kinds free from defects.

2. Materials, equipment of similar application; same manufacturer, except as noted.

3. Gauges as noted.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Ship in original crated sections of a size to permit passage through available space.

B. Obtain approval and schedule delivery oaf material to meet Owner's requirements.

C. Storage of equipment and materials shall be coordinated with Owner.

1.8 WARRANTY

A. The elevators and associated equipment shall be free of defective material, imperfect work and faulty operation not due to ordinary wear and tear or improper use or care, for a period of one year from final acceptance of each elevator. Defective work shall be repaired or replaced at no additional cost to the Owner.

1.9 MAINTENANCE SERVICE

A. Initial Full Maintenance Service: Provide initial 12 month maintenance service during warranty period, by trained mechanics. Maintenance shall commence upon completion and acceptance of all elevator work and shall include examination, adjustment, greasing, oiling, parts replacement due to normal use.

B. Future Maintenance Contracts:

1. Submit with base bid separate alternate lump sum price for the following maintenance contract for a period of five years commencing after the initial full service maintenance contract outlined above expires. Provide the monthly price for this contract.

2. The lump sum prices shall not be based on escalation. Annual adjustment of the contract price shall be made at the end of each year the contract is in force. Each adjustment shall be made on the following basis:

a. Twenty percent of the total contract price shall be increased or decreased based on the increase or decrease shown by the index of "Wholesale Commodity Prices for Metals and Metal Products" published by the U.S. Department of Labor, Bureau of Statistics for the month within which each yearly adjustment date falls due as compared with the index published for the same period in the year of the last adjustment. The index used in establishing the current price of this contract is (Contractor to indicate in bid) as published for the month of (Contractor to indicate in bid).

b. Eighty percent of the total contract price shall be increased or decreased by the percentage of increase or decrease in the straight time hourly rate paid to the elevator mechanic in the locality where the elevator equipment is maintained, on the annual adjustment date as compared to the rate paid for the same period in the year of last adjustment. The hourly wage rate used in establishing the current price of this contract is _____ (Contractor to indicate in bid) dollars.

c. For the purpose of this agreement and subsequent adjustments, the straight time hourly rate for elevator mechanics shall equal the actual hourly rate paid to the elevator mechanics plus the fringe benefits granted in lieu of, or in addition to, hourly rate increases.

d. Any change in price under this provision shall not result in the payment of more than the maximum price permitted by any applicable legally issued government regulations in effect at the time such adjustment is made.

3. Initial Full Maintenance and Future Maintenance Contract shall include:

a. Regularly and systematically examine, adjust, lubricate, clean and, when conditions warrant, repair or replace the following items and all other mechanical or electrical equipment:

1) Machine: Worm, gear, thrust bearings, lateral bearings, shaft bearings, drive sheave, and other machine components.

2) Brake pulley, brake coil, brake pins, brake contacts, linings and other brake components.

3) Motor: Motor windings, rotating elements, commutators, brushes, brush holders, bearings field coils, rotators, stator slip rings.

4) Controller, encoder, and dispatching equipment: All components including all relays, solid state components, resistors, condensers, transformers, contacts, leads, computer devices, encoder devices, mechanical or electrical driving equipment, coils, magnet frames, contact switch assemblies, springs, solenoids, resistance grids, hoistway vanes, magnets and inductors.

5) Governor: Including governor sheave, shaft assembly gears, bearing contacts, jaws and pit tension assembly.

6) Sheaves: Including defector, secondary, compensating sheaves, shafts, bearings, grease retainers, compensation sheave frame, contacts and hold down devices.

7) Hoistway door interlocks or locks and contacts, hoistway door

hangers, tracks, bottom door gibs, cams, rollers and auxiliary door closing devices for power operated doors. Chains, tracks, cams, interlocks, sheaves for vertical bi-parting doors.

8) Hoistway limit switches, slowdown switches, leveling switches and associated cams, vanes and electronic components.

9) Guide shoes including rollers or replaceable guides.

10) Automatic power operated door operators, door protective devices, car door hangers, tracks and car door contacts.

11) Traveling cables.

12) Elevator control wiring in hoistway and machine room.

13) Hoist cables, governor cables, compensating cables and compensating chains, including adjustment of tension on all cables.

14) Car safety mechanism and load weighing equipment.

15) Buffers.

16) Fixture contacts, pushbuttons, key switches, locks, lamps and sockets or button stations (car and hall), hall lanterns, position indicators (car and hall), direction indicators.

17) The guide rails shall be kept free of rust and dry.

18) Examine all safety devices and governors, and conduct an annual no load test, and every fifth year perform a full load, full speed test of safety mechanism, overhead speed governors, car and counterweight buffers. The car balance shall be checked and governor set. If required, the governor shall be calibrated and sealed for proper tripping speed. All tests shall be performed in accordance with the provisions of the American Society of Mechanical Engineers, Safety Code for Elevators and Escalators (ASME A17.2), current edition.

19) Furnish lubricants compounded specifically for elevator usage.

b. The Elevator Contractor shall not be required to install new attachments on the elevator whether or not recommended or directed by insurance companies or by governmental authorities, or make any replacements with parts of a different design. The Contractor shall not be required to make renewals or repairs necessitated by reason of negligence or misuse of the equipment or by reason of any other cause beyond the Contractor's control except ordinary wear and tear unless the Contractor receives just compensation.

c. The Elevator Contractor shall not be responsible for the following items of elevator equipment: car enclosure (including removable panels, door panels, car gates, hung ceilings, light diffusers, light tubes and bulbs, handrails, mirrors, and carpets), hoistway enclosure, hoistway doors, frames and sills.

d. All work is to be performed during regular working hours of regular working days. Provide twenty (24) hour emergency service during the maintenance period consisting of a prompt response (within 60 minutes) to emergency request by telephone or otherwise if an elevator is inoperable or in case of injury, entrapment, or potential injury to persons.. Should overtime maintenance or repair work be required, the Owner will pay only the actual amount of the premium portion of the wage, the Contractor will pay the basic hourly rate.

e. The Contractor shall check the group dispatching systems and make necessary tests to insure that all circuits and time settings are properly adjusted, and that the system performs as designed and installed.

C. Maintenance Responsibility:

1. The Contractor shall keep the elevator maintained to operate at the original contract speed, keeping the original performance times, including acceleration and retardation as designed and installed by the manufacturer. The door operation shall be adjusted as required to maintain the original door opening and door closing times, within legal limits.

2. The Owner reserves the right to make inspections and tests as and when deemed advisable. If it is found that the elevator and associated equipment are deficient either electrically or mechanically, the Contractor will be notified of these deficiencies in writing, and it shall be his responsibility to make corrections within 30 days after his receipt of such notice. In the event that the deficiencies have not been corrected within 30 days, the Owner may terminate the contract and employ a Contractor to make the corrections at the original bidder's expense.

3. Approximately six months prior to the end of the contract term, the Owner will make a through maintenance inspection of all elevators covered under the contract. At the conclusion of this inspection, the Owner shall give the Contractor written notice of any deficiencies found. The Contractor shall be responsible for correction of these deficiencies within 30 days after receipt of such notice.

D. The Owner reserves the right to accept or reject any or all alternates.

E. Diagnostic Tools and Spare Parts: At the completion of the work as specified, the Contractor shall provide items listed. The items shall become the Owner's property.

1. One complete set of all diagnostic tools and equipment required for the complete maintenance of all aspects of the control and dispatch system and solid-state motor drive units. The diagnostic system shall be an integral part of the

controller and provide user-friendly interaction between the serviceman and the controls. All such systems shall be free from secret codes and decaying circuits that must be periodically reprogrammed by the manufacturer.

2. A list of vendors for all parts used in the installation.

1.10 ELECTRIC SERVICE

A. Power: 480 volts, 3 phase, 60 hertz.

B. Lighting: 120 volts, 1 phase, 60 hertz.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product of individuals, firms or corporations regularly engaged in manufacturing elevators comparable with this contract and in satisfactory operation for a period of not less than five years.

B. Qualified Bidders:

1. Fujitec Elevator Company.

2. Hollister-Whitney Elevator Corporation.

3. KONE Elevator Company.

4. MCE (Motion Control Engineering Company, Inc.).

5. Otis Elevator Company.

6. Schindler Elevator Company.

7. Thyssen/Dover Elevator Company.

8. Approved Equal.

2.2 OUTLINE OF EQUIPMENT

A. Elevator Number: 1 - 3

1. Elevator use: Passenger.

2. Contract load, in lbs.: 4,000

3. Contract speed, in FPM: 350

4. Machine location: Overhead MRL.

5. Machine type: Gearless.

6. Type of control: AC variable frequency.

7. Operation: Group

8. Car and hoistway door type: One speed, Center Opening.

9. Car and hoistway door operation: Power High-speed, heavy duty (minimum opening speed 3.0 FPS).

10. Cab enclosure: Glass.

2.3 MACHINE AND CONTOL EQUIPMENT

A. Provide MRL (Machine Room Less) type equipment to fit space conditions shown.

B. Gearless Machine: Sheave: The sheave material shall be accurately machined of semi-steel of hardness BHN 220-250. Anti-vibration Mounts: For machines that are support beam mounted, an anti-vibration mounting pad is to be provided.

C. Motor: The motors shall be of the alternating current reversible asynchronous or synchronous type of a design adapted to the severe requirements of elevator service. Motor shall be capable of developing the torque required to meet or exceed an acceleration rate of 2 ft/sec^2 for the elevator car. A means to protect the windings and bearings from airborne dust shall be provided. Insulation of all windings shall be impregnated and baked to prevent absorption of moisture and oil. The insulation resistance between motor frame and windings shall not be less than one meg-ohm. The motor windings shall stand a dielectric test of twice the normal voltage plus 1000 RMS volts of 60 Hertz, alternating current for one minute. Motor leads in the conduit box shall have the same insulation class as the windings. Motor lead wire shall be rated 125 C and shall be sized for 105 C at the motor nameplate amperes at 1.0 Power Factor per Electrical Apparatus Service Association (EASA) recommendations. Leads are to be numbered for clockwise rotation when facing opposite the shaft end. The motor shall be designed to stand the severe loads encountered in elevator service and the windings shall have a minimum insulation temperature rating two ratings higher than the actual temperature rise of the motor, with a minimum rating of NEMA class F.

D. Brake: Provide dual brakes that shall be of the self adjusting fail-safe (spring applied and electrically released) type provided with a remotely operated, in the controller room, manual brake release and designed to meet the service factor demand of its intended use. Access panels at the top of hoistway shall not be required. Dual brakes shall operate independent of each other for ascending car over speed and unintended car movement. Provide operation to prevent the elevator from striking the hoistway overhead or unintended car movement per the requirements of code.

E. Controllers: Provide enclosed controller panels with ventilated cabinets and hinged or removable doors. Provide permanently marked symbols or letters identical to those on wiring diagrams adjacent to each component. The system shall utilize

isolated solid state input/output interface for the majority of signals. It is understood, where required by Code, relays contacts are to be utilized for safety and power control considerations. The use of relays as input or output devices are not acceptable.

1. All controller components shall be designed to provide the required operation as herein specified.

2. All assemblies, power supplies, switches, relays and other items shall be securely mounted on a substantial, self-supporting steel frame of angles or channels and shall be totally enclosed with covers in a floor mounted cabinet. Equipment shall not be mounted on any of the covers.

3. All controller switches and relays shall be magnet operated with contacts of design and material to insure maximum conductivity, long life and reliable operation without overheating or excessive wear and shall provide a wiping action to prevent sticking due to fusion.

4. Where time delay relays are used in the circuits, they shall be of an acceptable design that is reliable and consistent, such as condenser timing or electronic timing circuits. No dashpot time relays shall be used.

5. Each device on all panels shall be properly identified by name, letter, or standard symbol which shall be neatly stencil painted (or otherwise marked), in an indelible and legible manner, on device or panel. Identification markings shall be coordinated with identical markings used on wiring diagrams. The ampere rating shall be marked adjacent to all fuse holders. All spare conductors shall be neatly formed, laced and identified.

6. Safety switch shall cut off current, automatically apply brake and stop car upon current failure or upon operation of any electrical safety device.

F. Encoder: Provide solid-state, optical, digital-count type, mechanically coupled to car via a slotted tape with drive sheaves and a pit-tensioning sheave or driven from the car governor. Optical, inductive pulse, or mechanical target-type tape encoder mounted in the hoistway is acceptable.

G. Machine Beams: Provide steel beams, channels and bearing plates to support machine, governors and rope hitches. Include any required clip angles, tie rods, etc. as required.

2.4 OPERATING SYSTEMS

A. Group Supervisory System:

1. Provide a solid state microprocessor dispatch system that shall provide for continuously changing operations in various traffic situations, and efficiently handle the varying passenger traffic demands:

a. It shall provide for a continuously changing program of varying combinations when there are landing calls registered. These shall include components of incoming, outgoing, interfloor and special traffic in varying intensities.

b. The main floor up call is to be given priority.

c. The system shall have forecasting capabilities that will assign the desired degree of priority to any additional entrance floor.

d. The system shall measure the call waiting times on all floors, and determine through forecasting whether the elevator on becoming vacant shall continue in the previous running direction or reverse and assist in concentrated interfloor traffic in specific areas of the building.

e. The system shall constantly evaluate the service quality of all forecasted waiting times. The process of optimization will allocate the landing calls with no final assignment established until the total quality of passenger service is assessed.

f. A light traffic mode is assumed when there are no registered landing calls within a preset time. During periods of traffic, elevators shall be parked in anticipation of new landing calls. At least one elevator is to be parked at the main floor. Other elevators can be parked at upper or lower floors, as previously stated. The elevators shall be parked with the doors closed. The need for parking shall be checked by the system at frequent intervals.

    1) With the increasing traffic intensity, a priority method of call assignments shall be initiated. Priority of service for landing calls is determined by the call waiting time in relation to the prevailing traffic condition. The system shall prevent waiting times that are excessive as compared to the traffic intensity.

    2) Peak type of demands shall be recognized by monitoring the total traffic flow including a predominance of car calls in one direction, a high intensity of landing calls in one direction, a sudden high percentage of load increase when answering landing calls, main floor landing hall call intensities and departure of elevators from a designated floor with a predetermined load several times in a preset time.

3) When an up peak type of demand is recognized, the main floor up call is immediately classified as priority call. The first vacant elevator is always dispatched to the main floor, the dispatch of another vacant elevator to the main floor is subject to optimization by the computer and decisions depending on the degree of up intensity and the amount of traffic flow against main flow. When passengers enter the elevator, the elevator can start as the first car call has been registered. The doors shall, however, stay open as long as further passengers are detected entering the elevator. Once the car call has been registered, the control system shall dispatch another vacant elevator to the main floor, unless a vacant elevator is already there.

4) With an up peak traffic type of operation, the main traffic flow (incoming traffic) shall receive preferential service. The system shall continuously re-evaluate the traffic pattern, and adjust the group operation. If it detects a sudden simultaneous intensive down demand, it shall cancel the automatic return to the main floor.

5) When a down peak condition is recognized, the down call shall be served through the optimization process to provide efficient traffic handling. In extremely intense down traffic situations, the priority of the up calls is decreased to a preset value according to the main traffic flow preference system. The system shall provide equal service to every floor, even during exceptionally heavy down traffic.

6) The system operation shall continuously change by demand and shall not require forced system changes to provide optimum operation and call response.

g. Dispatch Protection: The system shall automatically provide dispatching in the event of failure of the primary system. A visible and audible alarm shall be provided to indicate loss of the dispatching computer.

h. Delayed Car Protection: The system shall automatically disassociate a car from the Group System in the event the car is delayed for a predetermined time. The car shall be automatically restored to the Group System when the cause of the delay has been eliminated.

i. Programmed Door Control: Separate adjustable times shall be provided for each car to establish minimum passenger transfer time

for car stops, intermediate floor hall call stops and lobby floor stops. All timing shall be computerized to coincide with traffic demands.

j. Designated Parking: The system shall provide for cars to park as designated by the Group Controller or park at its last call.

k. Next Car: The car selected, as next up at the lobby floor shall park with its door open. If an absence of calls exists, the door shall close automatically as commanded by the Group Controller.

B. Independent Service: Provide controls to remove elevator from normal operation and provide control of the elevator from car buttons only. Car shall travel at contract speed and shall not respond to corridor calls.

C. Car Top Operation: Provide per Code requirements.

D. Emergency Recall Operation (Fire Service): Provide operation and equipment per NYC Code requirements. Provide a Phase I key switch at the main fire egress lobby and a Phase II key switch in each cab.

E. Emergency Car Lighting and Alarm System: Unit shall provide emergency light in car upon failure or interruption of normal car lighting. Emergency lighting unit shall provide a minimum illumination of 0.2 foot-candle at 4 feet above car floor approximately 1 foot in front of car operating panel for not less than 4 hours. Battery shall be 6 volt minimum, sealed rechargeable lead acid or equal. Battery charger shall be capable of restoring battery to full charge within 16 hours after resumption of normal power. Provide an external means for testing battery, lamps, and alarm bell.

F. Load Weighing: Provide automatic load weighing device set at approximately 80% of full load. The device when activated shall cause the elevator to bypass corridor calls and shall initiate dispatch of car at main terminal prior to elapse of normal dispatching interval. Provide adjustable setting from 50 - 80% of full load.

G. False Call Canceling: Provide device to cancel all car calls when car loading is not equal to the number of calls registered.

H. Standby Power Panel and Operation:

1. Elevator Contractor shall provide all control wiring for automatic emergency power operation of elevator. Elevator shall automatically be selected to remain on emergency power operation.

2. Include all relays, auxiliary contacts and selector switches for emergency operation control and for motor starters in machine room.

3. Power wiring from emergency source to emergency operating control provided by Electrical Contractor.

4. All relays shall automatically reset as emergency supply becomes available for each car.

5. Submit wiring diagrams for coordination.

6. Emergency operation shall be arranged such that the elevator system shall sense a loss of normal power at each automatic transfer switch on an individual basis. Upon power loss at one transfer switch (partial power failure), no more than one elevator served by that transfer switch shall be capable of operating at one time. Upon loss of power at more than one elevator transfer switch, the elevators shall be interlocked such that no more a specific number of elevators may operate simultaneously from the emergency power system. Sensing contacts at each transfer switch and relayed wiring to each elevator machine room shall be by the Electrical Contractor. The Elevator Contractor shall coordinate with the Electrical Contractor to determine the type of sensing contacts required (normally open or normally closed) and the contact rating. Refer to the electrical drawings for number of transfer switches and elevators served.

7. Provide an indicator in the fire control panel indicating normal power operation or emergency power operation.

A. Vertical Transportation System Monitoring and Management System: Provide provisions to connect to a central elevator monitoring system which shall incorporate all elevator and escalator controls systems. The Monitoring system shall be a separate or integrated microcomputer unit which acts as a communications interface between the Elevator Control System and Elevator Monitoring and Management control system via common serial ports or Ethernet combined with TCP/IP. When an elevator shutdown occurs, the elevator system shall initiate an emergency call to an elevator command center. The monitoring system shall receive and process any emergency call by displaying the event on the monitor screen sending a message to a communications system or printing the event on a designated printer. While connected to the elevator system, the remote monitoring system shall download and collect available data, which shall be organized in a database. This software shall provide easy-to-use pull down menus, using the Microsoft Windows operating system, allowing the user to monitor and review the elevator performance database in different formats. It shall also provide the proper menus for altering various elevator system parameters. The following programmed modes shall be activated by typing in the appropriate request on the terminal keyboard.

1. Traffic Mode – The monitor shall display the following data on a selective per elevator bank basis: Elevator Movement, Elevator Position, Elevator calls, Landing Calls, Landing Call Allocations, Timed Out Calls, Passenger Load, Elevator Status, Group Status, Door Motion, Door Position, Fire Alarm, Emergency Power Status, Fault Indications, Restricted Floor Status, Clock.

2. Fault Mode – The monitor shall display the following data and may communicate to the printer: Detect faults; type, elevator no., time, frequency, etc. Add fault message to monitor. Store all fault data. The monitor shall display the following data and may communicate to the printer: System parameters; load weighing settings, floor priorities, etc. Verify parameter changes.

3. Setup Mode- The monitor shall display the following data and may communicate to the printer: System parameters; load weighing settings, floor priorities, etc. Verify parameter changes.

4. Test Mode-The monitor shall display the following and may communicate to the printer: Self-diagnostic test. Test results.

I. Ascending Car Overspeed and Unintended Car Movement Protection:

1. Ascending car overspeed and unintended car movement protection shall be provided to prevent the car from striking the hoistway overhead structure and/or unintended car movement away from the landing with the hoistway door not in the locked position or the car door not in the closed position as a result of a failure in:

a. The electric driving machine motor, brace, coupling shaft or gearing.

b. The control system or any other component upon which the speed of the car depends.

2.02 HOISTWAY EQUIPMENT

A. Guide Rails: Planed steel, standard T-sections. Extend rails from pit floor to underside of concrete slab or grating at top of hoistway.

1. Provide necessary car and counterweight rail brackets and counterweight spreader brackets of sufficient size and design to secure substantial rigidity to prevent spreading or distortion of rails under any condition.

a. Slotted or oversized holes shall be fitted with flat washers. Where fastenings are over 14 feet apart, rails shall be reinforced with 9-inch channel or approved equal backing to secure the rigidity required.

b. Provide individual brackets of sufficient length to span between the guide rail assembly and the building structure. Provide any additional bracing required.

2. Guide rail loads shall be shown on Elevator Contractor's drawings. Include safety application, running, loading and seismic loads.

B. Buffer: Oil type with spring or gravity return. Provide struts, braces, inspection ladder and platform where needed.

C. Counterweights: Structural steel channel frame with metal filler weights. If compensation is not required provide metal guard as required by Code.

D. Suspension Means: If steel core ropes are supplied, a means to provide constant lubrication shall be provided.

E. Governor Ropes: Provide 8 x 25 filler wire type for governor rope; fasten with adjustable shackles.

F. Governor: Overhead centrifugal type, car driven, with electrical shutdown switches.

G. Safety: Flexible guide clamp, Type B.

H. Automatic Terminal Stopping Device: Per Code.

I. Wiring:

1. Conductors: Provide copper insulated wiring with flame retarding and moisture resisting outer cover. Install in galvanized metal wireways and raceways. Conductors from shaft riser to door interlocks shall be SF-2 type or equal, maximum operating temperature 392 degrees F. All terminations shall be insulated to maintain integrity of wiring. Flexible conduit may be used for short connections. Provide 10% spare conductors throughout.

2. Electrical Cables:

   a. Traveling Cables shall be provided new. Pad cab platforms where cables rub. Provide hardware cloth for full traveling cable movement height between cables and all hoistway divider beams.

   b. The car operating panel, position indicator, and other electric equipment on the car shall be connected with the controller by means of flexible cable run from the bottom of the car to an approved outlet in the hoistway.

   c. Cables shall have a flame-retarding and moisture-resistant outer cover, and shall be suitably suspended to relieve strain in individual conductors.

   d. CCTV Camera Interface – Provide two coax cables rated for elevator traveling cable use and two, two conductor 18 gauge stranded cables with an overall braided shield and drain wire.

   e. CCTV camera interface traveling cables shall be isolated from other traveling cables used to carry high voltage alternating current circuits.

   f. Each traveling cable shall contain 10% spare wires and in any event not less than one spare wire.

3. Remote Wiring: Provide wiring between machine room, hoistway and remote locations of guard, security, life safety and fire control panels.

4. Work Light and Plug Receptacles: Provide on top and bottom of car with lamp guards.

5. Stop Switches. Provide Code required stop switches in the pit and near the governor access door if required.

2.03 DOOR AND ENTRANCE EQUIPMENT

A. General: Provide entrance assembly with UL 1½ hour rating. Elevator landings which are provided with a zero clearance vestibule shall be provided with entrance frames which shall not exceed 5 and 5/8 in).

B. Frames: Fabricate from 14 gauge cold rolled furniture steel, bolted to form a one piece unit. A fireproof and sound-deadening material shall be applied to the unexposed side of each frame. Finish shall be stainless steel No.4 brushed finish.

1. Provide handicapped designations at a height of 60" above the floor.

a. The plaques shall have light colored numerals on a black background.

b. Designations shall be flush with inconspicuous mechanical mounting.

C. Sills: Extruded nickel silver with a non-slip surface.

D. Struts: Minimum 3 inch continuous hot rolled or formed steel angle with secure fastening to sill above.

E. Header: Minimum 3/16 inch thick formed steel designed to support hangers. Header shall be bolted to supporting struts.

F. Hanger Cover Plates: Removable, full length No. 14 gauge steel. Covers shall be made in sections for convenient access to hangers.

G. Fascia: No. 14 gauge steel plates extending from top of header to sill of door above, or beam above if there is no door opening. Provide continuous fascia if front hoistway walls are not built out where openings do not exist.

H. Toe Guard: No. 14 gauge sheet steel.

I. Dust Cover: No. 14 gauge sheet steel.

J. Door Bumpers: Provide on vertical struts at top and bottom.

K. Doors: Door panels shall be laminated glass flush door construction that meets the requirements of ANSI Z97.1 requirements. Provide reinforced stainless steel No. 4 brushed finish rectangular tubing frame. Tubing frame width shall be as indicated with gasketing as required by Code. Doors shall be provided with two removable, non-metallic gibs, located at the leading and trailing edge of the door panel. Center opening doors shall be provided with full length rubber astragal at leading edge of each door. Finish for exposed hardware shall be stainless steel No. 4 brushed finish.

L. Sight guards: Provide for each landing door panel, constructed of No. 16 gauge furniture steel. Finish to match doors. Landing designations shall be permanently applied to each sight guard.

M. Hanger: Provide two-point suspension sheave type with provisions for vertical and lateral adjustments. Sheaves shall be minimum 2¼ inch in diameter with sealed ball or roller bearings.

N. Tracks: Cold drawn steel shaped and finished to permit free movement of sheaves. Bottom of track shall be in contact with upthrust roller.

O. Closer: Spring or spirator type.

P. Interlocks: Electrical contacts shall prevent the operation of the elevator by normal operating devices unless hoistway doors are closed or within tolerances allowed by Code.

2.04 CAR EQUIPMENT

A. Car Frame: Welded or bolted steel channel construction.

B. Top Shroud: 14 gauge sheet steel with baked enamel Black - Matte finish. Coordinate with overhead and door operator clearances. Provide minimum 6" clearance between top of shroud and nearest obstruction when elevator is at uppermost point of travel. Provide with guardrail assembly minimum 3'-6" high for car top inspection. Coordinate with overhead clearances. Provide minimum 6" clearance between raised handrail and nearest obstruction when elevator is at uppermost point of travel.

C. Car and Counterweight Sheaves (As required): Provide cast iron machined and grooved for diameter of ropes and adequately supported. Provide cable guards designed to withstand shock and prevent ropes from leaving their proper grooves. All bearings are to be shielded or sealed.

D. Canopy: Provide 8'-0" clear height under canopy. Reinforced 14 gauge furniture steel, finish shall be stainless steel No. 4 finish. Arrange for hinged top emergency exit including lock.

E. Glass Shell: Sides and back shall be minimum 9/16 inch laminated glass which meets the requirements of ANSI Z97.1. Provide panels in strict conformance with the requirements of ANSI Section 204. Framing finish shall be stainless steel No. 4 brushed finish.

F. Suspended ceiling and lighting:

1. Provide down light type suspended ceiling panels. Finish shall be stainless steel No. 4 brushed finish. Provide 7'-6" clear height under the suspended ceiling.

2. Provide LED lighting fixtures which uniformly distributes the light at handrail height as required by Code.

3. Provide clear access to the emergency exit.

G. Sill: Extruded nickel silver with a non-slip surface.

H. Guide Shoes: Roller type with three or more sound-deadening rollers with adjustable springs or other method to maintain rail contact.

I. Front return panels and entrance columns: 14 gauge sheet steel. Return panel shall be swing type to allow access to car station wiring and fixtures. Provide cabinets for special operating features and telephone required by these specifications. All exposed fasteners shall be spanner type security screws. Finish shall be stainless steel No. 4 brushed finish.

J. Transom: 14 gauge sheet steel finish to match front return panels and entrance columns.

K. Glass car door panels: Same construction as hoistway door panel. Hardware finish shall be stainless steel No. 4 brushed finish.

L. Mullions and muntins: Provide mullions and muntins. Clad all exposed surfaces with stainless steel No. 4 brushed finish. Cladding shall be attached with oval head stainless steel screws.

M. Handrail: Provide a 1 1/2 inch diameter stainless steel No. 4 brushed finish tubular handrail at the rear and sides of the car. Return ends. Provide adequate mounting. Centerline to be 32 inches above the finished floor.

N. Base: Provide a 4 inch high base. Finish shall be stainless steel No. 4 brushed finish.

O. Toe Guard: Per Code.

P. Hangers and tracks: Same as hoistway entrance doors hangers and tracks.

Q. Floor covering: Provide new. Pattern and color as selected by the Owner.

R. Door Protection:

1. Proximity detector: Provide a door proximity edge that projects an infrared curtain of light guarding the door opening. Arrange to reopen doors if one beam of the curtain is penetrated. Unit shall have Transmitters and Receivers spaced at a minimum distance to provide the maximum amount of protection within the height of the doorway. Systems which have the availability to turn Off or On individual zones within the curtain will not be allowed.

2. Differential door timing feature: Provide adjustable timers to vary the time that the doors remain open in response to a car or hall call. The doors shall remain open for one second in response to a car call and five to eight seconds for a hall call. This time shall be reduced to ½ second if the proximity detector is interrupted. The doors shall remain open as long as passengers are crossing the threshold.

3. Nudging: When doors are prevented from closing for 20 seconds due to failure of the proximity device or obstruction, the doors shall close at reduced speed and a buzzer shall sound.

S. Door Operator: Provide a high speed, closed loop, heavy duty master electric power door operator to automatically open and close the car and hoistway doors. The doors shall be capable of smooth and quiet operation without slam or shock.

1. Opening speed shall not be less than 2.0 f.p.s. with reversal in no more than 2½ inches.

2. An auxiliary-closing device shall automatically close hoistway doors if car leaves the landing zone.

3. In case of power interruption, it shall be Possible to manually operate car and hoistway doors from inside the cab.

T. Car Door Contacts: Electrical contacts shall prevent the operation of the elevator by normal operating devices unless car doors are closed or within tolerances allowed by Code.

U. Door Restrictors: Provide door restricting devices to prohibit the opening of car doors by more than 4" when outside of the unlocking zone.

V. Ventilation: Two-speed exhaust fan with battery backup as required for glass car enclosures.

W. Elevator Cab Air Conditioners: Provide and install Elevator Cab Air Conditioner Package for each elevator as manufactured by Elevator Motors/Materials Corporation (EMCO) Model LIFTAIRE II or equal. Package shall include 14,000 BTUH nominal cooling capacity, high efficiency heater with 5,600 BTUH heating output, flexible ducts, automatic change over on/off, heat/cool thermostat, and all hardware required for a complete installation. Install on elevator canopy below top shroud, coordinate location with cab manufacturer to provide clear access to top emergency exit and code required refuge space.

2.05 SIGNALS AND FIXTURES

A. Car Operating Panels:

1. Provide vandal resistant type main and auxiliary car operating panels integral with swing out type front return panels. Panels shall have illuminating pushbuttons numbered to conform to floors served. Buttons shall light to show registration and extinguish when car stops in response to a call. Each panel shall include a keyed In Car Stop switch and alarm bell button, DOOR OPEN and DOOR CLOSE button. All operating controls shall be located no higher than 54" for side approach and 48" for front approach above the car floor, (35" for stop switch and alarm button). Provide main car panel with Phase II emergency fire service panel and switch, fire jewel, fire operating instructions, CALL CANCEL button, intercom grill and flush mounted speaker grill for the "Hands Free" telephone.

a. Braille/Arabic designations shall be flush with inconspicuous mechanical mounting.

1) The plaques shall have light colored numerals on a black background.

2. Provide within the panel of the service cabinet, a locked flush hinged or sliding door and integral certificate frame.

a. Certificate Frame shall have durable Plexiglas window and be accessible from backside of locked door. Minimum window size to be 7" wide by 3" high.

b. Cabinet shall contain the following toggle type controls:

1) A light switch.

2) Two speed fan switch.

3) Inspection switch, conforming to the ASME Code.

4) Independent service switch.

5) A G.F.C.I. duplex 120 volt, A.C. convenience outlet.

3. Engrave the car operating panels with the following:

a. No Smoking. Minimum 1 inch high lettering.

b. Elevator Number over operating buttons. Minimum ¼ inch high lettering.

c. Elevator Capacity. Minimum ¼ inch high lettering.

d. Firefighters Operating Instructions. Minimum 1/8 inch high lettering.

B. Car Position Indicator: Provide digital readout type with 1" high (minimum) indications over each operating panel. Provide audible floor passing signal.

C. Hall Buttons: Provide one riser of hall pushbuttons. Station shall include flush mounted faceplate. Centerline of riser to be 3'-6" above the finished floor. Provide Code required pictograph Fire signs above the hall buttons, at all floors. Provide Code required Phase I key switch and operational instructions engraved on the faceplate, at the main lobby. Fire signs shall be integral within the faceplate, at all floors. Finish shall be stainless steel No. 4 brushed finish. Backfill for engraving shall be epoxy filled. Integral Signs shall be as follows:

1. Fire Signs. Minimum ½ inch high lettering.

2. Fire Operational Instructions. Minimum 1/8 inch high lettering]

D. Hall Lanterns: Provide UP and DOWN lanterns at intermediate landings, single lantern at terminal landings. Gongs for each lantern shall sound twice for the down direction of

travel. The lantern shall illuminate for corresponding direction of car travel and the gong shall sound when the elevator is at a predetermined distance from the scheduled floor stop. The design and location of the hall lanterns shall be circle type as detailed by architect. Faceplate material identical to hall button faceplate.

E. Hall Position Indicator: Provide a digital readout type with 1" high (minimum) indications at the main lobby. Faceplate material identical to hall button faceplate.

F. Security Control Station: Provide a remote monitoring security control station for the elevator located at the Central Terminal Building.

G. Hoistway Access Switch: Mount with faceplate in entrance frame side jamb at all top and bottom terminals where walk in pits are not provided. Faceplate to match hall button finish.

2.06 COMMUNICATION SYSTEM:

A. Emergency Communication System: Provide an intercom system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." The communication system shall include a car station in the elevator and master stations installed in the Central Terminal Building security control room, and elevator control room. The car station shall have a loudspeaker and a microphone to provide hands-free communication without using a handset. The car station shall be installed behind the car operating panel, with identification, instructions for use, and battery backup power supply. Provide the master stations with selector pushbuttons, annunciator lights for each connected station, speaker/microphone, volume control and function buttons. The master station shall be connected to any of its designated car stations by depressing the corresponding call button. The lamp in the button shall be illuminated while the button is depressed. In the car station an audible tone shall be emitted and after the audible tone immediate communication established. The call shall be ended by depressing the button a second time, disconnecting the circuit. The car station shall be connected to the master station by depressing the corresponding call button and the lamp shall be illuminated with a steady light. Upon activation, the car station shall provide visible signals that indicate when system has been activated and when master station has responded. At the called master station, an audible tone shall be emitted and the lamp corresponding to the "calling elevator" shall be illuminated. After the audible tone, immediate communication is established. Provide all power supplies, wire, traveling cable, conduit, fittings, etc. The intercom system shall include a test button to verify audio circuit path.

1. Provide a telephone symbol minimum 2 inch high, and raised 1/32 inch with Braille indications adjacent to a separate activation button mounted on the control panel.

2. Provide engraved emergency instructions above the activation button. Instructions shall read: "TO USE EMERGENCY TELEPHONE, PRESS BUTTON BELOW. DIALING WILL OCCUR AUTOMATICALLY. Identical instructions in Braille shall be provide below the engraved instructions.

3. Provide a visual indication, approximately ¾ inch in diameter, or a jewel that illuminates once a call has been received by the master station. Instructions under the visual indicator or within the lighted jewel shall read: "ASSISTANCE IS ON THE WAY".

B. Provide wiring from master stations to terminal box in elevator machine rooms.

3.00 EXECUTION

3.01 EXAMINATION

A. The elevator contractor shall examine the supporting structure and the conditions under which the work shall be installed and notify the contractor of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected and are acceptable.

B. Verify dimensions of supporting structure at the site by accurate field measurements. The work shall be accurately fabricated and fitted to the structure. Elevator contractor shall be satisfied by review of the working drawings and field observation that the clearances and the alignments are proper for the installation of this work.

C. Coordinate works with the work of other trades, and provide items to be placed during the installation at the proper time to avoid delays in the overall work. Use contractor's benchmarks where necessary.

D. The elevator contractor shall review the electrical drawings and verify all conditions for proper installation of this work. Verify the size of all feeders and related equipment and furnish all equipment for proper operation. The elevator contractor shall be responsible for furnishing any electrical changes or upgrades required.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Perform as required by Code and as required by authorities having jurisdiction.

2. Provide labor, materials, equipment and connections.

3. All test results shall be documented and submitted for approval.

4. Repair or replace defective work as required.

5. Pay for restoring or replacing damaged work due to tests.

B. Final Inspection: When all work is completed, and tested to the satisfaction of the contractor, the contractor shall notify the Owner in writing that the elevator is ready for final inspection and acceptance test. A testing and inspection date shall be arranged. The proper operation of every part of the elevator system and compliance with contract requirements, including compliance with all applicable requirements of the Code, shall be demonstrated to the Owner. Furnish all test instruments, weights, and materials, required

at the time of final inspection. The following tests shall be made on each elevator at the time of final inspection:

1. Test Period: The elevator shall be subjected to a test for a period of one hour continuous run, with full specified load in the car. During the test run, the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor.

2. Speed Load Tests: The actual speed of the elevator car shall be determined in both directions of travel with full contract load and with no load in the elevator car. Speed shall be determined by a tachometer. The actual measured speed of elevator car with full load shall be within 5% of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined between the "UP" and the "DOWN" directions shall be checked.

3. Floor-to-floor times with no and full carload shall be checked.

4. Car Leveling Tests: Elevator car leveling devices shall be tested for accuracy of landing at all floors with no and with a full load in car, in both directions of travel. Accuracy of floor landing (plus or minus 1/8 in.) shall be determined both before and after the full-load run test.

5. Final Systems Tests for Smoke Detection/Elevator Recall, Emergency Power and Tenant Security Operation: After work is completed, conduct a final test of entire system.

6. Reinspection: If any equipment is found to be damaged or defective, or if the performance of the elevator does not conform with the requirements of the contract specifications or the Safety Code, no approval or acceptance of elevators shall be issued until all defects have been corrected. When the repairs and adjustments have been completed and the discrepancies corrected, the Owner shall be notified and the elevator will be reinspected. Rejected elevators shall not be used until they have been reinspected and approved.

3.03 ADJUSTING AND CLEANING

A. All equipment shall be adjusted prior to final testing and acceptance.

B. Paint exposed work soiled or damaged during installation. Repair to match adjoining work prior to final acceptance.

END OF SECTION

DIVISION 15

SECTION 15375

FIRE STANDPIPE SYSTEM PIPING AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements of piping and appurtenances for the fire standpipe systems.

B. Standpipe water service installed under this Section ends at the building line unless otherwise shown on the Basic Contract Drawing. The continuation of the standpipe water service is specified under Division 2 of the Specifications. Types of material and installation of the piping under this Section shall be compatible with types of material and installation specified under Division 2.

C. Trenching and backfilling required in conjunction with underground piping furnished under this Section shall be as specified in applicable Sections of Division 2 and shall be included as Work under this Section.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, as though the Authority were a private corporation, and with the latest industry standards including, but not limited to, the entities listed below:

New York City Building Code
New Jersey Uniform Construction Code
Municipal Water Company
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Water Works Association (AWWA)
Factory Mutual Engineering Corp. (FM)
National Fire Protection Association (NFPA)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. The fire standpipe system design shall be based on water supply information as shown on the Basic Contract Drawing or, if not shown, as determined by a water flow test by the Contractor.

1.03 QUALITY ASSURANCE

A. Fire standpipe system piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing Work shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 PIPE, FITTINGS, AND FLANGES

A. Provide pipe, fittings, and flanges in accordance with the "Pipe, Fittings and Flanges Schedule" specified below, including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of piping systems.

B. Nipples shall be extra-heavy shoulder-type of same material as pipe; close nipples are not acceptable.

C. Gaskets for flanges shall be 1/16-inch thick (after compression), rubber or neoprene, full-faced, and punched bolt holes.

D. Grooved Piping Mechanical Couplings

1. Couplings shall be complete with gaskets, bolts and nuts recommended by the manufacturer for the service. Use vandal proof nuts and bolts on vertical piping in stairs.

2. Couplings shall be Victaulic "Style 75" lightweight for system pressure not exceeding 400 psi (including shutoff pressure of fire pump and static street pressure of water main) and Victaulic "Style 77" for system pressure exceeding 400 psi, or approved equal. Flush-seal gaskets shall be used on all dry standpipe system piping.

3. Couplings shall be manufactured by Victaulic Co. of America; Tyler Pipe Subsidiary, Tyler Corp./Gustin-Bacon Division; Gruvlock Couplings by Grinnell; or approved equal.

Pipe, Fittings and Flanges Schedule

Systems	Pipe	Fittings and Flanges
Wet Standpipe	Black Steel, ATM A 795, A 53, or A 135, Schedule 40	A. Black Malleable Iron, ANSI B16.3 or Ductile Iron AWWA C110, 300 lb. Class, 500 psi w.w.p., Threaded B. Companion Flanges, Cast Iron, ANSI B16.1, 125 lb. Class C. Ductile Iron ASTM A 536, Grooved, Mechanical Type Couplings and Gaskets
Dry Standpipe, or piping subject to corrosion; Piping between Siamese connection and check Valve and Automatic Ball Drip Drain	Galvanized Steel, ASTM A 795 or A 53, Schedule 40	Same as for Wet Standpipe except all fittings and flanges shall be galvanized
Drain Piping	Galvanized Steel, ASTM or A 53, Schedule 40	Galvanized Cast Iron (Drainage), ANSI B16.12, 125 lb. Class, Threaded
Piping at Standpipe Water Meter Assembly	Galvanized Steel, ASTM or A 53, Schedule 40	Galvanized Cast Iron (Drainage), ANSI B16.1, 125 lb. Class, Flanged

2.02 VALVES

A. Control Valves

1. Valves

a. Valves shall be flanged, iron body, bronze mounted, OS&Y, solid wedge gate valves with rising stem and wheel handles, rated for 175 psi w.w.p., or as shown on the Basic Contract Drawing. Valves shall have gland followers in stuffing box and shall be repackable while open and under pressure. Provide valved bypass around valves six inches and larger.

b. Valves shall be manufactured by Crane Co., Walworth Co., Stockham Valves & Fittings, or approved equal.

2. Tamper Switches

a. Provide tamper switches in accordance with manufacturer's recommendations.

b. Tamper switches shall monitor the control valves to detect and indicate when a valve has been closed.

c. Unless otherwise shown on the Basic Contract Drawing, tamper switches shall be completely factory assembled and wired and shall be mounted on the control valve. The valve stem shall be prepared as required to accept the actuating roller rod. Switches shall be Potter Electric Signal Co. Model OSYS-U-1 or -2, or approved equal.

d. Wiring to control circuit shall be as specified in Division 16.

e. Tamper switches shall be manufactured by Potter Electric Signal Co., Fire Control Instruments Inc., or approved equal.

B. Drain Valves (Dry Systems)

1. Valves shall be threaded, bronze, angle or globe type with composition disc, 200 psi w.w.p, or as shown on the Basic Contract Drawing.

2. At system low points where drain piping does not extend to a drain receptacle, provide a threaded hose end adapter at the valve outlet.

3. For dry standpipe system to be filled with compressed air, provide drum-drip drains on all low points in the systems. Enclose drum-drips in cabinets as shown on the Basic Contract Drawing. Provide heating for drum-drip cabinets as shown on the Basic Contract Drawing. Provide the drum-drip drains in protected locations. Extend auxiliary drains from drum-drips to the drain shown on the Basic Contract Drawing.

4. The numbers and locations of drum-drips shown on the Basic Contract Drawing are minimum; actual installation requirements and quantities shall be determined by the Contractor based on approved shop drawings.

5. Valves shall be manufactured by Crane Co., Walworth Co., Stockham Valves & Fittings, or approved equal.

C. Check Valves

1. Check valves shall be swing type, flanged, iron body, bronze mounted with renewable composition disc, bronze seat ring, and bolted cover, rated for 175 psi w.w.p., or as shown on the Basic Contract Drawing.

2. Valves shall be manufactured by Crane Co., Walworth Co., Stockham Valve & Fittings, or approved equal.

D. Dry Standpipe System Automatic Valves

1. For dry fire standpipe system, activation shall occur through one of the applicable automatic valves specified below and as shown on the Basic Contract Drawing:

a. Deluge valve shall be electrically operated, release type with manual trip device complete with all drains, accessories, and controls. Deluge valve shall be operational from electrically operated, remote control stations located at each hose rack. All drains shall be connected and discharged into the drain receptor. Valve shall be Star Sprinkler "Model D", or approved equal. Controls, switches, panels, alarms, etc. shall be as specified in Division 16.

b. Dry-pipe valve shall be of the differential type, only. The dry-pipe valve shall be furnished with bronze clapper and latch and shall be Star Sprinkler "Model A", or approved equal.

c. Provide opening device on all systems. The device shall be of the exhauster pattern, designed and installed so as to provide for a full 2 inches air release from the system and designed to operate upon a 2 psi differential pressure within 7 seconds after fully opening the standard test connections. Exhauster shall be Star Sprinkler "Model BB", or approved equal.

2. Automatic valves shall be manufactured by Reliable Automatic Sprinkler Co. Inc., Star Sprinkler Corp., Viking Corp., or approved equal.

2.03 SIAMESE CONNECTIONS

A. Siamese connections shall be two-way type, having a brass body, with clapper valves, hose thread swivels and red painted plugs, as required by local code. Provide the siamese connections with breakable caps, unless indicated otherwise on the Basic Contract Drawing. Siamese connection escutcheon shall be lettered in accordance with code requirements. Threads shall conform to local fire department requirements.

B. Where automatic ball drip is shown on the Basic Contract Drawing to extend to the exterior at the siamese connection location, the siamese connection escutcheon shall be modified with a sillcock flange. In lieu of a sillcock flange, a drain elbow may be provided.

C. Flush type siamese connection shall be Potter-Roemer Series 5020, or approved equal. Size and location of outlet shall be as shown on the Basic Contract Drawing. Extra-heavy nipple extensions shall be installed to connect the yoke to the outside assembly.

D. Exposed type siamese connection shall be Potter-Roemer Series 5720 (back outlet) or 5730 (90° angle outlet) as shown on the Basic Contract Drawing, or approved equal. Size and location of outlet shall be as shown on the Basic Contract Drawing.

E. Finish of siamese connection assembly including escutcheon shall be polished brass unless otherwise shown on the Basic Contract Drawing.

F. Siamese connections shall be manufactured by Potter-Roemer Inc., Elkhart Brass Manufacturing Co. Inc., or approved equal.

2.04 FIRE LINE BACKFLOW PREVENTER

Provide a backflow preventer on the fire standpipe system water service. The installation shall be in accordance with the regulations of the local authorities. Backflow preventer shall be one or combination of the following devices and as specified on the Basic Contract Drawing:

A. Single detector check with bypass meter

B. Double detector check with bypass meter

C. Reduced pressure zone device

2.05 FIRE HOSE STATIONS

A. Fire standpipe equipment shall be manufactured by Potter-Roemer Inc., Elkhart Brass Manufacturing Co. Inc., or approved equal.

B. All the fire standpipe equipment numbers specified herein are those of Potter-Roemer Inc.

C. Hose Racks (2 ½-inch Valve with 1 ½-inch Hose)

At each hose station, exposed or in a hose cabinet, where shown on the Basic Contract Drawing, provide a Figure (Fig.) 4075, 2 ½-inch brass angle valve, complete with 2 ½-inch brass rack supporting hose nipple, a Fig. 2810, 2 ½-inch x 1 ½-inch reducer, with 1 ½-inch Fig. 2915, Polyflex synthetic fire hose (length of hose is shown on the Basic Contract Drawing, in 25- or 50-foot sections); Fig. 2930, satin cast brass expansion ring couplings attached; Fig. 2960 adjustable fog nozzles of molded polycarbonate/Lexan plastic; Fig. 2794, all steel, red enameled hose rack with non-detachable sliding pins and spring clip nozzle holder and trigger mechanism; and Fig. 6057, Universal Spanner with brass chain.

D. Hose Racks (2 ½-inch Valve with 2 ½-inch Hose)

At each hose station, exposed or in a hose cabinet, where shown on the Basic Contract Drawing, provide a Fig. 4075, 2 ½-inch brass angle valve, complete with 2 ½-inch brass rack supporting hose nipple, with 2 ½-inch Fig. 2916, Polyflex synthetic fire hose (length of hose is shown on the Basic Contract Drawing, in 25- or 50-foot sections); Fig. 2936, satin cast brass expansion ring couplings attached; Fig. 2961 adjustable fog nozzles of molded Polycarbonate/Lexan plastic; Fig. 2887, all steel, red enameled hose rack with non-detachable sliding pins and spring clip nozzle holder and trigger mechanism; and Fig. 6057, Universal Spanner with brass chain.

E. Hose Cabinets

Selection of hose cabinet shall be as shown on the Basic Contract Drawing and shall conform to the applicable description specified below:

1. Hose Cabinets (Recessed/Space for Extinguisher)

   Cabinet for hose station and extinguisher shall be Fig. 1300 Series for 1 ½-inch valve (Fig. 1400 Series for 2 ½-inch valve), recessed cabinet with 20-gauge steel body and 18-gauge trim, having 20-gauge door of style "AW" Full Panel wire glass. Cabinet shall be white enamel inside and prime coated outside.

2. Hose Cabinets (Surface-Mounted/Space for Extinguisher)

   Cabinet for hose station and extinguisher shall be Fig. 1350 Series for 1 ½-inch valve (Fig. 1450 Series for 2 ½-inch valve), surface-mounted cabinet with 20-gauge steel body and trim, having 20-gauge door of style "AW" Full Panel wire glass. Cabinet shall be white enamel inside and prime coated outside.

3. Hose Cabinets (Recessed/No Space for Extinguisher)

   Cabinet for hose station shall be Fig. 1000 Series for 1 ½-inch valve (Fig. 1100 Series for 2 ½-inch valve), recessed cabinet with 20-gauge steel body and 18-gauge trim having 20-gauge door of style "DW" Duo Panel wire glass. Cabinet shall be white enamel inside and prime coated outside.

4. Hose Cabinets (Surface-Mounted/No Space for Extinguisher)

Cabinet for hose station shall be Fig. 1050 Series for 1 ½-inch valve (Fig. 1150 Series for 2 ½-inch valve), surface-mounted cabinet with 20-gauge steel body and trim, having 20-gauge door of style "DW" Duo Panel wire glass. Cabinet shall be white enamel inside and prime coated outside.

5. Valve Cabinets (2 ½-inch Valve)

Hose valve cabinet for recessed or surface-mounted use shall be Fig. 1800 Series with 20-gauge steel body, 18-gauge trim having 20-gauge door of style "AW" Full Panel wire glass. Cabinets shall accommodate 2 ½-inch angle valve with cap and chain and shall be white enamel inside and prime coated outside.

F. Adjustable Pressure Restricting Devices

Where shown on the Basic Contract Drawing, provide Fig. 2765, 1 ½-inch, or Fig. 2766, 2 ½-inch, brass, suitable outlet pressure reducer where hydrostatic pressure exceeds 85 psi for 1 ½-inch hose and 55 psi for 2 ½-inch hose.

G. Fire Extinguisher Cabinets (All)

Fire extinguisher cabinet for recessed or surface-mounted use shall be Fig. 1700 Series with 22-gauge steel body, 18-gauge trim having tubular door of style "AW" Full Panel wire glass. Cabinet shall be of size to accommodate extinguisher type, as shown on the Basic Contract Drawing, and shall be white enamel inside and prime coated outside.

H. Roof Manifolds

Size and position of roof manifold shall be as shown on the Basic Contract Drawing and shall be Fig. 5890 Series vertical, or Fig. 5880 Series horizontal, complete with three Fig. 4065, 2 ½-inch brass valves with Fig. 4625 brass caps and chains.

2.06 ACCESSORIES

A. Automatic Ball Drips

For each siamese connection and wherever shown on the Basic Contract Drawing, provide a Potter-Roemer Model 5982 automatic ball drip, or approved equal. Provide pipe discharge to exterior or a drain receptacle. Where static pressure at location requiring drainage exceeds the ball drip operating characteristics, a valved drain shall be used.

B. Pressure Gauges

Gauges shall have aluminum case, 4 ½-inch diameter aluminum ring-bronze bourdon tube, stainless steel linkage, ½-inch bottom connection, black pointer, white face with black figures and segment range of 0-200 psi, 20 psi figure intervals, 2 psi intermediate graduations. Dial shall have red marker at 175 psi. Gauges shall be Dresser Industries Inc. "Ashcroft Series 1379", or approved equal.

C. Pipe and Valve Identification

1. Adhesive Bands

a. Provide approved adhesive bands in sets of two, one identifying the piping system type and the second, the direction of flow. Sets shall be provided in quantities sufficient to accommodate the requirements of 3.04 A of this Section.

b. For 3-inch or larger pipe, the adhesive band identifying the piping system shall display the name of the service in white letters at least two inches high and the band indicating direction of flow shall display a white arrow of similar size. For 2 ½-inch or smaller pipe, the letters and the arrow shall be white and shall be not less than one inch high. Bands shall have red backgrounds and shall conform to ANSI A 13.1.

c. Adhesive bands shall be W. H. Brady Co. "Quik-Label", or approved equal.

2. Valve Tags, Charts and Schedules

a. Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be ¼-inch high and valve number shall be ½-inch high, on two lines with service designation on the upper line and valve number on the lower line. The characters shall be indented and filled with durable black compound.

b. Provide diagrammatic valve charts and schedules, using a valve numbering system which differentiates between classes of service and indicates floor level of valve location.

c. Tags shall conform to the numbers, locations and uses listed in the valve charts and schedules.

d. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

e. Tags and the frames for valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

3. Identification Signs

a. Provide identification signs for control valves. Identification signs shall be Reliable Style A and B, or approved equal.

b. On the outside of doors to rooms where control valves are located, provide suitable signs making note of such valve locations.

D. Access Ladders

Control valves located seven feet or more above the finished floor shall be provided with a permanent steel access ladder. Ladder construction shall be approved by the Engineer.

E. Access Doors

Provide a complete list of all access doors (including locations) that are required in finished walls, ceilings, partitions, and any other areas for access to all valves and drains concealed behind such finished construction. Access doors shall be furnished and installed under appropriate Access Door Sections of Division 8.

2.07 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Provide hangers and supports, with beam clamps, restraints, supplemental steel, inserts, fish plates, mounting devices, and similar items to support piping in alignment without sagging or interference, and to permit complete drainage and free expansion and contraction.

C. All hangers and supports shall be capable of screw adjustment after piping is erected and shall be provided with a locking nut (double nut) to prevent loss of adjustment.

D. Where required, provide anchors, sway bracing, blocking and steel to connect to structure to prevent excessive pipe movement that could cause damage due to expansion, contraction, or thrust.

E. All pipe hangers, inserts, supports, supplemental steel, rods, and components shall be galvanized.

F. Support hangers from building steel framing wherever possible. Provide any additional miscellaneous steel supports between existing framing members as required. Do not support piping from other piping, ductwork and conduit.

G. Tabs in metal deck construction shall not be used to support piping.

H. Where required, provide supplemental channels and steel to support Work of this Section. Cut ends of steel shall be ground smooth, free from burrs and sprayed with a galvanized coating.

I. Where several pipes rest on a common trapeze, increase hanger rod diameter and decrease spacing in accordance with maximum and minimum pipe sizes, respectively.

J. Expansion anchors, self-drilling expansion shields, power driven studs and similar devices shall not be used, unless specifically approved by the Engineer.

K. Provide pipe restraints to prevent movement by an upward thrust in the pipe risers.

L. Support vertical piping at the lowest level, at each alternate level above and below offsets, and at the top of the riser by use of riser clamps. Provide additional intermediate support brackets, secured to structure, on piping utilizing gasket coupling joints.

M. Support horizontal piping as follows:

1. For piping sizes of 3 to 8 inches, support on clevis type hangers.
2. For piping 10 inches and larger, support on trapeze hangers constructed of channel iron and hung from rod and insert assembly. Load calculations shall be performed.

N. Hanger system shall not penetrate waterproofing.

O. If removal of existing fireproofing is required for installation purposes, such removal shall be performed by the Contractor and shall be kept to a minimum. The Contractor shall replace all removed fireproofing with new fireproofing to the satisfaction of the Engineer and at no additional cost to the Authority.

P. Unless otherwise specifically approved, hanger rod size and spacing shall be within the following limits:

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
2-1/2" to 3-1/2"	12 ft. o.c.	1/2"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8"	12 ft. o.c.	7/8"
10" and 12"	12 ft. o.c.	7/8"

Q. Provide thrust restraint on underground piping entering the building through the floor or wall to serve the fire standpipe systems.

R. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hanger Co. Inc., or approved equal.

2.08 SLEEVES, SEALS AND ESCUTCHEONS

A. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the outside diameter of the pipe. Sleeve shall be flush with the finished wall or partition surface.

B. Sleeves through concrete floors for piping shall have the opening 1/2 inch in diameter larger than the outside diameter of the pipe passing through. Floor sleeves shall project one inch above floor slab.

C. Pipe insulation shall be omitted at penetrations through fire-rated barriers. In all cases, pack the annular space between the pipe and sleeve with mineral wool. Additionally at penetrations through fire-rated barriers, seal the annular space to retain the fire rating integrity of the barrier with non-hardening through-penetration firestops having F-ratings compatible with fire ratings of the barriers in which they are installed, per ASTM, E814. Firestop systems shall be UL-approved, and shall be as manufactured by 3M, Bio-fireshield, Inc., General Electric co., Dow Corning Corp., or approved equal.

D. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for 12 inches and larger. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

E. Piping in exposed areas, passing through walls, floors or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

F. Piping passing through floor waterproofing membrane shall be provided with a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches above the floor. The annular space between the flashing and the pipe shall be sealed watertight.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Install piping and appurtenances in accordance with manufacturers' installation procedures, requirements of NFPA 14, and as specified.

2. Coordinate piping installation with other Work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry to avoid necessity of cutting finished structure.

3. All measurements, both horizontal and vertical, shall be based on established benchmarks. All Work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the Work.

4. Perform necessary cutting and patching in accordance with requirements specified in the Section of Division 2 entitled "CUTTING, PATCHING AND REMOVAL". All openings in existing slabs required for pipe penetrations shall be core drilled.

5. Electrical installation of appurtenances furnished under this Section shall be in accordance with requirements specified under Division 16.

6. Installation requirements for pipe hangers and supports and pipe penetration sleeves, seals, and escutcheons are specified in 2.07 and 2.08, respectively.

B. Piping

1. Install piping as shown on the Basic Contract Drawing and straight and direct as possible, forming right angles or parallel lines with building walls, neatly spaced, with risers plumb and true.

2. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing pipe, thoroughly clean the inside free of cutting and foreign matter. Cut all piping square and smooth and make up all joints to required limits.

3. Make changes in pipe size by the use of reducing fittings. Do not use reducing bushings except by approval of the Engineer.

4. Install piping so that no part thereof will interfere with doors, windows, heating, plumbing or electrical equipment. Coordinate Work specified in this Section with that specified in other Sections to avoid any interference with potential effectiveness of the fire standpipe systems.

5. Provide protective pans under pipes passing over high voltage electric bus duct or switchgear equipment. Construct the pans of 18-gauge copper, suitably reinforced to prevent sagging. Turn the edges of the pans up to 6 inches on all sides with corners brazed to make the pans watertight. Support the pan with hangers and provide drainage clear of the electrical work.

6. Dry systems shall be installed so that the system can be drained.

7. All piping shall be thoroughly blown out, rodded out, or washed out at least twice, in a manner as directed and approved by the Engineer, to remove all accumulation of dirt, chips or other deleterious materials. Make all temporary connections and furnish all appliances required for the purpose of cleaning.

C. Pipe Joints

1. Threaded joints shall be made up tight using pipe joint Teflon compound or tape, applied on the male threads only.

2. Grooved pipe and fittings shall be clean and free from indentations, projections and tool marks in the area from pipe end to groove for proper gasket sealing. Provide a thin uniform coat of lubricant on the suitable gasket intended for specified service as recommended by the manufacturer. Place the gasket over one pipe end, align pipe ends and bring together, positioning the gasket between the groove on each pipe end. Assemble the housing over the gasket with housing key section engaging both grooves. The bolts shall be inserted, nuts started and uniformly tightened until the housing bolt pads are firmly seated together, metal to metal.

3. Flanged joints shall be made up square and tight with gaskets. Dip bolts and nuts in mixture of graphite and oil immediately prior to installation.

4. Joints between copper or brass and steel pipe shall be made by using a dielectric coupling.

3.02 FIELD TESTS

A. Notify the Engineer and those authorities having jurisdiction, at least 48 hours in advance of making the required tests, so that arrangements may be made for their presence to witness the tests.

B. Perform all tests prior to painting or concealing.

C. Isolate all equipment, controls and instruments from the piping system during the required tests.

D. Provide and install necessary equipment, instruments, hardware, temporary piping, vents, drains, and include necessary personnel required to perform all tests.

E. Perform hydrostatic tests for all sections of the piping systems (except siamese connections), at not less than 200 psi pressure for two hours, or at 50 psi in excess of the maximum pressure, when the maximum pressure to be maintained in the system is in excess of 150 psi. Test pressure for siamese connections shall not be less than 300 psi. The test pressure shall be read from a gauge located at the low elevation point of the individual system or portion of the system being tested.

F. Test dry-pipe systems with air at 40 psi for 24 hours, prior to performing the hydrostatic tests specified in3.02 E above. Permissible air leakage shall not exceed the value specified in NFPA 14.

G. Set the adjustable pressure reducing devices according to the manufacturer's instructions to produce flows at the required rate and pressure in accordance with the applicable code requirements, as if this Contract were being performed for a private corporation. A written record shall be furnished to the Engineer of all settings throughout the system.

H. With the entire system under normal operating pressure, each control valve shall be opened and closed to demonstrate proper operation.

I. All tests shall conform to the requirements of NFPA 14. Records of all tests shall be made available for the Engineer's inspection, as required.

J. Should the tests reveal any leaks or deficiencies in piping installed under this Section, make necessary corrections immediately and flush, clean and retest the system for the Engineer's approval at no cost to the Authority.

K. Repair or replace any portion of the system installed under this Section that is damaged as a result of test operations at no cost to the Authority.

L. Where piping installed under this Section is connected to any existing system, such installed piping shall be isolated from the existing system during the performance of the required field tests, unless otherwise directed by the Engineer.

M. The Engineer reserves the right to direct the Contractor not to isolate the newly-installed piping from the existing system during the performance of the required field tests. In such event, the Contractor shall correct any revealed leaks or other deficiencies within the first 20 feet of the existing system, measured in any direction from the point of connection with the newly installed piping, all as directed by the Engineer and at no additional cost to the Authority.

N. Dispose of water removed from pipelines in a manner that shall not cause damage to any property.

3.03 PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Basic Contract Drawing. Painting shall be in accordance with the requirements of the Division 9 Section entitled "PAINTING".

3.04 PIPE AND VALVE IDENTIFICATION

A. Pipe Identification

Affix sets of pipe adhesive bands specified in 2.06 C.1 where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system.

At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed and the identity of the piping system cannot be readily ascertained.

B. Valve Tags

Securely fasten valve tags specified in 2.06 C.2 with approved brass chain.

END OF SECTION

SECTION 15375

FIRE STANDPIPE SYSTEM PIPING AND APPURTENANCES

APPENDIX A

SUBMITTAL REQUIREMENTS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

1. Detailed piping layout drawing, including hanger and support locations and details, with load calculations where required.
2. Electrical wiring diagrams.
3. Catalog cuts, including product data for the following:
   a. Hose stations
   b. Fittings and flanges
   c. Valves
   d. Tamper switches
   e. Hangers and supports
   f. Sleeves and escutcheons
   g. Valve tags and pipe identification bands
   h. Pressure gauges
   i. Siamese and other fire department connections
   j. Adjustable pressure restricting devices
   k. Other specialty items specified in this Section
4. Piping material and schedule for each piping system
5. Valve charts and schedules
6. Access ladder drawings
7. List of access doors, including their locations

B. Submit operation and maintenance manuals, including replacement and spare parts lists for fire standpipe systems

C. Submit field test results, and include in operation and maintenance manual

END OF APPENDIX "A"

DIVISION 15

SECTION 15410

PLUMBING PIPING AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for domestic water service piping, storm and sanitary sewer piping, and appurtenances.

B. Domestic water service and storm and sanitary sewers installed under this Section end at the building line unless otherwise shown on the Basic Contract Drawing. The continuation of the domestic water service and storm and sanitary sewers is specified under Division 2 of the Specifications. Types of material and installation of the piping under this Section shall be compatible with types of material and installation specified under Division 2.

C. Trenching and backfilling required in conjunction with underground piping furnished under this Section shall be as specified in applicable Sections of Division 2 and shall be included as Work under this Section.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

New York City Building Code

New Jersey Uniform Construction Code

Municipal Water Company

American National Standards Institute (ANSI)

American Society for Testing and Materials (ASTM)

American Society of Mechanical Engineers (ASME)

Cast Iron Soil Pipe Institute (CISPI)

American Water Works Association (AWWA)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.03 QUALITY ASSURANCE

A. Plumbing piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities performing the Work of this section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

B. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

C. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.05 SUBMITTALS

Refer to Appendix A.

PART 2. PRODUCTS

2.01 PIPE, FITTINGS, AND FLANGES

A. Unless otherwise shown on the Basic Contract Drawing, provide pipe (and tube), fittings, and flanges in accordance with the "Pipe, Fittings, and Flanges Schedule" specified below, including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of piping systems.

B. Nipples shall be extra-heavy shoulder type. No close nipples shall be used. All nipples shall have designation mark of the manufacturer and shall conform to ASTM pipe specifications for system served.

C. Gaskets for flanges shall be 1/16-inch thick (after compression) rubber or neoprene, full-faced, and punched bolt holes.

D. Unions shall be malleable iron, threaded, conforming to ANSI B16.39.

Pipe, Fittings and Flanges Schedule

Systems	Pipe	Fitting and Flanges
Storm & Sanitary Drainage & Vent (underground)	Cast Iron, ASTM A 74, Service Weight Hub & Spigot Type	Cast Iron, ASTM A 74, Service Weight Hub & Spigot Type; caulked or compression type joints
Storm & Sanitary Drainage & Vent (above ground and underground)	Cast Iron, CISPI-301, ASTM A888, Service Weight Hubless Type	Cast Iron, CISPI-301, ASTM A888, Service Weight, Hubless Type
Storm & Sanitary Pump Discharge	Galvanized Steel, ASTM A 53, Schedule 40	Galvanized Malleable Iron, ANSI B16.3, 150 lb. Class, Threaded
Sanitary Indirect Drainage	Galvanized Steel, ASTM A 53, Schedule 40	Galvanized Cast Iron (Drainage), ANSI B16.12, 125 lb. Class, Threaded
Domestic Water	Copper Tubing, ASTM B 88, Type L, Drawn, Nominal Wall	Cast Bronze, ANSI B16.18, Same Wall as Tube, Solder Joints
Domestic Water at Meter Assembly (3 inches and larger)	Galvanized Steel, ASTM A 53, Schedule 40	Galvanized Cast Iron, ANSI B16.1, 125 lb. Class, Flanged (Companion)

2.02 VALVES

A. General

1. Provide types of valves as and where shown on the Basic Contract Drawing.
2. All gate and globe valves shall be the products of one manufacturer.
3. Valves shall be of one of the following manufacturers, or approved equal:
   a. Stockham Valves and Fittings
   b. Crane Co.
   c. Walworth Co.
   d. NIBCO Inc.

B. Gate Valves

1. For piping 2 inches and smaller: Class 125, bronze body, screw-in bonnet, rising stem, solid wedge, approved equal of Stockham fig. B-122 (threaded ends), or Fig B-109 (soldered ends).
2. For piping 2 1/2 inches and 3 inches
   a. Class 125, iron body, bolted bonnet, rising stem, solid wedge, bronze mounted, flanged ends, similar to Stockham Fig. G-623, or approved equal.
   b. Class 150, bronze body, screw-in bonnet, rising stem, solid wedge, threaded ends, similar to Stockham Fig. B-122, or approved equal.

3. For piping 4 inches and larger: Class 125, iron body, bolted bonnet, solid wedge, bronze mounted, OS&Y, flanged ends, similar to Stockham Fig. G-623, or approved equal.

C. Globe Valves

Class 150, bronze body, screw-in bonnet, rising stem, integral seat, renewable disc, approved equal of Stockham Fig. B-22 (threaded ends), or Fig. B-24 (soldered ends).

D. Drain Valves

Class 125, gate valve, bronze body, screw-in bonnet, non-rising stem, solid wedge, threaded ends on inlet side of valve and hose end thread with cap and chain on the outlet side, similar to NIBCO Fig. T-113-HC, or approved equal.

E. Check Valves

1. For pipe 2 inches and smaller: Class 125, bronze body, horizontal swing, renewable disc, approved equal of Stockham Fig. B-321 (threaded ends), or Fig. B-319 (soldered ends).

2. For piping 2 1/2 inches and larger: Class 125, iron body, bronze mounted, bolted bonnet, horizontal swing, renewable seat, flanged ends, similar to Stockham Fig. G-931, or approved equal.

3. Ball Valves

For piping 1 inch and smaller: Class 150, bronze body, full port, bronze trim, approved equal of Stockham Fig. S-216 BRRT (threaded ends) or Fig. S-216 BRRS (soldered ends).

2.03 ACCESSORIES

A. Pipe and Valve Identification

1. Adhesive Bands

a. Provide approved adhesive bands in sets of two, one identifying the piping system type and the second, the direction of flow. Sets shall be provided in quantities sufficient to accommodate the requirements of 3.04 A of this Section.

b. For 3-inch or larger pipe, the adhesive band identifying the piping system shall display the name of the service in letters at least two inches high and the band indicating direction of flow shall display an arrow of similar size. For 2 1/2-inch or smaller pipe, the letters and the arrow shall be not less than one inch high. Bands shall be in colors and shall conform to ANSI A13.1.

c. Adhesive bands shall be W.H. Brady Co. "Quik-Label", or approved equal.

2. Valve Tags, Charts and Schedules

a. Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be 1/4-inch high and valve number shall be 1/2-inch high, on two lines with service designation on the upper line, and valve number on the lower line. The characters shall be indented and filled with durable black compound.

b. Provide diagrammatic valve charts and schedules, using a valve numbering system that differentiates between classes of service and indicates floor level of valve location.

c. Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules.

d. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

e. Tags and the frames for valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

B. Access Doors

Provide a complete list of all access doors required in finished walls, ceilings, partitions and any other areas for access to all valves concealed behind such finished construction. Access doors will be furnished and installed under other Sections.

2.04 PIPE HANGERS AND SUPPORTS

A. Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

B. Hangers and supports shall include guides, anchors, stops, restraints, welded attachments, insulation shields, saddle strands, stays, braces, bolts, nuts, washers, expansion bolts, pipe clamps, beam clamps, and supplementary structural steel for pipe hangers and supports.

C. Keep the different types of hangers to a minimum. Provide clevis type hangers for sizes 3 inches and above.

D. Suspend hangers from beam clamps, brackets, fish plates, inserts or other approved means. Furnish and install any additional miscellaneous steel supports between building framing members as may be required. The installation of "C" clamps on beams must include retaining straps to prevent separation of beam and clamp.

E. Copper plate all hangers that will be in direct contact with brass or copper tubing.

F. Support vertical piping with steel riser clamps. Additional intermediate support brackets, secured to the structure, shall be installed on piping utilizing gasket or coupling joints in accordance with the manufacturer's recommendations.

G. Trapeze type hangers of steel construction, with hold-down U-bolts, may be used for two or more pipes which have a uniform slope throughout.

H. Base hanger loads on weight of pipe supported, weight of insulation covering and weight of fluid being transported.

I. When loads between supports can be expected to cause a sag in the pipe in excess of 1/4 inch, reduce spacing as necessary to stay within such a limit.

J. Provide and install on all supporting rods, a forged steel turnbuckle with top and bottom lockouts having a vertical adjustment of 6 inches, minimum.

K. All pipe hangers, rods, supports, insulation shields, clamps, and other associated components shall be galvanized.

L. Do not hang piping from other piping and ductwork, except for small water branches in pipe enclosures behind toilet rooms or as approved by the Engineer.

M. Vertical pipes shall be supported on every floor and at intervals between floors so that no more than 10'-0" of pipe is unsupported.

N. Provide protection shields for all insulated piping at all points of support. Shields shall be 12 inches long, galvanized steel plate with a radius suitable for the required applications, including insulation.

O. Tabs in metal deck construction shall not be used to support pipe or equipment.

P. Provide pipe anchors where necessary to restrain forces due to thermal expansion and contraction of pipe.

Q. Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

R. Provide pipe guides where necessary to confine movement along the centerline of the pipe due to thermal expansion and contraction between anchors. Guides shall be adequately designed and placed, generally between 20 to 30 feet on centers and an equal distance from the expansion loop.

S. Expansion anchors, self-drilling expansion shields, power driven studs and similar devices shall not be used, unless specifically approved by the Engineer.

T. Unless otherwise specifically approved, hanger rod size and spacing shall be within the following limits:

1. Steel Pipe

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	8 ft. o.c.	3/8"
1 1/4" to 2"	10 ft. o.c.	3/8"
2 1/2" to 3 1/2"	12 ft. o.c.	1/2"
4" and 5"	12 ft. o.c.	5/8"
6"	12 ft. o.c.	3/4"
8"	12 ft. o.c.	7/8"
10" and 12"	12 ft. o.c.	7/8"

2. Copper Tube

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1 1/4"	6 ft. o.c.	3/8"
1 1/2" and 2"	8 ft. o.c.	3/8"
2 1/2" to 3 1/2"	10 ft. o.c.	5/8"

3. Cast Iron Soil Pipe (No-Hub)

Supports for horizontal or vertical no-hub pipe shall be on each side of every stainless steel coupling except for spaces behind toilet rooms or where many fittings are installed at one location. At these points, support every 5'-0" o.c. and on as many fittings as necessary so that no more than one fitting shall be without a hanger in any 5'-0" space. Rod size shall be the same as for steel pipe above for corresponding pipe size.

4. Cast Iron Soil Pipe (Hub and Spigot)

a. Support vertical piping at base and at each story height but in no case at intervals greater than 20 feet.

b. Support horizontal piping at 5-foot intervals and behind every hub except for spaces behind toilet rooms or where many fittings are installed at one location. At these points, support every 5'-0" o.c. and on as many fittings as necessary so that no more than one fitting shall be without a hanger in any 5'-0" space. Rod size shall be the same as for steel pipe above for corresponding pipe size.

5. Base of Cast Iron Stacks

Bases of cast iron stacks shall be supported on concrete, on brick laid in cement mortar, by metal bracket attached to the building construction, or by equivalent methods. All stacks shall be anchored so as to relieve the load from the base of the stack.

U. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hanger Co. Inc., or approved equal.

2.05 SLEEVES, SEALS, AND ESCUTCHEONS

A. Pipe Penetration through Walls, Partitions and Floors

1. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the diameter of the insulated pipe. Sleeve shall be flush with the finished wall or partition surface.

2. Sleeves through concrete floors for piping shall have the opening 1/2 inch in diameter larger than the diameter of the insulated pipe passing through. Floor sleeves shall project one inch above floor slab.

3. Pipe insulation shall be omitted at penetrations through fire-rated barriers. In all cases pack the annular space between the pipe (whether insulated or uninsulated) and sleeve with mineral wool. Additionally, at penetrations through fire-rated barriers seal the annular space to retain the fire integrity of the fire-rated barrier with nonhardening through-penetration firestops having F-ratings, compatible with the fire ratings of the barriers in which they are installed, per ASTM E814. Firestop systems shall be UL-approved, and shall be as manufactured by 3M, Bio Fireshield, Inc., General Electric Company, Dow Corning Corporation, or approved equal.

4. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for 12 inches and larger. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

5. Piping in exposed areas, passing through walls, floors or ceilings shall be fitted with chromium-plated cast brass escutcheons with fastening set screws.

6. Piping passing through floor waterproofing membrane shall be provided with a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches above the floor. The annular space between the flashing and the pipe shall be sealed watertight.

7. Piping passing through roof construction shall be provided with counterflashing, consisting of steel rainhood secured all around the pipe and overlapping the flashing.

B. Pipe Penetration through Exterior Foundation and Pit Walls

1. General

a. All penetrations for piping through perimeter foundation walls and subgrade pit walls shall be provided with the pipe sleeves and seals as shown on the Basic Contract Drawing.

b. Sleeves shall be Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for sizes 12 inches and larger. All pipe sleeves shall be galvanized steel, set into foundation walls with anchors and water stop plates.

2. Lead-Oakum Seals

Where "Lead-Oakum" seal is shown on the Basic Contract Drawing, the annular space between the pipe and the sleeve shall be made watertight by caulking with oakum and poured lead, edged and trimmed.

3. Interlocking Modular Seals (Link-Seal)

a. Where "Link Seal" is shown on the Basic Contract Drawing, seal shall be modular mechanical type, consisting of interlocking sealing element links shaped to continuously fill the annular space between the pipe and the sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the sealing elements to expand and provide a watertight seal between the pipe and the sleeved opening. The seal shall provide electrical insulation between the pipe and wall.

b. The inside diameter of each wall sleeve shall be sized as recommended by the manufacturer to fit the pipe, seal, and any coating or insulation to ensure a watertight joint.

c. Install sleeves and seals in accordance with the seal manufacturer's instructions to provide a watertight installation.

d. Seals for perimeter foundation wall penetrations shall be two individual sealing units in tandem unless otherwise shown on the Basic Contract Drawing. Single sealing unit shall be used for pit wall penetration unless otherwise shown on the Basic Contract Drawing.

e. Seals shall be Thunderline Corp. "Link-Seal", or approved equal.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. Install piping and appurtenances in accordance with manufacturers' installation procedures, applicable codes and standards, and as specified.

2. Coordinate piping installation with other Work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry to avoid necessity of cutting finished structure.

3. All measurements, both horizontal and vertical, shall be based on established benchmarks. All Work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the Work.

4. Perform necessary cutting and patching in accordance with requirements specified in the Section of Division 2 entitled "CUTTING, PATCHING AND REMOVAL". All openings in existing slabs required for pipe penetrations shall be core drilled.

5. Installation requirements for pipe hangers and supports and pipe penetration sleeves, seals, and escutcheons are specified in 2.04 and 2.05, respectively.

B. Piping

1. Install piping as shown on the Basic Contract Drawing and straight and direct as possible, forming right angles or parallel lines with building walls, neatly spaced, with risers plumb and true.

2. Piping shall pitch back toward system drain valve and any installed low points or pockets shall have a hose end drain valve.

3. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing pipe, thoroughly clean the inside, free of cuttings and foreign matter. Cut all piping square and smooth and make up all joints to required limits.

4. Erect all piping to obtain sufficient flexibility to prevent excessive stresses in materials and excessive bending moments at joints or connections.

5. Make changes in pipe size by the use of reducing fittings. Do not use reducing bushings except by approval of the Engineer. Do not use close or shoulder nipples.

6. Arrange water piping so that system can be completely drained. Where lines are purposely pitched for drainage, a uniform grade shall be maintained. Lines shall be so supported as to prevent pocketing of water. No lines shall have pockets due to changes in elevation unless proper provisions for draining are made.

7. Installed piping shall not interfere with the operation or accessibility of doors and windows; shall not encroach on aisles, passageways and equipment; and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.

C. Pipe Joints

1. Threaded Joints

   Make up threaded joints tight using pipe joint Teflon compound or tape, applied on the male thread only.

2. Flanged Joints

   Make up flanged joints square and tight with gaskets. Dip bolts and nuts in mixture of graphite and oil immediately prior to installation.

3. Soldered Joints

   a. Cut ends of tubing square and remove all burrs. Clean inside and outside of tubing with steel wool.

   b. Make joints with non-corrosive paste flux and 95 per cent tin and 5 per cent antimony solder. Cored or lead-containing solder is not permitted.

   c. Remove excess solder while still in plastic state.

   d. Leave a fillet at the wall of the fitting.

   e. Prior to silver soldering, remove the internal parts of all valves or other devices to be installed directly in line.

4. Caulked Joints

   For cast iron pipe with hub, pack hub firmly with hemp or picked oakum and fill with molten lead, using a minimum of twelve ounces of lead for each inch of pipe size per joint and to a one-inch minimum depth. After the lead has cooled, the joints shall be thoroughly caulked, using approved caulking irons, faced smooth and made tight without the use of putty, paint or cement.

5. Compression Joints

   Make compression joint with ASTM C564 neoprene rubber gaskets and lubricant. Gaskets shall match class of pipe and fittings. Make joints in accordance with recommendations of CISPI.

6. Cast Iron No-Hub Joints

No-hub cast iron pipe joint shall be of a coupling type. Each joint shall consist of 2 spigot ends of pipe or fitting, and a sealing sleeve assembly, consisting of a stainless steel shield over a neoprene gasket, held together by stainless steel clamps. The gasket shall be slid over the ends of the two pipes to be joined, then the shield and clamps shall be placed over the gasket. The entire coupling shall be held firmly together by the clamps, by alternately turning the screws to 100-115 in.-lb. torque. Couplings shall be "Clamp-All" type manufactured by Clamp-All Corp., or Husky SD Series 4000 type manufactured by Anaheim foundry Company, or approved equal.

3.02 FIELD TESTS

A. General

1. Perform tests as herein specified on the various piping systems or portions thereof prior to backfilling, painting, concealing or insulating.
2. Notify the Engineer and those authorities having jurisdiction, at least 48 hours in advance of making the required tests, so that arrangements may be made for their presence to witness the tests.
3. Provide and install all equipment and devices required in connection with tests. Provide all necessary materials, supplies, labor and power for the tests.
4. Should the tests reveal any leaks or deficiencies in piping installed under this Section, make the necessary repairs immediately, or, if required by the Engineer, replace defective work with new work without additional cost to the Authority. Repeat tests as directed until the entire installation is proven satisfactory. No temporary method of repairing leaks will be permitted.
5. Where piping installed under this Section is connected to any existing system, such installed piping shall be isolated from the existing system during the performance of the required field tests, unless otherwise directed by the Engineer.
6. The Engineer reserves the right to direct the Contractor not to isolate the newly-installed piping from the existing system during the performance of the required field tests. In such event, the Contractor shall correct any revealed leaks or other deficiencies within the first 20 feet of the existing system, measured in any direction from the point of connection with the newly installed piping, all as directed by the Engineer and at no additional cost to the Authority.
7. Dispose of water removed from pipelines in a manner that will not cause damage to any property.
8. Provide and install the required air vents in the piping system tested.
9. All equipment, including water coolers, and all controls and instruments shall be isolated from the piping system during test, as well as during cleaning, disinfecting and flushing procedures.

B. Hydrostatic Tests

1. Storm and Sanitary Drainage and Vent

a. Tightly close all openings in the entire system and fill it with water to the point of overflow above the roof. The water level shall be maintained for one hour.

b. When piping is tested in sections, test piping with a pressure equivalent to a 10-foot water head. The water level shall be maintained for one hour.

c. For piping added, relocated or replaced on existing systems, install a test tee at the lowest elevation of each added, relocated or replaced piece of pipe and fill it with water to overflow level of next highest fixture outlet or drain. The water level shall be maintained for one hour.

2. Domestic Water

a. Cap or plug all outlets, apply a hydrostatic pressure of 125 psi and sustain such pressure for one hour.

b. For piping added, relocated or replaced on existing systems, apply a hydrostatic pressure of 50 psi above the existing system pressure for one hour.

C. Cleaning and Disinfecting

The potable water system shall be disinfected prior to use by a method of disinfection in accordance with the applicable code.

3.03 PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Basic Contract Drawing. Painting shall be in accordance with the requirements of Division 9, Section entitled "PAINTING".

3.04 PIPE AND VALVE IDENTIFICATION

A. Pipe Identification

Affix sets of pipe adhesive bands specified in 2.03 A.1 where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system. At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed and the identity of the piping system cannot be readily ascertained. A set of such bands shall be affixed at each branch and riser takeoff; adjacent to each valve; at each pipe passage through floor and ceiling construction; at each capped line; and at each pipe passage to an underground area.

B. Valve Tags

Securely fasten valve tags specified in 2.03 A.2 with approved brass chain.

END OF SECTION

SECTION 15410

PLUMBING PIPING AND APPURTENANCES

APPENDIX A

SUBMITTAL REQUIREMENTS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

1. Detailed piping layout drawings, including hanger and support locations and details.
2. Catalog cuts, including product data, for the following:
   a. Fittings and flanges
   b. Valves
   c. Hangers and supports
   d. Sleeves and escutcheons
   e. Valve tags and piping identification bands
3. Pipe material and schedule for each piping system
4. Valve charts and schedules
5. List of access doors
6. Hanger and support schedule showing manufacturer's figure No., size, location and features of each required hanger and support.

B. Submit operation and maintenance manuals, including replacement and spare parts lists, for each type of valve.

C. Submit field hydrostatic test results.

END OF APPENDIX "A"

DIVISION 15

SECTION 15453

SUBMERSIBLE SEWAGE EJECTORS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for submersible sewage ejectors.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American Society for Testing and Materials (ASTM)
American Society of Mechanical Engineers (ASME)
Hydraulic Institute (HI)
National Electrical Manufacturers Association (NEMA)
National Electrical Code (NEC)
Sump and Sewage Pump Manufacturers Association (SSPMA)
Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Design and performance requirements of submersible sewage ejectors shall be as specified in the Schedules shown on the Basic Contract Drawing.

1.03 QUALITY ASSURANCE

Submersible sewage ejectors, of sizes and capacities required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver ejectors and components in factory-fabricated protective packaging.

B. Handle ejectors and components carefully to prevent breaking, denting and scoring.

C. Store ejectors and components in clean, dry spaces and protect them from weather.

D. Comply with manufacturer's rigging instructions for unloading ejectors and moving them to final location for installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, provide submersible sewage ejectors of one of the following manufacturers, or approved equal:

Weil Pump Co.
Flygt Corp.
General Signal Corp./Aurora Pump
Federal Pump Corp.
Paco Pumps

2.02 MATERIALS

Materials for submersible sewage ejectors shall be as specified below.

Casing:	Cast iron
Impellers:	Cast iron (high strength) or bronze
Shaft:	Stainless steel
Motor Cover (shell):	Cast iron
Slide Rail Guide Bars:	Galvanized steel

2.03 CONSTRUCTION FEATURES

A. Ejectors

1. Ejectors shall be of sizes, arrangements (simplex or duplex), and capacities specified in the Schedules and as shown on the Basic Contract Drawing.
2. Impellers shall be dynamically balanced, and shall be, non-clog type, capable of passing a minimum of 2 1/2-inch diameter solids.
3. Provide tandem mechanical shaft seals, with permanent oil lubrication by means of sealed oil-reservoir.

B. Motors

1. Provide each ejector with submersible motor having electrical characteristics specified in the Schedules shown on the Basic Contract Drawing. Motor shall be close-coupled to the ejector.
2. The motor shall be suitable for continuous duty and shall have built-in thermal overload protection.
3. Motor shall be of an air filled design. Oil filled motor shells will not be considered equal. Motor shall be housed in a watertight shell suitable for submersible conditions, and shall have Class F insulation.

4. Additional provisions for motor shall be in accordance with requirements specified in the Section entitled "MOTORS and MOTOR CONTROLLERS". Select the motor characteristics, the motor mountings, and all accessories necessary to satisfy the requirements of the ejector motor drive unit in all operating modes.

C. Removable Lift Type Submersible Ejectors

1. If "Removable Lift" (Quick Removal) type ejectors are specified in the Schedules shown on the Basic Contract Drawing, the installation shall include additional appurtenances as described below.

2. The design shall be such that the ejectors will be automatically connected to the discharge piping when lowered into place. The ejectors shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be removed for this purpose, nor need personnel to enter the ejector pit. The ejectors shall be fitted with a stainless steel chain from each ejector, of adequate strength and length to raise the ejector for inspection and removal.

3. The installation shall include a separate base plate, incorporating a stationary discharge elbow to receive the discharge when the ejector is lowered into place. The receiving edge of the discharge elbow shall be fitted with a non-sparking material to prevent spark ignition during ejector installation and removal.

4. Furnish and install two guide bars for each ejector to permit raising and lowering the ejector. Guide bars shall be of two-inch galvanized steel pipe of adequate length to extend from the lower guide holders mounted on the access frame.

5. Access cover shall be installed for each ejector, complete with hinged and flush locking mechanism, upper guide holder and level sensor cable holder. Frame shall be provided with sliding nut rails to attach the accessories required. Lower guide bar holders shall be integral with the discharge connection. The guide bars shall not support any portion of the weight of the ejector. Doors shall be of skid proof design.

D. Control System

1. Provide a motor control panel in a single enclosure with a hinged door of NEMA enclosure type as shown on the Basic Contract Drawing. Mount the panel where shown on the Basic Contract Drawing.

2. For single ejector installations, the control equipment shall consist of an automatic, heavy-duty, float switch to start and stop the ejector. The motor control panel shall contain a disconnect switch, magnetic motor starter with overload protection and "Hand-Off-Automatic" selector switch.

3. For duplex ejector installations, the control equipment shall consist of four submersible mercury float switches. Each switch shall be hermetically sealed in a corrosion resistant float and mounted on a stainless steel pipe with wall bracket. The switches shall be arranged to provide ejectors off, one ejector operation along with alternation, two ejector emergency protection and high water alarm condition. The motor control panel shall contain two fusible disconnect switches with lockout handles through cover, two magnetic across-the-line starters with 3-phase, overload and low voltage protection, two ejector running lights, one automatic electric alternator, two "Hand-Off-Automatic" selector switches, two overload reset buttons, one numbered and wired terminal strip, high water alarm bell, light and silencing button.

E. Basin

Provide a cast iron basin (unless other material is shown on the Basic Contract Drawing), complete with sewage inlet fitting and steel basin cover. The cover shall be provided with openings as required for ejector discharge piping, access with cover, vents and controls. All connections penetrating the cover shall be made gas tight. The basin shall be provided with a cement anchor flange. Size of basin shall be as shown on the Basic Contract Drawing.

F. Explosionproof Installation

1. If "Explosionproof" type ejectors are specified in the Schedules shown on the Basic Contract Drawing, the installation shall include additional appurtenances as described below.

2. Motors shall be UL listed for Class 1, Group D hazardous locations.

3. The ejector control system shall include an intrinsically safe pilot circuit for each mercury float switch to reduce the power to the float switch to a level incapable of releasing sufficient electrical or thermal energy to ignite explosive gases.

G. Provide submersible rated cables to all electrical devices that will be submerged. Submersible cables shall be long enough to reach from the submerged electrical device to the proper terminations in the ejector motor controller without splicing.

2.04 SHOP TESTS

A. General

1. Manufacturer's standard shop tests shall be performed on ejectors, motors, controllers, and appurtenances in conformance to the requirements of this Section.

2. All shop tests may be witnessed by the Engineer. Notify the Engineer 14 days in advance of scheduled tests.

B. Performance Tests

Each ejector shall be performance tested in accordance with the procedures of the Hydraulic Institute Standards.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install ejectors in locations shown on the Basic Contract Drawing, in accordance with manufacturer's installation procedures. Alignment of the "Removable Lift" type ejectors during installation shall be in strict adherence to manufacturer's instructions.

B. Provide a gate valve and check valve on the discharge of each ejector.

C. Set cover over basin and fasten to top flange of basin so that cover is flush with finish floor, as applicable.

D. Field install all electrical devices furnished under this Section.

E. Verify that electrical wiring installation is in accordance with Engineer-approved manufacturer's submittal and in accordance with installation requirements of Division 16.

F. Clean the basin of all construction debris before putting the system into operation.

3.02 FIELD ADJUSTMENTS

A. Check alignment. Where necessary, readjust the slide rail guide bars, and realign shafts of motors and ejectors within tolerances recommended by ejector manufacturer and in presence of the manufacturer's service representative.

B. Lubricate ejectors before operation.

3.03 FIELD TESTS

Operate ejectors after the installation has been completed to verify that ejectors, float switches, alarms, valves, etc. are in working order. Operate ejectors in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15453

SUBMERSILE SEWAGE EJECTORS

APPENDIX A

SUBMITTAL REQUIREMENTS

A. Submit the following in accordance with requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

1. Catalog cuts.
2. Ejector performance characteristic curves with design points clearly indicated.
3. Shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.
4. Electrical wiring diagrams for electrical power supply, interlock and control.
5. Installation procedures.

B. Submit certified shop test reports.

C. Submit operation and maintenance manuals, including replacement and spare parts lists.

END OF APPENDIX "A"

DIVISION 15

SECTION 15503

FUEL OIL PIPING AND APPURTENANCES

1. GENERAL

A. SUMMARY

This Section specifies requirements for fuel oil piping and appurtenances.

B. DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods specified herein shall comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

American National Standards Institute (ANSI)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

National Electrical Code (NEC)

National Fire Protection Association (NFPA)

Underwriters Laboratories Inc. (UL)

In addition, specific provisions cited herein shall govern for the associated specific application.

1.) Fuel oil piping systems shall be designed in accordance with NFPA 31, and leak detection system shall comply with National Electrical Code.

C. QUALITY ASSURANCE

1.) Fuel oil piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

2.) Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

D. DELIVERY, STORAGE, AND HANDLING

1.) Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

2.) Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

3.) Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

E. SUBMITTALS

Refer to Appendix A.

2. PRODUCTS

A. PIPE, FITTINGS, AND FLANGES

1.) Provide pipe (and tube), fittings, and flanges in accordance with the "PIPE, FITTINGS, AND FLANGES SCHEDULE" shown within this Section, including gaskets, bolts, nuts, washers and other pressure containing parts necessary for the complete installation of fuel oil piping.

2.) All welding elbows shall be long radius pattern unless otherwise shown on the Basic Contract Drawing.

3.) Buttwelding fittings shall be manufactured by Ladish Company, Crane Co., Grinnell Corp., or approved equal.

4.) Socket welding fittings shall be manufactured by Crane, Grinnell, or approved equal.

5.) Underground fuel oil piping shall consist of a primary (carrier) pipe, completely enclosed within a secondary (containment) pipe. The primary and secondary pipes and fittings shall be manufactured of glass fiber reinforced epoxy resins. Both pipes shall incorporate integral corrosion-resistant resin-rich reinforced liners. The primary pipe shall be centered within the secondary pipe by use of centering spacers furnished by the pipe manufacturer. Adhesive for joining the piping shall be UL listed epoxy, manufactured by pipe manufacturer. Pipe shall be Ameron Co. "Dualoy 3000/L"; Smith Fiberglass Products, Inc. "Red Thread IIa"; or approved equal. The secondary containment pipe shall be sized and configured so that the interstitial space between the primary and secondary pipes will accommodate adequately a leak detection system cable running throughout the length of the pipe. It shall be Contractors responsibility to coordinate the piping (size and configuration) with the leak detection system specified herinafter in this Section. Means for installing the leak detection cable, and for venting and draining the piping, and for inspecting the leak detection system shall be provided adequately along the length of piping and where required.

6.) Required disconnects for above ground piping shall be made up using welding neck flanges.

7.) Welding backing rings for buttwelding joints shall be Robvon Backing Ring Co. "Type CC", or approved equal.

8.) Gaskets for steel pipe shall be 1/8-inch thick (after compression) for raised face flanges and 1/16-inch thick (after compression) for flat face flanges, and shall be stainless steel, spiral-wound, non-asbestos filler, ring type.

9.) Gaskets for glass fiber pipe shall be Class 150 full-face, 1/8-inch thick (after compression) sheet rubber, ANSI B16.21, with a Shore durometer hardness between 55 and 65, ASTM D1330.

10.) Gaskets for glass fiber pipe-to-steel pipe flanged joints shall be as described hereinbefore 2.01 I for glass fiber pipe.

11.) Piping shall be designed to contain and remain inert to diesel fuel and heating fuel oil.

Pipe, Fittings and Flanges Schedule				
Fuel Oil Above Ground				
Size	Pipe	Joints	Fittings	Flanges
Up to 2"	ASTM A 53, Gr.B, Seamless, Sch. 80	Socket Weld	ASTM A 105, ANSI B16.11, 3000 lb. Rating, Gr. WPB	ASTM A 105, ANSI B16.5, 150 lb. Class
2-1/2" to 10"	ASTM A 53, Gr.B, Seamless, Sch. 40	Butt Weld	ASTM A 234, Gr. WPB, ANSI B 16.9, Same as Pipe Rating	ASTM A 105, ANSI B 16.5, 150 lb. Class
Up to 2"	ASTM B 88 Type K, Drawn, Nominal Wall (where shown on the Basic Contract Drawing)	Solder 95-5	Wrought Copper ANSI B16.22, Same as Pipe Rating	

Fuel Oil Underground		
Pipe	Joints	Fittings
Primary carrier pipe, centered within a secondary containment pipe Both pipes shall be Glass Fiber Reinforced Epoxy Resin Pipe, UL-Listed, ASTM D2310, ASTM D 2996; Grade 1, Type 1, Class C	Bell and Spigot	Same as pipe; flat face only

B. GATE, GLOBE, AND CHECK VALVES

1.) Provide valves where shown on the Basic Contract Drawing, in accordance with the "Gate, Globe and Check Valves Schedule" shown in this Section.

2.) All gate and globe valves shall be the products of one manufacturer.

3.) Swing check valves shall be suitable for installation in the horizontal position.

4.) All valve Figure Numbers specified in the "Gate, Globe and Check Valves Schedule" shown in this Section, are those of Crane Co. for cast steel valves (2 1/2 inches and larger) and Smith Valve Corp. for forged steel valves (2 inches and smaller).

5.) Subject to compliance with requirements of this Section, valves shall be one of the following manufacturers, or approved equal:

a. Cast Steel Valves

Crane Co.

Walworth Co.

Powell (William) Co.

b. Forged Steel Valves

Smith Valve Corp.

Vogt (Henry) Machine Co. Inc.

GATE, GLOBE AND CHECK VALVES (2-1/2 INCHES AND LARGER) SCHEDULE				
Type	Fig. No.	Ends	Rating Class	Construction Features
Gate	47	FL	150	Compliance with ANSI B16.34
	47-1/2	BW	150	Gates & Globes: Rising stem, OS&Y, back seated, bolted bonnet and gland (gasketed), renewable seats and discs, flexible wedge (for gate) and plug type (for globe) disc Checks: Renewable seats and discs, bolted bonnet.
Globe	143	FL	150	
	143-1/2	BW	150	Materials: Body & bonnet – Cast Steel, ASTM A216 Gr. WCB
Swing Check	147	FL	150	
	147-1/2	BW	150	Stem – 11-14 Chrome, ASTM A182 F6 heat treated
				Seat & Backseat Facing – Ferritic or austentic base metal stellite face
				Disc Facing - 11-14 Chrome, ASTM A 182 F6 heat treated

GATE, GLOBE AND CHECK VALVES (2 INCHES AND SMALLER) SCHEDULE				
Type	Fig. No.	Ends	Rating Class	Construction Features
Gate	888W	SW	600	Compliance with MSS SP-84
Globe	G80W	SW	600	Gates & Globes: Rising stem, OS&Y, back seated, bolted bonnet and gland (gasketed), renewable seats and wedges
Lift Check	C80W	SW	600	
				Checks: Renewable seats and discs, bolted bonnet
				Materials: Body & Bonnet - Forged steel, ASTM A 105 Stem and Disc - 11-14 Chrome, ASTM A 182 F6 heat treated Seat - Base metal stellite

C. FUEL OIL SPECIALTIES

Provide the following fuel oil specialties where shown on the Basic Contract Drawing:

1.) Fuel Oil Foot Valves

Bronze body, integral intake strainer, single poppet, screwed ends, Preferred Utilities Fig. No. 932 and 918; or approved equal.

2.) Pressure Relief Valves

Bronze body, steel spring, 300 psi w.o.g. rating, adjustable pressure settings, screwed ends, Preferred Utilities Type R; or approved equal.

3.) Pressure Regulating Valves

Bronze body, steel spindle end spring, 300 psi w.o.g. rating, screwed ends, Preferred Utilities Model BQ; or approved equal.

4.) Duplex Strainers

Cast iron body, brass strainer baskets with 3/64 inch perforations, quick-opening covers with airtight seals, switching handles, Preferred Utilities Fig. No. 50; or approved equal.

D. ACCESSORIES

1.) Pipe and Valve Identification

a. Adhesive Bands

(i) Provide approved adhesive bands in sets of two, one identifying the piping system type and the second, the direction of the flow. Sets shall be provided in quantities sufficient to accommodate the installation requirements of 3.04 A of this Section.

(ii) For 3-inch or larger pipe, the adhesive band identifying the piping system shall display the name of the service in letters at least two inches high and the band indicating direction of flow shall display an arrow of similar size. For 2 1/2-inch or smaller pipe, the letters and the arrow shall be not less than one inch high. Bands shall be in colors and shall conform to ANSI A 13.1.

(iii) Adhesive bands shall be W.H. Brady Co. "Quick-Label", or approved equal.

b. Valve Tags, Charts and Schedules

(i) Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be 1/4-inch high on the upper line, and valve number shall be 1/2-inch high on the lower line. The characters shall be indented and filled with durable black compound.

(ii) Provide diagrammatic valve charts and schedules, using a valve numbering system that differentiates between classes of service and indicates floor level of valve location.

(iii) Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

(iv) Valve tags and the frames for the valve charts and schedules shall be manufactured by Seton Name Plate Corp., or approved equal.

2.) Access Doors

Provide a complete list of all access doors required in finished walls, ceilings, partitions and any other areas for access to all valves concealed behind such finished construction. Access doors shall be furnished and installed under other Sections.

E. PIPE HANGERS AND SUPPORTS

1.) Design, fabricate and provide all pipe hangers and supports adequate to support and guide the piping, allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

2.) Hangers and supports shall include guides, anchors, stops, restraints, welded attachments, insulation saddles, saddle strands, stays, braces, bolts, nuts, washers, expansion bolts, pipe clamps, beam clamps, and supplementary structural steel for pipe hanger and supports.

3.) All hangars and supports shall conform to requirements of MSS SP-58 and SP-69.

4.) Structural members required for suspended loads shall be shop fabricated for bolting to building structural members.

5.) Do not hang piping from other piping. In no case shall hangers be supported by means of vertical expansion bolts.

6.) Keep the different types of hangers to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

7.) Support riser piping independently from the connected horizontal piping.

8.) Pipe support attachments to the riser piping shall be riser clamp lugs at each floor level.

9.) Provide pipe anchors where shown on the Basic Contract Drawing and where necessary to restrain forces due to thermal expansion and contraction of pipe.

10.) Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

11.) Unless otherwise specifically approved, hanger size and spacing shall be as follows:

a. Steel Piping

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	5 ft. o.c.	3/8"
1-1/2" to 3-1/2"	9 ft. o.c.	1/2"
4" to 6"	14 ft. o.c.	3/4"
8" to 12"	19 ft. o.c.	7/8"

b. Copper Tubing

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	5 ft. o.c.	3/8"
1-1/4" to 2"	7 ft. o.c.	3/8"
2-1/2" to 3"	9 ft. o.c.	1/2"
3-1/2" to 4"	11 ft. o.c.	5/8"

12.) All hangers and supports shall comply with the requirements specified under the Section entitled " VIBRATION ISOLATION AND CONTROL".

13.) Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hangar Co. Inc., or approved equal.

F. SLEEVES, SEALS, AND ESCUTCHEONS

1.) Pipe Penetration through Walls, Partitions and Floors

a. Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the diameter of the insulated pipe. Sleeve shall be flush with the finished wall or partition surface.

b. Sleeves through concrete floors for piping shall have the opening 1/2-inch in diameter larger than the diameter of the pipe passing through. Floor sleeves shall project one inch above floor slab.

c. Pack the annular space between the pipe and sleeve with mineral wool. Additionally at penetrations through fire-rated barriers, seal the annular space to retain the fire rating integrity of the barrier with non-hardening through-penetration firestops having F-ratings compatible with fire ratings of the barriers in which they are installed, per ASTM, E814. Firestop systems shall be UL-approved, and shall be as manufactured by 3M, Bio-fireshield, Inc., General Electric Co., Dow Corning Corp., or approved equal.

d. Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

2.) Pipe Penetration through Exterior Foundation and Pit Walls

a. General

(i) All penetrations for piping through perimeter foundation walls and subgrade pit walls shall be provided with the pipe sleeves and seals as shown on the Basic Contract Drawing;

(ii) Sleeves shall be Schedule 40 for sizes up to 10 inches and 3/8-inch wall thickness for sizes 12 inches and larger. All pipe sleeves shall be galvanized steel, set into foundation walls with anchors and water stop plates.

b. Lead-Oakum Seals

Where "Lead-Oakum" seals are shown on the Basic Contract Drawing, the annular space between the pipe and the sleeve shall be made watertight by caulking with oakum and poured lead, edged and trimmed.

c. Interlocking Modular Seals (Link-Seal)

(i) Where "Link-Seal" is shown on the Basic Contract Drawing, seal shall be modular mechanical type, consisting of interlocking sealing element links shaped to continuously fill the annular space between the pipe and the sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the sealing elements to expand and provide a watertight seal between the pipe and the sleeved opening. The seal shall provide electrical insulation between the pipe and wall.

(ii) The inside diameter of each wall sleeve shall be sized as recommended by the manufacturer to fit the pipe and seal to ensure a watertight joint. If pipe outside diameter is nonstandard due to coating or insulation, consult the manufacturer for recommendations before proceeding with wall sleeve sizing.

(iii) Install sleeves and seals in accordance with the seal manufacturer's instructions to provide a watertight installation.

(iv) Seals for perimeter foundation wall penetrations shall be two individual sealing units in tandem unless otherwise shown on the Basic Contract Drawing. Single sealing unit shall be used for pit wall penetration unless otherwise shown on the Basic Contract Drawing.

(v) Seals shall be Thunderline Corp. "Link-Seal", or approved equal.

G. UNDERGROUND FUEL OIL PIPE LEAK DETECTION SYSTEM

1.) Provide a complete leak detection system to automatically detect and locate the presence of leaked fuel oil and/or underground water at any point along the secondary (containment) pipe of the fuel oil piping system. The leak detection system shall include electronic control module, fuel/water sensing cable, graphic display panel, and all auxiliary equipment, accessories and appurtenances necessary to make the system complete and operable.

2.) The system shall sound audible and visual alarms and locate the event with a digital display to within approximately one foot.

3.) The system shall have uniform sensitivity throughout the length of the sensing cable. No more than one (1) foot of leaked fluid in contact with the cable, at a depth of 1/8-inch shall be required to actuate the audible and visual alarms.

4.) The system shall operate in such a manner that the presence of a leak cannot be suppressed or otherwise ignored once it is detected. However, it shall be possible to silence the audible alarm after acknowledgement; but the visual alarm shall be maintained until the leak has been corrected.

5.) The system shall be UL listed and FM approved.

6.) The system shall be tested to Third Party Procedures developed according to the US EPA's "Standard Test Procedures for Evaluating Leak Detection Methods: Liquid Phase Out of Tank Product Detectors."

7.) The electronic control module shall be capable of monitoring the entire length of the sensing cable(s). It shall continuously monitor the sensing cable for fuel and/or water contact. Contact with any fuel/water shall result in visual/audible alarms, a "leak" LED signal, actuation of an output relay, and a digital display of the location of the point of contact.

8.) The electronic control module shall monitor the sensing cable and interconnecting cable for continuity. Any break in the cables shall result in an audible alarm and a "continuity" LED signal, and shall actuate the output relay.

9.) The electronic control module shall provide the following additional features:

   a. An "events history log" which shall allow events (leaks) to be tracked, if not responded to immediately. A password shall be required to access the log for modifications or erasure.

   b. Ability to customize user settings, such as choice of units, use and update of passwords, modifying the re-alarm intervals, etc.

   c. Nonvolatile memory to hold the events history log and user settings.

   d. Provisions for connection to building management and control system.

10.) Control module power requirements shall be 120 Vac, 240 Vac or 24 Vac/Vdc, single phase, 60Hz, as indicated on the Basic Contract Drawing.

11.) The electronic control module shall require no operator programming, and shall be capable of automatically calibrating the entire system whenever power is applied.

12.) The fuel sensing cable shall detect the presence of fuel oil and other hydrocarbons, as well as water; and shall be capable of accommodating any number of branches using the system's branching connectors.

13.) Provide jumper cable as required to interconnect sensing cables, or for remote mounting of the electronic panel, without reducing the maximum amount of sensor cable that the electronic panel is capable of monitoring.

14.) Provide a portable test box to permit field inspection and testing of the complete system or portions thereof.

15.) The fuel oil leak detection system shall be the product of Raychem Corporation, Trace Tek Products Group; or PermAlert, Subsidiary of Perma-Pipe, Inc.; or approved equal.

3. EXECUTION

A. PRE-INSTALLATION INSPECTION

1.) Fully inspect FRP pipe for damage. Locate, cut out or replace damaged pipe.

2.) Contractor shall complete items A thru E of checklist FPTPI-P8/89 and obtain the Engineer's initials where required.

B. INSTALLATION

1.) Install piping system in accordance with manufacturers' installation procedures, requirements of NFPA 31 and applicable codes, and as specified.

2.) Coordinate piping installation with other Work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry work to avoid necessity of cutting finished structure.

3.) The piping layouts shown on the Basic Contract Drawing shall be considered as diagrammatic. Install piping suitable in every respect for the Work intended and clearances required.

4.) Run exposed piping perpendicular and parallel to walls and floors.

5.) Install all valves and specialties to permit easy operation and ready access for maintenance and repair.

6.) Install an isolation gate valve at each branch connection to supply mains and elsewhere as indicated on Basic Contract Drawing.

7.) Install drain valves at low points and vents at high points in mains, risers, branch lines, and elsewhere as required for system drainage and venting.

8.) Installation requirements for hangers and supports and for pipe penetration sleeves, seals and escutcheons are specified in 2.05 and 2.06, respectively.

9.) Glass Fiber Reinforced Epoxy Pipe

a. Install all glass fiber reinforced epoxy piping in compliance with requirements/recommendation of the manufacturer.

b. Unless otherwise indicated on Basic Contract Drawing, install the underground piping in a compacted, fine sand bedding. Bedding shall be free of clay or sharp gravel.

c. Flanged valves in glass fiber piping shall be flat face or raised face, with spacer or backer rings provided for the mating glass fiber flange.

d. Transitioning from glass fiber pipe to steel pipe shall be accomplished after termination of the secondary (containment) pipe aboveground, immediately after exiting the ground. It shall be achieved by means of flanged joints for pipe sizes 2 1/2-inch and larger, and via glass fiber adaptors (bell x female NPT) for pipe sizes 2-inch and smaller.

e. Valves, strainers and all other fuel oil system components shall be supported independently of the glass fiber pipes.

f. Glass fiber piping shall be supported/restrained, as required, at all changes in direction and at all branches.

g. Secondary containment piping shall be sealed only after primary piping passes inspection and hydrostatic testing.

10.) Steel Pipe

a. All steel pipe shall be welded unless otherwise shown on the Basic Contract Drawing.

b. Each welder shall be certified in accordance with ASME Section IX.

11.) Copper Tubing

Joints shall be silver soldering.

12.) Glass Fiber Pipe Fuel Oil Leak Detection System

a. It shall be Contractor's responsibility to coordinate the installation of the glass fiber fuel oil piping system specified herein in this Section with the installation of the fuel oil leak detection system serving that system.

b. The piping installer shall provide a clean and dry secondary (containment) piping system with free-running pull ropes and adequate clearances to install the sensing cable system.

c. The fuel oil leak detection system shall be installed in accordance with system manufacturer's installation instructions/procedures. Installation shall include, but shall not be limited to functional testing of the system and mapping thereof.

C. FIELD TESTS

1.) Glass fiber reinforced epoxy pipe shall be hydrostatically tested in accordance with the manufacturer's recommendations.

2.) Steel piping from the pump discharge to the oil burner connection shall be hydrostatically tested at 200 psi, for a period of two hours. All equipment controls and instruments shall be isolated from the piping system during the test.

3.) Fuel Oil Leak Detection System:

a. Upon completion of the fuel oil leak detection system installation, a factory-furnished fuel sensing cable, of a length established by the system manufacturer, shall be temporarily installed at the far end of the leak detection circuit. One foot of the fuel sensor shall be immersed in a trough containing fuel oil, to a depth of 1/8-inch, to confirm that an alarm is generated and the location thereof is identified on the control module. The procedure shall be repeated utilizing water. The test shall be performed and certified in the presence of Engineer.

b. Upon completion of the test and removal of the temporary test section, the containment piping system shall be sealed.

c. A graphic display map, prepared from "as-built" drawings, shall be furnished upon completion of the test. The map shall indicate the location of the permanent sensor cable and landmarks such as equipment, piping access parts, changes in cable direction, and cable distance readings.

d. Provide qualified technical representatives of the system's manufacturer to instruct and train Authority personnel in the operation and maintenance of the leak detection system for a minimum of 8 hours.

4.) Prior to backfilling pipe trench, primary piping system shall be hydrostatically tested to either 150% of working pressure or 50 psig for 30 minutes. All piping found leaking shall be repaired or replaced. After test has been completed, maintain 25 psig pressure on primary piping and monitor pressure loss while installing secondary containment piping. Secondary containment piping shall be pneumatically tested with soap at 5 psig for 30 minutes upon completion. Make repairs as required if pressure loss occurs for either piping system.

D. PAINTING

Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Basic Contract Drawing. Painting shall be in accordance with the requirements of Section entitled "PAINTING".

E. PIPE AND VALVE IDENTIFICATION

1.) Pipe Identification

Affix sets of pipe adhesive bands specified in 2.04 A.1 where they can be easily read, with their long dimension parallel to the axis of the pipe and no more than 40 feet apart on a piping system. At least one set of identifying bands shall be affixed in all occupied and unoccupied rooms as well as in all other spaces, such as hung ceilings or shafts, where piping may be viewed and the identity of the piping system cannot be readily ascertained.

2.) Valve Tags

Securely fasten valve tags specified in 2.04 A.2 with approved brass chain.

END OF SECTION

SECTION 15503

FUEL OIL PIPING AND APPURTENANCES

APPENDIX A

SUBMITTAL REQUIREMENTS

1.) Submit the following in accordance with the requirement of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

a. Fuel oil piping layout drawings, including hanger and support locations and details.

b. Catalog cuts for the following:

(i) Fittings and flanges

(ii) Valves and specialties

(iii) Hangers and supports

(iv) Sleeves and escutcheons

(v) Valve tags and piping identification bands

(vi) Fuel oil leak detection system and components, including pertinent wiring diagrams

c. Pipe material and schedule for each piping system.

d. Valve charts and schedules

e. Fuel oil leak detection system graphic display map. Include copy of map in the operation and maintenance manual specified herein below.

2.) Submit operation and maintenance manuals, including operation and maintenance of the fuel oil leak detection system. Include replacement and spare parts lists, for each type of valve, specialty and component.

3.) Submit field hydrostatic test results.

4.) Submit fuel oil system test results.

5.) Submit "Fiberglass Piping Systems Installation Checklist for Underground Petroleum Pipe", Publication No. FPTPI-P8/89, published by the Fiberglass Petroleum Tank & Piping Institute.

END OF APPENDIX "A"

DIVISION 15

SECTION 15504

FUEL OIL PUMP AND TRANSFER SYSTEM

PART - GENERAL

1.1 QUALITY ASSURANCE

A Acceptable Suppliers

1. The fuel oil handling system including the Pump Set, Control Cabinet, Safety Devices, Tank Gauging, Day Tank and accessories shall be supplied by one Original Equipment Manufacturer (OEM). The OEM shall have employees who manufacture, design, start up and service fuel oil handling systems of this nature throughout the United States. Proof of manufacturing and starting up of the herein specified system(s) within the last five years must be supplied. This is to assure the highest standards of product quality and system integration capabilities for the customer

B Certification

1. Tanks shall be designed, constructed and labeled according to Underwriters Laboratories (UL 142) standards and/ or as required by local code.
2. The Fuel Management Control Cabinet shall be manufactured and labeled in accordance with UL508A. Simply supplying UL recognized individual components is not sufficient. The assembled control cabinet, as a whole, must be inspected for proper wiring methods, fusing, etc., and must be labeled as conforming to UL508A. Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL).

C Submittals

1. Contractor shall submit a complete, project-specific submittal package containing scale drawings of all major components, complete bill of materials, control cabinet layouts, sequence of operations, electrical wiring diagrams, catalog data and Proof of Product Liability Insurance. All drawings and product information shall be project specific, no catalog cuts or "standard drawings" shall be acceptable.

2. Job Specific Submittal Drawings Require:

   a. Scale drawing of set showing all components with both plan and elevation dimensions.
   b. Schedule of components with complete bill of material..
   c. Control cabinet layout detail
   d. Specific System Sequence Of Operation.
   d. Electrical Wiring Diagrams for all electrical cabinets.
   e. Layout of tank gauge and leak detection system in the main control cabinet.

D. Factory Testing

1. Prior to shipment, the manufacturer shall test all "Packaged" assemblies. A copy of the test procedures shall be sent to the consulting engineer and owner. The owners and or the consulting engineer at their discretion shall observe this and all other tests.
2. Electrical components shall be functionally tested with all instruments and controls. Settings of all instruments and controls shall be verified for conformance to these specifications. A certificate of factory testing, together with a copy of the wiring diagram shall be placed in the control cabinet prior to shipment. The UL-508 label shall be affixed to the inside of the cabinet.
3. Pump Sets shall be fully tested prior to shipment. Testing shall include both a pressure and vacuum testing period. First, the complete pump set shall be pressure tested to rated pressure using an air pressure source. The test shall confirm that the pump set piping system can maintain rated pressure for 4 hours. Next, the complete pump set shall be brought to a vacuum greater than 25"Hg. The test shall confirm that the pump set piping system can maintain vacuum for 4 hours. Following a pressure and vacuum test the pump set shall be given a full operational test. The pump set shall be connected to a fuel oil supply and return. The pump set shall be operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within 10% of rated motor amps. During the test the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested.
4. Fuel oil storage tank hydrostatic testing is required to ensure tightness prior to shipment. The minimum pressure for testing the tank shall be twenty- five psi. The hydrostatic pressure shall be maintained until all joints and connections have been visually inspected for leaks, but in no case for less than one-half hour. The tank shall not show any permanent deformation as a result of the test. The test shall be run for no less than one-half hour.

PART 2 - FUEL OIL TRANSFER PUMPS AND STRAINING SET

2.2 Automatic Fuel Oil Transfer System:

A. Application

1. Provide and install a factory- assembled "Packaged" Automatic Fuel Oil Transfer and Monitoring System to ensure a reliable supply of fuel oil to the emergency generators included in this project. System to be factory fabricated/ tested and certified as a complete unit. Field assembled units are not acceptable.
2. The system shall include automatic pump set lead/lag, storage tank and day tank level monitoring, leak monitoring, LCD operator display, manual back-up stations, time and date stamped alarm and event summary, and the system shall include the capability to simultaneously communicate to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via Modbus protocol, and dial out to an alphanumeric pager system via field installable plug-in option modules in the future. The control system shall be a microprocessor-based design with field expandable plug-in Input/Output modules.

Pump System Piping and Mounting

3. Provide a duplex pump and straining set that is factory assembled with components piped and mounted on a common base plate. Pipe shall be scheduling 40 ASTM A-53

Grade "A" with ANSI B16.3 Class 150 malleable iron threaded fittings. Baseplate shall include 3" steel side rails continuously welded for containment and to contain potential leaks shall extend beyond any fitting, valve, pump, strainer, or selector valve. Provide a ½" containment basin plugged drain connection.

4. Positive Displacement Pumps
Provide and mount two (2) positive displacement **gear** pumps, with cast iron housing, and mechanical seal. The pump shall be capable of developing 25" Hg. Vacuum at 0 PSIG as factory tested, however, for normal operation, vacuum shall not exceed 15" Hg. Pump to have 3- bolt mounting foot. Pumps that have aluminum, brass, or bronze housings or rotors are not acceptable. Packing gland equipped pumps, close-coupled pumps, Carbonator shaft mounted pumps or centrifugal pumps are not acceptable.

5. Motors
Provide and mount two (2) open drip proof, rigid base, standard NEMA frame motors. Motor shall have copper windings, a dynamically balanced rotor, ball bearings and a heavy gauge steel NEMA Frame.

6. Pump and Motor Assembly
The pumps shall be connected to the piping in the set through stainless steel flexible metallic braided jackets, and the pump and motor assemblies shall be welded to the base plate. Pumps and motors shall be mounted on a structural steel channel and equipped with flexible coupling and full OSHA approved coupling guard. Pumps and motors shall be mounted with bolts threaded into the steel channel for ease of maintenance. Mounting bolts shall not penetrate the secondary containment basin.
Flexible coupling general: The pump shall be connected to the motor by an elastomeric jaw type flexible coupling that does not require lubrication. The coupling wear member shall be replaceable without disturbing the alignment of either the pump or motor. Sizing of the flexible coupling shall be based on motor horsepower and rpm. Materials of construction: The coupling body shall be sintered iron and cast iron. The elastomeric wear member shall be NBS Rubber.

7. Pump Isolation and Check Valves
Provide and mount four (4) pump isolation valves. Locate one (1) valve on the suction and discharge side of each pump. Isolation valves will allow off-line pump maintenance without system loss of availability. Isolation valves shall be ball type, rated 400 WOG, include stainless steel ball and Teflon seat. Valve to provide full flow while open and positive shutoff when closed. Additionally, two (2) class 150 swing check valves shall be provided and mounted, one (1) located on the discharge of each pump. Valves to have a re- grindable bronze seat and a threaded cap.
Fuel Oil Strainer

8. Factory install, One (1) Duplex strainer, basin mounted, on the suction side of the pumps. Strainer to be sized for less than ½ psi of mercury drop through a clean strainer basket with the maximum anticipated flow in the suction line. Strainer shall be one piece cast iron body and shall be suitable for 200 psi. Strainer baskets shall be 40 mesh stainless steel. Strainer shall come complete with lever wrench handle and be bolted in place without bolting through pan.

9. Strainer Differential Pressure Switch
Strainer shall be equipped with an optional factory mounted and wired differential pressure switch to indicate that the basket needs to be cleaned. Indicating scale plate shall be three position color coded for easy indication of strainer basket flow status. Switch shall provide indication on the main pumpset control cabinet to alert operators.

10. Relief Valves, External
Provide and mount for each pump a relief valves sized to relieve the full outlet flow of the pump without causing the pump motor to overload or any component's pressure rating to be exceeded if the discharge is inadvertently valved off. Relief valves must be externally mounted from the pumps and piped to the return line in the field according to NFPA 30. Pump internal relief valves shall not be accepted.

11. Compound and Pressure Gauges
Provide and mount a compound gauge on the suction side of the strainer. The gauge

shall read 30" vacuum -15 psig. **Provide and mount a pressure gauge on the discharge side of each pump.** Each gauge shall be equipped with an isolation ball valve.

12. Containment Basin Leak Detection Switch
Provide a factory mounted and wired float operated Containment Basin Leak detection Switch to shut off the pumps and energize an audible and visual alarm should a leak be detected. The leak sensor shall be a plasma welded stainless steel construction. The leak sensor shall be internally mounted within the pump basin. Electrical connections shall be contained in a factory installed weatherproof junction box.

13. Pump Set Control Cabinet
Provide a Fuel Oil Management Control Cabinet factory mounted on the fuel oil pump set. The Control Cabinet shall be completely pre-wired, factory programmed and tested to ensure job site reliability. The pump set and control cabinet shall be the product of one manufacturer for single source responsibility. Cabinet to be manufactured by Nationally recognized trade union personnel and be approved by a nationally recognized independent testing laboratory, equal to UL- 508A.
Provide a factory assembled NEMA 4 rated control panel mounted operator interface control switches, indicators and displays. All PLC indicators, manual back-up control switches and indicators must be mounted on the factory installed subplate.
Panel to include a NEMA 4 alarm light mounted on top of the panel. Alarm light shall be visible from all angles. Include an isolated 120V duplex receptacle with faceplate. Provide a sub plate mounted power isolation switch for the PLC.

14. Control and Monitoring Hardware
System shall be custom designed to accomplish the control strategy as outlined. The control strategy shall be microprocessor-based. The control strategy shall be factory configured and stored on an EEPROM, and shall be password protected from re-configuration by unauthorized / un-qualified personnel. The controller shall be designed so that it will "fail safe" in the event there is a microprocessor failure. RELAY LOGIC SHALL NOT BE ACCEPATABLE. Control hardware shall include combination magnetic motor starters with overload protection and circuit breakers. Provide safety interlocks to shutdown both pumps during any of the following conditions: day tank "leak detected", riser "leak detected", day tank "high-high" level, day tank "vent" and main storage tank "vent". These interlocks must continue to ensure safe pump operation even if the controller has failed or is out of service and the pump set is operated in manual "hand" mode.

15. Operator Interface
The control system shall include a 16 line x 40 character or greater LCD display for pump set status, storage tank level indication, alarm listing, and trouble shooting functions. LCD screen shall be backlit and have a contrast dial for screen adjustment. Provide a tactile feedback, numeric keypad for data entry. Provide dedicated pushbuttons for Alarm Silence and for the Home Page display and a "Hand-Off-Automatic" control switch for each fuel pump. In "Hand" position the pump shall be capable of manual operation in the event of a controller failure. The control system shall monitor the position of each "Hand-Off-Automatic" control switch. Should a switch be put into the "Off" position, the controller shall log the event with a Time/Date stamp and store within the controller memory. Provide an Elapsed Time Recorder (ETR) to measure running time for each pump. Provide a Fuel Oil Overview Display (Home Page) capable of simultaneous viewing of pump set status, day tank status and main storage tank status. The Fuel Oil Overview display shall include the following information:

a. Lead Pump Selection – Auto/Manual
b. Pump Status – Off/Run/Standby
c. Day Tank Status – Normal/High/Low/Leak/ Vent Line
d. Main Tank Status – Capacity in US Gallons, Normal/High/Low/Leak
e. Day Tank Status – Capacity in US Gallons, Normal/High/Low/Leak
f. Vent Alarms for all oil tanks

g. Discrete alarms for each field mounted sensor
h. Three Most Recent Alarms

16. Alarm and Event Logs
The control system shall include a 200 Alarms, events and operator actions memory minimum. Provide an alarm display page for viewing the most recent 8 alarms/events with scrolling capability to view the complete 200 point alarm/event memory. Each event and alarm condition must be displayed with a distinct, descriptive, English language description and time and date stamp. New alarms shall trigger the common alarm output relay. Events shall be recorded, but shall not trigger an alarm. A dedicated Alarm Silence button shall silence the alarm output. The control system shall record and annunciate the following alarms: Pump Thermal Overload, Pump Loss Of Flow, Pump Set Failure, Riser leak, Containment pipe leak (each sensor), Riser pipe leak, Day Tank Leak, Day Tank High level, Day Tank Low level and Day Tank Vent. The control system shall record the following events: Pump Started, Pump Control Switch in "Off" position, and Pump Selected as Lead.

17. Fuel Pump Alternation and Lead-Lag Operation
Provide automatic, microprocessor-based day tank level control. The lead fuel pump shall be energized when Day Tank oil level falls below 50%. The lead pump shall continue to operate until the day tank level is greater than 80%. Upon the next call for fuel, the lead pump shall be automatically alternated. The control system shall automatically energize the back-up pump upon detecting a low level condition (40% full condition). Both pumps shall then continue to operate until the level of oil reaches the high level point (90% full condition). Upon detection of loss of flow or lead pump thermal overload the control system shall automatically energize the backup pump and de-energize the lead pump.

18. Pump Automatic Sequencing Flow Switch
Provide a time delayed flow sensing switch on the discharge of the pump set to bring on the lag pump should the lead pump fail to maintain flow. Flow switch shall be vane operated to actuate a single double throw snap switch. Switch shall be factory wired to the control cabinet for alarm and backup pump operation. Switch shall be rated for 1450 psig. Provide a flow switch outlet isolation valve for maintaining the flow switch without draining the fuel system.

19. Main Storage Tank Monitoring
The control system shall include main storage tank level sensor and discriminating leak sensor monitoring. Provide a continuous display of tank content, in both gallons and inches of product, within the main storage tank. Tank alarm displays shall not interfere with the display of the tank content. Provide data recall of the instantaneous display of tank content at the time of leak alarm condition. The control system shall include an overfill alarm circuit test pushbutton to provide instantaneous proving of audible and visual alarm circuitry associated with instrument overfill alarm contact. The controller must be field expandable using plug-in input modules to monitor up to 2 storage tanks and 6 discriminating leak sensors. Provide all equipment capabilities specified in this paragraph even if a connecting level and leak sensors are not included in this project.

20. Day Tank Level Monitoring
The control system shall include day tank level sensor and leak sensor monitoring. Provide a continuous display of tank content, in both gallons and inches of product, within the day tank. Tank alarm displays shall not interfere with the display of the tank content. Provide data recall of the instantaneous display of tank content at the time of leak alarm condition. The controller must be field expandable using plug-in input modules to monitor up to 2 storage tanks and 6 discriminating leak sensors. Provide all equipment capabilities specified in this paragraph even if a connecting level and leak sensors are not included in this project.

21. Communications
The pump set must include an optically isolated RS485 communications data highway. The RS485 protocol shall allow: Auto/Manual mode change, lead pump selection,

sensing and silencing of alarms, change of any configuration parameter, change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting BAS system is not included in this project. It must be possible to field upgrade the control system to "dial out" to an alphanumeric pager system via field installable plug-in option modules in the future.

22. Quality Assurance
The Control Cabinet shall be manufactured and labeled in accordance with UL508A. Simply supplying UL recognized individual components is not sufficient. The assembled control cabinet, as a whole, must be inspected for proper wiring methods, fusing, etc., and must be labeled as conforming to UL508A. Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL).

23. Factory Testing
Pump Sets must be fully tested prior to shipment as follows: Testing shall include both a pressure and vacuum testing period. First, the complete pump set shall be pressure tested to rated pressure using an air pressure source. The test shall confirm that the pump set piping system can maintain rated pressure for 4 hours. Next, the complete pump set shall be brought to a vacuum greater than 25"Hg. The test shall confirm that the pump set piping system can maintain vacuum for 4 hours. Following a pressure and vacuum test the pump set shall be given a full operational test. The pump set shall be connected to a fuel oil supply and return. The pump set shall be operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within 10% of rated motor amps. During the test the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested. A copy of the test procedures shall be sent to the consulting engineer and owner. The owners and or the consulting engineer, at their discretion, shall observe this and all other tests. A certificate of factory testing, together with a copy of the wiring and arrangement diagrams shall be placed in the control cabinet prior to shipment.

PART 3 - TANK GAUGING, LEAK MONITORING & OVERFILL PREVENTION COMPONENTS

A. The Liquid Level Sensor:

1. Shall consist of an aluminum, submersible (NEMA 6P) electronics head external to the tank and a float internal to the tank. The float shall be connected to the sensor head by a flexible stainless cable. The flexible cable shall allow installation or removal when overhead obstructions are present. The sensor shall include an external test mechanism to allow overfill alarm and full tank calibration checks without removing the sensor from the tank.

2. Tests that electronically simulate a high tank level instead of physically moving the float are not acceptable. The sensors operation shall be unaffected by internal tank obstructions located within 7" of the float cable. The assembly shall mount to the tank through a standard 4" 125/150 lb. flat faced flange opening with standard bolt pattern. The mechanism's control head shall be constructed of 1/4" cast aluminum. This sealed transducer housing shall encapsulate all transmitter electronics in a non-conductive oil and be moisture tight. Sensors assembly shall be water resistant and capable of operating in a submerged or manhole environment without damage.

3. The unit shall be capable of easy installation and maintenance with only 14 inches of clearance between the flange and any overhead obstructions. If buried suitable accesses for removal of the wire float assembly must be provided. Tank gauge calibration shall be possible at any tank fluid level (empty, part full, or full.) The sensor operation and accuracy shall be unaffected by changes in the specific gravity of the tank

liquid, and be suitable for use with non-corrosive fluids and fuels up to and including No. 4 fuel oil.

B. The Leak Detector:

1. Detectors shall be solid state and discriminate between oil and water, display the leak with (2) LED's on its indicating transmitter, and send an appropriate alarm signal to the instrument. All leak sensors shall be intrinsically safe, have continuous electronic checking, fail safe to an alarm condition, and have indicating transmitters with a magnetic test mechanism at grade level to exercise the sensors and check the indicating instrument response. Test systems that bypass the sensors or rely only on electronic simulation are unacceptable.

C. Overfill Prevention:

1. Emergency High Level Switch shall be arranged to *(sound an alarm)(provide an electrical interlock)* and activate the overfill alarm via the Fuel Oil Management Center PLC logic when the liquid level reaches 90 percent of tank capacity. Unit shall be float operated, suitable for #2 oil at 150 psi, have brass and Buna N wetted parts, and be mounted in a 1 1/4" tapping in the tank top. Switch shall be hermetically sealed and fully isolated from tank contents and external atmosphere. Electrical connections shall be made externally to the tank in an explosion-proof head assembly approved by UL for Class 1, Group D applications.

2. Provide and install in the tank fill pipe a Preferred Utilities Type 61 Overfill Prevention Valve system. The unit shall have a float operated two stage valving system. The main valve shall shut-off at approximately 95 % of the tank capacity leaving a small bypass valve open to permit hose drain down. At 5 inches above the main valve shut-off, the by-pass valve will close completely to shut-off all flow. The Type 61 Overfill Prevention Valve system is to be used on a gravity feed fuel oil system only.

D. Gauge Installation Requirements:

1. Contractor must adhere strictly to manufacturer's installation procedures. Factory startup and calibration to be included for tank gauging and leak detection system by Gauge manufacturer. This requirement shall not be waived by the contractor.

2. A letter from the tank gauge and leak detection systems manufacturer shall be provided to the mechanical engineer stating that the system was checked out and calibrated by a factory trained representative and that all components are in working order.

3. Tank manufacturer's certified tank print and stick chart must be provided to properly calibrate and manufacture gauge. This information must be provided to the tank gauge and leak detection manufacturer at the time of order.

E. Main Oil Storage Tank Accessories:

1. **Fill Station:** Provide for filling the oil tank a Recessed Wall Fill Station. Station to include an internal explosion- proof complete Overfill Alarm System. System to include tank readout in US Gallons.
Storage tank fill lines shall terminate in the Spill Station. The fill box shall have a minimum of a 5 U.S. Gal. holding capacity and include: a door-seal, locking handle, NEMA 4 rated construction. Include an oil connection gravity fill adapter.

The enclosure shall be equipped with a 2" mounting flange. Cabinet shall be ***304 stainless steel*** 12 gauge construction and be equipped with rear mounted 1/2" NPT drain connection. The door shall match the cabinet construction and be fully gasketed with a neoprene gasket. The door shall mount to the cabinet with:

a. full length stainless steel piano hinge on swing side
b. three point latch with locking handle on the access side (locking at center/ top and bottom).

The entire interior shall be prime coated and painted with white enamel.

Provide Overfill Alarm Indication integral to the Horizontal Spill Container. System to be interfaced with the PWC Panel for proper function.
The station shall consist of an explosion proof Alarm Horn, "Overfill Alarm" light and "Alarm Silence" pushbutton.
Include an explosion- proof rated gallons of inventory digital display.
The light and bell shall be automatically silenced in 90 seconds or instantly silenced when the operator selects the "Alarm Silence" button.
Explosion proof components are required to prevent the ignition of the fuel oil vapors generated from the sun heating the spill container.
Provide an Aluminum Dry Disconnect Adapter, matching dust cap and Truck Coupler for pressure fill applications.

The Caution Sign shall read as follows:

CAUTION WHEN ALARM BELL SOUNDS
OIL TANK FILLED TO CAPACITY
DO NOT OVERFILL

2. Furnish and install for the fuel oil tank a weatherproof cast aluminum vent brick. Vent brick shall be installed flush in the wall be designed to prohibit water infiltration in to the vent line and shall be the full size of the vent pipe in accordance with NFPA-30 2-4.5.2. and NFPA 31 and include NPT threaded connection. A slip on connections are not acceptable.

3. Furnish and install inside the building, at the high point of the oil suction line from the fuel oil tank a machined cast bronze U.L. listed Anti-Syphon Valve. Valve shall be sized to meet the flow requirements and shall be equipped with a spring to match the vertical distance between the highest oil storage level, of the main tank, and the inlet to the fuel oil pumps. The Anti-Syphon to be installed only if the centerline of the fuel oil transfer pump is below the top of the main oil storage tank. Valves with cast iron bodies are not acceptable.

4. Provide where shown in the fuel oil supply line a quick-closing, spring loaded, Lever Gate Valve held open by a wire with fusible link arranged so that the valve will automatically close if the link melts. An oil tight, NEMA 4, electromechanical switch shall be provided to alert the fuel oil management system of valve closure.

5. Provide and install on the tank suction stub a brass, 1-1/2" Double Poppet Foot Valve, with lapped-in seat, double guided poppet stems and 20 mesh monel screen. The foot valve shall come with a 233-FV foot valve extractor fitting which shall allow for easy access to and repair of the foot valve. The foot valve extractor fitting shall come with an extractor wrench of the appropriate size.

6. Provide where shown on the drawings a switch for leak sensing on all containment piping within the building. There shall be a switch on each floor as the containment pipe runs up through the building, and at the end of each pitched horizontal run. Switch shall be

redundant sealed against vapors and fluids, be lever float operated and magnetically actuated. Factory mounted wiring enclosure shall be cast aluminum, NEMA 4, and watertight.

7. Riser Leak Collection Drum: Provide a 55 gallon UN1A1/Y1.8/300 rated, closed head steel drum. Drum is painted black with white heads. Include with the drum a leak sensor. Sensor shall be top mounted and extend to bottom of drum. Sensor shall be redundant sealed against vapors and fluids, be float operated and magnetically actuated. Factory mounted wiring enclosure shall be cast aluminum, NEMA 4, and watertight. Sensor shall interface directly with the pump control cabinet.

END OF SECTION

DIVISION 15

SECTION 15505

RECTANGLE PROTECTED/SECONDARILY CONTAINED ABOVEGROUND DIESELTANK

1. GENERAL

1.1. Provide the rectangular Aboveground Tank system constructed and listed in accordance with Underwriters Laboratories, Inc. (UL) Standard 2085, Aboveground Storage Tanks for Flammable and Combustible Liquids, Protected Type, Non-Metallic Secondary Containment with Vehicle Impact and Projectile Resistance.

1.2. The tank system must comply with all provisions of: 1) UFC 79-7, Appendix A-II-F, for both Vehicle Impact Protection and Projectile Resistance; 2) NFPA 30 and 30A; 3) IFC Chapter 22; and 4) IFC Chapter 34.

1.3. The tank system shall be tested, certified and approved for Vapor Recovery by the State of California Air Resource Board (CARB) under Executive Order VR-302-B Standing Loss Control Recovery System for New Installations of Aboveground Storage Tanks effective 11/30/09.

1.4. The tank system shall be warranted by the manufacturer against defects in material or workmanship for 20 or 30 years following the delivery of the tank. Warranties that limit such coverage for shorter periods will not be permitted. See warranty documents.

2.0 DESIGN AND CONSTRUCTION

2.1 **Primary Tank:** The primary tank shall be rectangular in shape and listed per UL Standard 142. Welds shall be continuous on all sides and exterior seams, conforming to the American Welding Society Standard for continuous weld. The primary steel tank shall be pressure tested at 20 psig for a minimum of 24 hours. All openings shall be from the top only.

2.2 **Secondary Containment Tank:** The secondary leak containment tank shall be rectangular in shape, listed per UL142 and pressure tested at 5psig for a minimum of 24 hours.

2.3 **Tertiary Containment and Corrosion Protection:** The tank system shall include secondary containment consisting of an impervious barrier of 30 Mil (0.76 mm) High-Density Polyethylene enclosing the primary steel tank and insulation material to contain leaks from the primary tank and isolating the primary tank from the concrete to protect against corrosion. All steel exterior to the concrete encasement shall be anti-oxidant powder coated to inhibit corrosion and meet ASTM B117.

2.4 **Concrete Encasement:** A vaulted concrete enclosure shall encase and protect both the primary steel tank and the secondary containment. The concrete encasement shall be 6" thick with a minimum design strength of 4000 psi. The concrete design shall include the following for long-term durability: air entrainment, water-reducing admixture, and steel reinforcement. Concrete placement shall be a visually verifiable monolithic (seamless) pour to ensure the absence of voids on all sides and beneath the steel tank. Designs with an unprotected secondary containment will not be permitted.

The vault enclosure shall have concrete support legs of unitized monolithic construction raising the concrete enclosure a minimum of 3" above the ground to meet visual inspection requirements. A mid-level seam or other cold joint construction which could compromise the liquid tightness (secondary containment) and fire protection capability of the vault is not permitted.

2.5 **Thermal Protection:** The tank system construction shall include covering the outer surface of the primary steel tank with a minimum 1/4" inch of polystyrene foam panels and 6" thick reinforced concrete for thermal insulation to protect against temperature extremes.

2.6 **High Explosive (HE) Blast Resistance:** The tank system design shall have been subjected to a Blast Effects Analysis (BEA) assessing resistance and performance under the following blast threat scenarios per the FEMA 426 - Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings: 1) a 50-pound man-portable improvised explosive device (MPIED) at the standoff distance of 5 ft. ; 2) a 500-pound vehicle-born improvised explosive device (VBIED) at the standoff distance of 20 ft.; and 3) a vapor cloud explosion (VCE) with a load of 10 psi.

The BEA shall conclude that the tank system will resist the explosion loads and remain intact, without failure of the primary tank or movement of the tank exceeding 2". The engineering consultants performing the BEA shall be a nationally recognized firm offering comprehensive services related to blast and impact effects analysis, explosive safety design, vulnerability assessments and threat mitigation.

2.7 **Fire Resistance:** The tank system shall be designed and tested to provide 2 hour fire protection for the primary tank as per UL 2085 2-hour furnace fire test and 2 hour simulated pool fire test. The average maximum rise in temperature of the primary tank during the test shall not exceed 260° F and the maximum temperature of any single point on the primary tank shall not exceed 400° F. No steel members shall penetrate the walls or floor of the concrete encasement to assure isolation from pool fire heat.

2.8 **Leak Monitoring:** A thru-tank leak detection monitoring tube terminating between the primary tank and the secondary containment shall be provided to monitor any leaks from the primary tank.

2.9 **Spill/Overfill Containment:** The tank system shall include a U.L.UL listed 7 gallon spill/overfill container manufactured as an integral part of the primary tank, surrounding the fill pipe, and protected by 2 hour fire rating of the enclosure. The spill/overfill container shall include a stick port and normally closed drain valve to release spilled product into the main tank. Exterior steel shall be anti-oxidant powder coated to inhibit rust

2.10 **Overfill Protection:** Overfill protection shall be provided by the following methods: a) direct reading level gauge visible from fill pipe access; b) valve rated for pressurized delivery located within fill pipe to close automatically at 95% full level; and c) high level alarm.

2.11 **Exterior Finish:** The tank system exterior shall be a low maintenance architectural coating or exposed aggregate concrete finish. Models with fiber clad or painted steel exterior tanks will not be accepted.

3.0 EXECUTION

3.1 The tank system shall be installed in strict accordance with the manufacturer's recommendations, industry standards, and applicable fire and environmental codes. All state and local permits shall be obtained prior to installation.

3.2 The tank system shall be handled, lifted, stored and installed in accordance with the manufacturer's instructions on a reinforced concrete base slab designed to support the fully loaded tank. Tanks shall be marked on all sides with warning signs and product identification as required by applicable codes.

3.3 The tank system shall be grounded in accordance with NFPA 780 and all electrical work shall be in accordance with applicable codes.

END OF SECTION

DIVISION 15

SECTION 15590

FUEL OIL EQUIPMENT AND APPURTENANCES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for #2 fuel oil equipment.

B. Types of fuel oil equipment specified in this Section are:

1. Fuel Oil Tank
2. Fuel Oil Pumps and Controls
3. Piping and Accessories

1.02 REFERENCES

(Not Used)

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design and performance of components and methods specified herein shall comply with the applicable provisions of the codes, standards, recommendations of the entities listed below.

American National Standards Institute (ANSI)

Underwriters Laboratories Inc. (UL)

Building Officials & Code Administration (BOCA)

National Fire Protection Association (NFPA)

American Society of Mechanical Engineers (ASME)

American Petroleum Institute (API)

American Society for Testing & Materials (ASTM)

National Electrical Manufacturers Association (NEMA)

Occupational Safety and Health Administration (OSHA)

Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

National Electrical Code (NEC)

National Fire Protection Association (NFPA)

American National Standards Institute (ANSI)

New York City Mechanical Code- 2008

United Nations (UN)

In addition, specific provisions cited herein shall govern for the associated specific application.

B. Design and performance requirements of fuel oil equipment shall conform to the applicable codes, standards and recommendations of the organizations referenced in 1.03 A, and, for pumps, as specified in the Pump Schedules (hereinafter referred to as "SCHEDULES"), shown on the Basic Contract Drawings.

C. Fuel oil piping systems shall be designed in accordance with NFPA 30 and NFPA 31, and leak detection system shall comply with National Electrical Code.

1.04 QUALITY ASSURANCE

A. Fuel oil equipment, and fuel oil piping and appurtenances, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Fuel oil equipment shall be subject to factory inspection prior to shipping.

C. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment with factory-installed wooden skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle equipment carefully to avoid damage to components.

C. Store equipment in clean, dry spaces and protect them from weather.

D. Comply with manufacturer's rigging instructions for unloading equipment, and moving equipment to final location for installation.

E. Clean all pipe sections of foreign matter and cover ends with temporary sheet metal closures or plastic end caps of sufficient tightness to prevent entry of foreign matter prior to shipping to the construction site.

F. Store pipe, fittings, valves and other components at the construction site on pallets or raised platforms with suitable coverings satisfactory to the Engineer to protect them against damage and weather.

G. Inspect all pipe, fittings, valves and other components for damage before moving them from storage to the point of installation at the construction site.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide factory-fabricated fuel oil equipment of one of the following manufacturers or approved equal:

A. Fuel Oil tank (Steel)

Mass Tank

Adamson Company Inc.

A. L. Eastmond & Sons (EASCO)

Highland Tank & Mfg. Co.

Cardinal Tank Corp.

B. Fuel Oil pumps

Preferred Utilities.

IMO Pump Div., IMO Industries Inc.

Blackmer Pump Div./Dover Corp.

Viking Pump Inc.

Lonergan Pump Systems Inc. w/ Tuthill Pumps

C. Fuel Oil system accessories

Preferred Utilities.

Pneumercator Company Inc.

2.02 MATERIALS

Materials for fuel oil equipment shall be as specified below.

A. Fuel oil Tank

Steel Tank

B. Pumps

Case:	Cast iron
Power Rotor:	Alloy steel
Idler Rotors:	Pearlitic iron

2.03 CONSTRUCTION FEATURES

A. Fuel Oil Tank

1. Provide a 1,000 gallon, double wall, steel storage tank 48" diameter by 150" long as shown on the Basic Contract Drawings. Tank shall be as manufactured by Mass Tank or approved equal.
2. UL labels shall be affixed to tank.
3. The fuel oil tank shall be cylindrical in shape, approved for use in New York City and UL 142 label. Welds shall be continuous on all sides and exterior seams, in conformance to American Welding Society Standard for continuous weld. The primary steel tank shall be pressure tested at 20 psig for a minimum of 24 hours. The secondary leak containment tank shall be pressure tested at 5psig for a minimum of 24 hours.
4. Install tank as shown on the Basic Contract Drawings and in accordance with manufacturer's instructions.
5. Provide fittings for the following:

   Fill line

   Supply line

   Return line

   Remote gauge line

   Normal vent

   Primary emergency vent

   Secondary emergency vent

   (2) 2" spare tappings (what is the need for this, can this be fabricated?)

   (2) 4" spare tappings (what is the need for this, can this be fabricated?)
6. Within the primary tank, under each tank opening, provide wear/striker plate.
7. Provided welded steel support saddles for fuel oil tank. Number and location of saddles shall be as recommended by the tank manufacturer and capable of supporting the full capacity of the tank.

8. A thru-tank leak detection monitoring tube terminating between the primary tank and the secondary containment shall be provided to monitor any leaks from the primary tank.

9. Provide lifting lugs on tank capable of withstanding weight of tank with a safety factor of 3 to 1.

B. Fuel Oil Transfer Pumps and Straining Set

1. Provide packaged automatic fuel oil transfer and monitoring system to ensure a reliable supply of fuel oil to the emergency generators specified under this contract. System to be factory fabricated/ tested and certified as a complete unit. Field assembled units are not acceptable. Packaged automatic fuel oil transfer and monitoring system as manufactured by Preferred Utilities model ATPS-103-208-50-D-DP-L-TG2-Z1121, or approved equal

2. Provide control panel with lead/lag, level monitoring, LCD operator display, alarm and event summary, capability to communicate simultaneously with Modbus protocol and capability to dial out to pager via plug-in.

3. Pump System Piping and Mounting: Provide a duplex pump and straining set that is factory assembled with components piped and mounted on a common base plate. Base plate shall form a pan or basin suitable for containment. Pan and side rails shall be ¼" thick plate steel. Pipe shall be scheduling 40 ASTM A-53 Grade "A" with ANSI B16.3 Class 150 malleable iron threaded fittings. Base plate shall include 3" steel side rails continuously welded for containment and to contain potential leaks shall extend beyond any fitting, valve, pump, strainer, or selector valve.

4. Pump Containment Basin (See Specification in 3. above): Provide a ½" containment pan plugged drain connection.

5. Positive Displacement Pumps:Provide and mount two (2) positive displacement gear pumps, with cast iron housing, and mechanical seal. The pump shall be capable of developing a 13.3 psig vacuum (25" Hg) at 0 PSIG as factory tested. For normal operation, vacuum shall not exceed 7.4 psig (15" Hg).. Pump shall have bolted mounting foot. Pumps that have aluminum, brass, or bronze housings or rotors are not acceptable. Packing gland equipped pumps, close-coupled pumps, Carbonator shaft mounted pumps or centrifugal pumps are not acceptable.

6. Motors: Provide and mount two (2) open drip proof, rigid base, standard NEMA frame motors. Motor shall have copper windings; a dynamically balanced rotor, ball bearings and a heavy gauge steel NEMA Frame.

7. Pump and Motor Assembly: The pumps shall be connected to the piping in the set through stainless steel flexible metallic braided jackets, and the pump and motor assemblies shall be welded to the base plate. Pumps and motors shall be mounted on a structural steel channel and equipped with flexible coupling and full OSHA approved coupling guard. Pumps and motors shall be mounted with bolts threaded into the steel channel for ease of maintenance. Mounting bolts shall not penetrate the secondary containment basin. Flexible coupling general: The pump shall be connected to the motor by an elastomeric jaw type flexible coupling that does not require lubrication. The coupling wear member shall be replaceable without disturbing the alignment of either the pump or motor. Sizing of the flexible coupling shall be based on motor horsepower and rpm. Materials of construction: The coupling body shall be sintered iron and cast iron. The elastomeric wear member shall be NBS Rubber.

8. Pump Isolation and Check Valves: Provide four (4) pump isolation valves. Locate one (1) valve on the suction and discharge side of each pump. Isolation valves will allow off-line pump maintenance without system shutdown. Isolation valves shall be ball type, rated for 400 psig, with stainless steel ball and teflon seat. Valve to provide full flow while open and positive shutoff when closed. Provide two (2) class 150 swing check valves. One (1) located on the discharge of each pump. Valves to have bronze seat and a threaded cap.

9. Fuel Oil Strainer: Provide one (1) duplex strainer, on the suction side of the pumps. Strainer to be sized for less than ½ psi pressure drop through a clean strainer basket with the maximum anticipated flow in the suction line. Strainer shall be one piece cast iron body and shall be suitable for 200 psi. Strainer baskets shall be 40 mesh stainless steel. Strainer shall come complete with lever wrench handle and be bolted in place without bolting through pan.

10. Strainer Differential Pressure Switch: Strainer shall be equipped with factory mounted and wired differential pressure switch to indicate that the basket needs to be cleaned. Indicating scale plate shall be three position color coded for easy indication of strainer basket flow status. Switch shall provide indication on the main pump set control cabinet to alert operators.

10. Relief Valves: Provide in dischqrge piping of each pump a relief valve sized to relieve the full outlet flow of the pump without causing the pump motor to overload or any component's pressure rating to be exceeded if the discharge is inadvertently valved off. Relief valves must be externally mounted from the pumps and piped to the return line in the field in accordance with NFPA 30. Pump internal relief valves shall not be accepted. Relief valve shall be as manufactured by Preferred Utilities Type R relief valves, or approved equal

11. Pressure Gauges

    a. Provide compound pressure gauge on the suction side of the strainer. The gauge shall read 30" vacuum to 15 psig. Compound pressure gauge shall be as manufactured by Preferred Utilities Catalog No. 11131, or approved equal

    b. Provide pressure gauge on the discharge side of each pump. The gauge shall read from 0-100 psig. Each gauge shall be equipped with an isolation ball valve. Pressure gauge shall be as manufactured by Preferred Utilities Catalog No. 11135,or approved equal.

12. Containment Basin Leak Detection Switch: Provide a factory installed float operated containment basin leak detection switch to shut off the pumps and energize an audible and visual alarm should a leak be detected. The leak sensor shall be of stainless steel construction. The leak sensor shall be internally mounted within the pump basin. Electrical connections shall be contained in a factory installed weatherproof junction box.

13. Control Cabinet: Provide a fuel oil management control cabinet factory mounted on the fuel oil pump set. The control cabinet shall be completely pre-wired, factory programmed and tested to ensure job site reliability. The pump set and control cabinet shall be the product of one manufacturer for single source responsibility. Control cabinet shall bear UL-508A label.

    Provide factory assembled NEMA 4 rated control panel mounted operator interface control switches, indicators and displays. All programmable logic control (PLC) indicators, manual back-up control switches and indicators must be mounted on the integral sub-plate. Panel to include a NEMA 4 alarm light mounted on top of the panel. Alarm light shall be visible from all angles. Include an isolated 120V duplex receptacle with faceplate. Provide a sub plate mounted power isolation switch for the PLC.

14. Control and Monitoring Hardware: System shall be designed to accomplish the control sequences as outlined herein. The system shall include automatic pump set lead/lag (1/2, 2/1, auto selection switch), storage tank and day tank level monitoring, leak monitoring, LCD operator display, manual back-up H-O-A switches, time and date stamped alarm and event summary, and the system shall include the capability to simultaneously communicate to a Building Management System (BMS) via Modbus protocol, and dial out to an alphanumeric pager system via field installable plug-in option modules in the future. The control system shall be a microprocessor-based design with field expandable plug-in input/output modules. The control system shall be factory configured and stored on an EEPROM, and shall be password protected from re-configuration by unauthorized / un-qualified personnel. The controller shall be designed so that it will "fail safe" in the event there is a microprocessor failure. Relay logic shall not be accepatable. Control hardware shall include combination magnetic motor starters with overload protection and circuit breakers. Provide safety interlocks to shutdown both pumps during any of the following conditions: day tank "leak detected", riser "leak detected", day tank "high-high" level, day tank "vent" and main storage tank "vent". Vent leak sensors shall be as manufactured by Preferred Utilities Model RBS, or approved equal, and mounted in capped tees off of vent line to prevent obstruction. These interlocks must continue to ensure safe pump operation even if the controller has failed or is out of service or the pump set is operated in manual "hand" mode. System shall be as manufactured by Preferred Utilities Plant Wide Controller (PWC), or approved equal

15. Operator Interface: The control system shall include a 16 line x 40 character or greater LCD display for pump set status, storage tank level indication, alarm listing, and trouble shooting functions. LCD screen shall be backlit and have a contrast dial for screen adjustment. Provide a tactile feedback, numeric keypad for data entry. Provide dedicated pushbuttons for Alarm Silence and for the Home Page display and a "Hand-Off-Automatic" control switch for each fuel pump. In "Hand" position the pump shall be capable of manual operation in the event of a controller failure. The control system shall monitor the position of each "Hand-Off-Automatic" control switch. Should a switch be put into the "Off" position, the controller shall log the event with a Time/Date stamp and store within the controller memory. Provide an elapsed time recorder (ETR) to measure running time for each pump. Provide a Fuel Oil Overview Display (Home Page) capable of simultaneous viewing of pump set status, day tank status and main storage tank status. The Fuel Oil Overview display shall include the following information:

(1) Lead Pump Selection – Auto/Manual
(2) Pump Status – Off/Run/Standby
(3) Day Tank Status – Normal/High/Low/Leak/ Vent Line
(4) Main Tank Status – Capacity in US Gallons, Normal/High/Low/Leak
(5) Day Tank Status – Capacity in US Gallons, Normal/High/Low/Leak
(6) Vent Alarms for all oil tanks
(7) Discrete alarms for each field mounted sensor
(8) Three most recent alarms

16. Alarm and Event Logs: Control system shall include a minimum of 200 alarms, events and operator actions in its memory. Provide a scrollable alarm display page for viewing the most recent 8 events with capability to view the complete 200 point alarm/event memory. Each event and alarm condition must be displayed with a distinct description with a time and date stamp. New alarms shall trigger the common alarm output relay. Events shall be recorded, but shall not trigger an alarm. A dedicated Alarm Silence button shall silence the alarm output. The control system shall record and annunciate the following alarms: Pump Thermal Overload, Pump Loss of Flow, Pump Set Failure, and each specific type of leak alarm, Riser Leak, Containment Pipe Leaks, Day Tank Vent Leak, etc. The control system shall record the following events: Pump Started, Pump Control Switch in "Off" position, and Pump Selected as Lead.

17. Fuel Pump Alternation and Lead-Lag Operation: Provide equipment selector switch (1/2, 2/1, and auto), microprocessor-based day tank level control. The lead fuel pump shall be energized when day tank oil level falls below 66% of the gross capacity. The lead pump shall continue to operate until the day tank level is greater than 80% of the gross capacity. The control system shall be programmed to have a pump alternate after 168 hours of operations. The control system shall automatically energize the back-up pump upon detecting a low level condition of 40% of the gross capacity. Both pumps shall then continue to operate until the level of oil reaches the high level point of 90% of the gross capacity. Upon detection of loss of flow or fail to start lead pump, the control system shall automatically energize the backup pump and de-energize the lead pump. A pump suction line integrity test shall be

automatically initiated weekly that runs each pumps for two minutes to confirm the operability of both pumps.

18. Pump Automatic Sequencing Flow Switch: Provide a time delayed flow sensing switch on the discharge of the pump set to bring on the lag pump should the lead pump fail to maintain flow. Flow switch shall be vane operated to actuate a single double throw snap switch. Switch shall be factory wired to the control cabinet for alarm and backup pump operation. Switch shall be rated for 250 psig. Provide a flow switch outlet isolation valve for maintaining the flow switch without draining the fuel system.

19. Fuel Storage Tank Monitoring: The monitoring system which is a part of the software of the Preferred Utilities Plant Wide Controller (PWC), or approved equal, shall include main storage tank level sensor and discriminating leak sensor monitoring. Provide a continuous display of tank content, in both gallons and inches of product, within the main storage tank. Tank alarm displays shall not interfere with the display of the tank content. Provide data recall of the instantaneous display of tank content at the time of leak alarm condition. The monitoring system shall include an overfill alarm circuit test pushbutton to provide instantaneous proving of audible and visual alarm circuitry associated with instrument overfill alarm contact. The controller must be field expandable using plug-in input modules to monitor up to 2 storage tanks and 6 discriminating leak sensors.Fuel storage tank monitoring system shall be as manufactured by Preferred Utilities TG-EL-WF-7C, or approved equal.

20. Day Tank Inventory Level Monitoring (Gallons): The control system which is a part of the software of the Preferred Utilities Plant Wide Controller (PWC), or approved equal, shall include day tank level sensor and leak sensor monitoring, Provide a continuous display of tank content, in both gallons and inches of product, within the day tank. Tank alarm displays shall not interfere with the display of the tank content. Provide data recall of the instantaneous display of tank content at the time of leak alarm condition. The controller must be field expandable using plug-in input modules to monitor up to 2 storage tanks and 6 discriminating leak sensors. Sensor shall be Preferred Utilities Model TR-420-Z1121, or approved equal.

21. Communications: The pump set must include an optically isolated RS485 communications data highway. The RS485 protocol shall allow: Auto/Manual mode change, lead pump selection, sensing and silencing of alarms, change of any configuration parameter, change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting BMS system is not included under this contract. System shall be capable of field upgrade the control system to "dial out" to an alphanumeric pager system via field installable plug-in modules.

C. Tank Gauging, Leak Monitoring & Overfill Prevention Components

1. The liquid level sensor

a. Sensor shall consist of an aluminum, submersible (NEMA 6P) electronics head external to the tank and a float internal to the tank. The float shall be connected to the sensor head by a flexible stainless cable. The flexible cable shall allow installation or removal when overhead obstructions are present. The sensor shall include an external test mechanism to allow overfill alarm and full tank calibration checks without removing the sensor from the tank.

b. The sensor's operation shall be unaffected by internal tank obstructions located within 7" of the float cable. The assembly shall mount to the tank through a standard 4" 125/150 lb. flat faced flange opening with standard bolt pattern. The mechanism's control head shall be constructed of 1/4" cast aluminum. This sealed transducer housing shall encapsulate all transmitter electronics in a non-conductive oil and be moisture tight. Sensor assembly shall be water resistant and capable of operating in a submerged or manhole environment without damage. Tests that electronically simulate a high tank level instead of physically moving the float are not acceptable.

c. Sensor shall be capable of easy installation and maintenance with only 14 inches of clearance between the flange and any overhead obstructions. Tank gauge calibration shall be possible at any tank fluid level (empty, part full, or full.) The sensor operation and accuracy shall be unaffected by changes in the specific gravity.

d. Sensor shall be a level control as manufactured by Preferred Utilities TG-EL-WF-7C, or approved equal, for a., b. and c., above.

2. The Leak Detector

Each detector shall be solid state and discriminate between oil and water, display the leak with (2) LED's on its indicating transmitter, and send an appropriate alarm signal to the instrument. All leak sensors shall be intrinsically safe, have continuous electronic checking, fail safe to an alarm condition, and have indicating transmitters with a magnetic test mechanism to exercise the sensors and check the indicating instrument response. Test systems that bypass the sensors or rely only on electronic simulation are unacceptable. Leak detectors shall be provided in the day tank rupture basin.

3. Overfill Prevention

a. High level switch shall be arranged to sound at the indoor level and leak alarm panel and activate the overfill alarm via the Plant Wide Controller (PWC), or approved equal, when the liquid level reaches 90 % of gross capacity. Alarms shall sound until manually silenced or the fuel level drops below 90% of gross capacity. Unit shall be float operated, suitable for #2 oil at 150 psi, have brass and Buna N wetted parts, and be mounted in a 1 1/4" tapping in the tank top. Switch shall be hermetically sealed and fully isolated from tank contents and external atmosphere. Electrical connections shall be made externally to the tank in an explosion-proof head assembly approved by UL for Class 1, Group D applications.

b. Critical High Level Overfill protection shall be provided by valve rated for pressurized delivery located within fill pipe to close automatically at 95%

full level. The Critical High Level alarms shall sound at the indoor level and leak alarm panel and outdoor high level alarm station until manually silenced or the fuel level drops below 90% of gross capacity

c. High Level Switch shall be Preferred Utilities Model PLS-1-Z1121, or approved equal.

4. Gauge Installation Requirements

a. Contractor must adhere strictly to manufacturer's installation procedures. Factory startup and calibration shall be included for tank gauging and leak detection system by gauge manufacturer. This requirement shall not be waived by the contractor.

b. A written certificate from the tank gauge and leak detection systems manufacturer shall be provided to the Engineer stating that the system was tested and calibrated accurately a factory trained representative and that all components correctly and as required.

c. Tank manufacturer's certified tank print and stick chart must be provided to properly calibrate and manufacture gauge.

5. Fuel Oil Storage System Accessories

a. Fill Station: Provide a recessed wall fill station, Preferred Utilities Model #2-SS4-3-Z1121, or approved equal, for filling the oil tank at location shown on the Basic Contract Drawings. Station shall include an Overfill Alarm System including tank readout in US Gallons. Storage tank fill line shall terminate in the Spill Station. The fill box shall have a minimum 5 U.S. gal. holding capacity and include: a door-seal, locking handle, NEMA 4 rated construction. The enclosure shall be equipped with a 2" mounting flange. Cabinet shall be 304 stainless steel 12 gauge construction and be equipped with rear mounted 1/2" NPT drain connection. A ½" drain line with ball valve shall be run to a 55 gallon drum as shown on the Fuel Oil Piping Diagram. An alarm shall sound when the drum is half full as detected by a leak sensor mounted at mid height of drum. The door shall match the cabinet construction and be fully gasketed with a neoprene gasket. The door shall mount to the cabinet with full length stainless steel piano hinge on swing side. The entire interior shall be prime coated and painted with white enamel.

Provide a redundant check valve in the fill line close to the fill box.

Provide overfill alarm indication integral to the Fill Station shall be interfaced with the PWC Panel for proper function.
The station shall consist of an Alarm Horn, "Overfill Alarm" light and "Alarm Silence" pushbutton. Include a Rated Gallons of inventory digital display. The audio alarm shall be silenced when the "Alarm Silence" button is pushed.

Provide aluminum, dry disconnect adapter, matching dust cap and cam lock truck coupler for pressure fill applications.

Provide Caution Sign that shall read as follows:

CAUTION WHEN ALARM BELL SOUNDS
OIL TANK FILLED TO CAPACITY
DO NOT OVERFILL

b. Furnish and install for the fuel oil tank a weatherproof cast aluminum vent brick. Vent brick shall be installed flush in the wall be designed to prohibit water infiltration in to the vent line and shall be the full size of the vent pipe in accordance with NFPA-30 2-4.5.2. and NFPA 31 and include NPT threaded connection. A slip on connections are not acceptable.

c. Furnish and install inside the building, at the high point of the oil suction line from the fuel oil tank a machined cast bronze U.L. listed Anti-Siphon Valve. Valve shall be sized to meet the flow requirements and shall be equipped with a spring to match the vertical distance between the highest oil storage level, of the main tank, and the inlet to the fuel oil pumps. The Anti-Siphon is to be installed only if the centerline of the fuel oil transfer pump is below the top of the main oil storage tank. Valves with cast iron bodies are not acceptable.

d. Provide and install on the tank suction stub a brass, 1-1/2" Double Poppet Foot Valve, with lapped-in seat, double guided poppet stems and 20 mesh monel screen. Double Poppet foot Valve shall be as supplied by Preferred Utilities Mfg. Corp. Model Type 22. The foot valve shall come with a 233-FV foot valve extractor fitting which shall allow for easy access to and repair of the foot valve. The foot valve extractor fitting shall come with an extractor wrench of the appropriate size.

e. Provide where shown in the fuel oil supply line a quick-closing, spring loaded, Lever Gate Valve held open by a wire with fusible link arranged so that the valve will automatically close if the link melts. Oil tight, NEMA 4, electromechanical switch shall be provided to alert the fuel oil management system of valve closure.

f. Provide where shown on the drawings a switch for leak sensing on all containment piping within the building. There shall be a switch on each floor as the containment pipe runs up through the building, and at the end of each pitched horizontal run. Switch shall be redundant sealed against vapors and fluids, be lever float operated and magnetically actuated. Factory mounted wiring enclosure shall be cast aluminum, NEMA 4, and watertight.

g. Leak Collection Drum: Provide a 55 gallon, closed head steel drum. Drum shall be painted black with white heads. Include with the drum a level sensing leak detector. Sensor shall be top mounted and extend to bottom of drum. Sensor shall be redundant sealed against vapors and fluids, be float operated and magnetically actuated. Factory mounted wiring enclosure shall be cast aluminum, NEMA 4, and watertight. Sensor shall interface directly with the pump control cabinet. Level sensor shall be as manufactured by Preferred Utilities Model PLS-1-Z1121, or approved equal.

D. Pipe and Pipe Fittings

1. Horizontal fuel oil piping shall consist of a primary (carrier) pipe, completely enclosed and centered within the secondary (containment) pipe by use of centering spacers furnished by the pipe manufacturer. The secondary containment pipe shall be sized and configured so that the space between the primary and secondary pipes to permit the draining of fuel to a low point in the segment of piping. Coordinate the piping (size and configuration). . The supply and return piping shall each have its own secondary piping.

2. Piping system shall be designed to contain #2 fuel oil.

E. Gate and Check Valves

1. Provide valves where shown on the Basic Contract Drawings, in accordance with the specification in this Section.

2. All gate and check valves shall be the products of one manufacturer.

3. Swing check valves shall be suitable for installation in the horizontal position.

4. All valve Figure Numbers specified in the Gate and Check Valves shown in this Section, are those of Vogt Machine Co., Inc.for forged steel valves (2 inches and smaller).

5. Valves shall comply with MSS SP-84

6. Gate valves shall be risingstem, OS&Y, back seated, bolted bottet ands gland (gasketed), renewable seats and wedges.

7. Check valves shall have renewable seats and discs, and bolted bottets.

8. Materials: Body & Bonnet – Forged steel, ASTM A 105 Stem and Disc – 11 – 14 Chrome, ASTM A 182 F6 heat treated Seat – Base metal satellite.

9. Ends shall be threaded.

10. Class Rating shall be 600.

11. Subject to compliance with requirements of this Section, valves shall be one of the following manufacturers, or approved equal:

(a) Forged Steel Valves

Vogt (Henry) Machine Co. Inc.

Smith Valve Corp.

F. Fuel Oil Specialties

Provide the following fuel oil specialties where shown on the Basic Contract Drawings:

1. Pressure Relief Valves

Bronze body, steel spring, 300 psi rating, adjustable pressure settings, screwed ends, Preferred Utilities Type R; or approved equal.

2. Pressure Regulating Valves

   Bronze body, steel spindle end spring, 300 psi rating, screwed ends, Preferred Utilities Model BQ; or approved equal.

H. Pipe Hangers and Supports

1. Design, fabricate and provide all pipe hangers and supports adequate to support the piping, allow for imposed forces, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures.

2. Hangers and supports shall include guides, anchors, stops, restraints, saddle strands, stays, braces, bolts, nuts, washers, expansion bolts, pipe clamps, beam clamps, and supplementary structural steel for pipe hanger and supports.

3. All hangars and supports shall conform to requirements of MSS SP-58 and SP-69.

4. Structural members required for suspended loads shall be shop fabricated for bolting to building structural members.

5. Do not hang piping from other piping. In no case shall hangers be supported by means of vertical expansion bolts.

6. Keep the different types of hangers to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

7. Support riser piping independently from the connected horizontal piping.

8. Pipe support attachments to the riser piping shall be riser clamp lugs at each floor level.

9. Anchors shall be adequately designed to rigidly oppose forces acting on them and shall be embedded in structural concrete or connected to the building structural steel framework.

10. Unless otherwise specifically approved, steel piping hanger size and spacing shall be as follows:

Pipe Size	Maximum Hanger Spacing	Minimum Rod Size
1/2" to 1"	5 ft. o.c.	3/8"
1-1/2" to 3-1/2"	9 ft. o.c.	1/2"

11. All hangers and supports shall comply with the seismic requirements under this contract.

12. Hangers and supports shall be manufactured by Grinnell Corp., Carpenter & Patterson Inc., Michigan Hangar Co. Inc., or approved equal.

I. Sleeves, Seals, and Escutcheons

1. Pipe Penetration through Walls, Partitions and Floors

(a) Piping passing through masonry or concrete walls and framed partitions shall have a trim opening cut no greater than necessary for the installation of a sleeve secured therein. Sleeve shall be 1/2 inch in diameter larger than the diameter of the insulated pipe. Sleeve shall be flush with the finished wall or partition surface.

(b) Sleeves through concrete floors for piping shall have the opening 1/2-inch in diameter larger than the diameter of the pipe passing through. Floor sleeves shall project one inch above floor slab.

(c) Pack the annular space between the pipe and sleeve with mineral wool. Additionally at penetrations through fire-rated barriers, seal the annular space to retain the fire rating integrity of the barrier with non-hardening through-penetration firestops having F-ratings compatible with fire ratings of the barriers in which they are installed, per ASTM, E814. Firestop systems shall be UL-approved, and shall be as manufactured by 3M, Bio-fireshield, Inc., General Electric Co., Dow Corning Corp., or approved equal.

(d) Sleeves in walls and floors shall be galvanized steel pipe, Schedule 40. Sleeves in partitions shall be 20-gauge galvanized sheet metal.

2.04 SHOP TESTS

A. Equipment shall be tested according to manufacturer's standard shop tests.

B. All shop tests may be witnessed by the Engineer. Notify the Engineer 14 days in advance of scheduled tests.

C. Prior to shipment, the manufacturer shall test all "Packaged" assemblies. A copy of the test procedures shall be sent to the consulting engineer and owner. The owners and or the consulting engineer at their discretion shall observe this and all other tests.

D. Electrical components shall be functionally tested with all instruments and controls. Settings of all instruments and controls shall be verified for conformance to these specifications. A certificate of factory testing, together with a copy of the wiring diagram shall be placed in the control cabinet prior to shipment. The UL-508 label shall be affixed to the inside of the cabinet.

E. Pump Sets shall be fully tested including pressure tests prior to shipment. Testing shall include both a pressure and vacuum testing period. First, the complete pump set shall be pressure tested to rated pressure using an air pressure source. The test shall confirm that the pump set piping system can maintain rated pressure for 4 hours. Next, the complete pump set shall be brought to a vacuum greater than 12.3 psig. The test shall confirm that the pump set piping system can maintain this vacuum for 4 hours. Following a pressure and vacuum test the pump set shall be given a full operational test. The pump set shall be connected to a fuel oil supply and return. The pump set shall be operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within 10% of rated motor amps. During the test the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested.

F. Fuel oil storage tank hydrostatic testing is required to ensure tightness prior to shipment. The minimum pressure for testing the tank shall be 25 psi. The hydrostatic pressure shall be maintained until all joints and connections have been visually inspected for leaks, but in no case for less than one-half hour. The tank shall not show any permanent deformation as a result of the test. The test shall be run for no less than one-half hour.

PART 3. EXECUTION

3.01 PRE-INSTALLATION INSPECTION

Fully inspect pipes for damage. Locate, cut out or replace damaged pipe.

3.02 INSTALLATION

A. Install equipment in locations shown on the Basic Contract Drawings, in accordance with manufacturer's installation procedures.

B. Field install all electrical devices furnished under this Section.

C. Verify that electrical wiring installation is in accordance with Engineer-approved manufacturer's submittal and in accordance with installation requirements of Division 16.

D. Coordinate all trades to ensure that the installation of the equipment is not in conflict with the work performed by other trades.

E. Install piping system in accordance with manufacturers' installation procedures, requirements of NFPA 31 and applicable codes, and as specified.

F. Coordinate piping installation with other Work to avoid interference. Coordinate as necessary to ensure that all hangers, supports, sleeves and other built-in devices are incorporated in forms or in masonry work to avoid necessity of cutting finished structure.

G. The piping layouts shown on the Basic Contract Drawings shall be considered as diagrammatic. Install piping suitable in every respect for the Work intended and clearances required.

H. Vent leak sensors shall be mounted in capped Tees off of vent line to prevent obstruction.

I. The rear mounted ½" NPT drain connection of the Fill Station cabinet shall be connected to a ½" drain line with ball valve shall be run to a 55 gallon drum. A leak detector at mid-level shall annunciate an alarm when the drum is half full.

J. Access Doors: Provide a complete list of all access doors required in finished construction and any other areas requiring inspection or service behind such finished construction. Access doors shall be furnished and installed under other Sections.

K. Contractor shall provide hasp and pad lock on fuel oil pump set control panel.

L. Run exposed piping perpendicular and parallel to walls and floors.

M. Install all valves and specialties to permit easy operation and ready access for maintenance and repair.

N. Install an isolation gate valve at each branch connection to supply mains and elsewhere as indicated on Basic Contract Drawings.

O. Install drain valves at low points and vents at high points in mains, risers, branch lines, and elsewhere as required for system drainage and venting.

P. Comply with installation requirements for hangers and supports and for pipe penetration sleeves, seals and escutcheons.

Q. The tank system shall be grounded in accordance with NFPA 780 and all electrical work shall be in accordance with applicable codes.

3.03 FIELD TESTS

A. Provide qualified technical representatives of the manufacturers to advise on field tests.

B. The leak detection performance of the storage tank's monitoring system shall be tested and verified by a qualified independent consultant.

C. Steel piping from the pump discharge to the oil burner connection shall be hydrostatically tested at 200 psi, for a period of two hours. All equipment controls and instruments shall be isolated from the piping system during the test.

D. Fuel Oil Leak Detection System:

1. Upon completion of the fuel oil leak detection system installation, a factory-furnished fuel sensing cable, of a length established by the system manufacturer, shall be temporarily installed at the far end of the leak detection circuit. One foot of the fuel sensor shall be immersed in a trough containing fuel oil, to a depth of 1/8-inch, to confirm that an alarm is generated and the location thereof is identified on the control module. The procedure shall be repeated utilizing water. The test shall be performed and certified in the presence of Engineer.

2. Upon completion of the test and removal of the temporary test section, the containment piping system shall be sealed.

3. A graphic display map, prepared from "as-built" drawings, shall be furnished upon completion of the test. The map shall indicate the location of the permanent sensor cable and landmarks such as equipment, piping access parts, changes in cable direction, and cable distance readings.

4. Provide qualified technical representatives of the system's manufacturer to instruct and train Authority personnel in the operation and maintenance of the leak detection system for a minimum of 8 hours.

E. Piping system shall be hydrostatically tested to either 150% of working pressure or 50 psig for 30 minutes. All piping found leaking shall be repaired or replaced. After test has been completed, maintain 25 psig pressures on primary piping and monitor pressure loss while installing secondary containment piping. Secondary containment piping shall be pneumatically tested with soap at 5 psig for 30 minutes upon completion. Make repairs as required if pressure loss occurs for either piping system.

3.04 PAINTING

A. Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Piping to be painted shall be as shown on the Basic Contract Drawings. Painting shall be in accordance with the requirements of Section entitled "PAINTING".

B. Storage tank shall be thoroughly cleaned and painted in accordance UL 142.

3.05 PIPE, VALVE AND TANK IDENTIFICATION

A. Pipe identification

1. Provide approved adhesive bands in sets of two, one identifying the piping system type and second, the direction of the flow. Sets shall be provided in quantities sufficient to accommodate the installation.

2. For 2 ½ -inch or smaller pipe, the letters and the arrow shall be not less than one inch high. Bands shall be in colors and shall conform to ANSI A 13.1.

3. Adhesive bands shall be W.H. Brady Co. "Quick-Label", or approved equal.

B. Valve Tags, Charts and Schedules

1. Provide each valve with a 2-inch diameter 18 gauge brass tag with brass chain. Service designation shall be 1/4-inch high on the upper line, and valve number shall be 1/2-inch high on the lower line. The characters shall be indented and filled with durable black compound.

2. Provide diagrammatic valve charts and schedules, using a valve numbering system that differentiates between classes of service and indicates floor level of valve location.

3. Tags shall conform to the numbers, locations, and uses listed in the valve charts and schedules. Valve charts and schedules shall be mounted under glass in wood frames or aluminum self-closing frames.

END OF SECTION

DIVISION 15

SECTION 15590

FUEL OIL EQUIPMENT AND APPURTENANCES

APPENDIX "A"

1. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

2. Storage Tank and Day Tank

   a. Tank details showing critical dimensions and locations of all fittings, tappings, anchor straps, hydrostatic monitoring system and piping connections.

   b. Manufacturer's installation details and instructions including required clearance.

   c. Equipment materials and gauges

   d. Field test report for the storage tank's monitoring system.

   e. Manufacturer's latest calibration charts.

3. Pumps

   a. Pump performance characteristic curves with design points clearly indicated.

   b. Shop drawings indicating dimensions, required clearances, and methods of assembly of components

   c. Electrical wiring diagrams for electrical power supply, interlock and control.

   d. Installation instructions

   e. Certified shop test results.

   f. Operation and maintenance manuals, including replacement and spare parts lists

4. Fuel Oil Controls

   a. Single line flow diagrams and details showing all components that function in the sequences such as, valves, sensors, switches, leak detectors, controllers, etc.

   b. Sequences of Operation

   c. Points schedule

   d. Product outlines and dimensions including required clearance

   e. Components and materials

   f. Performance data

   g. Installation instructions

END OF APPENDIX "A"

DIVISION 16

SECTION 16000

ELECTRICAL GENERAL REQUIREMENTS

PART 1. GENERAL

1.01 SUMMARY

Unless otherwise shown on the Basic Contract Drawing, or unless otherwise specified in other Sections of these Specifications, the general requirements specified in this Section are applicable to all electrical work of this Contract. Additional requirements applicable to individual Sections of these Specifications are specified in those Sections, or are shown on the Basic Contract Drawing.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C 2	National Electrical Safety Code.
	American Society of Testing and Materials (ASTM)
ASTM D 178	Standard Specification for Rubber Insulation Matting.
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code.
	Occupational Safety and Health Administration (OSHA)

1.03 QUALITY ASSURANCE

A. Any entity performing Work shall have had experience on at least two projects involving quantities and complexities at least equal to those required under this Division or the applicable Section thereof.

B. All workmen performing under this Division shall be skilled workers of the trade involved. Where specialty work, such as splicing or welding are required, submit proof of training, experience and work history for each workman, for review by the Engineer. Only approved workmen shall perform specialty work.

C. All electrical work shall be performed under the supervision of an electrical contractor, licensed in the state (and the city as required) in which the work is to be performed. Submit a copy of the qualifying license for review by the Engineer.

D. All calculations required by this and other various Sections of these Specifications, or as shown on the Basic Contract Drawing, shall be certified and sealed by a Professional Engineer licensed in the state in which the Work is to be performed, and shall be submitted to the Engineer for review.

E. Various Sections of these Specifications contain the requirement for the specific material or equipment to be furnished with an experience statement "satisfactorily used for purposes similar to those intended herein" or words of similar intent and a statement that specifies the required experience time. These statements shall mean that the manufacturer of the material or equipment being furnished for the Work specified in this Contract shall have manufactured similar material or equipment to that specified, for at least the time specified.

F. In various Sections of this Division there is a statement that refers to the length of required experience that must be satisfied.

G. Polyvinyl Chloride (PVC): PVC conduits, PVC-insulated power wiring, or items containing PVC, except PVC-insulated wiring for communications systems, remote control, signaling, and power limited circuits, shall not be installed in any indoor area. PVC-insulated wiring for communications systems, remote control, signaling, and power-limited circuits shall be furnished and installed in accordance with NFPA 70.

H. Asbestos

Asbestos or items containing asbestos shall not be furnished or installed.

I. Conformance Labels

All electrical materials and equipment for which there is a nationally recognized standard shall bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories Inc., Factory Mutual, ETL, or approved equal. Where the phrase "where there are established UL standards, shall bear the UL label", or words of similar intent appear in other Sections, the instructions for the conformance label above shall apply.

1.04 CODES AND STANDARDS

A. The electrical installation shall conform to all requirements of ANSI C2, NFPA 70, and the codes and standards specified in other Sections, all local codes and the requirements of OSHA, which would be applicable if the Authority were a private corporation.

B. Standards publications of technical organizations and regulatory agencies are referenced in other Sections, and unless stricter requirements are indicated, materials and equipment so specified shall be manufactured, tested and installed to conform, as a minimum, to the requirements of such reference standards and publications.

C. Installations for aeronautical markers, lighting, guidance signs, and other work as shown on the Basic Contract Drawing, shall comply with the standards of the Federal Aviation Administration (FAA), where applicable.

D. In case of conflict between provisions of codes, laws and ordinances, the more stringent requirement shall apply.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturers' original unopened protective packaging.

B. Store materials in original packaging in a manner to prevent soiling, physical damage, wetting or corrosion prior to installation.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible maintain protective coverings until installation is complete and remove such covers as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces to the satisfaction of the Engineer.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 SPECIAL TERMS

Throughout this and other Sections of this Division the term "Authority" is used. In PATH contracts, substitute the term "PATH" is deemed substituted for the term "Authority".

PART 2. PRODUCTS

2.01 MATERIAL AND EQUIPMENT TO BE FURNISHED

Equipment and materials furnished shall be new and unused, prior to this installation, first grade commercial quality and shall be essentially the standard cataloged products of a manufacturer regularly engaged in the manufacture of the products. Only those items specifically shown on the Basic Contract Drawing as existing, relocated or Authority furnished shall be reused in this installation. Rebuilt or remanufactured equipment will not be permitted.

2.02 IDENTIFICATION

A. All parts of equipment, such as switchboards, panel boards, safety switches, motor starters, circuit breakers, time clocks, contactors and similar items shall be identified by name, function or control with laminated plastic nameplates consisting of two black sheets with one white sheet bonded to and between the two outer sheets and having letters machine engraved in the face sheet to the depth of the white plastic. Nameplates shall not be smaller than 1 inch by 3 inches with characters not less than one-quarter inch. Where letter sizes are not specified, use one-inch high letters for panel boards, switchboards and motor control centers and one quarter inch high elsewhere. Nomenclature shall be according to a schedule approved by the Engineer.

B. All device plates other than lighting switch plates, telephone and 120 volt, single phase, 15 or 20 ampere receptacles, shall have black or white (as directed) silk-screened lettering Helvetica Medium type face (or other type face as directed by the Engineer) designating:

1. System.
2. Voltage (where applicable).
3. Number of phases (where applicable).
4. Current rating (where applicable).
5. Frequency (where applicable).

C. Before placing orders for nameplates or silk-screened device plates, submit a typewritten list to the Engineer for review.

D. The outside of the covers of all junction or pull boxes located above hung ceilings and the inside of the covers of all junction or pull boxes exposed shall be labeled with an indelible marker indicating the operating voltage and the system contained therein.

E. All device plates of receptacles connected to a standby or emergency power distribution system shall be labeled with an orange plastic nameplate, engraved with the panel board and circuit number to which the receptacle is connected. Nameplate character engraved shall be not less than one-quarter inch in height.

F. Unless otherwise shown on the Basic Contract Drawing, all panel boards, switchboards, switchgear, circuit breakers, switches and transformers connected to a standby or emergency power distribution system shall be finished Federal Safety Orange in color.

2.03 RUBBER MATTING

A. Provide continuous insulated rubber matting not less than 36 inches wide and not less than one quarter inch thick in one piece in front of:

1. Substation transformers.
2. Switchgear.
3. Switchboards.
4. Motor control centers.
5. Panel boards.
6. On each side and end of a standby or emergency generator set.
7. Other locations as shown on the Basic Contract Drawing.

B. Matting shall conform to ASTM D 178, Type 2.

PART 3. EXECUTION

3.01 GENERAL

A. Work of this Division shall include all labor, material and apparatus necessary for the completion of all electrical work as shown on the Basic Contract Drawing and as hereinafter specified, left ready for satisfactory operation.

B. Coordinate with Authority operations and construction by other trades.

1. Coordinate with the Work of all trades as necessary to facilitate timely completion, avoid unnecessary cutting and patching and to ensure proper installation and operation of all equipment.
2. Coordinate all components and aspects of the Work, in order to minimize power shutdowns to the power distribution systems. Should any part of the Work require an "off-hours" shutdown in excess of 8 hours, supply temporary services or feeders as required to maintain operation of the existing systems and equipment.

3. Furnish to appropriate trades, shop drawings, catalog cuts and instructions necessary for construction of concrete bases, concrete encasement, anchor bolts, and other construction required to accommodate installations under other Sections.

4. Obtain all wiring diagrams and other instructions required for proper electrical connection of equipment installed or furnished under other Divisions of these Specifications and coordinate the installation, wiring and connections for equipment furnished under this Division, or other various Divisions.

C. The arrangement of electrical equipment and conduit runs as shown on the Basic Contract Drawing and described in the Specifications is schematic. Locate and install electrical work in coordination with other trades so that all electrical equipment and material is installed with working clearances in accordance with NFPA 70. Route conduit to avoid interference with existing installation and with work to be performed by other trades.

D. The location of equipment and motors shown on the Basic Contract Drawing shall be subject to minor revisions due to field conditions or coordination with other trades without any increase in Contractor's compensation. Prior to roughing-in, verify the exact location of all electrical connections to equipment and motors from reviewed shop drawings and field verification.

E. Maintain records of all inspections, testing, overload and overcurrent settings throughout the construction and any corrective actions taken, and submit records to the Engineer for review.

F. All electrical work shall be subject to inspection by the Engineer. Correct any deficient work, as required for the approval of the Engineer.

G. Any equipment, materials, wiring or labor that are a necessary part of the electrical work and to its proper performance, although not specifically mentioned herein or shown on the Basic Contract Drawing, shall be furnished and installed as if called for in detail, without additional cost to the Authority.

3.02 REMOVALS, RELOCATIONS, RECONNECTIONS, RESTORATIONS

A. Relocate existing equipment and materials as shown on the Basic Contract Drawing.

B. Unless otherwise shown on the Basic Contract Drawing, existing equipment and materials that are to be removed and not required to be relocated under this Contract, will become the property of the Contractor and shall be removed from the property of the Authority, and shall be properly disposed of. Disposal of equipment and materials shall comply with all local, state and Federal laws and regulations as if the Authority was a private corporation.

C. Unless specifically shown on the Basic Contract Drawing, salvaged equipment and materials shall not be reused in the installation.

D. If existing electrical feeders, wiring, conduit, lighting fixtures or equipment interfere with the installation of new construction of any trade, the existing electrical feeder, wiring and conduit shall be rerouted or the equipment relocated in a manner approved by the Engineer to permit installation of the new construction. Where existing circuits or devices, or portions of the existing wiring system are to remain in service, but are interrupted by the construction, continue the existing wiring to maintain the remainder of the wiring system in operation.

E. Notify the Engineer immediately of any damage caused by the Contractor to existing wiring, services or feeders that are to remain in service. Repair the damage in a workmanlike manner to restore to service, at no cost to the Authority.

F. Before shutdown or discontinuation of service on any circuit, system or feeder, coordinate such activities with the Engineer in order to minimize shutdown periods. Provide a minimum of two weeks notice in writing to the Engineer before performing any shutdowns. The minimum period may be reduced with the express written permission of the Engineer.

3.03 LOCATION OF EQUIPMENT

A. Unless otherwise shown on the Basic Contract Drawing, the location of outlets or devices, from finished floor to center of plate or device, shall be as follows:

1. Lighting switches: 48 inches.
2. Thermal switches: 48 inches.
3. Receptacles: 16 inches.
4. Telephone outlets: 16 inches.
5. Fire alarm stations: 48 inches.
6. Fire alarm horn/light signals: 7 feet 6 inches.
7. Clocks: 7 feet 8 inches.

B. Unless otherwise shown on the Basic Contract Drawing, the location of equipment, from finished floor to top of enclosures shall not exceed 6 feet, 6 inches, and shall not protrude more than 4 inches if higher than 27 inches.

1. In exposed or public locations, panel boards and cabinets shall generally be flush mounted and all covers shall be identical in layout and size, and shall be installed to maintain a level and straight top and bottom alignment.
2. In concealed locations, or in closets or electrical or mechanical rooms, or non-public locations, panel boards and cabinets shall generally be surface mounted and shall be installed to maintain a level and straight top alignment.

3.04 DISSIMILAR METALS

A. Dissimilar metals shall mean those metals that are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating so as to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

B. Transitions in raceways, from one metal to a dissimilar metal shall only be made at boxes or other enclosures, except where shown on the Basic Contract Drawing.

3.05 NAMEPLATES

Secure nameplates on equipment or walls with stainless steel or brass screws.

3.06 RUBBER MATS

A. Install rubber mats in front of each panelboard, switchboard, motor control center, switchgear and substation transformers, and along each side and the end or each generator set, or as shown on the Basic Contract Drawing.

B. Rubber mats, when installed, shall lay flat without curling.

3.07 CUTTING AND PATCHING

A. Perform all cutting and patching of existing construction required for installation of all materials and equipment as specified in this Division.

B. Perform all patching to match existing adjacent construction to the satisfaction of the Engineer and using the best possible workmanship of the various trades involved.

3.08 FINAL FIELD TESTS

A. The entire electrical installation shall be inspected prior to final acceptance testing, thoroughly cleaned, and damaged finishes touched up after final completion and prior to final acceptance testing being performed. Not less than 30 days prior to the testing, furnish a test plan, to the Engineer for review, outlining all aspects of the testing, including tests to be performed and the expected results.

B. Perform the following field test in the presence of the Engineer to demonstrate the reliability of the electrical installation. Give the Engineer a minimum of one-week advance notice of such tests.

1. Operate all electrical systems and equipment for a period of 24 hours, unless in the opinion of the Engineer, a different test period is required, to prove the operation and performance of a system and its equipment.

2. Should the foregoing test reveal any defects, promptly correct such defects and re-run the tests until the entire installation conforms to the requirements of these Specifications and the Basic Contract Drawing.

C. Tests requiring certified reports and those requiring factory or field inspection shall be conducted and reported to the Engineer in conformance with standards herein specified.

D. In addition to the tests outlined above, after completion of the electrical system and prior to occupancy:

1. The following equipment and devices, as a minimum, shall be thermographically inspected utilizing a Hughes Aircraft Probeye infrared detector, or approved equal, with videotaping attachment.

a. High voltage cable splices and connections.

b. Switchboard.

c. Transformer.

d. Switchgear.

e. Panelboards.

f. Motor control centers.

g. Automatic transfer switch and emergency power system connections.

h. Chiller motor and starter connections.

i. All 600 volt (nominal) cable connections rated 100 amperes (#3 AWG) or greater.

j. Other equipment as shown on the Basic Contract Drawing.

2. The inspection shall be made by an independent inspection company such as Infrared Services, Inc, Montville, N.J., General Electric Apparatus Service Division, or approved equal. The inspection shall be made with all equipment, motors, lighting fixtures, and miscellaneous loads operating and with all equipment covers removed. Inspection reports complete with color photographs of the infrared scan and control photographs indicating the ambient temperature and any hot spots of each item inspected shall be submitted to the Engineer for approval. Any equipment, connections or devices indicated to be operating improperly performing equipment shall be replaced or repaired by the Contractor at no cost to the Authority. The cost of the inspections and necessary repairs shall be included in the Contract.

E. Demonstrate to the Engineer equipment or systems installed or modified in this Contract.

1. After completion of all testing, and prior to placing equipment or systems in operation, demonstrate the features and operation of the equipment or systems to the Engineer, and all other staff or interested parties, as designed by the Engineer, so that operational and maintenance personnel are familiarized with the equipment and systems, as follows:

a. Switchboards and panelboards.

b. Transformer.

c. Switchgear.

d. Motor control centers.

e. Fire alarm and smoke detection systems.

f. Automatic transfer switches.

g. Standby/Emergency generator sets.

h. Other equipment as shown on the Basic Contract Drawing.

2. Provide the necessary accessories, test equipment, and personnel, for each demonstration.

3. Complete all arrangements for the demonstrations through the Engineer.

4. Upon the completion of each demonstration or instructional session, obtain "sign-off" from the Engineer. The "sign-off" shall state that the demonstration or instructions for use were provided, that they were complete and were given to the designated personnel.

END OF SECTION

SECTION 16000

ELECTRICAL GENERAL REQUIREMENTS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Substation and high-voltage transformers.
2. Switchgear.
3. Switchboards.
4. Motor control centers.
5. Emergency lighting battery systems.
6. Working drawings for the installation sequence of medium voltage cables, and other systems where shown on the Basic Contract Drawing, including the reel designations for each leg of the installation. Drawings shall include the calculations for pulling tensions and sidewall pressure of all cable pulls, including identification of manhole locations with splices and manholes that will be "pulled-through" without splicing. Calculations shall be certified and sealed by a Professional Engineer licensed in the State in which the Work is to be performed.

B. Catalog Cuts

1. Conduit, and fittings.
2. Wire and cable.
3. Wiring devices.
4. Multi-outlet assemblies.
5. "Standard" outlet and junction boxes.
6. Medium voltage cable, splicing and termination kits.
7. Lightning arresters.
8. Capacitors.
9. Panel boards and cabinets.
10. General purpose transformers.
11. Circuit breakers.
12. Lighting fixtures.
13. Pulling devices and end seals.
14. Special pull and junction boxes.

15. Supporting devices.

C. Certifications

Training, experience and work history for certified splicers and welders.

D. Design Calculations

Calculations where required by the Specifications or the Basic Contract Drawing.

E. Maintenance Manuals

Operation and maintenance manuals, where required by the Specifications or the Basic Contract Drawing.

F. Schedules

Nameplate designations.

G. Record Documents

One set of Shop Drawings revised, completed and brought up to date showing the permanent construction as actually made, in accordance with "Shop Drawings, Catalog Cuts and Samples" of Division 1, and showing the exact location of all equipment and conduit runs, as actually installed.

H. Site Inspection Reports

A final copy of the records and certified test reports for all tests, to the Engineer for review, for not less than the following:

1. Primary cable and terminators insulation testing.
2. Insulation testing of 600V (nominal) cables rated 100 amperes (#3 AWG) and above.
3. Ground resistance test of each service ground.
4. Ground fault circuit breaker and receptacle testing.
5. Setting of all adjustable overcurrent devices.
6. Setting or size of all overload elements installed, indicating the following:
   a. Motor designation.
   b. Nameplate horsepower, full load current, voltage and phases.
   c. Operating current and voltage.
   d. Overload element size or setting.
7. Emergency power distribution equipment and system test results.

END OF APPENDIX "A"

DIVISION 16

SECTION 16110

RACEWAYS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for raceways.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The raceways shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

American National Standards Institute (ANSI)

ANSI C80.1 - Specification for Rigid Steel Conduit, Zinc Coated

ANSI C80.3 - Electrical Metallic Tubing - Zinc Coated

ANSI C80.5 - Rigid Aluminum Conduit

ANSI C80.6 - Intermediate Metal Conduit - Zinc Coated

National Electrical Manufacturers Association (NEMA)

FB1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies

RN1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

TC3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

TC6&8 - PBC Plastic Utilities Duct for Underground Installations

TC14 - Thermosetting Resin Conduit and Fittings

ASTM International (ASTM)

E800 Standard Guide for Measurements of Gases Present or Generated During Fires

National Fire Protection Association (NFPA)

70 - National Electrical Code

Underwriters Laboratories Inc. (UL)

1 - Flexible Metal Conduit

5 - Surface Metal Raceways and Fittings

6 - Rigid Metal Conduit

209 - Cellular Metal Floor Raceways and Fittings

360 - Liquid-Tight Flexible Steel Conduit

514B - Fittings for Conduit and Outlet Boxes

651 - Schedule 40 and 80 Rigid PVC Conduit

651A - Type EB and A Rigid PVC Conduit and HDPE Conduit

797 - Electrical Metallic Tubing

870 - Wireways, Auxiliary Gutters, and Associated Fittings

884 - Underfloor Raceways and Fittings 1242 - Intermediate Metal Conduit

1479 - Standard for Fire Tests of Through-Penetration Firestops

1684 –Reinforced Thermosetting Resin Conduit

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The raceways and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 3 years.
2. The Manufacturer shall be ISO 9001 certified.
3. All materials utilized for a RGS/PVC installation shall be by a single manufacturer. The contractor shall not utilize conduits from different manufacturers in a conduit system, or mix conduits, fittings, bodies and clams from different manufacturers.

B. Installer Qualifications

1. The installer shall be certified by the RGS/PVC manufacturer to install PVC coated conduit systems

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete. Where ever possible, all devices and accessories shall be in place.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions. If any electrical devices or accessories must be shipped loose they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with suitable non-corrosive tag.

D. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

E. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

F. Touch up any damage to finishes to match adjacent surfaces.

G. The equipment shall be shipped on wood pallets for ease of handling and installation.

H. Each shipping section shall have removable lifting eyes.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, furnish and install products as listed on the Contract Drawings.

2.02 MATERIALS

A. General

1. Locations, types and sizes of raceways are shown on the Contract Drawings.
2. Minimum size of conduit shall be 3/4 inch.
3. Conduit shall be supplied in a minimum of 10-foot lengths and accordance with UL.

B. Rigid Metal Conduit

1. RGS - Rigid galvanized steel conduit (Heavy-wall) hot dipped galvanized inside and out, with hot dipped galvanized threads, conduit shall conform to UL 6 and ANSI C80.1.
2. IMC - Intermediate metal conduit, galvanized steel (medium-wall) conduit, threads shall be galvanized and shall conform to ANSI/UL 1242 and ANSI C80.6.
3. ALC - Aluminum conduit shall conform to UL 6 and ANSI C80.5.
4. All preformed elbows shall be the same in construction to and of a type designed for use with the appropriate conduit and shall conform to UL 6.

5. All fittings shall be threaded and shall conform to NEMA FB1.

6. If threads are cut after the zinc coating has been applied, the threads shall be treated with protective coating of zinc equivalent to hot-dipped process.

C. Electrical Metallic Tubing

1. EMT - Electrical metallic tubing (thin-wall) shall be galvanized steel and shall conform to ANSI/UL 797 and ANSI C80.3

2. All fittings shall be indenter or compression type made of malleable or pressed steel and shall conform to ANSI/NEMA FB1.

D. Polyvinyl Chloride Coated Rigid Galvanized Steel Conduit

1. RGS/PVC shall be PVC coated rigid galvanized steel conduit (heavy wall). All conduit shall be hot dipped galvanized steel inside and out, with hot dipped galvanized threads. Conduit shall be certified as conforming to UL-6 and ANSI C80 prior to application of the PVC coating. All PVC coated conduit boxes, bodies and fittings shall be hot dipped rigid galvanized steel, certified as conforming to UL-514B prior to application of the PVC coating. Unless otherwise noted all hardware shall be stainless steel type 304.

2. The interior of all conduits, boxes, bodies and fittings shall have a uniformly applied urethane coating, a minimum of 2 mils thick. The exterior of all conduits, boxes, bodies and fittings shall have a 40 mils thick PVC coating, smoothly and uniformly applied by dipping in liquid plastisol. All conduits shall have a series of longitudinal ribs, 40 mils in thickness, to protect the PVC coating from damage during installation. All threads shall be protected from damage until installed.

3. All PVC coating materials shall be certified as conforming to NEMA RN-1 and UL-6, after application of the PVC coating. The PVC shall be certified as providing the primary corrosion protection, in accordance with UL-6. All materials shall bear the UL label accordingly. Third party certification with periodical audits for compliance is required and shall be furnished to the Authority as requested by the Engineer unless otherwise indicated on Contract Drawings.

4. The exterior PVC coating and interior urethane coating applied to all conduits shall have sufficient flexibility to permit field bending without cracking, flaking, or chipping of any of the coatings.

5. All PVC coating shall be UV resistant.

E. Cellular Metal Floor Raceway

1. Cellular Metal Floor Raceway and Fittings shall conform to NFPA 70 and ANSI/UL 209.

F. Flexible Metal Conduit

1. FSC - Flexible steel (galvanized) conduit shall conform to ANSI/UL 1.

2. LSC - Liquid-tight flexible metal conduit shall conform to ANSI/UL 360.

3. Fittings shall be of a type designed for use with the respective conduit and shall conform to ANSI/UL 514B.

G. Surface Metal Raceways

1. Surface raceways shall conform to ANSI/UL 5.

2. Surface metal raceways shall come complete with all necessary accessories for installation.

H. Underfloor Raceways

1. Duct, fittings, and accessories shall be suitable for encasement in concrete and shall conform to NFPA 70 and ANSI/UL 884.

2. Underfloor raceways shall come complete with all necessary accessories for installation.

I. Rigid Nonmetallic Conduit

1. PVC Type 40 Standard Wall polyvinyl chloride conduit shall conform to ANSI/UL 651 and NEMA TC-3.

2. PVC Type 80 Heavy wall polyvinyl chloride conduit shall conform to ANSI/UL 651.

3. PVC Type "A" Light wall polyvinyl chloride conduit shall conform to NSI/UL 651A

4. PVC Type EB Light wall polyvinyl chloride conduit shall conform to ANSI/UL 651A and NEMA TC-8.

5. PVC Type DB Light wall polyvinyl chloride conduit shall conform to ANSI/UL 651A and NEMA TC-8.

6. High Density Polyethylene (HDPE) Type 40 Standard wall High-Density Polyethylene conduit shall conform to ANSI/UL 651A and NEMA TC-6.

J. Fiberglass Reinforced Epoxy Conduit

1. Fiberglass Reinforced Epoxy conduit (FRE) shall conform to ANSI/UL 870. All FRE conduit installed above or below ground shall be UL listed as an approved raceway for above or below ground installations respectively. FRE shall be one of the following, as indicated on the Contract Drawings:

   a. Heavy Wall Fiberglass Conduit (FRE-S): FRE -S conduit wall thickness shall be not less than 70 mils for conduits less than 4 inch trade size, not less than 90 mils for conduits 4 inch trade size and not less than 110 mils for larger than 4 inch trade size. Type FRE -S shall only be used where direct buried or encased in concrete and shall be UL listed for the intended use.

   b. Extra Heavy Wall High Impact/Bullet Resistant Fiberglass Conduit (FRE -XW): FFE-XW shall have a wall thickness not les than 250 mils for all trade sizes. Type FRE -XW shall be used for exposed exterior installations, next to active roadways, where installed on or below bridges and elevated roadway or where subject to physical damage. All FRE -XW shall be UL listed for above ground installation.

2. FRE Conduit installed in exterior locations, inside tunnels or in railroad/subway, areas shall not contain any compounds or materials that release halogens when burned. Submit certification from conduit manufacturer that the conduit and fittings are zero-halogen. Zero-halogen shall be defined as not exceeding the following gas toxicity levels, as tested in accordance with ASTM E800:

	Gases	Values (max P.P.M.)
1.	Hydrogen Chloride	0
2.	Hydrogen Bromide	0
3.	Hydrogen Cyanide	<1
4.	Hydrogen Sulfide	0
5.	Vinyl Chloride	<10
6.	Ammonia	0
7.	Aldehides as HCHO	<10
8.	Oxides of Nitrogen	<50
9.	Carbon Monoxide	<250
10.	Carbon Dioxide	<12,000

K. Fire Stops, Through Penetrations of Conduits

1. Where raceways penetrate wall or floor, fire stops with a fire rating equal or greater than the rating of the penetrated wall or floor shall be provided.

2. All fire stops shall conform to the UL 1479.

L. Wireways

1. Wireways shall be seamless galvanized steel construction, cover to be locked with captive screws and shall conform to ANSI/UL 870.

2. Wireways shall come complete with all necessary accessories for installation.

M. Fastening Devices

1. Provide inserts, clamps, bolts and washers, or any other type of fastening devices conforming to the requirements of Section 16190 required to secure conduits to walls or above hung ceilings. Unless otherwise shown on the Contract Drawings, all fasteners shall be hot dipped galvanized and of sizes and types recommended by the equipment manufacturer.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

1. All conduit bends shall be accomplished with a trade approved bending tool and in accordance with the manufacturer's recommendations and NFPA 70.

2. Ream conduit ends free from burrs prior to installation, and draw joints up tight.

3. Make transitions in conduit from one metal to a dissimilar metal only at boxes or other enclosures, unless otherwise shown on the Contract Drawings.

4. Install concealed conduits or tubing in as direct a line as possible.

5. Install exposed raceways, located above hung or accessible ceilings, parallel with or at right angles to the lines of buildings and as close to the ceiling as possible, unless otherwise shown on the Contract Drawings.

6. Install expansion fittings in all conduits that cross expansion joints, where conduits attach to independent structures, or where exposed to large temperature changes.

7. Securely fasten threaded conduits entering enclosures, other than threaded cast boxes, by means of two lock-nuts, one on each side of the enclosure. Terminate the conduits in insulated bushings.

8. Cap all free ends of empty conduit to prevent water entrance.

9. Conduit through roofs and external walls of buildings, manholes and other structures shall be watertight.

10. Where portions of an interior raceway system are exposed to widely different temperatures, make provisions to prevent circulation of air from a warmer to a colder section through the raceways.

11. Apply zinc rich paint to all exposed threads after joints have been made up clean and tight.

12. Support all conduits as required in these Specifications under Section 16190.

13. All conduit runs shall leave or enter structures perpendicularly.

14. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

15. RGS/PVC shall be installed in accordance with the manufacturer's recommendations.

B. Rigid Metal Conduit

1. RGS shall be used where fire alarm systems are installed.

2. RGS/PVC shall not be used indoors.

3. IMC may not be used in wet locations, or high corrosive area, otherwise NFPA 70 Article 342 fully applies.

C. Electrical Metallic Tubing

1. EMT used for power feeder or branch circuits, shall not exceed 2-inch trade size. EMT used for control circuits and communications systems shall not exceed 4-inch trade size.

D. Polyvinyl Chloride Coated Rigid Galvanized Steel Conduit

1. All conduit mounting channels and supports shall be stainless steel. All accessories shall be PVC coated hot dipping rigid galvanized steel. U-bolts shall be specially formed and sized to snug fit the outside diameter of the conduit. All screws and bolts shall have PVC encapsulated heads. All nuts, bolts, screws, which cannot be PVC coated shall be stainless steel.

2. The RGS/PVC conduit system shall be installed in accordance with manufacturer recommendations, using the proper tools specifically manufactured for installation of RGS/PVC conduit systems. Any PVC coating damaged during the installation shall be either repaired in accordance with the manufacturers recommended procedures and materials, or the damaged conduit section replaced, as determined by the Engineer at no additional cost to Authority.

E. Cellular Metal Floor Raceway

1. Comply with NFPA 70.

F. Flexible Metal Conduit

1. Install FSC for motor connections and for other equipment connections where subject to movement and vibration. Conduit shall be installed to permit maximum flexibility, without crushing or permanent deformation, and shall not exceed 18 inches in length, without approval of the Engineer.

2. Use LSC for the same installation conditions as FSC above, and where also subjected to one or more of the following conditions:

   a. Exterior locations

   b. Condensating, moist, wet or humid conditions;

   c. Corrosive atmospheres;

   d. Water spray;

   e. Dripping oil, grease or water.

3. LSC installed within tunnel facilities, ventilation buildings, railroad/subway tunnels, and stations shall have a galvanized steel core with a low smoke, halogen free, polyurethane outer jacket.

4. PVC jacketing may be substituted for the low smoke, halogen free, polyurethane outer jacket only for non-tunnel, outdoor installations. PVC jacketing will not be accepted as a substitute for installation within the tunnels, ventilation buildings, railroad/subway tunnels and stations.

5. Install FSC and LSC with a separate, insulated copper, code-sized, equipment grounding conductor, installed inside the flexible conduit.

G. Surface Metal Raceways

1. Only metallic surface metal raceways will be permitted, unless otherwise shown on the Contract Drawings. Installation shall be in accordance with manufacturer's written recommendations and instructions accompanying the raceways.

2. Provide surface raceway system with means for assuring a continuous ground path throughout.

3. Use fittings without sharp edges introduced into any part of the raceway system.

H. Underfloor Raceways

1. Install underfloor raceways in accordance with the Contract Drawings, NFPA 70, ANSI/UL 884, and the recommendations and requirements of the manufacturer.

I. Polyvinyl Chloride Conduit

1. PVC conduit shall not be used indoors.

2. PVC conduits Types 40 and 80 shall conform to NFPA 70 Article 347 except it shall not be used indoors.

3. PVC conduits Types 40, A and EB shall be used for concrete encasement.

4. PVC conduit Type DB shall be used for direct burial, sand encased.

J. High-Density Polyethylene Conduit

1. HDPE conduit shall not be used indoors.

2. HDPE Type 40 shall be used for direct burial or encased in concrete.

K. Fiberglass Reinforced Epoxy Conduit

1. Shall be installed as described in NFPA 70.

2. All sweeps, bends, or changes in direction shall be done with fittings only.

3. All conduit elbows, joints, bodies, condulets and fittings shall be manufactured from the same materials and of a construction type identical to the conduit.

   a. Where type FRE-XW conduit is installed, type FRE-S bodies and condulets may be utilized for trade size where type FRE-XW conduit bodies are not manufactured.

4. All FRE conduit joints shall be of the epoxy adhesive type. When cured, the epoxy joint shall be as strong as the conduit itself and completely watertight.

5. The FRE conduit system shall be installed in accordance with manufacturer recommendations, using the manufacturers recommended tools and methods. Any part of the FRE conduit system damaged during the installation shall be either repaired in accordance with the manufacturers recommended procedures and materials, or the damaged conduit section replaced, as determined by the Engineer, all at no additional cost to the Authority

6. All materials utilized for a FRE installation, including elbows, fittings, joints and joint epoxy shall be by a single manufacturer. Do not utilize conduits and associated materials from different manufacturers in a conduit system, or mix conduit, fitting, couplings and joint epoxy from different manufacturers.

L. Dissimilar Metals

1. "Dissimilar metals" shall mean those metals, which are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data.

2. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

3.02 FIELD TESTS

A. Conduit Cleaning and Testing

1. After installation of conduits and accessories and completion of all concreting operations, if any, carefully clean and clear all conduit runs of all obstructions and foreign matter to the satisfaction of the Engineer.

2. Test conduits, in the presence of the Engineer, by pulling through each conduit a flexible cylindrical mandrel having an outside diameter not more than 1/4 inch smaller than the inside diameter of the conduit, but nominally 85 percent of the trade diameter, whichever is larger. Only nylon cable of adequate strength shall be used to pull the mandrel through the conduit system. The use of rope will not be permitted.

B. Connections to Existing Conduits

1. Where conduits installed under this Contract are connected to existing conduits, or conduits installed by others, test the entire run to the nearest box, manhole, handhole, or equipment enclosure as specified in this Section.

2. Report immediately to the Engineer any defect or stoppage found in portions of the conduit system not installed under this Contract. Do not attempt to rectify any defect or stoppage found in conduit not installed under this Contract unless specifically instructed to do so by the Engineer. The Contractor's compensation for the rectifying of such defects or stoppages at the direction of the Engineer will be determined in accordance with the Clause of the Contract providing compensation for Extra Work.

3. The Engineer will be the sole judge as to whether a defect or stoppage exists. Perform all tests required by the Engineer to enable the Engineer to make a decision.

END OF SECTION

SECTION 16110
RACEWAYS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Raceway systems - only when shop drawings are required by the Contract Drawings

B. Catalog Cuts

1. Conduit and Tubing and Accessories
2. Surface Metal Raceway and Accessories
3. Under floor Raceway and Accessories
4. Wireways and Auxiliary Gutters

C. Certificates

1. For FRE installations utilizing zero-halogen FRE, submit manufacturers' certification that no FRE conduit, fittings, and accessories exceed the toxicity levels specified in paragraph 2.01 J3 when tested in accordance with ASTM E800.
2. For FRE, PVC, and RGS/PVC installations, submit proof of installer certification by the Respective manufacturer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16114

CABLE TRAYS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the requirements for metallic and non-metallic cable trays and their accessories.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM A 153	Standard Specification for Zinc Coatings (Hot Dip) on Iron and Steel Hardware
ASTM A 123	Standard Specification for Zinc Coatings (Hot Dip) on Assembled Steel Products
ASTM A 653	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
ASTM A 568	Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low Alloy, Hot-Rolled and Cold-Rolled Sheet, General Requirements for
ASTM D 150	Standard Test Methods for AC Loss Characteristics and Permitivity (Dielectric Constant) of Solid Electrical Insulation
ASTM D 696	Standard Test Methods for Coefficient of Linear Thermal Expansion of Plastics
ASTM D 2583	Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 162	Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
ASTM E 662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
ASTM A 924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
	Military Specification (MIL)
MIL C 24643	Cable and Cord, Electrical, Low Smoke for Shipboard use, General Specification

National Electrical Manufacturers' Association (NEMA)

NEMA FG 1	Fiberglass Cable Tray Systems
NEMA VE 1	Metallic Cable Tray Systems

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 258	Standard Research Method for Determining Smoke Generation of Solid Materials

Underwriters Laboratories (UL)

UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The cable trays shall be designed, manufactured, and tested in accordance with the latest revision of the applicable ASTM, NEMA, NFPA, UL and MIL. SPEC. Standards. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

1.04 QUALITY ASSURANCE

Cable trays of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver material in manufacturer's original, unopened, protective packaging.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURER

Subject to compliance with requirements of this Section, provide cable tray products of one of the manufacturers listed on the Basic Contract Drawing.

2.02 CONSTRUCTION FEATURES

A. Cable trays shall be furnished as a complete system, including, but not limited to, all necessary fasteners, old-down clips, connectors, support systems, barrier strips, covers, horizontal and vertical fittings including elbows, reducers, tees and crosses. The cable tray system shall be in accordance with the requirements of NFPA 70.

B. Cable tray fittings shall be fully assembled by the manufacturer.

C. As shown on the Basic Contract Drawing, cable tray shall be ventilated or non-ventilated, and of the ladder, trough, solid bottom or channel-type, with or without covers of the ventilated or non-ventilated type.

D. Cable tray size shall be as shown on the Basic Contract Drawing. The minimum size shall be:

1. Width: 12 inches (inside)
2. Depth: 4 inches (outside)
3. Radii of Fitting: 24 inches (inside)

2.03 METALLIC CABLE TRAYS

A. Material

As shown on the Basic Contract Drawing, the material shall be:

1. Galvanized Steel
   a. Ladder, trough and solid bottom cable trays
      (1) Hot dipped after fabrication
      (2) Minimum 16 gauge
      (3) The material and galvanizing process shall be in accordance with the following: ASTM A 123 ASTM A 153 ASTM 568ASTM A 653 ASTM A 924
2. Aluminum
   a. Ladder and trough cable trays
      (1) Aluminum alloy shall be 6063-T6
   b. Solid bottom cable trays
      (1) Aluminum alloy shall be 5052
      (2) Corrugated construction
   c. Cover
      (1) Aluminum alloy shall be 3003
      (2) Solid flanged construction

B. Connectors

Connectors for tray sections shall be universal for use on straight sections and fittings. Connectors shall be of the high pressure, bolted type with the required number of bolts.

2.04 NON-METALLIC CABLE TRAYS

A. Splice plate fasteners shall be fiberglass encapsulated stainless steel. Fasteners must be capable of withstanding torque of 10 foot-pounds, without damage to threads or encapsulated coating.

B. Material

1. Cable trays shall be of pultruded glass reinforced polyester, meeting the following standards:

   ASTM D 2583, ASTM D 696, ASTM D 150ASTM E 162, ASTM E 84

2. The completed assembly shall pass the smoke generation test for both flaming and non-flaming when tested in accordance with ASTM E 662 and NFPA 258.Smoke density shall be measured by using the Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials in NFPA 258.

3. Halogen content not to exceed 0.2 percent when tested in accordance with MIL C 24643.

4. Flammability classification in accordance with UL 94.

C. Physical Properties

The manufacturer shall provide values for Mechanical, Electrical, Fire Retardant, Thermal Bending and Other Properties of the cable tray products in reference to related ASTM, NEMA, NFPA, UL, MIL SPEC Standards for the Purchaser's review

D. Veil

Glass reinforced polyester components shall have a dacronnexus veil applied to exterior surfaces to improve weatherability and inhibit ultraviolet degradation. An ultraviolet stabilizer shall be incorporated into the resin formulation in order to further inhibit ultraviolet degradation.

2.05 STRUCTURAL DESIGN

A. Cable tray shall be of ladder type design having "C" or "I" shaped side rails for metallic tray and "C" or "E" shaped side rails for non-metallic tray, as shown on the Basic Contract Drawing.

B. Rungs shall be of the same material as the side rail and securely bonded in place. Rungs shall be mechanically locked into place by means of an intermediate side rail flange to prevent rollover when cables are pulled into the tray.

C. Unless otherwise shown on the Basic Contract Drawing, cable tray sections shall be 20 feet in length (+/- 1/8 inch) excluding splice plates. Each straight section shall be furnished with pre-punched holes for splice plate attachment.

D. Tray system design shall meet or exceed loading capabilities in accordance with NEMA VE 1 and NEMA FG 1for Metallic and Non-metallic trays, respectively.

E. The fully loaded tray shall also be capable of supporting a 200 lb. concentrated static load at mid-span without failure or permanent deflection.

F. Manufacturer shall provide certified test data to verify compliance with above loading and deflection data.

2.06 WARNING SIGNS

Furnish and install warning signs, wording and layout as shown on the Basic Contract Drawing.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install cable tray in conformance with NEMA VE 1, NEMA FG 1 and NFPA 70 requirements, in accordance with the manufacturer's instructions and the following minimum requirements:

1. Cable tray shall be installed as a complete and continuous system, using the manufacturers standard fittings, from source to termination.
2. Drop-offs, take-offs, or extensions from cable tray system shall be via raceways approved by the Engineer. Raceways shall be fastened to the cable tray system using fittings approved or listed by a qualified electrical testing laboratory. Open or exposed cable leaving a cable tray system without a raceway is not permitted.

B. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of 10 feet, maximum.

C. Use expansion connectors where indicated in NEMA VE 1 and NEMA FG 1.

D. Cut standard straight sections to length in field.

E. Install warning signs, not to exceed 50 foot on center, on each side of the cable tray, along the route of the cable tray, located to be visible from the floor level.

F. Provide bonding continuity between metallic cable tray sections and fittings in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 16114

CABLE TRAYS

APPENDIX "A"

A. Submittal Requirements

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

1. Shop Drawings

   a. Outline drawings showing straight sections, horizontal and vertical fittings, connectors, covers and supports.

   b. Outline drawings showing dimensions, support points and weights of the sections and fittings.

   c. Bill of material for all equipment including description and part number

   d. Installation instruction including list of special tools required for field installation.

B. Test Reports

Submit data on the physical properties of the cable tray system as specified in 2.04 of this Section.

END OF APPENDIX "A"

DIVISION 16

SECTION 16115

UNDERGROUND CONDUIT SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for underground conduits, manhole, handholes, vaults and accessories.

B. Definitions

1. Conduit: A single enclosed raceway for wires or cables; duct
2. Ductbank: A structure containing one or more ducts or conduits
3. Conduit System: A combination of conduit, conduits, manholes, handholes, and vaults joined to form an integrated whole.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Underground Conduit Systems shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

American National Standards Institute (ANSI)

ANSI C2 - National Electrical Safety Code (NESC)

ANSI C80.1 - Specification for Rigid Steel Conduit - Zinc Coated

Institute of Electrical and Electronic Engineers (IEEE)

IEEE STD 837 - Standard for Qualifying Permanent Connections Used in Substation Grounding

ASTM International (ASTM)

ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

National Electrical Manufacturers Association (NEMA)

RN1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

TC2 - Electrical Polyvinyl Chloride (PVC) Conduit

TC14 - Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings

National Fire Protection Association (NFPA)

70 - National Electrical Code

Occupation Safety and Health Administration (OSHA)

Underwriters Laboratories Inc. (UL)

UL 6 - Rigid Metal Conduit

UL 514B - Fittings for Conduits and Outlet Boxes

UL 467 - Grounding and Bonding Equipment

UL 651 - Schedule 40 and 80 Rigid PVC Conduit

UL 651A - Type EB and A Rigid PVC Conduit and HDPE Conduit

UL 1684 – Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The Underground Conduit Systems and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 3 years

2. The Manufacturer shall be ISO 9001 certified

B. All electrical materials and equipment for which there is a nationally recognized standard, shall bear the conformance label of the nationally recognized third party inspection authority, such as Underwriters Laboratories Inc. (UL), Factory Mutual (FM), or ETL.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions.

D. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

E. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

F. Handle in a manner to prevent damage to finished surface.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Location, types and sizes of conduits and conduit systems are shown on the Contract Drawings.

2. Conduits shall be supplied in standard lengths in accordance with applicable UL standards.

3. Unless otherwise shown on the Contract Drawings, conduit or duct shall be Rigid Metal or Rigid Non-Metallic conduit.

B. Rigid Metal Conduit

1. RGS - Galvanized steel conduit (heavy-wall) shall be hot dipped galvanized after cutting and threading and shall conform to UL 6 and ANSI C80.1.

2. RGS-PVC - PVC coated, galvanized steel conduit (heavy-wall) shall be hot dipped galvanized after cutting and threading, shall be coated with 40 mils of PVC and shall conform to NEMA RN 1, Type A 40.

3. All preformed elbows shall be similar in construction to and of a type designed for use with the appropriate conduit and shall conform to UL 6.

4. All fittings shall be threaded.

C. Rigid Nonmetallic Conduit

1. Rigid nonmetallic conduit of the polyvinyl chloride (PVC) and fiberglass reinforced epoxy (FRE) type shall be in accordance with the requirements of Section 16110.

2. Elbows, fittings, offsets, and other components shall be preformed and similar in materials and construction to the conduit.

3. Couplings shall be of a type to provide a watertight installation of the conduit system.

D. Manholes, Handholes, and Vaults

1. Precast manholes, handholes, and vaults shall be as shown on the Contract Drawings. Concrete shall be in accordance with the requirements of Division 3 Section on concrete.

2. Cast-in-place manholes, handholes, and vaults conforming in size and strength to the precast manholes, handholes, and vaults shown on the Contract Drawings may be substituted, subject to the approval of the Engineer.

3. Continuous inserts shown on the Contract Drawings shall be hot-dipped galvanized steel, and shall be supplied complete with end caps and waxed cardboard closure strips. All metallic parts shall have a hot-dipped galvanized finish.

4. Racking assemblies shall be capable of being mounted on the continuous inserts supplied in manhole, handhole, and vault walls, without modification, utilizing hot-dipped galvanized spring nuts and bolts.

   a. The racking assemblies shall, at a minimum, include supports on each wall of the manhole, handhole, or vault, with arms on each support for each cable or arc-proofed cable group. Each arm shall have insulators to support each cable or cable group. Provide additional arms and insulators as shown on the Contract Drawings.

   b. Racking assembly arms and insulators, for installation on existing supports, shall match the existing supports without modification.

5. Manhole, handhole, and vault frames and covers shall be as shown on the Contract Drawings.

6. Provide Hubbard Co. No. 9119 pulling hooks, or approved equal.

E. Grounding Assemblies

1. Grounding bushings shall be plated malleable iron body, insulated type, rated 150 degrees C.

2. Ground rods shall be minimum 3/4-inch diameter, copper-clad steel. Unless otherwise shown on the Contract Drawings, ground rods shall be 10 feet long.

3. Unless otherwise shown on the Contract Drawings, conductors for grounding assemblies within manholes, handholes, or vaults shall be copper, minimum #4 AWG.

4. Ground rod connections shall be either exothermic welds, or high-strength compression-crimp system conforming to the requirements of IEEE 837 and UL 467, or approved equal.

5. Ground cable clamps shall be split-bolt, high strength, copper alloy connectors.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all conduit, equipment and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and existing underground utilities.

3.03 INSTALLATION

A. General

1. Underground conduit systems shall be installed in accordance with the requirements of ANSI C2, NFPA 70 and as shown on the Contract Drawings.

B. Excavation and Backfill

1. Excavation and backfill for underground conduits, handholes, manholes and shall be in accordance with the applicable requirements of Section 02221.

C. Concrete Encased Conduit

1. Concrete encasement of conduit shall conform to the details shown on the Contract Drawings and the requirements of Division 3 Section on concrete.
2. The dead-ending of conduit shall be accomplished as shown on the Contract Drawings.
3. No variation from a straight line of greater than 1/2 inch in 50 feet will be permitted when installing a concrete encased conduit.
4. Reinforce junctions with existing concrete encased conduit, or existing systems, with W8 x W4 - 10 x 10 welded wire fabric, conforming to ASTM A185, encased in 4 inches additional thickness of concrete around each set of conduits. The additional encasement shall extend at least 4 feet in each direction from the junction.
5. Where the placing of concrete is interrupted for one hour or more, reinforce the concrete encasement at the point of interruption with W4 x W4 - 10 x 10 welded wire fabric, conforming to ASTM A185.
6. Preformed or precast conduit may be substituted for the field-encased type, subject to the approval of the Engineer. All precast conduit shall meet the same requirements specified herein or shown on the Contract Drawings.
7. All conduits shall leave or enter structures perpendicularly.
8. Changes in direction of conduits shall be made by bends having a minimum radius of 15 feet. Elbows or sweeps to equipment or foundations shall have a radius not less than 10 times the trade diameter of the conduit.
9. Conduits shall be installed in true alignment and shall be sloped for drainage toward manholes or handholes. All free ends of empty conduits shall be sealed to prevent water entrance.
10. Openings for conduits in manhole construction shall be sealed and made watertight in an approved manner.
11. Transitions between conduits of different materials shall be made using the manufacturer's standard adapters.
12. Terminations of rigid nonmetallic conduits in manholes, handholes, and other concrete structures, shall be made with end bells, set flush with the inside face of the concrete.
13. Terminations of rigid metal conduits in manholes, handholes, vaults and other concrete structures, shall be made with insulated grounding bushings, projecting 2 inches beyond the inside face of the concrete.

D. Direct-Buried, Rigid Nonmetallic Conduit (PVC-H or FRE)

1. Direct-buried conduits shall be laid on firmly tamped and graded stone-free sand not less than 2 inches deep. Backfill in contact with the conduits shall be sand to a minimum of 3 inches above the conduits and the remainder of the backfill shall be unfrozen, stone-free earth. Buried depth shall be as shown on the Contract Drawings.

2. Conduit entering or exiting manholes, handholes, vaults, and other concrete structures shall be a 10-foot length of rigid metal conduit protected with two coats of asphaltic paint.

3. Terminations of conduits in manholes, handholes, vaults, and other concrete structures shall be made with insulated grounding bushings projecting 2 inches beyond the inside face of the concrete.

E. Manholes, Handholes and Vaults

1. Set precast manholes, handholes and vaults so that they are firmly and fully bedded at required grades.

2. Set frames and covers using mortar and masonry as required. Radially laid concrete brick shall have 1/4-inch thick vertical joints at inside perimeter. Lay all concrete brick in a full bed of mortar and completely fill all joints. Where more than one course of concrete brick is required, stagger vertical joints.

3. Set racking assemblies as required so that the unsupported length of wires or cables shall not exceed 30 inches.

F. Vertical Adjustment of Existing Manholes, Handholes and Vaults

1. Adjust the top elevation of existing structures to suit new finished grades in accordance with the details shown on the Contract Drawings.

2. Existing frames and covers shall be carefully removed, cleaned of all mortar fragments to the satisfaction of the Engineer and reset at the required elevation in accordance with the requirements shown on the Contract Drawings.

G. Grounding

1. Install a complete grounding system in each manhole or vault, and in selected handholes shown on the Contract Drawings. Electrically bond all arm supports, insulated grounding bushings, and ground rods together.

2. After installation, coat all bare surfaces or connections in the grounding system with asphaltic paint.

H. Testing

1. Test conduits, in the presence of the Engineer, by pulling through each conduit a flexible cylindrical mandrel having an outside diameter not more than 1/4 inch smaller than the inside diameter of the conduit, but nominally 85 percent of the trade diameter, whichever is larger. Only nylon cable of adequate strength shall be used to pull the mandrel through the conduit system. The use of rope will not be permitted.

I. Connections to Existing Conduits

1. Where conduits installed under this Contract are connected to existing conduits, test the entire run to the nearest box, manhole, handhole, vault or equipment enclosure, including all existing conduits installed by others, that will be used under this Contract.

2. Where any work shall be performed in conduits emanating from a manhole, handhole, vault or equipment enclosure, all existing spare conduits (conduits containing no electric wire or cable) shall be tested to the nearest manhole, handhole, vault or equipment and a pull line shall be left in place in each such conduit.

3. Report immediately to the Engineer any defect or stoppage found in portions of the conduit system not installed under this Contract. Do not attempt to rectify any defect or stoppage found in conduit not installed under this Contract unless specifically instructed to do so by the Engineer

4. The Engineer shall be the sole judge as to whether a defect or stoppage exists. Perform all tests required by the Engineer to enable him to make his decision.

3.04 ADJUSTMENTS

A. Conduit Cleaning

1. After installation of conduits, manholes, handholes, vaults, accessories and completion of all concreting operations, if any, carefully clean and clear all conduits of all obstructions and foreign matter to the satisfaction of the Engineer.

END OF SECTION

SECTION 16115

UNDERGROUND CONDUIT SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Handholes
2. Vaults
3. Frames and covers
4. Manholes, including "exploded" views with complete details as to the location of all existing and new conduits, wires and cables identified by permanent feeder numbers, racking assemblies and grounding assemblies. Manhole drawing blanks

B. Catalog Cuts

1. Conduit
2. Racking assemblies
3. Grounding assemblies
4. Continuous

C. Construction and Installation Procedures

1. Submit existing manholes coring and patching procedures and details.

END OF APPENDIX "A"

DIVISION 16

SECTION 16120

WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for wires, cables, splices, terminations, and appurtenances for electrical systems of 600 volts or less.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

American Society for Testing and Materials (ASTM)

ASTM B 1	Hard-Drawn Copper Wire
ASTM B 2	Medium-Hard-Drawn Copper Wire
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B 174	Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM B 189	Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
ASTM D 2802	Ozone-Resistant Ethylene-Propylene-Rubber Insulation for Wire and Cable
ASTM D 3005	Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
ASTM E 662	Standard Test Method for specific Optical Density of Smoke Generated by Solid Materials

Federal Specifications (FS)

HH-I-553	Insulation Tape, Electrical (Rubber, Natural and Synthetic)

Insulated Cable Engineers Association (ICEA)

ICEA S-19-81	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 3)

ICEA S-61-402	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 5)
ICEA S-66-524	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 7)
ICEA S-68-516	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC 8)
ICEA T-33-655	Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 383	Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations
IEEE 837	Standard for Qualifying Permanent Connections Used in Substation Grounding

Military Specifications

MIL C-24643	Electrical Cable and Cord for Shipboard Use, Testing for Low Smoke and Halogens

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code

Naval Engineering Standards

NES 713	Determination of Toxicity Index of Products of Combustion From Small Specimens of Materials

Underwriters Laboratories Inc. (UL)

UL 44	Rubber-Insulated Wires and Cables
UL 62	Flexible Cord and Fixture Wire
UL 83	Thermoplastic-Insulated Wires and Cables
UL 467	Grounding and Bonding Equipment
UL 510	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 854	Service-Entrance Cables
UL 1581	Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 1685	Standards for Safety Vertical Tray Fire Propagation and Smoke Release Test for Electrical and Optical Fiber Cables

1.03 QUALITY ASSURANCE

A. Wires and cables which have been manufactured more than two years prior to installation shall not be used in the Work of this Section.

B. Tapes for splices or terminations shall be dated by the tape manufacturer to indicate that they have been manufactured no longer than six months prior to use in the Work of this Section.

C. Polyvinyl Chloride (PVC): PVC-insulated power wiring and items containing PVC, except PVC-insulated wiring for communications systems, remote control, signaling, and power-limited circuits, shall not be installed in indoor area. PVC-insulated wiring for communications systems, remote control, signaling, and power-limited circuits shall be furnished and installed in accordance with NFPA 70.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Single conductor wire or cable sizes #4/0 AWG and larger that are to be installed in the same raceway shall be paralleled by the cable manufacturer prior to shipment. Cable assembly overall diameter shall be kept to a minimum.

B. Wire and cable sizes #4/0 AWG and larger shall be provided with fctory-applied caps unless otherwise shown on the Basic Contract Drawing. End seals shall be heat-shrink, irradiated, modified polyolefin, and shall be sized for individual wires and cables.

C. Store material in a clean, dry space and protect it from the weather.

1.05 SUBMITTALS

See Appendix "A" for submittals requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide wires, cables, wire and cable splicing, terminating and arcproofing materials of manufacturers as shown on the Basic Contract Drawing.

2.02 WIRES AND CABLES

A. General

1. Definitions

a. Wire shall be defined as a solid or stranded conductor smaller than No. 6 AWG with or without insulation.

b. Cable shall be defined as a single conductor No. 6 AWG or larger, or two or more conductors of any size wire under a common covering.

2. Locations, types, sizes and numbers of wires and cables are shown on the Basic Contract Drawing. Where not indicated, provide proper wire and cable selection to comply with this section and NFPA 70 Standards.

3. Unless otherwise shown on the Basic Contract Drawing, solid conductors shall be soft or annealed copper, conforming to ASTM B 33 (tinned), ASTM B 189 (lead-coated or lead-alloy coated), or ASTM B 3 (uncoated). Unless otherwise specified in this Section or unless otherwise shown on the Basic Contract Drawing, stranded copper conductors shall be concentric stranding conforming to ASTM B 8.

4. Unless otherwise shown on the Basic Contract Drawing, cable jackets for interior use shall be low smoke, low toxicity, non-halogen, flame retardant type and shall meet the following performance characteristics:

   a. Cables shall pass the flame propagatory and smoke release criteria according to the test method of UL 1685.

   b. The halogen content of cable jackets shall not exceed 0.2 percent according to the test method of MIL-C-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen".

   c. The toxicity index of cable jackets shall not exceed 4.0 according to the test method of NES 713.

   d. The cable jackets shall comply with ICEA T-33-655 for smoke generation.

   e. The acid gas content of cable jackets shall not exceed a maximum of 3.0 percent according to the test method of MIL-C-24643.

5. Use the additional performance characteristics for wires and cables which will be installed in subway areas, substations, tunnels, etc. where stringent flame retardency, low smoke, low toxicity, zero halogen and good circuit integrity during a fire are required.

   a. Wires shall pass the flame propagatory criteria according to the test method of VW-1.

   b. The halogen content of both the wire and cable insulation and cable jacket(s) shall not exceed 0.2 percent according to the test method of MIL-C-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen".

   c. The toxicity index of both the wire and cable insulation and cable jacket(s) shall not exceed 2.0 according to the test method of NES 713.

   d. The acid gas content of both wire and cable insulation and cable jacket(s) shall not exceed a maximum of 2.0 percent according to the test method of MIL-C-24643.

e. The wire and cable insulation materials shall pass the smoke generation test in accordance with ASTM E 662. Wire and cable insulation when tested on a specimen of 80 mils thick slab shall not exceed the following values:

Flaming Avg. Ds (4 minutes)	100
Flaming Avg. Dm (20 Minutes)	200
Non-Flaming Avg. Ds (4 minutes)	100
Non-Flaming Avg. Dm (20 minutes)	350

f. The cable jacket materials shall pass the smoke generation test in accordance with ASTM E 662. Wire and cable jacket when tested on a specimen of 80 mils thick slab shall not exceed the following values:

Flaming Avg. Ds (4 minutes)	50
Flaming Avg. Dm (20 minutes)	150
Non-Flaming Avg. Ds (4 minutes)	50
Non-Flaming Avg. Dm (20 minutes)	250

6. Color-Coding for Power and Lighting Conductors

a. Insulation or covering of wires and cables shall be factory color-coded by the use of colored compounds or coatings. The color-code shall be followed cnsistently throughout the performance of the Work.

b. Upon written request of the Contractor, the Engineer may permit the use of the following methods in lieu of the wire or cable manufacturer's color-coding, when limited quantities of wire and cable are involved, for sizes #8 AWG and larger.

(1) For dry locations only, spiral application of 3/4 inch wide, colored pressure sensitive plastic tape, half lapped for a distance of not less than six inches may be used. To prevent unwinding, the last two wraps of tape shall be applied with no tension.

(2) For wet or dry locations, application of three, 3/16 inch wide, colored, fungus-inert, self-extinguishing, self-locking, nylon cable ties spaced 3 inches apart may be used. The ties shall be snugly applied with a special tool or pliers, and any excess removed.

(3) Each wire and cable shall be color-coded at all terminal points, in all manholes, boxes, or other similar enclosures.

(4) Color markings shall be applied so as not to obliterate the manufacturer's identification markings.

c. Color code chart shall be as follows:

	System Voltage	
Conductor	208Y/120V	480Y/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

7. All wires, cables, splices and terminations, for which there are established UL standards, shall bear the UL label.

B. General-Purpose Wires and Cables

Unless otherwise shown on the Basic Contract Drawing, general purpose wires and cables shall be as follows:

1. General-purpose wires and cables shall be single conductor, ASTMB8, Class B stranded for sizes #8 AWG and larger, and solid for sizes #10 AWG and smaller.

2. Select from the following list of UL wire and cable types:

a. Type XHHW: Flame retarding, Cross-linked-polyolifin insulation, conforming to UL 44, for dry locations only.

b. Type XHHW-2: Flame retardant, Cross-linked-polyolifin insulation, conforming to UL 44.

c. Type THWN: Flame retardant, moisture and heat resistant thermoplastic insulation with a nylon jacket or equivalent; Double rated THHN-THWN gasoline-oil resistant II; conforming to UL 83.

The use of this cable shall be in accordance with the requirements of paragraph 1.03C of this Section.

d. Type USE: Heat and moisture resistant ethylene- propylene-rubber insulation with heavy duty thermosetting chlrosulphanated polyethylene or heavy- duty neoprene jacket; multiple rated "USE-RHH-RHW"; conforming to ASTM D 2802, ICEA S-68-516, UL 44 and UL 854. Unless otherwise indicated, Type USE shall be the only wire and cable used for underground installations.

C. Overhead Service Cables

Unless otherwise shown on the Basic Contract Drawing, overhead service cables shall be two or more type SE, ASTM B 8, Class B or Class C stranded, hard-drawn copper conductors, ethylene-propylene-rubber insulation, with heavy duty neoprene or heavy duty thermosetting chloro-sulphonated polyethylene jacketed, marked "sunlight resistant", conforming to ASTM D 2802, UL 44 and UL 854. Cable shall be factory assembled with copper-clad messenger conforming to ICEA S-68-516.

D. Portable Cords

Unless otherwise shown on the Basic Contract Drawing, portable cords shall be as follows:

1. Type S shall be 60 degrees C rated, with heavy-duty thermosetting insulation and jacket, conforming to UL 62, 600-volt rated.
2. Type SO shall be oil resistant, 60 degrees C rated, with heavy-duty thermosetting insulation and jacket, conforming to UL 62, 600-volt rated.
3. Type G or Type W shall be 90 degrees C rated, with ethylene-propylene-rubber insulation and Hypalon jacket, 600-volt rated.
4. Special types shall be used only where shown on the Basic Contract Drawing.

E. Lighting Fixture Wires

Unless otherwise shown on the Basic Contract Drawing, lighting fixture wires shall be stranded only, and shall be Type SF-2, silicone rubber insulated conforming to UL 62.

F. Grounding Wires and Cables

Unless otherwise shown on the Basic Contract Drawing, grounding wires and Cables shall be as follows:

1. Insulated
   a. Solid for sizes #8 AWG and smaller; ASTM B 8, Class B stranded for sizes #6 AWG and larger; and of the same insulation type as the power conductors.
   b. Covering shall be a continuous green color and conform to ASTM B 33 and UL 44.
2. Uninsulated
   a. General

      Solid for sizes #8 AWG and smaller; ASTM B8, Class B stranded for sizes #6 AWG and larger.

   a. In raceways

      Soft-drawn and conforming to ASTM B 3.

   b. Direct buried or encased in concrete

      Soft-drawn, medium-hard-drawn, or hard-drawn and conforming to ASTM B 1, B 2 or B 3, respectively.

G. Control Wires and Cables

Unless otherwise shown on the Basic Contract Drawing, control wires and cables shall be as follows:

1. Single conductor wires and cables shall be ASTM B 8, Class B stranded, type XHHW or XHHW-2 flame retardent, cross-linked-polyolifin insulation. Both shall conform to UL44 and ICEA S-66-524.

2. Multiconductor cables shall be ASTM B 8, Class B or Class C stranded, Control Cable Type B, conforming to ICEA S-61-402. Color-coded as per ICEA S-61-402, Method No. 1 for NFPA 70 applications (with white and green) or ICEA S-19-81, for paired conductor cables. Select from the following list of cable types.

   a. Individual ethylene-propylene rubberinsulation with overall flame retardent, cross-linked-polyolifin jacket; conforming to ICEA S-68-516, UL 44, and UL 1581.

   b. Individual ethylene-propylene-rubber insulation with individual and overall flame-retardent, cross-linked polyolifin jackets; conforming to ICEA S-68-516 and UL 44.

   c. Individual flame retardent, cross-linked-polyolifin insulation with and overall flame retardent, cross-linked-polyolifin jacket; conforming to ICEA S-66-524.

   d. Individual cross-linked-polyolifin insulation with overall polyvinyl chloride jacket conforming to ICEA S-66-524.

   e. Individual polyolifin insulation with individual and overall polyvinyl chloride jackets conforming to ICEA S-61-402.

H. Switchboard Wires and Cables

Unless otherwise shown on the Basic Contract Drawing, switchboard wires and and cables shall be as follows:

1. Switchboard wires and cables shall be single conductor, ASTM B 8, Class B stranded, except that for wires and cables crossing hinged joints and swinging panels, and where "Extra Flexible" wire or cable is shown on the Basic Contract Drawing, conductors shall be ASTM B 174, Class K stranded.

2. Wires and cables shall be Type SIS, cross-linked-thermosetting-polyethylene insulation, conforming to ICEA S-61-402, IEEE383 and UL 44.

I. Cable Tags

1. Dry Locations

   a. Fiberglass tags, 1/16 inch thick and 3/4 inch wide, indented with letters and numbers 5/16 inch high, with #14 AWG copper or nylon, weather-resistant cable ties.

   b. Lighting branch circuit wiring and single conductor signal and control wiring may be identified with "Quiklables" manufactured by W. H. Brady Company, or approved equal.

2. Wet Locations

Stainless steel metal tags, No. 28 gauge and 3/4 inch wide, embossed with letters and numbers 5/16 inch high, with #14 AWG copper or nylon, weather-resistant cable ties, or stainless steel cable ties.

2.03 SPLICING, TERMINATING AND ARCPROOFING MATERIALS

A. General

1. All splicing, terminating and arcproofing materials shall be compatible so that no one material will adversely affect the physical or electrical properties of any other, or of the wire or cable itself.
2. All materials for making splices and terminations shall be specifically designed for use with the type of wire or cable, insulation and installation and operating conditions of the specific application.

B. Connectors

Subject to compliance with requirements of this Section, provide connectors of the following types:

1. Solderless, uninsulated, high conductivity, corrosion resistant, compression connectors conforming to UL 467 and IEEE 837;
2. Insulated, indenter type compression butt connectors;
3. Insulated, integral self-locking flexible shell, expandable spring connectors;
4. Uninsulated, indenter type compression pigtail connectors;
5. Welded type connectors.

C. Terminals

Subject to compliance with requirements of this Section, provide terminals of the following types:

1. Solderless, uninsulated, high conductivity, corrosion resistant, compression terminals conforming to UL 467 and IEEE 837;
2. Insulated, compression terminals;
3. Solderless, high conductivity, corrosion resistant, hex screw type, bolted terminals;
4. Welded type terminals.

D. Shrinkable Tubing

Subject to compliance with requirements of this Section, provide shrinkable tubing of the following types:

1. Either irradiated modified polyvinyl chloride or irradiated modified polyolefin heat shrinkable tubing;
2. Cold shrinkable tubing.

E. Tapes and Sealers

1. Vinyl Tapes

Flame-retardent, cold and weather-resistant, 3/4 inch or 11/2 inches wide, as required, and conforming to UL 510 and ASTM D 3005.

a. For interior, dry locations, provide 7 mils, conforming to ASTM D 3005 (Type I); Scotch (3M) No. 33, or approved equal.

b. For exterior or damp and wet locations, provide 8.5 mils, conforming to ASTM D 3005 (Type II); Scotch (3M) No. 88, or approved equal.

2. Rubber Tapes

Ethylene-propylene, rubber-based, 30-mil splicing tape, rated for 130 degrees C operation; 3/4inch and wider (1, 1 1/2, 2 inches) as shown on the Basic Contract Drawing or approved by the Engineer, conforming to Federal Specification HH-I-553 (Grade A); Scotch (3M) No. 130C, or approved equal.

3. Insulating Putty

Rubber-based, 125-mil elastic filler putty; 1 1/2 inches wide; Scotch (3M) Scotchfil, or approved equal.

4. Silicone Rubber Tapes

Inorganic silicone rubber, 12-mil, 130 degrees C rated, anti-tracking, self-fusing tape; 1 inch wide; Scotch (3M) No. 70, or approved equal.

5. Sealer

Liquid applied, fast-drying sealant; Scotch (3M) Scotchkote, or approved equal.

F. Resin Filled Splices

1. Epoxy Molded Type

Two-piece, snap-together molded bodies, sized for wire or cable, with two-part low viscosity polyurethane insulating and sealing compound, rated for 600 volts, using crimp-type wire connector; Scotch (3M) No. 82-A1, 82-A2 or 82-A3 compound, or approved equal.

2. Re-Enterable Type

Transparent, molded bodies clamped with stainless steel strain-relief bar and shield continuity connectors, sized for wire or cable, with loosely woven polyester spacer web and jelly-like urethane formulation for permanent re-entry capability; Scotch (3M) No. 78-R1 thru 78-R5, with No. 2114 compound, or approved equal.

G. Arcproofing Materials

1. Fire resistant tapes shall be Scotch (3M) No. 77, or approved equal.

2. Glass cloth binding tapes shall be Scotch (3M) No. 69, or approved equal.

H. Special splicing materials and methods shall be as shown on the Basic Contract Drawing.

2.04 SHOP TESTS

A. For quantities as shown on the Basic Contract Drawing, regular dielectric-withstand and insulation-resistance in water tests for wires and cables shall be performed in accordance with UL44.

B. Flame tests for wires and cables shall be performed in accordance with IEEE 383.

C. The test results shall be certified for each reel/coil/box of wire or cable.

D. Factory inspection and witnessing of tests by the Engineer shall be required for all wires and cables furnished under this Contract. The Engineer reserves the right to require additional testing, or to waive factory inspection or witnessing of tests. The Contractor shall notify the Engineer 14 days in advance of the scheduling of such factory tests.

PART 3. EXECUTION

3.01 PREPARATION

A. Prior to pulling wires and cables, clean raceway systems of all foreign matter and perform all operations necessary so as not to cause damage to wires and cables while pulling.

B. Prior to pulling wires and cables into underground conduit systems, place a feeding tube approved by the Engineer at the entrance end of such systems.

3.02 INSTALLATION

A. Wire and Cable Installation

1. General

a. Keep wires and cables dry at all times.

b. Seal wire and cable ends with watertight end seals if splicing or terminating does not follow at once.

c. Before splicing or terminating wires and cables, make a thorough inspection to determine that water has not entered the wires and cables or that the wires and cables have not been damaged.

d. Use adequate lubrication when installing cables in conduits or raceways. Any pulling compounds shall be compatible with the finish of the wires and cables furnished.

2. General Purpose Wires and Cables

a. Minimum wire or cable size shall be #12 AWG for light and power service.

b. Wires or cables shall be at least #10 AWG for the entire length of branch circuits, where distances to first outlets are as follows:

(1) 100 feet or more on 480Y/277 Volt systems.

(2) 70 feet or more on 208Y/120 Volt systems.

3. Lighting Fixture Wires

a. For wiring within lighting fixtures only, where sizes #14 AWG or smaller are required, use Type SF-2 fixture hookup wire. Type SF-2 wire shall not be used for wiring end-to-end connected fluorescent fixtures.

b. For connecting lighting fixtures to branch circuit conductors, use either Type RHH-VW-1, XHHW or USE, up to 90 degrees C, in dry locations.

4. Grounding Wires and Cables

a. Use bare, uninsulated wire and cable only where shown on the Basic Contract Drawing or where approved by the Engineer.

b. Insulated grounding cable shall be of the type specified in this Section or as shown on the Basic Contract Drawing.

5. Control Wires and Cables

Control wires and cables shall not be smaller than #14 AWG unless otherwise shown on the Basic Contract Drawing.

B. Splicing and Terminating

1. General

Splicing and terminating shall be as specified in this Section. Details of special splicing and terminating shall be as shown on the Basic Contract Drawing. Any splicing or terminating methods other than those specified below, for which the components are in accordance with the requirements of this Section, shall be submitted to the Engineer for approval.

2. General Purpose Wires and Cables

a. Splices in dry locations for sizes #10 AWG and smaller

Splicing shall be completed using one of the following:

(1) Insulated, integral, self-locking flexible shell, expandable spring connectors shall be applied to the twisted conductors. Two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.

(2) Compression type, insulated butt connectors shall be applied to the butted conductors by means of an appropriate crimping tool, providing controlled indentation. Two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.

(3) Compression type, pigtail connectors shall be applied to the conductors by means of an appropriate crimping tool, providing controlled indentation. The connector shall be covered with a polyamide cap and two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.

b. Splices in dry locations for sizes #8 AWG and larger

Splicing shall be completed using all of the following:

(1) Connectors shall be split sleeve solderless type or solderless compression type.

(2) Fill indents of connectors with Scotchfil insulation putty.

(3) Apply rubber splicing tape equal to the original insulation rating.

(4) Apply two, half-lapped layers of vinyl tape, or a shrinkable tubing.

c. Splices in wet locations

(1) Same as dry locations specified in 3.02B.2.a and 2.b, except that after vinyl tape is applied, cover with two coats of sealer or shrinkable tubing.

(2) Resin-filled splice shall be covered with two, half-lapped layers of vinyl tape and two coats of sealer or shrinkable tubing.

d. Terminations in dry locations for sizes #10 AWG and smaller

Terminations shall be compression terminals, insulated or uninsulated.

e. Terminations in dry locations for sizes #8 AWG through #3/0 AWG

(1) Ring tongue terminals shall be solderless, uninsulated compression crimp type.

(2) Ring tongue lugs shall be bolted hex screw type.

f. Terminations in dry locations for sizes #4/0 AWG and larger.

Ring tongue terminals shall be solderless, uninsulated compression crimp type.

g. Terminations in wet locations

In addition to the dry location terminations specified in 3.02 B.2.d, 2.e and 2.f, cover the entire termination area with two, half-lapped layers of vinyl tape and apply two coats of sealer over the tape.

3. Overhead Service Cables

Splices and terminations in overhead service cables shall be the same as specified in 3.02 B.2.c and 2.g, respectively, appropriate for overhead service.

4. Portable Cords

a. Splices shall not be made in portable cords.

b. Terminations shall be made only at apparatus to be served or at branch circuit connection by means of any of the following:

(1) Insulated, integral, self-locking flexible shell, expandable spring, or crimp type connectors;

(2) Insulated, crimp type, compression connectors;

(3) Uninsulated, ring tongue terminals for connection to wire terminal strip block.

5. Lighting Fixture Wires

Connections to branch circuit and to fixture wiring shall be made by either insulated, integral, self-locking flexible shell, expandable spring, or crimp type connectors.

6. Grounding Wires and Cables

a. Splices and terminations shall be installed in accordance with the manufacturer's recommendations.

b. In hazardous or classified locations, splices and terminations shall be solderless high conductivity, corrosion resistant, compression type connectors and terminations shall be clamp type pressure connectors, suitable for such use.

c. All underground connections shall be covered with two coats of asphalt base paint.

7. Control Wires and Cables

a. Splices shall be made in accordance with the requirements specified in 3.02 B.2.c and shall be enclosed in a re-enterable splicing case. Where shielded cable is shown on the Basic Contract Drawing, the shielding shall be continued through the splice. Shields shall be grounded at one location only unless otherwise shown on the Basic Contract Drawing.

b. Terminations shall be insulated, indenter type ring tongue terminals.

8. Switchboard Wires

a. No splices are permitted.

b. Terminations shall be insulated, indenter type ring tongue terminals.

C. Arcproofing

1. Arcproofing shall be applied where shown on the Basic Contract Drawing.

2. Arcproofing, which has been disturbed for any reason, shall be reinstalled as soon as possible after the disturbance.

3. Arcproofing shall be installed as follows:

   a. Wires and cables shall be grouped by circuit and arcproofing applied over the group of wires and cables comprising one circuit. Splices shall be arcproofed individually and the taping shall join with and be overlapped by the group taping.

   b. Arcproofing shall be applied in two wrappings of half-lapped tape, bound with glass cloth tape applied at the ends of the fire resistant tape, and at intervals not to exceed 24 inches along the entire length of the cables. The two wrappings shall be applied with opposing-lays.

   c. Arcproofing shall be extended into the conduit opening or end bell of the raceway entering a handhole, manhole or box.

   d. Arcproofing tape shall be 1 1/2 inches wide where the diameter of the individual cable, or of the circumscribed circle for the circuit group, is less than 1 3/4 inches. For larger diameters, the tape shall be 3 inches wide.

D. Identification of Wires and Cables

1. Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, wireways and other enclosures and access locations, and at all terminal points.

2. The circuit designations shall be as shown on the Basic Contract Drawing. Tags shall be attached to wires and cables in such a manner as to be readily visible.

3. The tag ties shall be wrapped around all conductors comprising the circuit or feeder to be identified.

4. Wires and cables which are arcproofed shall also be identified outside the applied arcproofing.

3.03 FIELD TESTS

Test all wires and cables up to equipment installed under this Contract with a 1000-volt Megohmmeter. Furnish the Engineer with a copy of the "Megger" readings together with an outline of the method used. If, in the opinion of the Engineer, any reading is lower than that required by applicable codes, promptly replace the materials involved, at the Contractor's expense, and retest.

END OF SECTION

SECTION 16120

WIRE, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)

APPENDIX "A"

SUBMITTALS

A. Submit Catalog Cuts for the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

1. Wires and cables for each type and size;
2. Splice kit materials and installation procedures.

B. Submit certified shop test reports for wires and cables.

C. Submit field test results for wires and cables, including "Megger" readings with the test method used.

END OF APPENDIX "A"

DIVISION 16

SECTION 16121

WIRES, CABLES, SPLICES, TERMINATIONS

(MEDIUM VOLTAGE: 601 VOLTS TO 34,500 VOLTS, INCLUSIVE)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for wires, cables, splices, terminations and appurtenances for electrical systems of medium voltage: 601 volt to 34,500 volts, inclusive.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM B 1	Hard-Drawn Copper Wire
ASTM B 2	Medium-Hard-Drawn Copper Wire
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 29	Pig Lead
ASTM B 33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B 189	Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
ASTM D 1373	Medium-Voltage Rubber Insulating Tape
ASTM D 2802	Ozone-Resistant Ethylene-Propylene-Rubber Insulation for Wire and Cable
	Association of Edison Illuminating Companies (AEIC)
AEIC CS-6	Ethylene-Propylene-Rubber Insulated Shielded Power Cable Rated 5 through 69 KV
	Federal Specifications (FS)
HH-I-553	Insulation Tape, Electrical (Rubber, Natural and Synthetic)

Insulated Cable Engineers Association (ICEA)

ICEA S-68-516	Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 48	High Voltage AC Cable Terminators, Test Procedure and Requirements
IEEE 383	Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations
IEEE 404	Standard for Type Test of Cable Joints for Use with Extruded Dielectric Cable Rated 5,000 through 46,000 Volts, and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500 through 500,000 Volts
IEEE 837	Standard for Qualifying Permanent Connections Used in Substation Grounding

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 258	Standard Research Method for Determining Smoke Generation of Solid Materials
OSHA	Occupation Safety and Health Administration

Underwriters Laboratories Inc. (UL)

UL 44	Rubber-Insulated Wires and Cables
UL 467	Grounding and Bonding Equipment
UL 510	Insulating Tape
UL 1581	Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Wires, cables, splices and terminations for medium voltage: 601 Volts to 34,500 Volts, inclusive, shall be furnished and installed in accordance with this Section and as specified on the Basic Contract Drawing.

B. Components of the medium voltage system, manufactured, supplied and installed, shall comply with the requirements of NFPA 70, all local codes, and the requirements of OSHA.

1.04 QUALITY ASSURANCE

A. Wires and cables that have been manufactured more than two years prior to installation shall not be used in the Work of this Section.

B. Tapes for splices or terminations shall be dated by the tape manufacturer to indicate that they have been manufactured no longer than six months prior to use in the Work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Where multiple single conductor cables are to be installed as one cable, single conductor cables shall be paralleled by cable manufacturer prior to shipment. Cable assembly overall diameter shall be kept to a minimum.

B. Store material in a clean, dry space and protect it from the weather.

1.06 SUBMITTALS

See Appendix A.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Provide wires, cables, splices and terminations, and ancillary equipment, in compliance with the requirements of this section, and as shown on the Basic Contract Drawing.

2.02 MATERIALS

A. Wires and Cables

1. Locations, types, sizes and numbers of wires and cables are shown on the Basic Contract Drawing.

2. Unless otherwise shown on the Basic Contract Drawing, solid conductors shall be soft or annealed copper, conforming to ASTM B 33 (tinned), ASTM B 189 (lead-coated or lead alloy coated), or ASTM B 3 (uncoated).

3. Pulling Devices and End Seals

   a. Wires and cables shall be provided with factory fitted pulling devices and end caps unless otherwise shown on the Basic Contract Drawing. Shop drawings showing the pulling devices and end caps to be used shall be submitted to the Engineer for approval.

   b. For pulling tensions up to 1000 pounds per grip, basket grips may be utilized.

   c. All wires and cables shall be end-sealed, at both ends of each length. Lead cable shall be solder-wiped sealed with a heat-shrinkable cap, to prevent the entrance of moisture.

   d. Lead-sheathed cables shall be provided with either compression type or solder-wiped style pulling bolts or eyes on the leading end of each conductor, or on the overall assembly. The pulling device shall be installed and fitted with either solder-wipe or heat-shrinkable sleeve to prevent the entrance of moisture.

4. Wires and cables shall be identified in accordance with AEIC CS 6. Outer jacket shall be printed with manufacturer's identification, type of insulation, size of conductor, rated voltage, year of manufacture, insulation thickness and UL listing. Each reel shall carry a tag identifying manufacturer, cable type, size, voltage and length of cable on reel.

   In addition, on each single conductor cable when shipped triplexed or paralleled, there shall be a unique series of "111" or "222" or "333" respectively per phase or leg to identify the phase connection.

5. Grounding Wires and Cables

   Unless otherwise shown on the Basic Contract Drawing, grounding conductors shall be as follows:

   a. Insulated

      (1) Solid for sizes #8 AWG and smaller, Class B stranded for sizes #6 AWG and larger, 600 volt rated, XHHW or RHW.

      (2) Covering shall be a continuous green color and conform to ASTM B 33 and UL 44.

   b. Uninsulated

      (1) Solid for sizes #8 AWG and smaller, Class B stranded for sizes #6 AWG and larger.

      (2) In raceways

      Soft-drawn and conforming to ASTM B 3.

      (3) Direct buried or encased in concrete

      Soft-drawn, medium-hard-drawn or hard-drawn and conforming to ASTM B 1, B 2 or B 3, respectively.

6. Medium Voltage Flat Strap Cable, (FSC).

   a. Flat Strap Cable shall be used for all underground and outdoor locations unless otherwise shown on the Basic Contract Drawing.

   b. Jacketed, single conductor cable.

      (1) Voltage rating shall be as shown on the Basic Contract Drawing.

      (2) Insulation

      Insulation shall be Ethylene-Propylene-Rubber (EPR). Cables shall conform to AEIC CS-6, ASTMD-2802 and ICEA S-68-516.

      (3) General Construction

      In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

         (a.) Copper conductor shall be annealed, uncoated, compressed round strand or compact round strand when shown on the Basic Contract Drawing.

         (b.) Extruded conductor shielding;

         (c.) Insulation shall be EPR, 133 percent insulation level;

(d.) Extruded semiconducting insulation shielding;

(e.) Flat strap neutral shall consist of tin coated, annealed flat copper wires per ASTM B272, helicaly applied over the insulation shield. The edges of the straps shall be rounded. The equivalent conductor size shall be #2 AWG unless otherwise shown. It shall cover not less than 80% of the insulation-shielding surface;

(f.) Jacket of linear low-density polyethylene (LLDPE) in accordance with ASTM D1248. The jacket thickness shall be 50 mils and shall conform to IPCEA and UL standards. For cable used for indoor locations, jacketing material shall be selected to receive the UL label for tray use;

(g.) Maximum outside diameter shall be as shown on the Basic Contract Drawing;

c. Assembly

Unless otherwise shown on the Basic Contract Drawing, cables shall be triplexed at the factory prior to shipping.

7. Medium Voltage Lead-sheathed Cables (For Exterior and Underground Use)

a. Lead-Sheathed Cable shall only be used where specifically shown on the Basic Contract Drawing.

b. Jacketed, Single Conductor Cable

(1) Voltage ratings shall be as shown on the Basic Contract Drawing.

(2) Insulation

Insulation shall be ethylene-propylene-rubber (EPR). Cables shall conform to AEIC CS-6, ASTM D 2802 and ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

(a.) Copper conductor, annealed, uncoated, Class B stranded or compact strand or sector, as shown on the Basic Contract Drawing;

(b.) Extruded conductor shielding;

(c.) Insulation shall be EPR, 133 percent insulation level;

(d.) Extruded EPR, semi-conducting, insulation shielding;

(e.) Lead sheath overall;

(f.) Jacket of black polyethylene, polyvinyl chloride, or as shown on the Basic Contract Drawing.

(g.) Maximum outside diameter shall be as shown on the Basic Contract Drawing.

c. Jacketed, Three Conductor Cable

(1) Voltage ratings shall be as shown on the Basic Contract Drawing.

(2) Insulation

EPR insulated cables shall conform to AEIC CS-6 and ASTM D 2802, ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

(a.) Three insulated, shielded conductors, each with:

i. Copper conductor, uncoated, Class B stranded or compact strand or sector;

ii. Extruded conductor shielding;

iii. Insulation shall be EPR, 133 percent insulation level;

iv. Extruded, semi-conducting, insulation shielding;

v. Copper shielding tape, 5-mil, spirally wrapped with 12.5 percent overlap.

(b.) Ground conductors and fillers as necessary to provide an overall round cross section;

(c.) Tape binder over the three insulated, shielded conductors;

(d.) Lead sheath overall;

(e.) Jacket of black polyethylene, polyvinyl chloride, or as shown on the Basic Contract Drawing.

(f.) Maximum outside diameter shall be as shown on the Basic Contract Drawing.

8. Medium Voltage Cables (For Interior Use)

a. Jacketed, Single Conductor Cable

(1) Voltage ratings shall be as shown on the Basic Contract Drawing.

(2) Insulation

Insulation shall be Ethylene-propylene-rubber (EPR). Insulated cables shall conform to AEIC CS-6, ASTM D 2802 and ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, single conductor cable shall consist of the following:

(a.) Copper conductor, uncoated, Class B stranded or compact strand or sector, as shown on the Basic Contract Drawing;

(b.) Extruded conductor shielding;

(c.) Insulation shall be EPR, 133 percent insulation level;

(d.) Extruded EPR, semi-conducting, insulation shielding;

(e.) Tinned copper braided shield, 85% minimum coverage, or copper shielding tape, 5-mil, spirally wrapped with 12.5 percent overlap;

(f.) Jacket of flame retardant, low smoke chemically cross-linked polyolefin (XLPO), or chlorosulfonated polyethylene (CSP), or as shown on the Basic Contract Drawing.

(g.) Maximum outside diameter shall be as shown on the Basic Contract Drawing.

b. Jacketed, Three Conductor Cable

(1) Voltage ratings shall be as shown on the Basic Contract Drawing.

(2) Insulation

EPR insulated cables shall conform to AEIC CS 6 and ASTM D 2802, ICEA S-68-516.

(3) General Construction

In cross section from center to circumference, jacketed, three conductor cable shall consist of the following:

(a.) Three insulated, shielded conductors, each with:

i. Copper conductor, uncoated, Class B stranded or compact strand or sector;

ii. Extruded conductor shielding;

iii. Insulation shall be EPR, 133 percent insulation level;

iv. Extruded, semi-conducting, insulation shielding;

v. Tinned copper braided shield, 85% minimum coverage, or copper shielding tape, 5-mil, spirally wrapped with 12.5 percent overlap.

(b.) Ground conductors and fillers as necessary to provide an overall round cross section;

(c.) Tape binder over the three insulated, shielded conductors;

(d.) Jacket of flame retardant, low smoke chemically cross-linked polyolefin (XLPO), or chlorosulfonated polyethylene (CSP) or as shown on the Basic Contract Drawing.

(e.) Maximum outside diameter shall be as shown on the Basic Contract Drawing.

9. Cable Tags

Stainless steel metal tags, No. 28 gauge and 3/4-inch wide, embossed with letters and numbers 5/16-inch high, fastened to the cable at both ends of tags with nominal 1/16-inch diameter monel metal wire or stainless steel cable ties.

10. Splicing, Terminating and Arcproofing Materials

a. General

(1) All splicing, terminating and arcproofing materials shall be compatible so that no one material will adversely affect the physical or electrical properties of any other, or of the wire or cable itself.

(2) All materials for making splices and terminations shall be specifically designed for use with the type of wire or cable, insulation and installation and operating conditions of the specific application.

(3) Splices and terminations shall be supplied as complete kit assemblies with all components and detailed installation instructions. Unless otherwise shown on the Basic Contract Drawing, splices and terminations for medium voltage cables shall be heat-shrink polymeric type as manufactured by Raychem.

b. Connectors

Subject to compliance with requirements of this Section, provide Split-sleeve, solder, high conductivity, corrosion resistant connectors.

c. Terminals

Subject to compliance with requirements of this Section, provide Solder type, high conductivity, corrosion resistant terminals.

d. Shrinkable Tubing

Subject to compliance with requirements of this Section provide shrinkable tubing of the following types:

(1) Either irradiated modified polyvinyl chloride or irradiated modified polyolefin heat shrinkable tubing.

(2) Cold, shrinkable tubing.

e. Tapes and Sealers

(1) Vinyl Tapes

Flame-retardant, cold and weather-resistant, 3/4 inch and 1 1/2 inches wide, as required, and conforming to UL 510 and ASTM D 3005.

(a.) For interior, dry locations, provide Tape 7 mils thick, conforming to ASTM D 3005 (Type I).

(b.) For exterior or damp and wet locations, provide tape 8.5 thick, mils conforming to ASTM D 3005 (Type II).

(2) Rubber Tapes

Ethylene-propylene, rubber-based, 30-mil splicing tape, rated for 130 degrees C operation; 3/4 inch and wider (1, 1 1/2, 2 inches) or as shown on the Basic Contract Drawing, or as approved by the Engineer, conforming to ASTM D 1373 and Federal Specification HH-I-553 (Grade A).

(3) Insulating Putty

Rubber-based, 125-mil elastic filler putty; 1-1/2 inches wide; Scotch (3M) Scotchfil, or approved equal.

(4) Silicone Rubber Tapes

Inorganic silicone rubber, 12-mil 130 degrees C rated, anti-tracking, self-fusing tape; 1 inch wide.

(5) Sealer

Liquid applied, fast-drying sealant; Scotch (3M) Scotchkote, or approved equal.

f. Binding wire shall be uninsulated, tinned copper.

g. Lead sleeve shall be 5/32 inches thick, commercially and chemically pure, and shall conform to ICEA S-68-516 and ASTM B 29.

h. Solder

(1) Solder used on the shielding braids of any cable shall be 50% Tin / 50% Lead.

(2) Solder used for wiping the lead splice sleeve to the lead sheath of any cable shall be 40 Tin/60 Lead, Class A.

(3) Flux used when soldering conductor connectors or shielding tapes and shielding braids shall be of a non-corrosive and non-acid type.

i. Insulating compound shall be installed in all lead-covered splices and all potheads.

j. Arcproofing Material

For arcproofing materials, refer to Section 16128 of the Specification.

k. Ground Straps

Flexible, tinned copper braid, equivalent to #6 AWG.

l. Special splicing materials and methods shall be as shown on the Basic Contract Drawing.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all wire, cables, equipment and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. Prior to pulling wires and cables, clean raceway systems of all foreign matter and perform all operations necessary so as not to cause damage to wires and cables while pulling.

B. Prior to pulling wires and cables into underground conduit systems, place a feeding tube approved by the Engineer at the entrance end of such systems.

3.03 INSTALLATION

A. Wire and Cable Installation

1. General

a. Keep wires and cables dry at all times.

b. Seal wire and cable ends with watertight end seals if splicing or terminating does not follow at once.

c. Before splicing or terminating wires and cables, make a thorough inspection to determine that water has not entered the wires and cables or that the wires and cables have not been damaged.

d. Use adequate lubrication when installing cables in conduits or raceways. Any pulling compounds shall be compatible with the finish of the wires and cables furnished.

B. Splices and Terminations

1. General

a. All medium voltage wires and cables shall be spliced in each manhole through which they pass.

b. Any splicing or terminating methods other than those required by this Section, for which the components are in accordance with the requirements of this Section, shall be submitted to the Engineer for approval.

c. All cables shall be checked for phase identification before and after terminations have been made. All phase discrepancies shall be corrected.

2. Insulated Wires and Cables

a. Splices and terminations shall be completed by workmen trained and experienced in the type of cable and the voltage class specified in this Section, with not less than 3 years experience in this specialty type of work, and who perform similar splices and terminations on a regular basis.

b. Where required by the Engineer, sample splices shall be demonstrated to the Engineer by each splicer performing the Work of this Section. The sample shall be provided to the Engineer after completion of the demonstration.

c. Terminations using stress-relief cones, which conform to Class 1, IEEE 48 shall be made in accordance with the cable manufacturer's recommendations.

d. Splices shall conform to IEEE 404 and shall:

(1) meet the full electrical and physical integrity of the wire and cable construction, including voltage rating, ampacity, BIL, and type of waterproofing;

(2) conform to the wire and cable manufacturer's requirements and recommendations.

e. For cable where moisture is present, each such cable shall be nitrogen-purged to remove all moisture. The purging procedure shall be submitted to the Engineer for approval.

f. Where splices or terminations are on the Electrical Utility Company (Utility) side of incoming service equipment, the splices or terminations shall be of the type and style approved by the Utility and shall be submitted to the Utility for approval.

3. Grounding Wires and Cables

a. Splices and terminations shall be installed in accordance with the manufacturer's written recommendations.

b. In hazardous or classified locations, splices and terminations shall be solderless, high conductivity, corrosion-resistant, compression type connectors.

c. All underground connections shall be covered with two coats of asphalt base paint.

d. Each splice shall be bonded to ground, using a flexible ground strap, 2 feet long, not less than #6 AWG or equivalent size.

C. Arcproofing

For arcproofing of cables, see Section 16128, of the Specification.

D. Identification of Wires and Cables

1. Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, wire ways, and other enclosures, and at all terminal points.

2. The circuit designations shall be as shown on the Basic Contract Drawing. Tags shall be attached to wires and cables in such a manner as to be readily visible.

3. The tag ties shall be wrapped around all conductors comprising the circuit or feeder to be identified.

4. Wires and cables that are arcproofed shall be identified outside the applied arcproofing.

E. Field Tests

1. Medium Voltage Shielded Cables

a. After installation and before they are placed in service, run direct current voltage tests in accordance with AEIC CS 6, paragraphs K.2 and K.3, on all shielded cables.

b. A copy of all test reports, together with an outline of the test method used, shall be submitted to the Engineer for review.

2. Ground Wires and Cables

a. Ground wires and cables shall be tested to prove continuity and proper connections to equipment and ground rods.

b. The Contractor shall certify all field testing and shall submit the test results to the Engineer for approval.

F. Factory Tests

1. For quantities as shown on the Basic Contract Drawing, regular dielectric-withstand and insulation-resistance in water tests for wires and cables shall be performed in accordance with UL 44.

2. The following tests for wires and cables shall be performed and certified reports of these tests shall be submitted to the Engineer:

a. Flame tests in accordance with IEEE 383 (were appllicable).

b. Jacket tests in accordance with ICEA 5-68-516.

c. Cable tests in accordance with AEIC CS-6.

3. The test results shall be certified for each shipping reel of wire or cable.

4. Factory inspection and witnessing of tests by the Engineer shall be required for all wires and cables furnished under this Contract. The Engineer reserves the right to require additional testing, or to waive factory inspection or witnessing of tests. The Contractor shall notify the Engineer 14 days in advance of the scheduling of such factory tests.

G. Independent Laboratory Test

1. Unless otherwise shown on the Basic Contract Drawing, submit a 2'-0" sample from 25% of the shipping reels to an independent laboratory for the following tests which shall be performed in accordance with AEIC and ICEA standards.

   a. A.C. Voltage Breakdown Tests

   b. Adhesion of Insulation Shield to Insulation

   c. Volume Resistivity of Conductor Shield to Insulation Shield

   d. Dissection and Dimensional Analysis

   e. Microscopic examination for voids, contaminants, and protrusions

   f. Hot Creep Test to determine state of cure of insulation

   g. Partial Discharge (DC) measurements

   h. Dissipation factor of cable insulation

   i. Impulse breakdown tests.

3.04 ADJUSTMENTS

A. Should the test results reveal any defects, promptly correct such defects and rerun the tests until the entire installation is satisfactory to the Engineer in all aspects.

END OF SECTION

SECTION 16121

WIRES, CABLES, SPLICES, TERMINATIONS

(MEDIUM VOLTAGE: 601 VOLTS TO 34,500 VOLTS, INCLUSIVE)

APPENDIX 'A'

SUBMITTAL REQUIREMENTS

A. Submit the following in accordance with the requirements of "Shop Drawings", Catalog Cuts, and Samples", of Division 1 - General Provisions:

1. Shop Drawings

   Submit Shop Drawings for the installation sequence, pulling tensions and sidewall pressure of all wire and cable pulls, including identification of manhole or pullbox locations with splices.

2. Catalog Cuts

   a. Medium Voltage Cable(s)

   b. Ground Wire(s)

   c. Terminators

   d. Splices

   e. Pulling Devices and End Seals

B. Submit certified shop test reports for wires and cables.

C. Submit field test results for wires and cables, including all test data and methodology.

D. Submit nitrogen purge procedure for moisture laden wires and cables.

END OF APPENDIX "A"

DIVISION 16

SECTION 16126

FIBER OPTIC CABLING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the following types of control and signal transmission media:

1. Multimode Optical fiber cabling
2. Single-mode Optical fiber cabling

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The fiber optic cabling shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

Building Industry Consulting Service International (BICSI)

Telecommunications Design Methods Manual

Insulated Cable Engineering Association (ICEA)

ICEA STD T-33-655 Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets

International Telecommunications Union (ITU)

ITU T G.651-Characteristics of a 50/125um multimode graded index optical fiber cable

ITU T G.652-Characteristics of a single-mode optical fiber and cable

ITU T G.653-Characteristics of a dispersion-shifted single-mode optical fiber and cable

ITU T G.654-Characteristics of a cut-off shifted-mode optical fiber and cable

ITU T G.655-Characteristics of a non-zero dispersion-shifted single-mode optical fiber and cable

ITU T G.656-Characteristics of a fiber and cable with non-zero dispersion for wideband transport

Insulation Cable Engineers Association (ICEA)

ICEA T-33-655-Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code

NFPA 130 National Electrical Code

NFPA 502-Standard for Road Tunnels, Bridges, and Other Limited Access Highways

Naval Engineering Standards

NES 713 Determination of Toxicity Index of Products of Combustion From Small Specimens of Materials

International Electrical Testing Association (NETA)

NETA Acceptance Testing Specifications, Section 7.25

Telecommunications Industry Association (TIA) / Electronics Industries Alliance (EIA)

TIA/EIA 455-25C-FOTP-25 Impact Testing of Optical Fiber Cables

TIA/EIA 455-26A-FOTP-26 Crush Resistance of Fiber Optic Interconnecting Devices

TIA/EIA 455-33A-FOTP-33 Fiber Optic Cable Tensile Loading and Bending Test

TIA/EIA 455-41A-FOTP-41 Compressive Loading Resistance of Fiber Optic Cables

TIA/EIA 455-82B-FOTP-82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable

TIA/EIA 455-98A-FOTP-98 Fiber Optic Cable External Freezing Test

TIA/EIA 455-14A-OFSTP-14 Fiber Optic Cable Cyclic Flexing Test

TIA/EIA 526-14A-OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA/EIA 526-7-OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA/EIA 568-C.3-Optical Fiber Cabling Components Standard

TIA/EIA 598-C-Optical Fiber Cable Color Coding

TIA/EIA 604-Fiber Optic Cabling Intermateability Standard (FOCIS)

TIA/EIA 606-A-Administration Standard for Commercial Telecommunications Infrastructure

TIA/EIA 607-A-Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

Underwriters Laboratories Inc.

UL 910 Test for Flame - Propagation and Smoke - Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air

UL 1651-Standard for Safety for Optical Fiber Cable

UL 1666 Test for Flame Propagation Height of Electrical and Optical – Fiber Cables Installed Vertically in Shafts

UL 1685 Standards for Safety Vertical Tray Fire Propagation and Smoke Release Test for Electrical and Optical Fiber Cable.

UL 2024-Optical Fiber Cable Raceway

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The fiber optic cabling and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 3 years
2. The Manufacturer shall be ISO 9001 certified
3. All optical fiber materials for which there are established UL standards shall bear the UL label.
4. Where cables specified in this Section are used to provide signal paths for systems specified in other Sections of the Specifications, or for systems shown on the Contract Drawings, review the cable characteristics provided by this Section for compatibility and use with the system equipment to be connected to the fiber optic cables.
5. Wires and cables, which have been manufactured more than two years prior to installation, shall not be used in the Work of this Section.

B. Installer Qualifications

1. All optical fiber cable installations, splices and terminations shall be performed by qualified workers with prior experience in installing optical fiber cables and working on optical fiber systems. Work experience shall include the successful installation of at least three other optical fiber systems of similar complexity to the work of this Section. Installer qualifications shall include successful completion of training classes covering optical fiber cable installation, termination, splicing and connectorizing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions.

D. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

E. Handle cable to avoid braising, puncturing and tearing cable insulation and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of transmission media are maintained.

F. Test cables upon receipt at construction site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use an Optical Test Set or OTDR (Optical Time Domain Reflectometer)

2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CABLE – GENERAL

A. Locations, types, sizes and numbers of cables as shown on the Contract Drawings.

B. Unless otherwise shown on the Contract Drawings, cables that will be installed in riser areas shall pass the flame propagatory and smoke release criteria according to the test method of UL 1666.

C. Unless otherwise shown on the Contract Drawings, cables that will be installed in plenum areas shall pass the flame propagatory and smoke release criteria according to the test method of UL 910.

D. Unless otherwise shown on the Contract Drawings, use the following performance characteristics for cables which will be installed in subway areas, substations, tunnels, etc. where flame retardency, low smoke, low toxicity, zero halogen and good circuit integrity during a fire are required.

1. Cables shall pass the flame propagatory and smoke release criteria according to the test method of UL 1685.

2. The halogen content of the cable shall not exceed 0.2 percent according to the test method of MIL-C-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen".

3. The cable shall comply with ICEA T-33-655 for smoke generation.

4. The toxicity index of the cable shall not exceed 2.0 according to the test method of NES 713.

5. The acid gas content of the cable shall not exceed a maximum of 2.0 percent according to the test method of Mil-C-24643.

6. All cables, splices and terminations, for which there are established UL standards shall bear the UL label.

7. Surface-Burning Characteristics shall be as determined by testing identical products according to ASTM E 84 by a qualified testing agency as defined in paragraph 1.5 above. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.

   b. Smoke-Developed Index: 50 or less.

E. Project Conditions

1. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and system is operating and maintaining conditions as defined in paragraph 1.02-C-2 below.

2. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability.

   a. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 30 to 90 deg F dry bulb and 20 to 90 percent relative humidity, non-condensing.

   b. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, non-condensing. Use NEMA 250, Type 3R enclosures.

   c. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) Use NEMA 250, Type 4X enclosures.

2.02 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements.

B. Optical Fiber Cable (OFC) General Requirements

1. Optical fiber cables shall be factory-fabricated, single channel, low-loss, glass, graded index type. The number of fibers and optical requirements shall be as shown on the Contract Drawings.

2. The optical fibers shall be incorporated in the cable construction using either the loose buffer tube or tight buffer tube method. The optical fibers shall be individually cladded, jacketed, and identified within the buffer tubes.

3. Each fiber shall be distinguishable by means of a continuous color code, continuous numbering, continuous lettering, or a combination of methods. Color coding of optical fiber cables shall be in compliance with EIA/TIA-598.

4. Optical fiber cables shall conform to EIA FOTP-25 standard for impact resistance.

5. Optical fiber cables shall conform to EIA FOTP-33 standard for maximum pulling load.

6. Optical fiber cables shall conform to EIA FOTP-41 standard for crush resistance.

7. Optical fiber cables shall conform to EIA FOTP-104 standard for flexibility.

8. Optical fiber cables with PVC jackets are acceptable in indoor, general purpose and riser areas. Optical fiber cables with PVC jackets are not acceptable in indoor plenum areas.

9. Optical fiber cable for outdoor use shall be able to sustain the traffic-induced vibrations at all sites without damage to the physical and optical characteristics of the optical fiber.

10. Optical fiber cable for outdoor use shall be moisture resistant as per EIA FOTP-892 standards.

11. Patch Cords: Factory-made, dual-fiber cables conforming to types as called out on Contract Drawings and Specifications as defined herein while maintaining a minimum 48-inch length.

12. Fiber Optic Innerduct:

    a. Furnish and install fiber optic innerduct of the type, characteristics and size and at the locations indicated on the Contract Drawings. The innerduct shall be plenum-rated, low smoke, zero halogen type, corrosion resistant and, unless otherwise indicated on the Contract Drawings, shall be constructed of flexible polyethylene.

13. All materials used in the optical fiber cable shall be suitable for use under the following climatic conditions:

    a. Temperatures of -40 to +70 degrees centigrade

    b. Relative humidity of 5% to 100% condensing

14. Optical fiber cable for outdoor use shall be resistant to the following chemicals:

    a. Petroleum products (gasoline, diesel fuel, lubricants, etc.)

    b. Atmospheric nitric acid

    c. Carbon dioxide

    d. Carbon monoxide

    e. Nitrous oxides

    f. Atmospheric sulfuric acid

C. OFC Technical Requirements:

1. Multimode Fiber Optic Cable

    a. Description: Multimode, 62.5/125-micrometer, fiber strand count as depicted on Contract Drawings, non-conductive, optical fiber cable.

(1) Comply with ICEA S-83-596 for mechanical properties.

(2) Comply with TIA/EIA-568-B.3 for performance specifications.

(3) Comply with TIA-492AAAB for detailed specifications.

(4) Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

(a.) General Purpose, Nonconductive: Type OFN or OFNG

(b.) Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

(c.) Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.

(d.) General Purpose, Conductive: Type OFC or OFCG

(e.) Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.

(f.) Riser Rated, Conductive: Type OFCR, complying with UL 1666.

(5) Conductive cable shall be steel armored type.

b. Jacket:

(1) Jacket Color: Orange for 62.5/125-micrometer cable

(2) Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.

(3) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm)

2. Single mode Fiber Optic Cable

a. Description: Single mode, 50-micrometer, fiber strand count as depicted on drawings, non-conductive, optical fiber cable.

(1) Comply with ICEA S-83-596 for mechanical properties.

(2) Comply with TIA/EIA-568-B.3 for performance specifications.

(3) Comply with TIA-492AAAB for detailed specifications.

(4) Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

(a.) General Purpose, Nonconductive: Type OFN or OFNG

(b.) Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

(c.) Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.

(d.) General Purpose, Conductive: Type OFC or OFCG

(e.) Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.

(f.) Riser Rated, Conductive: Type OFCR, complying with UL 1666.

(5) Conductive cable shall be steel armored type.

b. Jacket:

(1) Jacket Color: Yellow for 50/125-micrometer cable

(2) Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.

(3) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.03 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements.

B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.

2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.04 IDENTIFICATION PRODUCTS

A. Requirements listed in this paragraph are for all cables within Section 16127.

B. Manufacturers: Subject to compliance with requirements

C. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

D. Provide a labeling plan and format to Engineer for approval prior to work.

PART 3. EXECUTION

3.01 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B.

B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 16 Section 16135 "Raceways and Boxes" for installation of conduits and wire ways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead.

4. Extend conduits 3 inches (75 mm) above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.02 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Division 16 Section 16190 "Hangers and Supports for Electrical Systems" for installation of supports for pathways, conductors and cables.

3.03 CABLE INSTALLATION REQUIREMENTS

A. Cable in Raceways and Enclosures;

1. Install cable in conduit. Conceal conduit except in unfinished spaces and as indicated on Contract Drawings. Minimum conduit size shall be 1". Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Pulling Requirements

1. Install cable as indicated in accordance with NFPA 70 requirements and manufacturer's written instructions.
2. Install transmission media without damaging conductors, shield, or jacket.
3. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.
4. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
5. Pull cables simultaneously where more than one is being installed in same raceway.
6. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
7. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.

C. Splicing Of Cable

1. Splicing of optical fiber cable shall be permitted only when the length of the cable run exceeds those of the cable manufacturers pulling distance restrictions.
2. The number of splices per cable shall be kept to a minimum. Splicing is permitted only in electrical closets. Splicing of cable runs in roadway or ramp areas is not permitted.
3. Splicing of optical fiber cable shall be performed by means of fusion splicing. The Contractor shall submit, for approval, a detailed written procedure, prior to start of work, which shall include:
   a. The number of splices per fiber, and location of each splice, for all optical fiber cables
   b. The means to support the splice
   c. Covering or sheathing of splice
4. Splicing shall be performed in a professional manner by experienced workers

5. Splices shall not have losses exceeding 0.2 dB per splice.

6. All splices shall be enclosed in a splice organizer and then placed in a splice enclosure box to be mounted in the electrical closet. Submit catalog cuts for splice organizers and enclosures to the Engineer for approval.

7. Use splice and tap connectors that are compatible with cable material. All splice locations shall be approved by the Engineer.

3.04 INSTALLATION OF CABLES

A. General Requirements for Cabling Installation:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Terminate all cable strands; no cable shall contain un-terminated elements. Make terminations only at indicated outlets and cross-connect and patch panels.

4. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

5. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

6. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

B. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.

2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

C. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.

3.05 TESTING

A. Factory Test.

1. Testing Agency:

a. Engage a qualified testing agency as defined above in this Section.

2. Factory Inspection

a. The Authority shall have the right to inspect the manufacturer's quality control, manufacturing, and testing facilities at any time during the procurement process. Inspection by the Authority will include visual examination of the cables, and all related documentation to ensure that the cables are being fabricated in accordance with the Specifications.

3. Factory Test Plan

a. The Contractor shall submit a test plan for each type of cable shown on the Contract Drawings. The test plan shall be approved prior to the start of the factory test. The test plan shall include test schedule, lists of test to be conducted, test equipment to be used, expected test results and test documents produced, and copies of any certified test data to be used in lieu of testing.

4. Factory Test

a. For those tests that are not conducted during factory tests, the Contractor shall submit certification by a recognized independent testing laboratory, showing the complete test results. The Contractor shall notify the Engineer 14 days in advance of the scheduling of such factory tests. The Engineer reserves the right to require additional testing, or to waive factory inspection or witnessing of tests.

b. If factory tests are required by the Engineer, the cables shall not be shipped until after the factory tests have been satisfactorily completed and the cables are approved by the Authority.

c. Factory tests for optical fiber cable shall include, but not necessarily be limited to, the following:

(1) Attenuation of each fiber

(2) Bandwidth of each fiber

(3) OTDR (Optical Time Domain Reflectometer) image of each fiber

(4) Factory test optical fiber cables on reels according to TIA/EIA-568-B.1.

(5) Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3

d. Cable will be considered defective if it does not pass tests and inspections

e. Prepare test and inspection reports.

B. Field Test.

1. Testing Agency:

a. Engage a qualified testing agency as defined above in this Section.

b. Perform tests and inspections as follows.

2. Tests and Inspections:

a. Visually inspect all cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B as applicable.

3. Test instruments:

a. Instruments shall meet or exceed applicable requirements in TIA/EIA-568-B. Perform tests with a tester that complies with performance and accuracy requirements in TIA/EIA-568-B. Use only test cords and adapters that are qualified by test equipment manufacturer.

4. Test parameters

a. Optical Fiber Cable Tests:

(1) Test settings:

(a.) Multimode Link Measurements: Test at 850 or 1310 nm in 1 direction according to TIA-526.

(b.) Single mode Link Measurements: Test at 1310 or 1550 nm in 1 direction according to TIA-526.

(2) Attenuation of each fiber

(a.) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

(3) Bandwidth of each fiber

(4) OTDR (Optical Time Domain Reflectometer) image of each fiber

(5) Factory test optical fiber cables on reels according to TIA/EIA-568-B.1.

(6) Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.

(7) Link End-to-End Attenuation Tests:

5. Test Results

a. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit

b. End-to-end cabling will be considered defective if it does not pass tests and inspections

3.06 FIRESTOPPING

A. Comply with requirements in Division 7 Section 07270 "Fire stopping."

B. Comply with TIA-569-B, "Fire Stopping" Annex A.

C. Comply with BICSI TDMM, "Fire Stopping Systems" Article

END OF SECTION

SECTION 16126

FIBER OPTIC SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts

1. Cable

B. Samples

1. One (1) foot sample of each type of cable for approval
2. Sample splice kit materials and installation procedures

C. Certificates

1. Cable certificates, acknowledged by the communication system manufacturers, certifying that the cables are suitable for the connected equipment as described in "Quality Assurance" above.

D. Qualifications

1. Qualification data for manufacturers as per Section "Quality Assurance" stating their capabilities and experience; Include list of completed projects and other information specified

E. Record Documents

1. Certified shop test reports for cable.
2. Field test reports indicating and interpreting test results.
3. One reproducible set and four sets of prints of the Shop Drawings that reflect the actual as built condition of the entire cable system.
4. Cable Schedule: A listing of all installed cables runs including but not limited to the following cable run number, cable origin point and cable destination point
5. Final Test Report for all installed cable
6. Test plan

F. Maintenance Agreements

1. Maintenance requirements for cables

END OF APPENDIX "A"

DIVISION 16

SECTION 16127

CONTROL/SIGNAL TRANSMISSION MEDIA

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for the following types of control and signal transmission media:

1. Shielded Twisted Pair (UTP) cabling
2. Coaxial cabling
3. RS-232 cabling
4. RS-485 cabling
5. Control cabling

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The control and signal transmission media shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

American Society for Testing and Materials (ASTM)

ASTM B 3 Soft or Annealed Copper Wire

ASTM B 8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM B 33 Tinned Soft or Annealed Copper Wire for Electrical Purposes

ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

Building Industry Consulting Service International (BICSI)

Telecommunications Design Methods Manual, Latest Revision

Insulated Cable Engineering Association (ICEA)

ICEA T-33-655 Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets

T-33-655-Guide for Low Smoke, Halogen-Free (LSHF) Polymeric Cable Jackets

Military Standards

MIL-C-17 Standards for Radio Frequency Coaxial Cables

MIL-C-24643 Electrical Cable and Cord for Shipboard Use, Testing for Low Smoke and Halogens

National Fire Protection Association (NFPA)

NFPA 70 National Electrical Code

NFPA 130 National Electrical Code

NFPA 502-Standard for Road Tunnels, Bridges, and Other Limited Access Highways

Naval Engineering Standards

NES 713 Determination of Toxicity Index of Products of Combustion From Small Specimens of Materials

International Electrical Testing Association (NETA)

Acceptance Testing Specifications, Section 7.25

Telecommunications Industry Association (TIA) / Electronics Industries Alliance (EIA)

TIA/EIA 568-C.1-Commercial Building Telecommunications Cabling Standard Part 1: General Requirements

TIA/EIA 568-C-2-Balanced Twisted-Pair Telecommunications Cabling and Components Standards

TIA/EIA 606-A-Administration Standard for Commercial Telecommunications Infrastructure

TIA/EIA 607-A-Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The control and signal transmission media and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 3 years.
2. The Manufacturer shall be ISO 9001 certified
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

4. Where cables specified in this Section are used to provide signal paths for systems specified in other Sections of these Specifications, or for systems shown on Contract Drawings, the Contractor shall obtain review of the cable characteristics and certification for use with the connected system equipment by the connected equipment manufacturer.

5. Wires and cables, which have been manufactured more than two years prior to installation, shall not be used in the Work of this Section.

6. All cable of each kind shall be the product of a single manufacturer

B. Testing Agency Qualifications:

1. Shall be a National Recognized Testing Laboratory (NRTL)

2. The Testing Agency's Inspector shall be currently certified by BICSI as a Registered Communications Distribution Designer (RCDD) to supervise on-site testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions.

D. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

E. Handle cable to avoid braising, puncturing and tearing cable insulation and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of transmission media are maintained.

F. Test cables upon receipt at construction site.

1. Test each pair of cable for open and short circuits.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CABLE – GENERAL

A. Locations, types, sizes and numbers of wires and cables shown on the Contract Drawings. Where not shown, Furnish and install wires and cables to comply with this Section and NFPA 70 Standards.

B. Unless otherwise shown on the Contract Drawings, solid conductors shall be soft, or annealed copper, conforming to ASTM B 33 (tinned), or ASTM B 3 (uncoated). Unless otherwise shown on the Contract Drawings, stranded copper conductors shall be concentric stranding conforming to ASTM B 8.

C. Unless otherwise shown on the Contract Drawings, wires and cables that will be installed in riser areas shall pass the flame propagatory and smoke release criteria according to the test method of UL 1666.

D. Unless otherwise shown on the Contract Drawings, wires and cables that will be installed in plenum areas shall pass the flame propagatory and smoke release criteria according to the test method of UL 910.

E. Unless otherwise shown on the Contract Drawings, use the following performance characteristics for wires and cables which will be installed in subway areas, substations, tunnels, etc. where flame retardency, low smoke, low toxicity, zero halogen and good circuit integrity during a fire are required.

1. Wires shall pass the flame propagatory criteria according to the test method of VW-1.
2. Cables shall pass the flame propagatory and smoke release criteria according to the test method of UL 1685.
3. The halogen content of the cable shall not exceed 0.2 percent according to the test method of MIL-C-24643. The Authority classifies 0.2 percent or less halogen content as "non-halogen".
4. The cable shall comply with ICEA T-33-655 for smoke generation.
5. The toxicity index of the cable shall not exceed 2.0 according to the test method of NES 713.
6. The acid gas content of the cable shall not exceed a maximum of 2.0 percent according to the test method of Mil-C-24643.
7. All wires, cables, splices and terminations, for which there are established UL standards shall bear the UL label.
8. Surface-Burning Characteristics shall be as determined by testing identical products according to ASTM E 84 by a qualified testing agency as defined in paragraph 1.3.G above. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 50 or less.

F. Project Conditions

1. Environmental Limitations: Do not deliver or install UTP, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and system is operating and maintaining conditions as defined in paragraph 1.07.B below.
2. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability.

a. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 30 to 90 deg F dry bulb and 20 to 90 percent relative humidity, non-condensing.

b. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, non-condensing. Use NEMA 250, Type 3R enclosures.

c. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) Use NEMA 250, Type 4X enclosures.

2.02 MULTIPLE SHIELDED TWISTED PAIR CABLE

A. Manufacturers: Subject to compliance with requirements.

B. General Requirements:

1. Quantity of twisted pairs and size of conductors shall be as indicated on the Contract Drawings; tinned-copper conductors; color-coded; overall aluminum/polyester shield and 22 AWG tinned-Copper drain wire.

2. Data/Telecommunications cabling shall be balanced twisted-pair 100-ohm of one or more of the category types as defined in TIA/EIA-568-C.2: Cable Category types used shall be as indicated on Contract Drawings.

   a. Category 5e: This designation applies to 100-ohm cables whose transmission characteristics are specified up to 100 MHz and for data transmissions up to 100 MBps.

   b. Category 6: This designation applies to 100-ohm cable whose transmission characteristics are specified up to 250 MHz and for data transmissions greater than 100 MBps.

3. All category cables specified in this Section shall meet or exceed the requirements of TIA/EIA 568-C.1.

4. Cable Construction: The cables shall have four (4) unshielded, twisted pairs consisting of 24 AWG, minimum, solid bare copper conductors.

5. Unless otherwise specified in Contract Drawings, the length of Category 5e and 6 cabling shall be limited to a total distance of 90 m (295 ft). In order to ensure compliance with the loss requirements specified in TIA/EIA-568-C.2, the horizontal cable distance may need to be reduced below 90 meters, using the method shown in Annex G of TIA/EIA-568-C.2, depending upon the average temperature of the environment over the length of the cable, the insertion loss margin of the installed cabling, and the insertion loss temperature coefficient of the cable.

6. Patch cords shall meet the requirements of TIA/EIA-568-C.2 and shall not exceed 20m in length (5m in the work area).

7. The cables shall be manufactured such that the orientation of each pair, with respect to every other pair in the cable, is positively maintained.

8. The insulation for the individual conductor pairs shall have colors in accordance with TIA/EIA 568-C.2:

9. Cable Jacketing:

   a. Interior: Cabling installed in interior locations shall have plenum-rated jacketing.

   b. Exterior: Cables installed in outdoor locations shall have Polyvinyl Chloride (PVC) jacketing.

   c. Cables installed in vehicular tunnels, ventilation buildings, railroad/subway tunnels and railroad stations shall have low smoke, zero-halogen jacketing.

10. Electrical Characteristics – Definition of Terms:

   a. Attenuation to Cross Talk Ratio (ACR): The ratio of attenuation and crosstalk measured in dB at a given frequency, also known as signal-to-noise ratio.

   b. Connecting Hardware: A device providing mechanical cable terminations.

   c. Equal Level Far-End Crosstalk (ELFEXT): A measure of the unwanted signal coupling from a transmitter at the near-end into another pair measured at the far-end, and relative to the received signal level.

   d. Far-End Crosstalk Loss (FEXT): A measure of the unwanted signal coupling from a transmitter at the near-end into another pair measured at the far-end, and relative to the transmitted signal level.

   e. Horizontal Cabling: The cabling between and including the telecommunications outlet/connector and the horizontal cross-connect.

   f. Insertion Loss: The ratio of signal power at the receiver end to the input power determined from measured voltages, also referred to as attenuation.

   g. Insertion Loss Deviation: The difference between the actual insertion loss as measured on a permanent link or channel and the insertion loss as determined by adding the component losses.

   h. Near-End Cross Talk Loss (NEXT): A measure of the unwanted signal coupling from a transmitter at the near-end into neighboring pairs measured at the near-end.

   i. Power sum attenuation to crosstalk ratio (PS ACR): A ratio, expressed in dB, determined by subtracting the insertion loss from the power sum near-end crosstalk loss.

   j. Power sum equal level far-end crosstalk (PS ELFEXT): A computation of the unwanted signal coupling from multiple transmitters at the near-end into a pair measured at the far-end, and normalized to the received signal level.

   k. Power sum near-end crosstalk loss (PS NEXT): A computation of the unwanted signal coupling from multiple transmitters at the near-end into a pair measured at the near-end.

   l. Return Loss: A ratio expressed in dB of the power of the outgoing signal to the power of the reflected signal.

C. Category 5E Cable

1. Category 5e Electrical Characteristics:

a. All Category 5e cable shall have an input impedance of 100 +/-22 ohms for frequencies from 100 to 200 MHz.

b. Unless otherwise indicated on the Contract Drawings, all Category 5e cable shall conform to the following cable limits, in accordance with TIA/EIA 568-C.1:

(1) Insertion Loss

(2) NEXT; pair-to-pair and power sum

(3) ELFEXT; pair-to-pair and power sum

(4) ACR; pair-to-pair and power sum

(5) Return Loss

c. Unless otherwise indicated on the Contract Drawings, all Category 5e cable shall conform to the connecting hardware limits, in accordance with TIA/EIA 568-C.1:

(1) Insertion Loss

(2) NEXT pair-to-pair

(3) ELFEXT pair-to-pair

(4) ACR pair-to-pair

(5) Return Loss

d. Unless otherwise indicated on the Contract Drawings, all Category 5e cable shall conform to channel limits, in accordance with TIA/EIA 568-C.1:

(1) Insertion Loss

(2) NEXT; pair-to-pair and power sum

(3) ELFEXT; pair-to-pair and power sum

(4) ACR; pair-to-pair and power sum

(5) Return Loss

e. Unless otherwise indicated on the Contract Drawings, all Category 5e cable shall conform to the following permanent link limits, in accordance with TIA/EIA 568-C.1:

(1) Insertion Loss

(2) NEXT; pair-to-pair and power sum

(3) ELFEXT; pair-to-pair and power sum

(4) ACR; pair-to-pair and power sum

(5) Return Loss

f. Patch cords shall be qualified for loss according to the Category 5e requirements of ANSI/TIA/EIA-568-C.2.

D. Category 6 Cable:

1. Category 6 Electrical characteristics

a. The cable shall have an input impedance of 100 +/-32 ohms for frequencies from 200 to 250 MHz.

b. Unless otherwise indicated on the Contract Drawings, all Category 6 cable shall have the following cable limits, in accordance with TIA/EIA 568-C.2:

c. Unless otherwise indicated on the Contract Drawings, all Category 5e cable shall conform to the following cable limits, in accordance with TIA/EIA 568-C.2:

(1) Insertion Loss

(2) NEXT; pair-to-pair and power sum

(3) ELFEXT; pair-to-pair and power sum

(4) ACR; pair-to-pair and power sum

(5) Return Loss

d. d. Unless otherwise indicated on the Contract Drawings, all Category 6 cable shall conform to the connecting hardware limits, in accordance with TIA/EIA 568-C.2:

(1) Insertion Loss

(2) NEXT pair-to-pair

(3) ELFEXT pair-to-pair

(4) ACR pair-to-pair

(5) Return Loss

e. Unless otherwise indicated on the Contract Drawings, all Category 6 cable shall conform to channel limits, in accordance with TIA/EIA 568-C.2:

(1) Insertion Loss

(2) NEXT; pair-to-pair and power sum

(3) ELFEXT; pair-to-pair and power sum

(4) ACR; pair-to-pair and power sum

(5) Return Loss

f. Unless otherwise indicated on the Contract Drawings, all Category 6 cable shall conform to the following permanent link limits, in accordance with TIA/EIA 568-C.2:

(1) Insertion Loss

(2) NEXT; pair-to-pair and power sum

(3) ELFEXT; pair-to-pair and power sum

(4) ACR; pair-to-pair and power sum

(5) Return Loss

g. Patch cords shall be qualified for loss according to the Category 6 requirements of ANSI/TIA/EIA-568-C.2.

2.03 MULTIPLE SHIELDED TWISTED PAIR CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements

B. RJ-45 Connections

1. Data/Telecommunications cable connecting hardware shall have configurations, terminal marking and be installed in accordance with the requirements of TIA/EIA-570-A.

2. Data/Telecommunications cabling shall be terminated with connecting hardware having the same or higher category rating.

3. Unless otherwise indicated on the Contract Drawings, modular jacks, connectors and couplers utilized for terminating Category 5e or 6 cables shall be eight-position RJ-45 type. Unless otherwise indicated on the Contract Drawings, comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher. T568A pin-pair assignments, as defined in TIA/EIA-568-C.2, shall be followed for terminating cables on RJ-45 jacks.

4. Utilize where required on Contract Drawings modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

   a. Number of Jacks per Field: One (1) for each four-pair UTP cable indicated

   b. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals

C. Connecting Blocks: 110-Type. Furnish blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.04 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements.

B. Coaxial Cable Types:

1. Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications.

   a. Single Conductor Coaxial: 75-ohm characteristic impedance, solid polyethylene core 97 percent coverage, copper-braid shield, polyethylene jacket; conforming to MIL-C-17.

   b. Single Conductor Plenum Coaxial: 75-ohm characteristic impedance, solid base copper, central conductor, foamed Teflon dielectric, 100 percent coverage tinned-copper, double-braid shield, Teflon jacket, suitable for installation in air-handling spaces; conforming to MIL-C-17.

   c. Direct Buried Coaxial: Single conductor, 75-ohm characteristic impedance, 18 AWG copper clad, steel center conductor, solid polyethylene dielectric, 34 AWG bare copper-braid outer conductor shield with 95 percent coverage, polyvinyl chloride (PVC) jacket.

d. Aerial Coaxial: Single conductor, 75-ohm characteristic impedance, 18 AWG copper-clad, steel center conductor, cellular expanded polyethylene dielectric, 34 AWG bare, copper braid outer conductor shield with 95 percent coverage, ultraviolet-resistant polyvinyl chloride (PVC) jacket.

C. Coaxial Cable Requirements

1. RG-11/U: NFPA 70, Type CATV.

a. No. 14 AWG, solid, copper-covered steel conductor

b. Gas-injected, foam-PE insulation

c. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.

d. Jacketed with sunlight-resistant, black PVC or PE

e. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C

2. RG59/U: NFPA 70, Type CATVR

a. No. 20 AWG, solid, silver-plated, copper-covered steel conductor

b. Gas-injected, foam-PE insulation

c. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip

d. Color-coded PVC jacket

3. RG-6/U: NFPA 70, Type CATV or CM

a. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation

b. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid

c. Jacketed with black PVC or PE

d. Suitable for indoor installations

D. NFPA and UL Compliance: Coaxial cables shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV

2. CATV Plenum Rated: Type CATVP, complying with NFPA 262

3. CATV Riser Rated: Type CATVR, complying with UL 1666

4. CATV Limited Rating: Type CATVX

2.05 COAXIAL CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Subject to compliance with requirements of this Section, the Contractor shall provide wires and cables and wire and cable splicing and terminating products of manufacturers as shown on the Contract Drawings.

C. Coaxial-Cable Connectors: Type BNC, 75 ohms

2.06 RS-232 CABLE

A. RS-232 communications require three conductors with an overall shield. Circuit is limited to a distance of not more than 50 feet (15 m).

B. Standard Cable: NFPA 70, Type CM

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors
2. Polypropylene insulation
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage
4. PVC jacket
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire
6. Flame Resistance: Comply with UL 1581

C. Plenum-Rated Cable: NFPA 70, Type CMP

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage
4. Plastic jacket
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire
6. Flame Resistance: Comply with NFPA 262

2.07 RS-485 CABLE

A. RS-485 communications require two twisted pairs. Circuit is limited to a distance of not more than 4000 feet (1220 m).

B. Standard Cable: NFPA 70, Type CM

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors
2. PVC insulation
3. Unshielded
4. PVC jacket
5. Flame Resistance: Comply with UL 1581.

C. Plenum-Rated Cable: NFPA 70, Type CMP

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors
2. Fluorinated ethylene propylene insulation
3. Unshielded
4. Fluorinated ethylene propylene jacket
5. Flame Resistance: NFPA 262, Flame Test

2.08 CONTROL CONDUCTORS

A. Multi-conductor Cables:

1. Multi-conductor Cables: Quantity and size of conductors shall be as indicated on the Contract Drawings.

B. Single Twisted Pair

1. Single twisted pair, tinned-copper conductors, size of conductors shall be as indicated on the Contract Drawings

a. Cabling shall conform to the following:

(1) Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83

(2) Class 2 Control Circuits: Stranded copper, Type THHN-THWN complying with UL 83

(3) Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83

b. Signaling Line Circuit circuits shall be twisted, shielded pair, not less than No. 18 AWG.

2. Cable Types:

a. #16 UTP:

(1) NFPA 70, Type CMG

(2) 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.

(3) PVC insulation

(4) Unshielded

(5) PVC jacket

(6) Flame Resistance: Comply with UL 1581

b. #16 UTP (Plenum-Rated)

(1) NFPA 70, Type CMP

(2) 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.

(3) PVC insulation

(4) Unshielded

(5) PVC jacket

(6) Flame Resistance: Comply with NFPA 262

c. #18 UTP:

(1) NFPA 70, Type CMG

(2) 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.

(3) PVC insulation

(4) Unshielded

(5) PVC jacket

(6) Flame Resistance: Comply with UL 1581.

d. #18 UTP (Plenum-Rated)

(1) NFPA 70, Type CMP

(2) 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.

(3) Fluorinated ethylene propylene insulation

(4) Unshielded

(5) Plastic jacket

(6) Flame Resistance: NFPA 262, Flame Test.

2.09 IDENTIFICATION PRODUCTS

A. Requirements listed in this paragraph are for all cables within Section 16127.

B. Manufacturers: Subject to compliance with requirements

C. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

D. Provide a labeling plan and format to Engineer for approval prior to work.

PART 3. EXECUTION

3.01 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B.

B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 16 Section "Raceways and Boxes" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead

4. Extend conduits 3 inches (75 mm) above finished floor

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.02 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Division 16 Section "Hangers and Supports for Electrical Systems" for installation of supports for pathways, conductors and cables.

3.03 CABLE INSTALLATION REQUIREMENTS

A. Cable in Raceways and Enclosures;

1. Install wiring in conduit. Conceal conduit except in unfinished spaces and as indicated on Contract Drawings. Minimum conduit size shall be 1". Control and data transmission wiring shall not share conduit with other building wiring systems.

2. Wiring within Enclosures Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

B. Pulling Requirements

1. Install cable as indicated in accordance with NFPA 70 requirements and manufacturer's written instructions.

2. Install transmission media without damaging conductors, shield, or jacket.

3. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.

4. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

5. Pull cables simultaneously where more than one is being installed in same raceway.

6. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.

7. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.

3.04 INSTALLATION OF CONDUCTORS AND CABLES

A. General Requirements for Cabling Installation:

1. Comply with TIA/EIA-568-B.1

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.

4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

B. TP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 5e rating of components and that ensure Category 5e performance of completed and linked signal paths, end to end.

1. Comply with TIA/EIA-568-B.2.

2. Install 110-style IDC termination hardware unless otherwise indicated.

3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

C. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm)

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm)

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm)

6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm)

3.05 TESTING

A. Conduct tests as described in following for cables provided under this Section.

B. Factory Test

1. Testing Agency:

a. Engage a qualified testing agency as defined in paragraph 1.5 in this section.

2. Factory Inspection

a. The Authority shall have the right to inspect the manufacturer's quality control, manufacturing, and testing facilities at any time during the procurement process. Inspection by the Authority will include visual examination of the cables, and all related documentation to ensure that the cables are being fabricated in accordance with the Specifications.

3. Factory Test Plan

a. The Contractor shall submit a test plan for each type of cable shown on the Contract Drawings. The test plan shall be approved prior to the start of the factory test. The test plan shall include test schedule, lists of test to be conducted, test equipment to be used, expected test results and test documents produced, and copies of any certified test data to be used in lieu of testing.

4. Factory Test

a. For those tests that are not conducted during factory tests, the Contractor shall submit certification by a recognized independent testing laboratory, showing the complete test results. The Contractor shall notify the Engineer 14 days in advance of the scheduling of such factory tests. The Engineer reserves the right to require additional testing, or to waive factory inspection or witnessing of tests.

b. If factory tests are required by the Engineer, the cables shall not be shipped until after the factory tests have been satisfactorily completed and the cables are approved by the Authority.

c. For all cable the following items shall be tested on a sample basis per the applicable test method:

(1) Consistency of color coding

(2) Cable length

(3) Dimensional tolerances

(4) Factory test TP cables according to TIA/EIA-568-B.2

d. Cable will be considered defective if it does not pass tests and inspections.

e. Prepare test and inspection reports.

C. Field Test.

1. Testing Agency:

a. Engage a qualified testing agency as defined in paragraph 1.5 in this section.

b. Perform tests and inspections as follows.

2. Tests and Inspections:

a. Visually inspect all cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B as applicable.

b. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test instruments:

a. Instruments shall meet or exceed applicable requirements in TIA/EIA-568-B. Perform tests with a tester that complies with performance and accuracy requirements in TIA/EIA-568-B. Use only test cords and adapters that are qualified by test equipment manufacturer.

4. Test parameters

a. Coaxial Cable Tests:

(1) Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

b. TP Cable Tests:

(1) Factory test TP cables according to TIA/EIA-568-B.2

(2) Test TP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors.

5. Test Results

a. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

b. End-to-end cabling will be considered defective if it does not pass tests and inspections.

3.06 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Firestopping."

B. Comply with TIA-569-B, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.07 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 16 Section "Grounding and Bonding."

END OF SECTION

SECTION 16127

CONTROL/ SIGNAL TRANSMISSION MEDIA

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

B. Catalog Cuts

1. Control/ signal transmission media

C. Manufacturer Test Reports

1. Certified shop test reports for control/signal transmission media.

D. Samples

1. One (1) foot sample of each type of control/signal transmission media for approval
2. Sample splice kit materials and installation procedures.

E. Certificates

1. Cable certificates, acknowledged by the communication system manufacturers, certifying that the cables are suitable for the connected equipment as described in Section 1.04 "Quality Assurance".

F. Qualifications

1. Qualification data for manufacturers as per Section 1.04 "Quality Assurance" stating their capabilities and experience. Include list of completed projects and other information specified.

G. Record Documents

1. Field test reports indicating and interpreting test results.
2. Maintenance requirements for cables.
3. Test plan
4. One reproducible set and four sets of prints of the Shop Drawings that reflect the actual as built condition of the entire cable system.
5. Cable Schedule: A listing of all installed cables runs including but not limited to the following cable run number, cable origin point and cable destination point
6. Final Test Report for all installed cable.

END OF APPENDIX "A"

DIVISION 16

SECTION 16128

ARCPROOFING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies arcproofing of low and medium voltage cables for new installations as well as existing installations from which asbestos fireproofing has been removed.

1.02 REFERENCES

	American Society for Testing and Materials (ASTM)
ASTM D 1000	Test method for Pressure Sensitive Adhesive Coated Tapes used for Electrical and Electronic Applications
ASTM D 1518	Test methods for Thermal Transmittance of Textile Material
ASTM D 2843	Test method for the Density of Smoke from the Burning or Decomposition of Plastics
ASTM D 2863	Test method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastic (Oxygen Index)
OSHA	Occupation Safety and Health Administration
	Underwriters Laboratories (UL)
UL 94V 0	Tests for Flammability of Plastic Materials for Part in Devices and Appliances

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Acrproofing shall be furnished, and installed, and reinstalled if required in accordance with this Section and as specified on the Contract Documents.

1.04 QUALITY ASSURANCE

All work shall be performed and completed in a thorough, workmanlike manner and shall follow the best modern practice. All work shall be performed by mechanics skilled in their respective trades.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.

B. Store material in original packaging in a manner to prevent soiling and physical damage prior to installation.

C. Handle in a manner to prevent physical damage.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 ARCPROOFING MATERIALS

A. Fire Resistant Tape shall be Scotch (3M) No. 77 or approved equal.

B. Glass Cloth Tape shall be Scotch (3M) No. 69 or approved equal.

C. Cable Tags

Stainless steel metal tags, No. 28 gauge and 3/4 inch wide, embossed with letters and numbers 5/16 inch high, fastened to the cable at both ends of tags with nominal 1/16 inch diameter monel metal wire or stainless steel cable ties.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect tape prior to installation. Defective tape shall be discarded.

3.02 INSTALLATION

A. Arcproofing shall be installed as follows:

1. Arcproof all wire and cables operating at greater than 600 volts (line to line).

2. Wires and cables shall be grouped by circuit and arcproofing applied over the group of cables comprising one circuit. Splices shall be arcproofed individually and the taping shall join with and be overlapped by the group taping.

3. Arcproofing shall be applied in two wrappings of half-lapped tape, bound with glass cloth tape applied at the ends of the fire resistant tape and at intervals not to exceed 24 inches along the entire length of the cables. The two wrappings shall be wrapped with opposing-lays.

4. Arcproofing shall be extended into the conduit opening or end bell of the raceway entering a handhole, manhole or box.

5. Arcproofing tape shall be 1 1/2 inch wide where the diameter of the individual cable, or the circumscribed circle for the circuit group, is less than 1 3/4 inches. For larger diameters, the tape shall be 3 inches wide.

B. Identification of Wires and Cables

1. Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, and other enclosures, and at all terminal points.

2. The circuit designations shall be as shown on the Basic Contract Drawing. Tags shall be attached to wires and cables in such a manner as to be readily visible.

3. The tag ties shall be wrapped around all conductors comprising the circuit or feeder to be identified.

4. Wires and cables that are arcproofed shall be identified outside of the applied arcproofing.

3.03 ADJUSTMENTS

A. Prior to final inspection, arcproofing that has been disturbed, for any reason, shall be reinstalled as soon as possible.

END OF SECTION

SECTION 16128

ARCPROOFING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts

Submit catalog cuts for Fire Resistant Tape, Glass Cloth Tape and Cable Tags.

END OF APPENDIX "A"

DIVISION 16

SECTION 16130

CONDUCTOR BARS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for conductor bars and all accessories and appurtenances thereto.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American Society for Testing and Materials (ASTM)
ASTM F 593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	Standard Specification for Stainless Steel Nuts
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code

1.03 QUALITY ASSURANCE

The Contractor shall arrange that the services of a factory-trained, qualified technical representative be provided to supervise the installation of the conductor bar system; to inspect the completed installation; to make all adjustments necessary to place the system in proper operation; and to instruct the Authority's operating personnel in the proper care and operation of the conductor bar system. The minimum required number of days shall be as shown on the Contract Drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver conductor bar equipment, components and accessories in manufacturers' original, unopened, protective packaging.

B. Store in original packaging in a clean, dry space and protect them from the weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces.

1.05 SPARE PARTS

Prior to completion of the Contract, furnish quantities of the required spare parts, as shown on the Contract Drawings, to the Engineer. The spare parts shall be protectively packaged and provided with substantial containers for storage under severe outdoor weather conditions. Each container shall be provided with legibly printed identification of the part designation and number.

1.06 SUBMITTALS

"Submittal Requirements" shall be in accordance with Appendix A, Section 16130-1.

PART 2. PRODUCTS

2.01 MANUFACTURER

Subject to compliance with the requirements of this Section, provide conductor bars, components and accessories from one of the manufacturers as shown on the Contract Drawing. No substitutions will be permitted.

2.02 MATERIALS

A. Each component of the conductor bar system shall be manufactured and furnished in accordance with the requirements of this Section, and as shown on the Contract Drawings.

B. The Contract Drawings show the locations of the conductor bars, hanger assemblies, expansion sections, splice assemblies, powerfeed assemblies and end covers required for the conductor bar installation under this Contract.

2.03 ACCESSORIES

All nuts, bolts, washers and other metallic fittings shall be stainless steel, AISI Type 304 and conforming to the applicable requirements of ASTM F 593 and ASTM F 594, unless otherwise shown on the Contract Drawings. Submit shop drawings of all fasteners, fittings and supports for approval by the Engineer.

PART 3. EXECUTION

3.01 INSTALLATION

A. All components of the conductor bar system shall be installed in accordance with the applicable provisions of NFPA 70 and in accordance with the manufacturer's written instructions and with the recommendations of the manufacturer's technical representative(s).

B. Conductor bar locations may, with the prior approval of the Engineer, be varied slightly to overcome any field interferences, providing that the installation is still in compliance with the requirements specified in this Section and with the manufacturer's instructions and recommendations.

The installation procedure used for the conductor bars, accessories and appurtenances shall be in accordance with the approved shop drawings. The Contractor shall not install the conductor bars until after the shop drawings are approved by the Engineer.

C. Any portions of the installation which, at the discretion of the Engineer, are damaged or defective or which are not installed in accordance with the manufacturer's recommendations shall be repaired or replaced to the satisfaction of the Engineer and as required to bring the installation into compliance with the manufacturer's recommendations.

3.02 FIELD TESTS

A. GENERAL

1. A method to reference each expansion joint, splice and connection with respect to the distance from one end of the bridge shall be provided to enable operating personnel to identify the hot spots, subject to approval by the Engineer.

2. One copy of the video tape record, the resistive loads, wiring diagrams for connection of resistive loads, and the results of the hot spot reference method testing shall be submitted to the Engineer upon completion of the test, and shall become the property of the Authority.

B. Infrared Thermographic Survey

Test the entire conductor bar installation by infrared thermographic survey as specified below. The test shall be witnessed by the Engineer and shall be performed in accordance with the specific test methods and equipment submitted by the Contractor and approved by the Engineer. The Contractor will not be permitted to start the conductor bar test until after the specific test methods, including the hot spot reference method, are approved. The test shall be performed in the following manner:

1. Disconnect the conductor bars from their normal 480 volt, 3 phase power source and from ground.

2. Furnish and connect an electric arc welder, or similar power source approved by the Engineer. The four conductor bars shall be temporarily connected to provide the test current simultaneously in all bars.

3. Unless otherwise shown on the Contract Drawings, the Authority power feeders shall be used to supply power for the test. If an engine-driven generator or welder is used for testing purposes, provide noise abatement shields in accordance with the requirements of "Conditions and Precautions" of Division 1 - GENERAL PROVISIONS.

4. Maintain a 60-ampere minimum current flow for a period of at least 24 hours immediately preceding the thermographic survey.

5. Inspect each conductor bar splice, expansion bar power connection and powerfeed connection for the full length of each conductor bar on each span. Check temperature differentials at each location using a thermographic scan, and provide a video tape record and one duplicate copy of the tape, of all thermographic scans. A hand held infrared thermometer shall be used to cross check and verify the absolute temperatures of any hot spots encountered during the scan. Any splice, expansion bar power connection or powerfeed connection, or any other location so directed by the Engineer, which demonstrates a 2.0 degree C temperature differential shall be disassembled, cleaned and reassembled in accordance with the manufacturer's instructions.

6. Retest locations that were disassembled and cleaned as required in 3.02 D of this Section.

C. Operational Test

1. After completion of the thermographic survey, reconnect the normal 480-volt, 3-phase power source to the conductor bars with proper phase connections.

2. Verify the phase relationship of any conductor bar sections through the use of a phase sequence meter. Demonstrate that the phase sequences are the same for adjacent sections.

END OF SECTION

SECTION 16130

CONDUCTOR BARS

APPENDIX A

SUBMITTAL REQUIREMENTS

A. Submit the following for approval, in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

B. Shop Drawings

1. Shop drawings, showing all mechancial parts and assemblies including electrical components, complete connection details, as well as a complete list of parts with full identification.

2. Shop drawings for fasteners fittings and supports.

C. Catalog Cuts

1. Components and accessories

D. Submitt the following to the Engineer for approval:

1. Test methods and equipment including connection diagrams.

2. Reference method for identification in accordance with 3.01 A of this Section.

E. Submitt the original and one duplicate copy of the thermographic survey.

END OF APPENDIX "A"

DIVISION 16

SECTION 16133

CONTROL PANELS, ENCLOSURES/CABINETS AND TERMINAL BOXES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for control panels, electrical enclosures, cabinets and terminal boxes.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. All control panels, enclosures/cabinets and terminal boxes shall shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

American National Standards Institute (ANSI)

ANSI - Z535.4 - Product Safety Signs and Labels

ASTM International (ASTM)

B174 – Standard specification for Bunch-Stranded Copper Conductors for electrical conductors.

Code of Federal Regulations (CFR)

47 CFR Part 15 – Radio Frequency Devices

National Electrical Manufacturers Association (NEMA)

ICS1 - Industrial Control and Systems. General Requirements

ICS1.1 - Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control

ICS2 - Industrial Control and Systems. Controllers, Contractors, and Overload Relays Rated 600 Volts.

ICS3 - Industrial Control and Systems: Factory Built Assemblies

ICS4 - Industrial Control and Systems: Terminal Blocks

ICS6 - Industrial Control and Systems Enclosures.

ICS9 - Industrial Control and Systems: Power Circuit Accessories

250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

National Fire Protection Association (NFPA)

70 - National Electrical Code

70E - Standard for Electrical Safety in the Workplace

Underwriters Laboratories Inc. (UL)

50 – Standard for Enclosures for Electrical Equipment

65 - Standard for Wired Cabinets

437 –Standard for Key Locks

467 – Standard for Grounding and Bonding Equipment

486A - Wire Connectors

486E – Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

508 – Standard for Electric Industrial Control Equipment

969 – Standard for Marking and Labeling Systems

1059 – Standard for Terminal Blocks

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The control panels, enclosures/cabinets and terminal boxes and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than three years.
2. The Manufacturer shall be ISO 9001 certified
3. Utilize commercial off-the-shelf products specifically manufactured for the application or function of the control panels, enclosures/cabinets and terminal boxes, to the fullest extent possible. All enclosures/cabinets and equipment, for which there are established UL standards, shall bear the UL label.
4. All internal electrical components shall be readily available commercial products. Avoid proprietary or custom-made components unless there is no reasonable commercial alternative, and then only with the written approval of the Engineer.
5. The performance, operation and integrity of the control panels, enclosures/cabinets and terminal boxes, shall not be impaired by electrical or environmental influences, including but not limited to electronic, magnetic or electromagnetic interference from radio signals, power lines, lighting, transformers or other sources that may be present at the installation location.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Control panels, enclosures/cabinets and terminal boxes shall be delivered to the construction site complete. Where ever possible, all electrical devices and accessories shall be in place and pre-wired.

B. Control panels, enclosures/cabinets, terminal boxes and accessories shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. The factory pre-assembled control panels, enclosures/cabinets and terminal boxes shall be shimmed, braced, blocked and tied down to prevent distortion or other damage during transportation.

D. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions. If any electrical devices or accessories must be shipped loose they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with suitable non-corrosive tag.

E. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

F. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

G. Touch up any damage to finishes to match adjacent surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 MAINTENANCE

A. One set of all special tools and wrenches required for assembly or disassembly of the panel or cabinet and the installation of devices shall be furnished.

B. Furnish a list of recommended spare parts for each panel or cabinet. This list shall contain the prices and availability of recommended the spare parts.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. List of acceptable manufacturers shall be as shown on the Contract Drawings.

2.02 CONSTRUCTION FEATURES

A. General

1. Location of control panels and enclosures/cabinets and their approximate dimensions shall be as shown on the Contract drawings.

2. Control panels, enclosures/cabinets and terminal boxes shall be designed in accordance with applicable standards of ANSI, NEMA, NFPA, and UL.

3. Each control panel, enclosure and cabinet shall be factory assembled, wired, tested and shipped as a single complete unit, with all devices, terminal blocks and internal wiring installed, unless written permission is given by the Engineer to disassemble any components or parts for shipment. Shipped loose components must fit and be ready for immediate installation in the field.

4. Devices installed shall be grouped according to their function. 15 percent spare mounting space shall be provided for future alterations.

5. All indicating devices, instruments, control switches and indicating lights shall be mounted on the door or front panel. Protection relays, if used, shall be semi-flush type with built-in test facilities wherever possible.

B. Interior

1. Control panel interior shall be designed and assembled so that individual devices, terminal blocks and other removable components and wiring may be easily accessible in order to add, remove or replace them without disturbing or removing adjacent units. All devices shall be located on two surfaces only, front and rear. No intermediate swing panels are allowed unless specified on Contract Drawings.

2. The distance between devices and wiring ducts and between terminal blocks and wiring ducts shall be sufficient to install and make clearly visible full wire designation, but not less than 1 inch.

3. All control cables shall be installed in gutters and wiring ducts with removable covers. Filling of gutters and ducts shall not exceed 50 percent. Wireways shall have 0.06 square inch area for each external connection terminal point. This area shall be in addition to wireways required for internal wiring.

4. All internal connections to door mounted devices or swing out panels shall be made with "Extra-Flexible" (19 strand) wiring conforming to ASTM B174 Class K, bundled together into a cable tie harness with sufficient slack for opening/closing of the door. The bundle shall be enveloped with a helical plastic lacing to prevent wire abrasion. The wire bundle shall be carried between supporting clamps on the door and fixed portion of the enclosure.

5. Devices and terminal blocks shall be mounted on a mounting panel to space them away from rear wall of the enclosure/cabinet.

6. Enclosures/cabinets with terminal blocks only shall include terminal straps and brackets sized for the particular enclosure/cabinet and designed to space the terminal blocks away from rear wall of the enclosures/cabinets. Straps and brackets shall be Hoffman, or approved equal.

7. Thermostatically controlled space heaters with mechanical guards shall be provided for all outdoor-located enclosures and for indoor enclosures if indicated on the Contract Drawings. Heaters shall be rated 240 volts and operated at 120 volts, each with an individual circuit breaker of suitable rating. Heaters shall be sized to keep the air inside the cabinet above the dew point.

8. If indicated on the Contract Drawings, enclosures/cabinets shall have internal ventilation fans, with replaceable filters, which are thermostatically controlled to provide air flow and keep the internal enclosure temperature below the rated temperature of the internal components. If a NEMA 4X stainless steel enclosure/cabinet is utilized, install stainless steel air louver kits provided by the enclosure manufacturer.

C. Enclosures and Cabinets

1. Unless otherwise shown on the Contract Drawings, enclosures/cabinets shall meet the following environmental requirements:

   a. Enclosures/Cabinets located in heated environmentally controlled interior areas shall be NEMA Type 1.

   b. Enclosures/Cabinets located in unheated areas or in areas without any environmental control subject to dust or oil, shall be NEMA Type 12 or 13.

   c. Enclosures/Cabinets located in outdoor areas or in interior areas subject to rain, dripping liquid, hosing, or in harsh corrosive environments shall be NEMA Type 4X, stainless steel. NEMA 3R or NEMA 4X non-metallic enclosures/cabinets may only be used where indicated on the Contract Drawings.

2. Enclosures/cabinets shall be fabricated of code-gauge sheet-steel, unless hot-dipped galvanized steel or NEMA 4X or stainless steel or non-metallic enclosure/cabinet is shown on the Contract Drawings.

3. Enclosures and cabinets shall have a hinged door unless otherwise indicated on the Contract Drawings. Doors shall be fitted with concealed, continuous, flush piano hinges.

4. Enclosures/cabinets and trims shall be for surface-mounting, recessed installation or free standing (floor mounting) installation as shown on the Contract Drawings.

5. Trim for recessed or flush-mounted enclosures/cabinets shall consist of a one-piece sheet-steel frame with hinged door, catch and lock. Frame shall extend 3/4-inch beyond each side of the cabinets and shall be set with their backs flush with the finished wall. Rolled lip around all sides of the enclosure shall be provided to exclude liquids and contaminants. Door and body stiffeners shall be provided where required to assure rigid construction.

6. Enclosures/cabinets for surface mounting shall be provided with the door, hinged directly to enclosures/cabinets. Door shall be made of one piece of sheet-steel, shall have a 3/4-inch flange around all edges shaped to cover the edge of the box, and shall be provided with a catch and lock. Rolled lip around all sides of the enclosure shall be provided to exclude liquids and contaminants. Door and body stiffeners shall be provided where required to assure rigid construction.

7. Floor mounting (freestanding) enclosures/cabinets shall be fabricated of 10-gauge steel with steel channel base to form a rigid, self-supporting structure. Heavy duty lifting eyes anchor into reinforced top shall be provided.

8. On panels or doors weakened by excessive area punched out for device mounting, reinforcing stiffeners shall be installed for extra rigidity.

9. Enclosures/cabinets with through wiring shall be provided with 4-inch-wide side gutters. Enclosures/cabinets shall be provided with top and bottom gutters not less than 6 inches wide.

10. All doors shall close against a rabbet placed all around the inside edge of the frame, with a close-fitting joint between the door and frame.

11. All doors shall be fitted with padlock hasps.

12. Doors smaller than 48 inches shall be secured in place with door screws or screw down door clamps. If door clamps are utilized they shall be stainless steel with spring tensioners. All door screws shall be captive, tamper-proof type.

13. Unless otherwise indicated on the Contract Drawings, NEMA Type 1, 3R, 12 and 13 enclosures and cabinets with doors more than 48 inches high, shall be provided with a handle connected to a heavy-duty, three-point latching mechanism with rollers on ends of latch rods for easy door closing. For NEMA 4X enclosures/cabinets, doors more than 48 inches shall utilize door clamps in compliance with the requirements for doors smaller than 48 inches.

14. If indicated on the Contract Drawings, each door shall be furnished with a flush cylinder tumbler lock, with catch and spring loaded type stainless steel door pull. Locks shall be fitted for separate keying of each system. Furnish a minimum of two keys for each cabinet installed, and a maximum of 20 keys per system.

15. The enclosure/cabinet shall include a separate instrument ground bus that will accommodate separate instrument ground connections from all system devises and components. The instrument ground bus shall be designed to serve as a single-point bond between the instrument ground and the enclosure/cabinet distribution system ground.

16. Fastening door screws or door clamps, where required, shall be stainless steel. Door screws shall be of the captive, tamper proof type.

17. Collar studs shall be provided with internal mounting panel.

18. Provide large removable print pockets, mounted inside of each enclosure/cabinet door.

D. Wiring

1. Wiring shall be sized to the duty and connected loads in accordance with NFPA 70

   a. Minimum wire size for Switchgear, Protective Relaying, MCC, motor controllers and power system control panels, enclosures/cabinets and terminal boxes shall be No. 14 AWG.

   b. Minimum wire size for general purpose controls, instrumentation, HVAC, and building management type systems shall be No. 16 AWG.

   c. Minimum wiring to all receptacles shall be No. 12 AWG.

   d. For analog and data sensors and instrumentation devices where shielded twisted pair wiring is required by the device manufacturer, shielded twisted pair smaller than No. 16 may be utilized with the approval of the Engineer.

e. For control panels utilizing Programmable Logic Controllers (PLC's), Direct Digital Control (DDC) units, Remote Terminal Units (RTU), Remote Data Units (RDU's) or similar pre-packed microprocessor based control units, wiring between field wiring terminal blocks and the microprocessor based control unit device may utilize pre-assembled ribbon cables and wiring harnesses of size smaller than No. 16 AWG, if the ribbon cable or wiring harness is a standard feature manufactured specifically for the microprocessor based control unit by its manufacturer and only if the connected loads do not exceed the current rating of the wire used for the ribbon cable or wiring harness. Use of such ribbon-cables or wiring harnesses shall only be with the approval of the Engineer.

2. For control panels, enclosures/cabinets and terminal boxes to be installed in locations designated on the Contract Drawings as being under the jurisdiction of NFPA-130 or NFPA-502, PVC insulated wiring shall not be utilized. All wiring for these areas shall be Low Smoke-Zero Halogen, conforming to be requirements of Section 16120, 16126 and 16127, as applicable.

3. Wiring of all relays, instruments, and other devices shall conform to the arrangement shown on approved wiring diagrams.

4. All control wiring, including all spare contacts of all devices, shall be wired to terminal blocks. Terminals shall be arranged for consecutive connections of conductors which compose a given control circuit or connected device. Number of spare contacts in each device shall be as shown on Contract Drawings.

5. All bus wiring such as 125 V DC, 120 V AC, alarm, etc. shall be insulated wire, run from terminal block to terminal block and not rigid buses.

6. Connections made on terminal blocks and devices shall be by means of insulated locking fork, or insulated ring type crimp terminals. All crimps shall be made with a ratchet type compression tool specifically made for this application to produce optimum mechanical and electrical performance.

7. On devices that do not permit locking fork or ring type terminals, control wiring shall be held by tubular screw-type connectors.

8. Internal wiring shall have no splices, nor shall more than two wires be terminated on one terminal point.

9. Contractor is solely responsible for correctness of the internal wiring and proper functioning of the equipment being connected.

E. Terminal blocks

1. Terminal blocks shall be as shown on the Contract Drawings, as follows:

a. Sliding link disconnect terminal blocks shall be rated 600 volt AC and shall be UL recognized, States type NT or NTM, Poweright Products Inc., series SLD-78-S, or approved equal.

b. Add on type terminal blocks with screw terminals and clamps, rated 600 volts, and sized to accept a wire range of No. 22 to No. 8 AWG, UL recognized and CSA certified. Terminal blocks shall be Allen-Bradley, Buchanan, GE or approved equal.

c. Solderless tubular terminal blocks add-on type shall be rated 600 volts, and sized to accept a wire range of No. 22 to No. 8 AWG, with non-rotating clamping surfaces, UL recognized and CSA certified. Terminal blocks shall be Allen-Bradley, Buchanan, GE or approved equal.

d. Fuse blocks shall be furnished with 600 volt rated fuses and switch-action, blown fuse indicator, pullers.

e. Provide terminal block accessories, including fanning strips, jumpers, marking strips and terminal covers.

2. Terminal block housings shall be molded from flame-retardant Lexan, Nylon or Polypropylene and terminal block accessories shall be made of flame-retardant materials. All terminal blocks shall be barrier type.

3. Each terminal block assembly shall be supported after every twelve points.

4. Terminal blocks rated 600 volts, 30 Amps shall be provided for all field wiring connections, unless otherwise shown on the Contract Drawings.

5. At least 20 percent uniformly distributed spare terminals shall be provided.

F. Identification

1. All devices shall be indelibly identified with engraved legend plates inscribed in accordance with approved shop drawings.

2. Each Enclosure/Cabinet shall be provided with a large engraved nameplate on its front. Nameplate nomenclature shall be as identified on the Contract Drawings.

3. Unless otherwise shown on the Contract Drawings, fabricate nameplates from an approved type of lamacoid plastic with letters engraved on the plate in black on white background. Where letter sizes are not shown on the Contract Drawings, use 1/2-inch high letters.

4. Secure nameplates on equipment with brass or stainless steel screws.

G. Accessories

1. If indicated on the Contract Drawings, front of board test facilities shall be provided for all instrument and relay current and potential circuits that cannot be individually tested by test devices inherently built into relays or meter. Auxiliary contacts and switches shall be provided where necessary to form part of the test blocks.

2. Interior lighting with switches and receptacles, 120 volts AC, shall be provided if called for on the Contract Drawings.

3. A color-coded mimic bus shall be provided if called for on the Contract Drawings.

4. Internal copper ground bus, sized ¼ inch by 1 inch and extended throughout the structure, shall be provided in free standing enclosures/cabinets if called for on the Contract Drawings. Ground bus shall be bolted, brazed or welded to the framework, side sheets, etc.

5. For all control panels (except Switchgear, Protective Relaying, MCC's and Power Systems controls, unless otherwise indicated on the Contract Drawings) provide a master power switch or main circuit breaker (sized as required) within the enclosure/cabinet which can de-energized all power to the control panel to allow for safe maintenance and servicing. All power removal switches and breakers shall be clearly labeled.

6. For motor controls or other controls identified on the Contract Drawings, provide power disconnect type door locks, wired and/or mechanically interlocked to remove all incoming power to the cabinet/enclosure when the door is opened.

7. Circuit breakers or fuses, in accordance with Section 16475 sized as per NFPA 70 for the connected load, shall be utilized for all internal cabinet power distribution (AC or DC).

8. Any receptacles utilized shall be in accordance with Section 16140 and shall have overcurrent protection in accordance with NFPA 70. For enclosure/cabinets to be installed outdoors or in damp or wet areas, receptacles shall be Ground Fault Interrupting type. If the Contract Drawings require a dedicated maintenance receptacle to be installed within an enclosure/cabinet, provide a clearly labeled separate power removal switch or breaker so the receptacle can remain energized when the rest of the enclosure/cabinet is de-energized.

9. All relays utilized shall be field replaceable with snap-in socket bases. Relay bases shall be either channel mounted or screwed to the back panel. All relay designations shall be clearly labeled or marked

10. Any power supply units utilized shall be field replaceable either channel mounted or with captive screw mounted brackets. All power supply units shall be UL listed, with field replaceable overcurrent protection sized for the full connected load.

11. Provide arc-flash labeling on all cabinet/enclosure doors in accordance with NFPA 70E.

2.03 PAINTING

A. Surfaces to be painted shall be prepared by the removal of all grease, oil, rust, scale or other foreign material and chemically treated to provide a bond between the paint and metal surface preventing the entrance of moisture and the formation of rust under the paint film.

B. The enclosure shall be coated using one of the following methods:

1. A prime coat of zinc chromate paint and two finish coats of baked on enamel paint shall be applied. The prime and finish shall be a compatible coating system.

2. All surfaces shall be coated with a baked on, electrostatically applied powder coating. For NEMA type 1 enclosures installed indoors epoxy or epoxy hybrid coatings may be utilized. For any other NEMA rated enclosures, or for any enclosure installed outdoors, only polyurethane or TGIC powder coatings may be utilized.

C. Unless otherwise indicated on the Contract Drawings, finish paint color for fire alarm and fire pump system panels shall be red, and all other system panels shall be ANSI 61 gray. Furnish a can of touch-up paint for use after all enclosures/cabinets have been installed.

D. Stainless steel panels shall not be painted. Galvanized panels shall be painted if shown on the Contract Drawings.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the Work of this Section in accordance with the Contract Documentation.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory Work, if any, will be needed to bring the equipment onto the site, and what will be the best and quickest method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where control panels or cabinets are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

3.02 FACTORY INSPECTION AND ACCEPTANCE TESTING

A. The Control Panels, Enclosures/Cabinets and Terminal Boxes, including all hardware and software within, shall be inspected and tested at the place of manufacture to verify conformance with the Contract Drawings and Specifications. The Control Panels, Enclosures/Cabinets and Terminal Boxes shall not be delivered to the Work site until the satisfactory completion of Factory Inspection and Acceptance Testing as specified in this Section.

B. The Engineer shall be permitted to inspect any equipment, material or work to be furnished under this specification and shall have the right to reject any parts considered defective, unsuitable for the purposes or not in accordance with these specifications. Free entry shall be permitted to the Engineer at all times and to all parts of the works engaged in the manufacturing of this equipment.

C. Prepare and submit a Factory Inspection and Acceptance Test Plan for review and approval by the Engineer not less than 60 calendar days in advance of the target test date. The Test Plan shall include procedures to verify compliance and demonstrate that every feature and function of the Control Panel hardware and software to be furnished conforms to the Contract Drawings and these Specifications.

D. Unless otherwise indicated on the Contract Drawings or directed by the Engineer, enclosures/cabinets with terminal blocks only do not require witnessed Factory Acceptance Testing.

E. The Factory Inspection and Acceptance Test Plan shall include the following information:

1. A summary of the purpose and objective of each part of the test

2. The method of testing

3. An enumerated listing of the specific items, components, and functions to be tested

4. A description of the test environment, including diagrams showing the equipment under test, test equipment, equipment hookup and interconnection, etc.

5. Specification of test hardware and software to be used during testing including a description of the devices to be simulated and simulation methods to be used.

6. Detailed test procedures that:

   a. Describes the purpose of the test

   b. Identifies the Specification or Contract Drawing requirement that will be demonstrated

   c. Identifies the initial conditions at the start of each test procedure

   d. Details the specific steps to be performed during each test

   e. Identifies the expected results/measurements of each test

   f. Provides space for recording actual measurements and results for each step and each test

   g. Describes visual and printed outputs (e.g., reports, database listings, statistical analyses, computer monitor displays, meter readings, etc.).

   h. Includes check boxes to indicate the completion of each test step

   i. Includes check boxes to indicate the pass/fail outcome of each test

   j. Provides space to record comments for each test

   k. Provides a place to record the signatures of the manufacturer's representative performing the test and the Engineer witnessing the test.

F. Factory tests shall be performed in accordance with applicable NEMA, ANSI and IEEE specifications. Testing shall include, but not be limited to:

1. Physical inspection of all equipment and components, including cabinet and panel layouts and appearance for conformance of construction, layouts, wiring, methods and materials to the approved shop drawings and applicable code requirements.

2. Continuity testing of all control circuits, to verify that all devices are wired correctly.

3. Simulated operating test to demonstrate the proper functioning of all Control Panels. Thoroughly exercise all functions and components, both individually and collectively, including test cases for both normal and failure conditions (as applicable)

4. Testing of any Contractor furnished spare parts or components through substitution.

5. For all Motor, Starter and Power control panels, perform high potential and operating tests on power equipment to demonstrate that this equipment will function correctly and in accordance with the intent of the specifications. Check rating of all protective devices (circuit breakers and fuses).

6. For all Motor, Starter and Power control panels, perform insulation resistance test for each circuit with equipment connected, except those containing electronic components, using a 1000-volt megger. The insulation resistance shall be no less than 25 megohms.

7. Any additional requirements identified on the Contract Drawings.

G. Facilities for any reasonable tests that may be considered necessary in connection with any inspection shall be furnished at no additional cost to the Authority.

H. All test and simulation equipment, including all hardware and software required for the test, shall be furnished by the Contractor. The Contractor shall provide all equipment, instruments, cables, tools and personnel required and shall bear all expenses incidental to the testing, including replacement of damaged parts and material.

I. The accuracy and calibration of all instruments to be utilized during the testing shall be verified and recorded at the beginning of the tests. For pre-calibrated instruments and equipment, include calibration certificates as part of the test documentation. All instruments and equipment shall have been calibrated within one year of the date of testing. Instruments and equipment with calibrations that are more than one year old shall not be utilized. Test procedures shall include verification that the serial numbers of the instruments or equipment used for the testing match those on the calibration certification documentation. During testing, all instrument and test equipment readings shall be visible to the Engineer.

J. The Engineer will review the submitted Factory Inspection and Acceptance Test Plan and will notify the Contractor that it is either approved or requires modification and is to be resubmitted. If re-submittal is required, the Factory Inspection and Acceptance Test Plan shall be revised and resubmitted, as necessary, until it is approved by the Engineer.

K. Prior to any witnessed Factory Inspection and Acceptance Testing by the Engineer, the Contractor shall conduct a Pre-Acceptance Test. For Pre-Acceptance testing, the Contractor shall perform the complete Factory Inspection and Acceptance Test, in accordance with the approved Factory Inspection and Acceptance Test plan, to verify that all equipment is fully operational in accordance with the requirements of these Specifications and the Contract Drawings and is ready for the witnessed Factory Inspection and Acceptance Testing. While this testing period shall, in general, be conducted by the Contractor without regular monitoring or witnessing by the Engineer, the Engineer shall have the right to review and inspect the results of this test process at any time. Upon completion of all Pre-Acceptance Testing, the Contractor shall submit to the Engineer written certification that the Pre-Acceptance testing has been completed and all results were satisfactory. This certification shall include a copy of all test results and data. Certification of successful completion of Pre-Acceptance testing must be submitted a minimum of 10 working days prior to the scheduled start of any witnessed Factory Inspection and Acceptance Test.

L. The Contractor shall schedule the dates and locations for the Factory Inspection and Acceptance Testing with the Engineer. All Factory Inspection and Acceptance Testing requests shall be submitted to the Engineer in writing, such that the Engineer shall receive the request a minimum of 20 working days prior to the desired start date. The request shall include the location of the inspections and testing and testing schedules including the estimated dates and durations of the testing. The Engineer reserves the right to require additional testing or to waive factory inspection or witnessing of tests. The Engineer will advise the Contractor which tests will be witnessed and which will be waived.

M. The Factory Inspection and Acceptance Test shall be performed by the Contractor using the approved Factory Acceptance Test Plan and shall be witnessed by the Engineer. Each test shall be performed in its entirety using simulated inputs and outputs as identified in the approved test procedure.

1. In the event any device or component fails a test, the test shall be halted and the Contractor shall make all necessary repairs or adjustments. The test shall then be repeated.
2. Unless permitted by the Engineer, subsequent test steps shall not begin until the test failure is satisfactorily corrected.
3. If in the judgment of the Engineer, a repair or adjustment jeopardizes the integrity of previously completed tests, the Engineer shall have the right to require that previous test steps be fully or partially repeated.
4. The Engineer may, in his sole judgment, authorize testing to begin on a different portion of the test while repairs or modifications are made to correct a failure.
5. If, in the judgment of the Engineer, there are an excessive number of test failures, the Factory Inspection and Test shall be terminated and rescheduled at a later date

N. During the witnessing of tests, all original test data shall be initialed by the Engineer, and at the conclusion of the tests he shall be furnished with one copy of all original test data. If any procedures or data was modified, the Engineer shall be apprised and such modification shall be subject to the approval of the Engineer.

O. If the Authority elects to waive witnessing of Testing, the Contractor shall perform all testing in accordance with the approved Factory Inspection and Acceptance Test Plan, and record all results in the same manner as if the Engineer were in attendance. The Contractor shall self certify the test results. Certification shall be by a Professional Engineer, licensed in the State in which tests were performed and so stamped. Certified copies of all test results shall be submitted to the Engineer.

P. Upon completion of the Factory Inspection and Testing, the Contractor shall prepare and submit a test report documenting the test results. The Factory Inspection and Acceptance Testing report shall identify the nature of any failures, the reasons for the failure, the corrective actions taken, and the specific equipment, components or devices repaired. These reports shall become part of the Factory Inspection and Acceptance Test documentation, as well as the historical QA failure record for the specific devices and components.

Q. Witnessing a test, waiving the right to witness a test, acceptance of the Factory Inspection and Acceptance Test results, or release of equipment for delivery by the Engineer shall not be deemed as acceptance of the Control Panels, Enclosures/Cabinets and Terminal Boxes, nor shall it relieve the Contractor of the responsibility to furnish equipment that is compliant with the Contract Drawings and Specifications.

3.03 PREPARATION

A. When control panels, enclosures/cabinets and terminal boxes are to connect to or interface with other equipment or systems, either existing or furnished as part of the Work of this Contact or furnished by others, the Contractor shall ensure that the design of control panels, enclosures/cabinets and terminal boxes is fully coordinated and all wiring connections are fully accounted for, as identified.

B. Install any channels, angles or other supports that are required to support or mount the control panels and enclosures/cabinets.

C. Use supports and fasteners as specified in Section 16190 or as shown on the Contract Drawings.

3.04 FIELD INSPECTION

A. After delivery, the Engineer will conduct a visual field inspection of all control panels, enclosures/cabinets and terminal boxes. If any equipment has been damaged, or for any reason does not comply with the Specifications or Contract Drawings, the Engineer will notify the Contractor in writing. The Contractor shall repair or replace the equipment, as determined by the Engineer, without any additional cost to the Authority, even though the equipment was previously inspected and approved for shipment. After satisfactory replacement or repair and receipt of the Engineer's written approval, the Contractor shall install the control panels, enclosures/cabinets and terminal boxes as required.

3.05 INSTALLATION

A. Install all control panels, enclosures/cabinets and terminal boxes in accordance with the Contract Drawings and approved Shop Drawings. Set work accurately at the proper locations.

B. Surface and flush mounted enclosures/cabinets shall be installed with tops 6 feet-6 inches above the floor, unless otherwise shown on the Contract Drawings.

C. Control panels and enclosures/cabinet shall be installed true and plumb on supporting struts and shall not be mounted directly on concrete, concrete block walls, or any other walls subject to moisture. Leave a minimum gap of 1/2 inch between the back of the enclosure/cabinet and the wall, using stainless steel hardware.

D. Where mounting directly on the wall is unavoidable the back of the enclosure shall be painted with two coats, minimum, of a bituminous paint.

E. Connect equipment as shown on approved shop drawings. Cables shall be neatly racked and bundled with nonflammable nylon ties, routed and supported within the enclosures/cabinets, cable ducts or gutters. Minimum bending radii as recommended by cable manufacturers shall not be reduced. Tag and identify all field terminations.

F. After conduits and cables are installed, the enclosures/cabinets shall be inspected for foreign materials and shall be vacuumed clean. Prior to energizing, the panels shall be tested as described herein.

G. Prior to issuance of Certificate of Final Completion, a set of As-Built drawings, neatly bound together in plastic covers, shall be placed in the print pocket of each enclosure/cabinet.

3.06 FIELD TESTING

A. After equipment installation, all control panels, enclosures/cabinets and terminal boxes shall be tested to verify proper installation and compliance with the Specifications and Contract Drawings. Field Testing shall consist of repeating operating and functional tests performed during the Factory Inspection and Acceptance Testing with the equipment energized and correctly wired to the all field equipment and devices. The Field Testing shall verify actual control panel functionality. All Field Tests shall continue until the results are satisfactory to the Engineer. Tests that fail shall be repeated upon correction of any deficiencies. Tests shall be repeated as often as required by the Engineer, until satisfactory performance is demonstrated

B. Testing, checking, start-up and commissioning of all control panels, enclosures/cabinets and terminal boxes shall be performed by the Contractor and witnessed by the Engineer. The Contractor, in conjunction with the equipment manufacturer, shall provide start-up service and testing for all equipment provided. The Contractor shall provide all required instrumentation, simulation devices, equipment and tools necessary for complete Field Testing.

C. After installation and permission by the Engineer to initiate Field Testing, each control panels, enclosures/cabinets and terminal boxes shall be tested in accordance with an approved Field Testing Plan. The Field Testing shall be conducted with all devices and components integrated as a system and correctly wired to all field devices and equipment. Simulation shall only be used where actual conditions cannot be initiated, or where doing so would cause injury to personnel or damage to equipment.

D. The Field Testing shall demonstrate and exercise all operational procedures and functions as well as demonstrate that all of the various components that make up and connect to each control panels, enclosures/cabinets and terminal box are integrated as a single, fully functional system.

E. Prepare a separate Field Test plan for each control panels, enclosures/cabinets and terminal box. The test scripts to be used for Field Testing shall include, but not be limited to, those test scripts used for the Factory Inspection and Acceptance Testing, modified accordingly, and with any additional test scripts required, to demonstrate proper operation using the actual field devices (e.g.: controlling and monitoring actual fans or breakers or lights, etc). The Field Testing shall also include inspection of the completed installation, testing of all field connections, inputs and outputs, and testing of all control panels, enclosures/cabinets and terminal boxes functions and features.

F. Field Testing shall include:

1. Visually inspect each device in the panel and operate manually.
2. Check all connections for tightness.

3. Check rating of all protective devices (circuit breakers and fuses). To each pole of the circuit breakers apply current three times its rating, recording currents and breaker trip times. Apply rapidly increasing currents and record the value that consistently causes instantaneous tripping of the breaker. Compare these recorded times with manufacturer's time current curves.

4. Perform wiring control tests on each panel control wiring tests to determine that all devices are functioning correctly when energized, in accordance with the intent of the Contract Drawings and Specifications.

5. Perform complete control system functional test. This test shall include a step by step procedure to determine that the entire control system (this control panel could be just part of it) operates properly.

G. All discrepancies found by the Contractor shall be brought to the attention of the Engineer.

H. All testing shall be performed in the presence of and as directed by the Engineer. The Contractor shall notify the Engineer when the equipment is installed and ready for testing.

1. Upon completion of Field Testing for each control panels, enclosures/cabinets and terminal box, prepare a report documenting the test results. The test result report shall identify the nature of any failures, the reasons for the failure, the corrective actions taken, and the specific equipment, components or devices repaired. These reports shall become part of the Field Acceptance Testing documentation, as well as the historical QA failure record for the specific devices and components.

3.07 30-DAY OPERATIONAL TEST:

A. 30-day operational testing shall be performed for each control panels, enclosures/cabinets and terminal box indicated on the Contract Drawings or as directed by the Engineer.

B. After satisfactory completion of each Field Test and when all associated field devices and equipment have been turned over for operation, as determined by the Engineer, a 30-day Operational Test shall commence. During the 30-Day Operational Test, Authority personnel shall operate and use each control panels, enclosures/cabinets and terminal box in a live, operating environment.

1. During the 30-Day Operational Test, the Contractor shall correct all malfunctions and failures as they occur, including but not limited to, equipment failures, and failure of each control panels, enclosures/cabinets and terminal box or its associated internal components, hardware and software to comply with the Specifications or Contract Drawings. The Contractor shall complete all corrections within 24-hours of notification of the failure by the Engineer.

2. After correction of all malfunctions or failures, the 30-day test shall be restarted from day one. The test shall continue until each control panels, enclosures/cabinets and terminal box has satisfactorily operated without interruption, malfunction, or failure for 30 continuous days, as determined by the Engineer, and the Engineer has issued written notice of satisfactory completion of the test.

3. Upon successful conclusion of each 30-Day Operational Test, submit a report documenting the test results. The test report shall identify the date, time and nature of any failures (if any). For all failures, the test report shall document the reasons for the failure, the corrective actions taken, the length of time required to take the corrective actions and the specific equipment, components or devices repaired.

3.08 PROTECTION AND SAFETY

A. During installation, energizing and testing, establish and follow Electrical Safety and Arc Flash protection procedures in accordance with OSHA and NFPA 70E, as applicable.

B. Prepare and submit for approval recommended procedures for workplace electrical safety and arc flash protection of maintenance personnel working on or around each control panels, enclosures/cabinets and terminal box, in accordance with OSHA and NFPA 70E. Include:

1. Recommended arc flash protection boundary around each control panels, enclosures/cabinets and terminal box.
2. Recommended safety related work practices and procedures with respect to operating control panels, enclosures/cabinets and terminal boxes.
3. Recommended safety related practices and procedures with respect to maintenance of control panels, enclosures/cabinets and terminal boxes.

END OF SECTION

SECTION 16133

CONTROL PANELS, ENCLOSURES/CABINETS AND TERMINAL BOXES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Manufacturers name, address and qualification information, including

1. List of previous control panels, enclosures/cabinets and terminal boxes manufactured brief description of their size, function and complexity, name of end user and dates of manufacture.
2. Copy of manufacturer's Quality Assurance (QA) policies and procedures.
3. The above must be submitted and approved by the Engineer prior to submittal of any of the ensuing documentation.

B. Catalog Cuts

1. Enclosures
2. Cabinets
3. Terminal blocks
4. All factory or field mounted devices and equipment shown on the control panel or enclosure/cabinet drawings

C. Shop Drawings

1. Shop drawings for each enclosure/cabinet shall include:
   a. Job name
   b. Item number
   c. Quantity of each enclosure/cabinet configuration
   d. Nameplate schedule in accordance with Contract Drawings
   e. Complete assembly drawings including plan, elevation and section views with dimensions. Show dimensioned location of all devices, terminal blocks, accessories and details for purchaser cable support. Indicate conduit entrance areas and mounting details.
   f. Cabinet/Enclosure construction details, floor plan and channel base detail drawings.
   g. Specification for enclosure/cabinet mechanical and electrical parts, and assemblies.
   h. Wiring interconnection and schematic diagrams as follows:
      (1) The elementary diagrams supplied by panel manufacturer shall contain:

(a.) Each device designation corresponding to panel layout drawing and wiring diagrams

(b.) All device terminal numbers corresponding to device vendor information

(c.) Contact development diagrams of all control, selector, and transfer switches, protection and auxiliary relays, pushbuttons, etc. Indicate connections to control panel terminal blocks

(d.) Contact diagrams for all alarm and indication circuits. Indicate connections to control panel terminal blocks

(2) Control panel internal connection wiring diagram shall contain:

(a.) Each device designation corresponding to panel layout drawing and elementary diagrams. All device terminals shall be identified identical to device vendor drawing and arranged in correct physical relationship.

(b.) Sufficient information at each wire termination to locate the other termination without recourse to routing sheets, supplementary tabulations, or any other document.

(c.) Terminal strips numbered sequentially from top to bottom and left to right. Show terminals requiring external connections. The terminal strips shall be shown on drawings spaced at least 4 inches apart, so as to permit external or field wiring to be shown on the same drawings.

(d.) External field connection diagram between the control panel and the equipment connected to it.

i. Bill of materials: Components shall be identified by manufacturer's catalog number, technical characteristics and settings required for the installation. Bill of materials shall correlate components to panel layout drawing and diagrams.

D. Schedules

1. Nameplate nomenclature

2. Terminal block designations

E. O & M Manuals (If required on Contract Drawings)

F. Factory Inspection and Acceptance Test Plan

1. Submit Factory Inspection and Acceptance Test Plan in accordance with 3.02 of this Section.

G. Pre-Acceptance Testing Results

1. If performed, submit Pre-Acceptance Testing results and certification letter in accordance with 3.02 K of this Section.

H. Request for scheduling and witnessing of Factory Inspection and Acceptance Testing.

1. Submit request and schedule for Factory Inspection and Acceptance Testing in accordance with 3.02 L of this Section.

I. Factory Inspection and Acceptance Test Results

1. Submit Factory Inspection and Acceptance Test Results for each control panels, enclosures/cabinets and terminal box, in accordance with 3.02 O and 3.02 P of this Section.

J. Field Test Plan

1. Submit Field Test Plan in accordance with 3.06 of this Section.

K. Field Test Results

1. Submit Field Test Results in accordance with 3.06 I of this Section

L. 30 Day Operational Test Results

1. For each control panels, enclosures/cabinets and terminal box for which there was a 30 Day Operational Test, submit 30 Day Operational Test results upon successful completion of said testing, in accordance with 3.07 B 3 of this Section.

M. Protection and Safety Recommendations

1. Prepare Protection and safety recommendations in accordance with the requirements of 3.08 of this Section

N. As-Built Documentation

1. Submit As-Built Documentation, including location plans and As-Built shop drawings and As-Built field wiring for each control panels, enclosures/cabinets and terminal box.

END OF APPENDIX "A"

DIVISION 16

SECTION 16135

BOXES AND FITTINGS

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for electrical boxes and fittings.

B. Types of electrical boxes and fittings specified in this Section are:

1. Outlet Boxes
2. Device Boxes
3. Pull Boxes
4. Junction Boxes
5. Conduit Bodies
6. Fittings

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	National Electrical Manufacturers Association (NEMA)
NEMA OS1	Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA OS2	Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
	Underwriters Laboratories Inc. (UL)
UL 50	Cabinets and Boxes
UL 514A	Metallic Outlet Boxes
UL 514B	Fittings for Conduit and Outlet Boxes
UL 514C	Nonmetallic Outlet Boxes, Flush Device Boxes, and Covers
UL 886	Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

1.03 QUALITY ASSURANCE

Boxes and fittings, of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years. A list of acceptable manufacturers is shown on Basic Contract Drawing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original, unopened, protective packaging.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces.

1.05 SUBMITTALS

"Submittal Requirements" shall be in accordance with APPENDIX A.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Locations, types and sizes of boxes and fittings are shown on the Basic Contract Drawing.

2. Boxes and fittings shall be metallic, unless otherwise shown on the Basic Contract Drawing, and shall conform to NEMA 0S1, NEMA 250, UL 50, UL 514A, UL 514B, and NFPA 70.

3. Nonmetallic boxes and fittings, shown on the Basic Contract Drawing, shall conform to NEMA 0S2, NEMA 250, UL 50, UL 514C, and NFPA 70.

4. Boxes and fittings to be located in hazardous (classified) areas, as shown by "area plans" on the Basic Contract Drawing shall conform to UL 886 & NFPA 70.

5. All electrical materials and equipment, for which there are established UL standards, shall bear the UL label.

6. Where the sizes or dimensions of a box are not shown on the Basic Contract Drawing, all boxes, whether for use on power, communications, signaling, control, telephone, or other purposes, shall be sized as follows:

   a. In straight pulls, the length of the box shall not be less than 8 times the trade diameter (nominal inside diameter) of the largest raceway.

   b. Where angle or "U" pulls are made, the distance between each raceway entry inside the box and the opposite wall of the box shall not be less than 6 times the trade diameter of the largest raceway. The distance shall be increased for additional entries by the amount of the sum of the diameters of all other raceway entries in any row on the same wall of the box. The distance between raceway entries enclosing the same conductor shall not be less than 6 times the trade diameter of the larger raceway.

c. Where a conduit entry is in the wall of a box opposite a removable cover, the minimum distance between the entry and the cover shall be as follows:

Conduit Size	Distance Between Entry and Cover
Up to 1-1/4"	4"
1-1/4" and 1-1/2"	6"
2" and 2-1/2"	8"
3" and larger	12"

d. The minimum depth of a box shall be not less than two times the trade diameter of the conduit entries in a single row and not less than 1-1/2 times the sum of the trade diameter of the largest raceway in each row for multiple rows.

7. Weatherproof cast boxes shall be used for exterior or damp locations. Weatherproof boxes shall be hot-dipped galvanized cast-steel or cast-aluminum. Cast boxes shall be threaded conduit entrance type provided with mounting lugs. Materials shall match the type of conduit i.e., galvanized steel or aluminum, used in the conduit run.

8. Covers for boxes located in public spaces or where shown on the Basic Contract Drawing shall be furnished with tamper-resistant hardware.

9. Cover plates for outlet boxes are specified in the Section 16140 entitled "WIRING DEVICES".

B. Interior Outlet and Device Boxes

1. Provide galvanized, flat-rolled, sheet-steel interior outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct boxes with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.

2. Outlet boxes shall be of proper sizes and shapes for conduits and wires entering them, and equipped with plaster ring or cover as necessary for the wiring devices to be installed.

3. Boxes for switches and receptacles shall be 4-inch square, minimum 2 1/8-inch deep, for up to two devices; solid, ganged boxes for over two devices; and installed so that device covers shall be tight and plumb with wall finish.

4. Provide suitable barrier in boxes where two or more 277-volt switches are to be installed, to isolate each on its own phase.

5. Boxes for lighting fixture installation shall be 4-inch square, minimum 2 1/8-inch deep, and provided with 3/8-inch studs.

6. Boxes to be installed in ceilings, plenums, or spaces used for supply or return of environmental air shall be UL listed for such use, without holes, openings or penetrations, and complete with gasketed cover plates.

7. Provide all sheet-steel boxes with suitable knockouts.

C. Exterior Outlet and Device Boxes

1. Provide corrosion-resistant, cast metal, weatherproof outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation.

2. For outlet boxes to be installed flush or recessed in exterior walls, provide galvanized, sheet-steel boxes, with suitable depth and tile, plaster or masonry rings for the wall construction.

3. Provide cast-metal faceplates with spring-hinged, waterproof caps suitably configured for each application, including faceplate gaskets and stainless steel or brass screws or fasteners. Faceplate material shall match the type of box i.e., galvanized steel or aluminum.

D. Junction and Pull Boxes

1. General

a. Unless otherwise shown on the Basic Contract Drawing, provide galvanized, code-gauge, sheet-steel junction and pull boxes and covers for interior locations and cast-metal boxes and covers for exterior locations of types, shapes and sizes to suit each respective location and installation, and equipped with stainless steel hinges, nuts, bolts, screws and washers.

b. Junction or pull boxes having any dimension larger than 36 inches shall contain racks or supports for all cables or conductors.

c. Provide pull boxes with suitable insulating barriers where shown on the Basic Contract Drawing or required by code. Vertical-offset pull boxes shall contain cable supports at turns to prevent cables from resting on corners.

d. Where shown on the Basic Contract Drawing, provide boxes with provisions for padlocking.

e. Special boxes shall be as shown on the Basic Contract Drawing.

f. Where shown on the Basic Contract Drawing, catches or vault handles shall be lockable. Locks shall be keyed alike for the same service, such as power, communications, signal or telephone. Each service type shall be keyed differently.

g. All covers in exposed exterior locations, or other areas as shown on the Basic Contract Drawing, shall be gasketed.

h. For covers heavier than 20 pounds or more than 24 inches in any dimension, provide two replaceable studs, located on each side of the box flange, to support the cover during installation.

i. Boxes containing, or designated for, conductors operating at greater than 600 volts (phase-to-phase) shall be constructed of minimum 12-gauge steel.

2. Interior Junction and Pull Boxes

a. Finished Areas

(1) Junction and pull boxes, located in finished areas and having any dimension larger than 12 inches, shall be furnished with flush-mounting, lockable, hinged covers, similar to adjacent panelboard cabinets. Locks shall be keyed alike for the same service, such as power, communications, signal or telephone. Each service type shall be keyed differently. Hinged covers shall contain catches to keep covers closed. Covers having any dimension larger than 36 inches and all multiple-section doors shall contain 3-point vault handles. Covers shall be furnished shop-primed for field painting, and shall be finished with a color as selected by the Engineer.

(2) Boxes having any cover dimension 12 inches or less shall be furnished with flush-mounting, screw-on covers, unless otherwise shown on the Basic Contract Drawing.

b. Unfinished Areas

Junction and pull boxes, located in electrical or telephone closets or rooms, in mechanical equipment rooms, in areas above hung or accessible ceilings or in areas shown on the Basic Contract Drawing as "unfinished," shall be furnished with screw-on covers for boxes having any cover dimension 24 inches or less, and with either single or multiple-section hinged covers for boxes having any cover dimension larger than 24 inches.

3. Exterior Junction and Pull Boxes

a. Junction and pull boxes, located in sidewalks, decks and in areas shown on the Basic Contract Drawing as "finished", shall be furnished with flush-mounting, screw-on covers.

(1) Boxes having any cover dimension 24 inches or less shall be cast-steel. Boxes shall be furnished with asphaltic paint finish on surfaces to be embedded in earth or concrete.

(2) Covers having any dimension larger than 24 inches shall be cast-steel "sidewalk" frames and covers, suitable for installation on a concrete box or handhole.

b. Unfinished Areas

Junction and pull boxes, located in areas shown on the Basic Contract Drawing as "unfinished", shall be furnished with screw-on covers for boxes having any cover dimension 24 inches or less, and with hinged, bolt-on covers for boxes having any cover dimension larger than 24 inches.

E. Floor Boxes

Provide cast-steel, waterproof, adjustable floor boxes with threaded-conduit entrance hubs, and vertical adjusting rings, gaskets, brass floor plates and flush, screw-on covers. All unused conduit openings shall be closed with appropriate plugs.

F. Conduit Bodies

Provide galvanized, cast-metal, conduit bodies, of types, shapes and sizes to suit each respective location and installation; construct with threaded-conduit entrance hubs, removable covers, and stainless steel or brass screws.

G. Bushings, Locknuts and Knockout Closures

Provide corrosion-resistant knockout closures and conduit locknuts, and insulated, malleable-iron, conduit bushings and offset connectors, of types and sizes to suit each respective use and installation.

H. Supporting Devices

Provide inserts, expansion shield lugs, bolts with nuts and washers, shims or any other type of fastening devices required to secure boxes, in accordance with the Section 16190 entitled "SUPPORTING DEVICES". Unless otherwise shown on the Basic Contract Drawing, all fasteners shall be hot-dipped galvanized and of sizes and types recommended by the equipment manufacturer and as approved by the Engineer.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install boxes and conduit bodies at the locations shown on the Basic Contract Drawing and as required by NFPA 70 at any other location where they are required to facilitate the pulling, supporting or connection of wires and cables.

B. Securely mount all boxes in a manner approved by the Engineer and support the boxes independently of conduits entering them.

C. Install boxes and conduit bodies in classified (hazardous) locations in accordance with their listing or label requirements. Conduit seal fittings shall be packed and filled only after proper operation of equipment and systems has been demonstrated and approved by the Engineer.

D. Paint exteriors of boxes exposed in mechanical equipment rooms or in electrical rooms or closets or spaces shown as "unfinished" on the Basic Contract Drawing, and the exteriors of boxes installed above hung or accessible ceilings, as follows:

1. Emergency: Orange
2. Fire Alarm: Red
3. High Voltage: Red with 1-inch, white block letters reading “HIGH VOLTAGE” on each exposed face and cover.

E. All installations shall conform to NFPA 70.

F. Dissimilar Metals

1. "Dissimilar metals" shall mean those metals which are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data.

2. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

END OF SECTION

SECTION 16135

BOXES AND FITTINGS

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit the following, for approval in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts

1. All boxes and fittings.

B. Shop Drawings

1. Special boxes.
2. Boxes larger than 12 inches.
3. Ancillary equipment if shown on Basic Contract Drawing.

END OF APPENDIX "A"

DIVISION 16

SECTION 16140

WIRING DEVICES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for wiring devices.

1.02 REFERENCES

The wiring devices specified in this Section shall be constructed, installed and tested in accordance with requirements of the following publications:

	Federal Specifications
W-C-596	Electrical Power Connector, plug, Receptacle and Cable
W-S-896	Outlet Toggle and Lock, Flush Mounted Switches
	Institute of Electrical and Electronic Engineers (IEEE)
IEEE 241	Electric Power Systems in Commercial Buildings
	National Electrical Manufacturers Association (NEMA)
NEMA WD 1	General Requirements for Wiring Devices
NEMA WD 6	Wiring Devices - Dimensional Requirement
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
	Underwriters Laboratories Inc. (UL)
UL 20	General Use Snap Switches
UL 498	Electrical Attachment Plugs and Receptacles
UL 917	Clock-Operated Switches
UL 943	Ground Fault Circuit Interrupters
UL 1054	Special - Use Switches

1.03 QUALITY ASSURANCE

Wiring devices, of types and ratings required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.

B. Store materials in clean, dry space and protect them from weather.

C. Handle in manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of this Section, provide wiring devices of the acceptable manufacturers as shown on Basic Contract Drawing.

B. All devices for wall system outlets shall be furnished by one manufacturer.

C. All device plates shall be furnished by one manufacturer.

2.02 CONSTRUCTION FEATURES

A. General

1. All wiring devices shall be heavy-duty, specification grade, conforming to the NEMA configurations and requirements of NEMA WD 1 and UL 498, including the requirements for pressure-blade contacts. NEMA configurations shall be as shown on the Basic Contract Drawing and shall match the requirements of the connected appliances.

2. Locations, types and sizes of wiring devices shall be as shown on the Basic Contract Drawing.

3. All devices shall be one gang wide, except as required for devices rated greater than 20 Amp.

4. All devices shall be terminated with screw terminals or screw-driven pressure clamps. Patented spring or torsion pressure clamps shall not be used.

5. All electrical materials and equipment, for which there are established UL standards, shall bear the UL label.

B. Switches

Switches shall be silent operating type, 20 Amp, 120 - 127 Volts AC, T-rated, flush mounted, conforming to requirements of Federal Specification W-S-896 and UL 20, 917 and 1054. Single-pole or double-pole, and 3-way or 4-way devices shall be as shown on Basic Contract Drawing.

C. Receptacles

1. Duplex convenience receptacles shall be 125 V, straight blade, 2-pole, 3-wire grounding type units with break-off terminal ties for two-circuits application. Receptacles shall be 15 Amp or 20 Amp as shown on Basic Contract Drawing.

2. Single receptacles shall be 20 Amp, 125 V, straight blade, 2-pole, 3-wire, grounding type units.

3. Clock outlets shall be single recessed receptacles rated 15 Amp, 125 V, 2-pole, 3-wire grounding type with a combination plate cover and clock hanger bracket.

4. Floor service receptacle outlets shall be furnished with 20A, 125V, 2-pole 3-wire grounding type duplex receptacle. Were shown on Basic Contract Drawing receptacle shall be flush mounted in floor box or installed in metallic above-floor service fitting.

5. Factory assembled "poke through" assembly device shall be furnished with 20A, 125v, 2-pole, 3-wire grounding receptacle and capable of maintaining floor fire rating of 3 hours.

6. Ground fault circuit interrupter receptacle shall be 20A, 125V, 60 Hz heavy duty grounding type duplex receptacle with ground fault circuit interrupter with solid-state ground fault sensing device having 5 (±1) milliampere ground-fault trip level and shall be "feed through" ready, for protecting downstream receptacles on a single circuit; suitable for installation in a 2-1/2" deep outlet box without adapter.

7. Special purpose receptacles as shown on Basic Contract Drawing shall conform to requirements of NEMA WD 6.

D. Device Plates

1. All device plates shall be 0.04" thick minimum with struck-up beveled edges and free of sharp corners and burrs. All device plates shall be one-piece sectional plates shall not be used.

2. Unless otherwise shown on Basic Contract Drawing, all device plates for wall outlets shall be satin finish anodized aluminum.

3. Device plates for wall telephone outlets shall contain a bushed hole.

4. Device plates for exposed work shall be stamped steel.

E. Color Selection

Wiring devices shall be available in standard white, ivory, gray, brown and black. The Engineer will select different colors for various areas and for different devices. No wiring device shall be ordered or installed until the engineer's final color selections have been made.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install wiring devices in accordance with manufacturer's installation procedures and applicable requirements of NFPA 70 and IEEE 241.

B. In areas where exposed conduit is used, receptacles and switches shall be surface mounted as shown on the Basic Contract Drawing.

C. Receptacles and switches located in finished areas, where concealed conduits are used shall be flush-mounted and provided with approved cover plates, installed level and plumb, with all four corners and edges in contact with finish surface.

3.02 FIELD TESTS

Prior to energizing circuitry, test wiring for electrical continuity and short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements of this Specification.

3.03 PROTECTION

After receptacles and wall plates have been installed, exercise care in use of convenience outlets. Prior to final inspection, replace devices that have been damaged.

END OF SECTION

SECTION 16140

WIRING DEVICES

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop drawings

1. Installation details for surface mounted receptacles and switches
2. Installation details for "poke-through" assemblies
3. Installation details for floor service receptacles

B. Catalog cuts

1. Receptacles
2. Switches
3. Wallplates
4. Ground fault circuit interrupter receptacles
5. Poke-through assembly devices

END OF APPENDIX "A"

DIVISION 16

SECTION 16150

MOTOR POWER AND CONTROL WIRING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for the furnishing, installation, connection and testing of motor power and control wiring.

A. Motor Power and Control Wiring

Furnish and install all conduits, wires and accessories, and make final connections to all motors, motor starters, motor control centers, control devices and appurtenances furnished under other Sections of the Specifications.

B. Motor Starters, Motor Control Centers, and Control Devices

Install motor starters, motor control centers, control devices (except as specified in the following sentence) and appurtenances furnished under other Sections of the Specifications. Control devices having piping connections shall be installed under other Sections, but shall be wired under this Section.

C. Wiring diagrams and Equipment Installation Schedules

Wiring diagrams and equipment installation schedules or functional and/or operational requirements are shown on the Basic Contract Drawing. Coordinate and supplement the wiring diagrams and schedules with any additional functional or operational requirements specified in other Sections of the Specifications. In the event of a conflict between the wiring diagrams and schedules and the functional and operational requirements, the latter shall govern.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	National Electrical Manufacturers Association (NEMA)
NEMA ICS 2	Industrial Control and Systems. Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 4	Industrial Control and Systems, Terminal Blocks
	National Fire Protection Association (NFPA)
NFPA 70	National Electric Code

Underwriters Laboratories Inc. (UL)

ANSI/UL 65	Electric Wired Cabinets
ANSI/UL 486E	Equipment Wiring Terminals for Use With Aluminum and/or Copper Conductors
ANSI/UL 486A	Wire Connectors and Soldering Lugs for Use With Copper Conductors
ANSI/UL 969	Marking and Labeling systems
UL 1059	Electrical Terminal Blocks
ANSI/UL 467	Electrical Grounding and Bonding Equipment
ANSI/UL 508	Electric Industrial Control Equipment

1.03 QUALITY ASSURANCE

Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.04 SUBMITTALS

See Appendix "A" for Submittal Requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Provide all conduits, wires, and accessories as shown on the Basic Contract Drawing and as required to perform the Work.

B. Provide all conduits and wires in accordance with the Sections of the Specifications entitled "RACEWAYS" and "WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS).

C. Provide angle iron supports, brackets or hangers for mounting starters, control panels and control devices in accordance with the Section of the Specifications entitled "SUPPORTING DEVICES".

D. All fuses and circuit breakers provided under this Section shall be of the ratings and types as shown on the Basic Contract Drawing or, if not shown on the Basic Contract Drawing, shall be as recommended by equipment manufacturers.

E. All motor control equipment shall be manufactured in compliance with NEMA ICS 2, NEMA ISC 4, ANSI/UL 65, ANSI/UL486E, ANSI/UL486A, ANSI/UL 969, ANSI/UL 467, ANSI/UL 508 and UL 1059.

PART 3. EXECUTION

3.01 EXAMINATION

A. Prior to making electrical connections, check all electrical equipment furnished under other Sections of the Specifications for the specified voltages and directions of rotation.

B. Prior to energizing motors, verify the specified overload rating of all heater elements and relay settings, furnished with the motor starters under other Sections of the Specifications, so that, in cases, the proper running protection will be provided for the motors. Should the overload ratings not be correct, notify the Engineer.

3.02 INSTALLATION

A. Install all motor starters, motor control centers, control devices, conduits, wires and accessories in accordance with the requirements of NFPA 70 and the manufacturers' installation procedures. Make final connections in accordance with approved shop drawings.

B. Install all conduits, wires, accessories and supports in accordance with the requirements of Sections specified in 2.01 B and C.

3.03 FIELD TESTS

A. Perform tests, in presence of the Engineer, to demonstrate the following and give the Engineer 24 hours advance notice of tests.

1. That each control device and its related motor starter operates properly.
2. That each overload protective and safety device functions properly.

B. Tests shall be performed in accordance with the equipment manufacturers' start-up and field test instructions and made jointly with all affected trades.

C. Should the tests reveal any defects, promptly correct such defects and rerun the tests until the entire installation is satisfactory in all respects.

END OF SECTION

SECTION 16150

MOTOR POWER AND CONTROL WIRING

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

Shop drawings shall include:

1. Job name
2. Item number
3. Specification for electrical parts, and assemblies.
4. Wiring interconnection and schematic diagrams as follows:

   a. The elementary diagrams supplied by equipment vendor shall contain

      (1) Each device designation corresponding to equipment layout drawing and wiring diagrams

      (2) All device terminal numbers corresponding to device vendor information

      (3) Contact development diagrams of all control, selector, and transfer switches, protection and auxiliary relays, pushbuttons, etc. Indicate connections to terminal blocks

      (4) Contact diagrams for all alarm and indication circuits. Indicate connections to control panel terminal blocks

   b. Connection wiring diagram shall contain

      (1) Each device designation corresponding to equipment layout drawing and elementary diagrams. All device terminals shall be identified identical to device vendor drawing and arranged in correct physical relationship.

      (2) Sufficient information at each wire termination to locate the other termination without recourse to routing sheets, supplementary tabulations, or any other document.

      (3) Terminal strips numbered sequentially from top to bottom and left to right. Show terminals requiring external connections. The terminal strips shall be shown on drawings spaced at least 4 inches apart, so as to permit purchaser's external wiring to be shown on the same drawings.

   c. External connection diagram between the equipment and devices connected to it.

B. Bill of materials. Components shall be identified by manufacturer's catalog number, technical characteristics and settings required for the installation. Bill of materials shall correlate components to equipment layout drawing and diagrams.

C. Catalog cuts

1. Protection and control devices
2. Terminal blocks
3. All factory or field mounted devices and equipment shown on Equipment drawings

D. Schedules

1. Terminal block designations

E. As-built Documentation

END OF APPENDIX A

DIVISION 16

SECTION 16190

SUPPORTING DEVICES

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for hangers and supports, sleeves and fasteners used to support electrical raceways and equipment, except as specified in B below.

B. Supporting devices, furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Sections of the Specifications.

1.02 REFERENCE

The supporting devices, specified in this Section shall be constructed, installed and tested in accordance with requirements of the following publications:

	American Institute of Steel Construction Inc. (AISC)
AISC	Manual of Steel Construction
	American Iron and Steel Institute (AISI)
AISI	Specifications for the Design of Cold-Formed Steel Structural Members
	American Society for Testing and Materials (ASTM)
ASTM A 36	Structural Steel
	American Welding Society (AWS)
AWS D1.1	Structural Welding Code, Steel
	National Electrical Contractors Association (NECA)
NECA 5055	Standard of Installation
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code

1.03 QUALITY ASSURANCE

Supporting devices, of types and sizes required, shall have been satisfactory used for purposes similar to those intended herein for not less than three years.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up damage to finishes to match adjacent surfaces, including re-coating of galvanized or plated surfaces where damaged, cut or drilled.

1.05 SUBMITTALS

See Appendix "A" For Submittal Requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide supporting devices of the acceptable manufacturers as shown on Basic Contract Drawing.

2.02 HANGERS AND SUPPORTS

A. General

1. Unless otherwise shown on the Basic Contract Drawing, provide hangers and supports as specified below.

2. Where more than one type of hanger or support is suitable for the intended use, selection is at the Contractor's option, subject to approval by the Engineer.

3. Hangers and supports, for which there are established Underwriters Laboratories Inc. (UL) standards, shall bear the UL label.

B. Raceway Support

1. Clevis Hangers

For supporting horizontal conduit; galvanized steel; with hole for treaded steel rod.

2. Riser Clamps

For supporting vertical conduits; galvanized steel; with two or three bolts and nuts, and 4-inch ears.

3. Reducing Couplings

Steel rod reducing coupling; size as required; galvanized or plated steel

4. C-Clamps

Black malleable iron or galvanized or plated steel; with hole for threaded rod.

5. I-Beam Clamps

Galvanized or plated steel, 1-1/4-inch x 3/16-inch stock; 3/8-inch cross bolt; 2-inch flange width

6. Right Angle or Parallel beam Clamps

Galvanized steel clamps for supporting or fastening conduit up to 2-inch trade size

7. One-Hole Conduit Straps

For supporting up to 1-inch conduit or electrical metallic tubing (EMT); galvanized steel

8. Two-Hole Conduit straps

For supporting conduit or EMT larger than 1-inch galvanized steel; 3/4" strap width.

9. Hexagon Nuts: galvanized steel

10. Round Steel Rod: galvanized or plated steel; threaded

11. Trapeze Hangers: Same as Specified in 2.02 C below

12. The following types of hangers and supports shall not be used:

    a. Perforated metal strapping;

    b. Slotted, perforated angles;

    c. Spring pressure or torsion clips, hangers or supports.

C. Equipment Supports

1. U-channel strut system shall be 12-gauge, hot-dipped galvanized steel. Provide with drilled or slotted holes as required for the application and with the following fittings which mate and match with U-channel:

    a. Fixture hangers

    b. Channel hangers

    c. End caps

    d. Beam clamps

    e. Wiring stud

    f. Thin wall conduit clamps

    g. Rigid conduit clamps

    h. Conduit hangers

    i. U-bolts

D. Supporting Steel Sections and Channels

Supporting steel sections and channels shall be fabricated of ASTM A 36 steel in accordance with the appropriate requirements of the AISC, AISI, and AWS publications specified in 1.02, and shall be hot-dipped galvanized after fabrication.

E. Cable Supports

1. Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers. Assembly shall include body of galvanized malleable iron with insulating wedging plug.

2. Provide cable supports for armored type electrical cables in risers. Assembly shall include body and pressure plates of galvanized steel.

2.03 SLEEVES AND SEALS

A. General

1. Unless otherwise shown on the Basic Contract Drawing, provide sleeves and seals as specified below.

2. Where more than one type of sleeve or seal is suitable for the intended use, selection is at the Contractor's option, subject to approval by the Engineer.

3. Sleeves and seals, for which there are established, UL standard, shall bear the UL label.

B. Pipe Sleeves

1. Provide pipe sleeves for conduits penetrating concrete or masonry floor and walls, as follows:

   a. Steel Pipe

      Fabricate from schedule 40, galvanized steel pipe; remove burrs.

   b. Iron Pipe

      Fabricate from cast iron or ductile iron pipe; remove burrs.

   c. Plastic Pipe

      Fabricate from either fiberglass or Schedule 40, PVC plastic pipe; remove burrs. Fiberglass sleeves may be utilized for interior or exterior usages, but PVC sleeves shall be utilized for exterior usage only.

2. Sleeves shall have a minimum inside diameter as shown below, based on the installed raceway diameter.

Raceway Diameter (inches)	Sleeve Inside Diameter (inches)
1 or less	2
1-1/4 to 2	3
2-1/2 to 3	4
3-1/2 to 4	5
5	6
6	7

3. Where a sleeve encloses only one conductor, phase or polarity, or a ground wire or cable, the sleeve shall be non-ferrous.

C. Interlocking Modular Seals

Provide interlocking modular type seals for conduit access located in exterior foundation and pit walls. The seals shall be multi-link, stainless steel bolted connection, high-temperature fittings.

D. Sealing Bushings

Provide sealing bushings for conduit access core-drilled through foundation walls or floors. The bushings shall be molded, one-piece neoprene sealing rings with PVC coated steel or uncoated aluminum pressure plates, stainless steel hex socket head cap screws and flat washers.

E. Fire Seals

Provide UL listed, 3 hour rating, silicone based foam, fire resistive, waterproof joint sealing system to prevent the passage of hot gases and fire.

F. Wall and Floor Seals

Provide watertight and pressure-tight wall and floor seals suitable for sealing around conduit passing through exterior concrete floors and walls. Assembly shall include steel sleeves, galvanized malleable iron body, neoprene sealing grommets and rings, metal pressure rings, membrane clamp were required by foundation design and pressure clamps with type 316 stainless steel hex head cap screws. Seal sizes shall be maximum published size for conduit to be installed therein.

2.04 FASTENERS

A. General

1. Unless otherwise shown on the Basic Contract Drawing, provide fasteners as specified below.
2. Where more than one type of fasteners is suitable for the intended use, selection is at the Contractor's option, subject to approval by the Engineer.

B. Toggle Bolts

Toggle bolts shall be spring head, galvanized or plated steel, 1/4-inch to 1/2-inch sizes, length as required.

C. Expansion Anchors

Expansion anchors shall be metallic expansion anchors or shields, including drop-in anchors, wedge and sleeve anchors, and two-piece and three-piece shields for lag screws or machine screws or bolts.

D. Powder activated Fasteners

Powder activated fasteners shall be steel, pin or stud type, selected for proper length and penetration for the equipment, clamp or strap to be installed, and the base material.

E. Bolts, Nuts, Lockwashers and Washers

1. All hardware shall be galvanized or plated steel, unless otherwise shown on the Basic Contract Drawing.
2. Bolts and nuts, 1/4-inch trade size and larger, shall be hex head or hex socket type, standard American sizes.
3. Lockwashers shall match the finish of the furnished bolts and nuts, and generally be installed one-per-bolt, at the nut end of the assembly.

4. Washers shall be standard or fender type, as required, and sized to match the installed bolts or screws.

F. The following types of fasteners shall not be used:

1. Lead anchors or studs;
2. Wooden plugs or anchors;
3. Plastic anchors;
4. "Nail-in" anchors, either of plastic or metal type.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the Work of this Section in accordance with the Contract Documents.

B. Report immediately to the Engineer any electrical, structural or related construction defects in areas where supporting devices are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

3.02 PREPARATION

Before installation the supporting devices, the Contractor shall investigate the site condition to determine, what preparatory work, if any, will be needed.

3.03 INSTALLATION

A. General

1. Install hangers and supports, sleeves and fasteners in accordance with approved printed manufacturer's installation procedures, and as specified.
2. Coordinate all affected trades and all aspects of the electrical work, including installation of raceways and wiring as necessary to interface installation of supporting devices with other work.
3. Install hangers and supports, and attachments to properly support raceways, equipment and accessories from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze hangers where possible. Install hangers and supports with maximum spacing not to exceed that permitted by NFPA 70 and NECA 5055, as applicable, unless otherwise shown on the Basic Contract Drawing.
4. Secure threaded rod couplings, trapeze hangers or supports or similar horizontal elements, using lock washers and jam nuts to prevent loosening.

B. Conduit and Raceway supports

1. Do not support raceways from hung ceiling supports or members, or metal roof deck.
2. Do not support raceways from mechanical ductwork, ductwork supports, piping or piping supports.

3. Threaded rod for the support of conduits, raceways or trapeze hangers of the given size, shall be not less than the following:

Conduit, Raceway, Hanger Size (inches)	Threaded Rod Size (inches)
2 or less	3/8
2-1/2 to 3-1/2	1/2
4 to 5	5/8
6	3/4

4. Where trapeze hangers are used, bolt or clamp the raceways in place to at least every third hanger and to the first hanger on each side of a bend, fitting, junction or pull box or change in direction.

C. Sleeves

1. Unless otherwise shown on the Basic Contract Drawing, extend sleeves for raceways and risers one inch beyond top of finished floor, curb or building element being penetrated.

2. Install sleeves level and plumb, accurately located and positioned to conform to the requirements of the equipment and in accordance with the approved layout drawings.

3. Install interlocking modular seals in tandem, one at the interior and one at the exterior face of the pipe sleeve.

4. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight seal.

D. Fasteners

1. Wood screws, lag screws, carriage bolts or machine screws shall be utilized for wood or materials of similar fibrous nature.

2. Welded or blazed threaded studs, bolts or machine screws or clamps shall be utilized for structural and miscellaneous steel, iron or other metals.

3. Metallic expansion shields, wedge anchors or drop-in anchors, with lag screws, bolts or machine screws shall be utilized for solid masonry or concrete.

4. Sleeve anchors, drop-in anchors or toggle bolts shall be utilized for concrete masonry units (CMU). Do not use powder-activated fasteners in CMU.

E. Dissimilar Metals

1. "Dissimilar metals" shall mean those metals which are incompatible with one another in the presence of moisture, as determined from their relative positions in the Electrochemical Series, or from test data.

2. Where dissimilar metals come in contact, paint the joint both inside and out with approved coating to exclude moisture from the joint, or provide a suitable insulating barrier separating the metals.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

Submit layout drawings for dimensioned locations of inserts, sleeves and anchors when required by the Basic Contract Drawing.

B. Catalog Cuts

1. Hangers and supports
2. Sleeves
3. Fasteners

C. Submit calculations for the following:

1. Supporting steel sections and channels, properly reflecting installed and future loading, including:
   a. Safety factors of not less than 4 to 1;
   b. Deflection ratio of not greater than 1/240.
2. Special hangers and supports shown on the Basic Contract Drawing
3. Hangers, supports and fasteners when required by but not specifically shown on the Basic Contract Drawing.

END OF APPENDIX "A"

DIVISION 16

SECTION 16250

TRANSFER SWITCHES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for all low voltage transfer switches and appurtenances.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

	Underwriters' Laboratories, Inc. (UL)
UL 1008	Standard for Automatic Transfer Switches.
	National Fire Protection Agency (NFPA)
NFPA 70	National Electrical Code.
NFPA 72	National Fire Alarm Safety Code.
NFPA 20	Centrifugal Fire Pumps.
NFPA 110	Emergency and Standby Power Systems.
	Institute of Electrical and Electronics Engineers (IEEE)
IEEE 446	Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
IEEE 241	Recommended Practice for Electric Power Systems in Commercial Buildings.
IEEE 472	Relays and Relay Systems Associated with Electric Power Apparatus.
IEEE 587	Surge Immunity in Solid State Control System.
	National Electrical Manufacturers Association (NEMA)
NEMA ICA10	AC Automatic Transfer Switches (formerly ICS2-447).
NEMA ICA-2	Standard for Industrial Control Devices and Controller and Assemblies.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The automatic transfer switches shall be designed and manufactured in accordance with the applicable provisions of ANSI, IEEE, NEMA, NFPA and UL. Where a discrepancy exist between the standards, the most stringent requirements shall apply. In addition, specific provisions cited herein, and those shown on the Basic Contract Drawing shall govern for the associated specific application.

1.04 QUALITY ASSURANCE

A. Transfer Switch and all components of the type and size indicated shall have been satisfactorily used in a similar purpose for not less then three years.

B. Tests requiring certified reports and those requiring factory or field inspection shall be conducted and reported to the Engineer in conformance with the standards herein specified. All electrical materials and equipment for which there are established UL standards shall bear the UL label.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials in the original packaging in a manner to prevent soiling, damage, wetting or corrosion, prior to installation.

B. Handle in a manner to prevent damage to finished surfaces.

C. Where possible, maintain protective coverings until installation is complete, and remove such covers as part of final cleanup.

D. Touch-up damages to finishes to match adjacent surface, including recoating of galvanized or plated surface where damaged, cut or drilled.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section and as shown on the Basic Contract Drawing, provide automatic transfer switch products of manufacturers listed on the Basic Contract Drawing.

2.02 MATERIALS

A. Automatic Transfer Switches (ATS)

Furnish and install the ATS with number of poles, amperage, voltage and accessories as required or indicated on the Basic Contract Drawing, and options as indicated on the Basic Contract Drawing. The ATS shall have a Withstand and Closing Rating (WCR) greater than the available fault current at the switch terminal. The ATS shall conform to the requirements of NEMA CS 10, UL 1008, and shall be rated for a total system load as per NFPA-70, NFPA-110 and NFPA-72.

1. Accessories

a. Switching Neutral: Unless otherwise shown on the Basic Contract Drawing, the ATS for all 3 phase 4 wire systems shall be provided with switching neutral contacts.

b. Isolation Bypass Switch: Unless otherwise shown on the Basic Contract Drawing, the ATS for the building emergency riser (where interruption in power distribution can not be afforded for maintenance or repair work) shall be provided with an isolation bypass switch.

2. Options

a. Feeder over current protection: Provide over current and short circuit protection on both incoming feeders (emergency and normal power) using fused switch units or molded case circuit breakers. The protection ratings shall be coordinated with the distribution system.

b. In-Phase Load Transfer Controls: Provide when connected loads are motor loads or when the load characteristic is unknown and the transfer switch will frequently transfer between both available sources. An arrangement of the adjustable time delay during the switching (the time when loads are isolated from both sources) is acceptable only when switching is coordinated with the connected load characteristic and their protection.

c. Engine Generator Controls: Provide when connected emergency power is directly fed from the individual generator.

d. Monitoring Network interface: Provide if the switch is intended to interface with the building management system.

B. The complete ATS shall be factory assembled and tested prior to shipment.

C. Unless otherwise shown on the Basic Contract Drawing, the enclosure for the ATS up to 400 amps shall be NEMA 1B non-ventilated wall mounted.

2.03 CONSTRUCTION FEATURES

A. Automatic Transfer Switch

1. Transfer switch shall be rated to carry 100 percent of the rated continuos current. Transfer switch shall be continuously rated in ambient temperatures of -20 to +50 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet.

2. Transfer switch shall withstand the magnitude of fault current available at the switch terminals or as specified on the Basic Contract Drawing.

3. Transfer switch shall be double-throw, mechanically interlocked, and mechanically held in either position.

4. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishment. Arc chutes shall have insulating covers to prevent interphase flashover.

5. Provide auxiliary contacts (2 N.O. and 2 N.C.) rated 10 amps at 250vac on both "Normal" and "Emergency" sides, to be operated by the transfer switch.

6. Electrical operation shall be accomplished by a linear, operating mechanism that receives power from the source to which the load is being transferred. Fuse or thermal protection of the main operator is prohibited. The operating transfer time in either direction shall be one-sixth of a second or less. Main operator shall be momentarily energized to operate, and mechanically held.

7. Transfer Switch shall have a fully rated insulated neutral bus unless otherwise specified with a switching neutral.

8. Enclosure shall be UL listed. The enclosure shall provide NEC required wire bending space. The cabinet door shall be key locking. Controls on cabinet door shall be key operated. Provide switch position indicator lamps and power available lamps for both sources (four total) on the outside cabinet door.

9. Transfer switch shall be mounted in an enclosure as designated on the Basic Contract Drawing. The enclosure shall be NEMA type as specified. The cabinet shall be provided with NEC required wire-bending space at point of entry as shown on the Basic Contract Drawing. Manual operating handle and all control switches (other than key-operated switches) shall be accessible to authorized personnel, only by opening the key-locking cabinet door.

10. Control shall be solid-state and designed for a high level of immunity to power line surges and transients, and demonstrated by test to IEEE Standard 587-1980.

11. Voltage sensors shall simultaneously monitor all phases of both sources. The control panel shall be microprocessor and/or solid state analog type with adjustable sensing and timing functions. All sensing and time delay functions shall be adjustable over the ranges indicated and shall operate with minimum drift (not to exceed +10 percent of set frequency, +2 percent of set voltage, and +10 percent of set time delay) over the temperature range of -20 degrees to +50 degrees C. The control panel shall be provided with a protective cover. All control wires between the control panel and main transfer switch shall be terminated on a terminal strip.

The following operational characteristics shall be provided:

a. Voltage Sensing

(1) Normal Source: Differential voltage of all phases (pickup adjustable from 85-100 percent of nominal voltage and drop out adjustable from 75-98 percent of pickup voltage) shall be factory set to pick up at 95 percent and drop out at 85 percent of nominal voltage. Sensing shall be on the line side of the transfer switch main controls unless otherwise shown on the Basic Contract Drawing.

(2) Emergency source: Independent single phase voltage (85-100 percent for dropout) and frequency (90-100 percent for pick-up) sensing to prevent premature transfer shall be factory set to pickup at 90 percent of nominal frequency and 100 percent voltage, and dropout at 85 percent voltage.

b. Time Delay Setting

(1) Time delay on momentary dips in normal source (0.5 -6.0 seconds) shall be factory set at 1.0 second.

(2) Time delay on transfer to emergency shall be 0 to 2 minutes, factory set to 0 minute or as shown on the Basic Contract Drawing. If specified at more than 2 minutes, an additional extend time delay component shall be provided.

(3) Time delay on retransfer to normal source shall be 0-30 minutes, factory set at 30 minutes, and an additional retransfer bypass switch (toggle switch) shall be provided.

12. Provide a key operated selector switch or momentary test switch in a secure location to simulate failure of normal source and restore back to normal.

13. Transfer switch shall be equipped with manual operators for service use, to operate under a de-energized condition.

14. Accessories

a. Switching Neutral

Switching neutral shall be the 4th pole, 100 percent rated and simultaneously operated with other power poles using the same actuator. This feature shall provide one of the following schemes unless otherwise indicated on the Basic Contract Drawing.

(1) Fourth pole similar to other power poles to be connected to a common crossbar with operation arranged to break before make and lagging in opening and leading in closing as compared to the power poles.

(2) Overlapping switching neutral connected to a common operator with operation arranged to make before break.

b. Bypass Isolation Switch

Bypass Isolation switch shall be constructed to provide a safe means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load without interruption, and to isolate the transfer switch from both sources. The switch equipment shall be UL listed per Standard 1008, CSA approved; with continuos current rating, voltage and frequency ratings, and withstand closing ratings equal to the transfer switch ratings and provide the following construction features.

(1) The bypass-isolation and switch shall be mechanically held in each position. The switch mechanism shall be of a stored energy contact type. No interruption of power is acceptable. The speed of the contact operation shall be independent of the force applied to the operating handles, which permit manual operation under load.

(2) The bypass switch shall provide bypass to either normal or emergency source by use of a permanently mounted, external operating handle.

(3) The bypass switch shall provide manual bypass without load break.

(4) Positive electrical and mechanical interlocks shall prevent all possible source to source interconnections. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action.

(5) A drawout isolation mechanism shall provide closed-door isolation of the transfer switch, using a permanently mounted, external handle. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open before the mechanism will permit isolation of the transfer switch. The isolation mechanism shall provide for a three-position operation; Connected, Test and Isolated.

(6) In the Connected position, isolation contacts shall be fully engaged and closed with the control cable connected. In the Test position, isolation contacts shall be open with the control cable connected. The Test position shall allow operational testing of transfer switch and controls without power disruption to the load. In the Isolated position, the transfer switch and control cable shall be completely isolated from all power sources. In the Isolated position, safety shutters shall close to cover bypass switch power terminals, minimizing the possibility of accidental contact with energized parts.

(7) In the Isolated position, the transfer switch shall be capable of being withdrawn from the cabinet. When re-installing the transfer switch, the isolation mechanism shall not permit connection of the transfer switch unless it is in the open position, or closed position on the same source as the bypass switch.

15. Options

a. Feeder over current protection shall be provided using either fused switch units or molded case breakers. The proper isolation shall be provided between the ATS and over current protection enclosures. The power connection shall be supplied with silver plated copper bus bars. The protection rating shall be coordinated with feeder size, available short circuit levels and connected loads.

b. In-phase load transfer control shall be similar to automatic synchronized transfer, by sampling the source voltage and residual voltage (slipping frequency) of the load side. The control shall be coordinated with the transfer switch speed and actively interfaced with residual voltage and frequency. The switching time delay feature can be acceptable only if it meets system distribution needs and is specified on the Basic Contract Drawing. The switching time delay shall be field adjustable with a range of 0 to 7.5 seconds.

c. Engine generator controls shall integrate engine start and engine exercising features with transfer switch controls, and shall be provided with a voltmeter, ammeter and frequency meter.

d. Monitoring network interface shall be capable of interfacing through a standard IEEE bus and open protocol.

16. Enclosure

The enclosure type shall be as designated on the Basic Contract Drawing. Enclosure construction shall be welded steel. Wire bending space shall comply with National Electrical Code for the maximum size and number of conductors the terminal lugs will accept. A key locking handle shall be provided.

PART 3. EXECUTION

3.01 FIELD SUPERVISION

A. Provide the services of a qualified, factory-trained ATS manufacturer's representative to provide technical field support in the installation and testing of the equipment specified in this Section. The manufacturer's representative shall provide technical direction and assistance in the following:

1. Direct the ATS installation and field control wiring connection.
2. Perform Required Field Testing.
3. ATS load transfer control parameters setting.

3.02 EXAMINATION

The Contractor is responsible for notifying the Engineer as soon as he finds conditions that prevent the proper installation of materials or methods specified in this Section.

3.03 INSTALLATION

A. The ATS shall be transported to the construction site, unloaded, uncrated, handled, stored, installed, including assembly of all component parts, and wired in accordance with the manufacturer's recommendations, applicable IEEE (formerly ANSI) standards, and the requirements specified in this Section.

B. Provide all equipment, supervision, labor, rigging, tools, including, but not limited to, special equipment such as cranes.

C. Before setting the ATS, the openings for conduits and bus entrances shall be checked for accuracy of position.

D. All floor-mounted ATS units shall be set on a concrete pad at the locations shown on the Basic Contract Drawing. Provide floor seals at the penetration. The ATS shall be set, aligned, and leveled in place, using shims where necessary.

E. Bus splices shall be cleaned and bolted together and insulated, either by taping, or by use of insulating boots if provided for that purpose.

F. The Contractor shall complete all internal and external power and control connections. All field-installed control wiring shall be identified using heat-shrinkable wire sleeves with origin/destination markings typed on them.

G. Install, wire, and connect the controls in accordance with the Basic Contract Drawing and manufacturer's drawings and instructions.

H. All damaged paint areas shall be properly prepared by the Contractor for an application of primer and finish coats of paint, which shall be supplied by the manufacturer for this purpose. The Contractor shall apply the primer and finish paint coats.

I. After each item of equipment is installed and connected, the Contractor shall make a thorough inspection of the installation and cleaning, prior to final acceptance of the Work.

J. All control cables shall be neatly racked and bundled with nonflammable nylon ties, routed and supported within the enclosures. Minimum bending radius recommended by cable manufacturers shall not be reduced.

3.04 FIELD TESTS

Field tests shall be performed in accordance with Approved Performance Test Plan of Appendix "A". Advise the Engineer, in writing, upon failure of any equipment or material to pass the tests performed, or to function properly as intended. In the event that testing does not meet the requirement for proof of satisfactory performance specified herein, the Contractor shall repeat the test. The Engineer reserves the right to decide whether a test must be repeated.

3.05 PROTECTION

Protect ATS and facilities against damage, mechanical or otherwise and provide maintenance until issuance of the Certificate of Final Completion. The switchgear and equipment shall be kept clean, dry, and protected at all times.

3.06 TRAINING

A. Provide training sessions for the number of Authority personnel, as specified on the Basic Contract Drawing.

B. The training sessions shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly and major components within the assembly.

C. For additional training time requirements, see Section 16000 of these Specifications.

END OF SECTION

SECTION 16250

TRANSFER SWITCHES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of DIVISION 1 - GENERAL PROVISIONS.

A. Shop Drawings

1. Schematic wiring diagrams.
2. Control wiring diagrams.
3. Dimensional data.
4. Description of operation.

B. Catalog Cuts

1. Transfer switches.

C. Test Reports

1. Factory test reports.
2. Certified Laboratory Test Data.
3. Prepare and submit to the Engineer for approval a Performance Testing Plan for the entire system a minimum of 30 days in advance of the earliest, approved, scheduled inspection and test date. The system shall be divided into the following stages:
   a. Inspection upon arrival at the construction site.
   b. On-site inspection and test immediately following the complete installation of the system to demonstrate compliance with the requirements of this Section.
   c. A 30-day operational test commencing with the successful completion of the on-site inspection and test.

D. Spare Parts

1. Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of this Section for approval by the Engineer.
2. Submit a list of recommended spare parts together with indications of what the price and delivery time of each part, starting from receipt of order, will be if such parts are ordered.

E. Prior to delivery, the Contractor shall submit procedures covering storage and preventative maintenance requirements to be applied after the receipt of the circuit breakers at the construction site.

F. Training

Prior to the on-site inspection and test of the system, prepare and submit to the Engineer for approval an emergency load transfer system curricula, in accordance with the requirements of this Section.

END OF APPENDIX "A"

DIVISION 16

SECTION 16315

MEDIUM VOLTAGE LOAD INTERRUPTER SWITCHES

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements of medium voltage, load interrupter switches.

1.02 REFERENCES

Not Used.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

Design and performance of components and methods herein shall comply with the applicable provisions of the codes, standards and recommendations of the following entities:

American National Standards Institute (ANSI)
American Welding Society (AWS)
Institute of Electrical and Electric Engineers (IEEE)
National Electrical Manufacturers Association (NEMA)
National Fire Protection Association (NFPA)
Underwriters Laboratories (UL)

In addition, specific provisions cited herein as shown on the Basic Contract Drawing shall govern for the associated specific application.

1.04 QUALITY ASSURANCE

Switchgear and all components of types and sizes required shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Switchgear shall be delivered to the site as complete as possible and in shipping splits that are as large as practical. All accessories, including but not limited to breakers, meters and relays, shall be in place and wired. Packing materials shall be such as to prevent damage to components due to vibration, jarring or the like during transportation and handling.

B. If any accessories must be shipped loose, they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with a noncorrosive tag.

C. The switchgear shall be handled in a manner to prevent damage to finished surfaces.

D. Touch up any damage to finishes to match adjacent surfaces.

1.06 SPARE PARTS AND SPECIAL TOOLS

A. Furnish 25 percent spare fuses of each size and type used in the switchgear with a minimum of six of each size and type.

B. Furnish one set of all special tools required for the erection, operation, and maintenance of all equipment furnished and installed under this Section. Covered under these Specifications for each independent area shall be furnished by the Contractor and one set of all special tools and wrenches required for assembly or disassembly of the load interrupter switchgear and for the removal of fuses.

C. Furnish a list of recommended spare parts for the switchgear and accessories. The list shall contain the prices and availability of the spare parts recommended.

D. Furnish two aerosol cans, each not less than 12 ounces, of touch-up paint required by other Sections.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, provide medium voltage load interrupter switch assemblies from one of the following manufacturers:

A. Load Interrupter Switch

General Electric Company
Westinghouse Electric Company
Asea Brown Boveri Incorporated (ABB)
Siemens Incorporated
Power Con (NEPA)
Square D Company
S & C Electric Company
Electrical Equipment Incorporated (EEI)

B. Load Interrupter Switch Assemblies

Load interrupter switch assemblies shall include the load interrupter switch and all appurtenances from one of the following manufacturers:

1. General Electric Company
   Westinghouse Electric Corporation
   Asea Brown Boveri Incorporated (ABB)
   Siemens Incorporated
   Power Con (NEPA)
   Powell Electrical Manufacturing Company
   Nelson Electric
   Controlled Power Corporation
   Pacs Industries Incorporated
   Square D Company
   S & C Electric Company
   Electrical Equipment Incorporated (EEI)

2.02 CONSTRUCTION FEATURES

A. General

1. Switchgear shall be factory assembled, of the indoor and/or outdoor type, as shown on the Basic Contract Drawing, dead front, metal enclosed, free standing, self supporting, front accessible only and completely equipped with load interrupter switches, fuses, instrument transformers, relays, metering, switches, and associated devices as specified in this Section and as shown on the Basic Contract Drawing.

2. If shown on the Basic Contract Drawing the load interrupter switchgear shall be provided with a throat connection or a transition section to match with a bus duct, a transformer throat or flange, or a metal clad switchgear. Provisions shall be made for extension of the switchgear in both directions.

3. Unless otherwise shown on the Basic Contract Drawing, provide a set of intermediate class lightning arresters.

4. All relays, meters, switches, pilot lights or other force-mounted equipment shall be arranged as shown on the Basic Contract Drawing.

5. Each vertical section shall be furnished with a factory wired space heater (120 volts) and thermostat. The space heater shall be installed within a grounded, perforated, galvanized steel guard.

B. Enclosure Design

1. The load interrupter switchgear shall consist of rigid self-supporting and self-contained electrically welded steel cubicles. Each cubicle shall be completely enclosed with formed steel sheets of #11 gauge (minimum) cold-rolled steel adequately braced to prevent distortion under normal conditions as well as during interruption of short circuit currents.

2. The structural details of each cubicle shall be identical. The cubicles shall be uniform in height, and built to form a continuous structure lining-up in front.

3. All louvers or other ventilating openings shall be furnished with filters and shall be so arranged and located as to prevent the entrance of water dripping from above or splashing from the floor into the switchgear. No openings shall be placed in the top cover of the switchgear enclosure unless the construction of the unit prevents the entrance of dust, water, and other foreign materials.

4. Sheet steel doors, #11 gauge minimum, fully gasketed, with galvanized, zinc plated, or stainless steel hinges and stainless steel hinge pins, shall be provided for access to the switch and fuse compartment(s).

5. Each door shall be furnished with one or more handles, knurled steel screws, or a combination of these, in order to firmly hold door closed.

6. Doors shall be mechanically or key interlocked with interrupter switches to prevent opening door when switchgear is energized and prevent closing of switch when door is open.

7. Each switch compartment door shall be furnished with a safety glass observation window(s), large enough to permit viewing of all poles and the position of the switch.

8. Provisions shall be provided for locking the switches in both the open and closed positions.

9. Sufficient space shall be provided within each unit to be able to apply stress cones to the incoming cables and to terminate them with compression or crimp type lugs.

10. Doors providing access to fuses or fused voltage transformers shall have provisions to store spare fuses and/or refill units.

11. Each switch vertical section shall be either of the following door designs:

    a. A separate top door for access to the interrupter switch and a separate bottom door to access the fuse compartment. Door to fuse compartment shall be mechanically or key interlocked with switch to prevent gaining access unless the switch is open.

    b. An inner screened barrier covering either the switch section completely or running the full height of the vertical section, where single door construction is provided, to prevent inadvertent contact with live parts.

12. Barriers shall separate secondary control devices from primary live parts.

13. The arrangement of equipment shall allow sufficient space for proper maintenance within the structure.

C. Outdoor Load Interrupter Switch

1. Outdoor switchgear shall be weatherproof and designed so that driving rain, snow, sand, or other materials will not interfere with the successful operation of the switchgear. The housing shall be constructed and ventilated so that the heating effects of solar radiation will not produce total temperature(s) rises in the equipment beyond those allowed by the applicable provisions of the Standard codes.

2. Suitable means shall be provided to prevent the condensation of moisture on the inside of the roof of the enclosure and the dripping of this moisture on live parts.

3. The undersurface of the enclosure shall be covered with a sealing undercoating of 1/8 inches minimum.

4. Space heaters rated 240 volts AC, sized for operation at 120 volts AC, with differential thermostats or other controls as recommended by the manufacturer shall be furnished to keep the air inside the enclosures sufficiently above the dew point to prevent condensation. The 120-volt power will be from an external source unless otherwise shown on the Basic Contract Drawing. The heaters shall be located so that wiring, bus, equipment, and control devices will not be overheated. Heaters shall be fused. Fuses shall be accessible when the load interrupter switch and assembly door are closed.

5. A minimum of 120-volt AC duplex outlet shall be provided for convenience power up to 2400 watts. Receptacles shall have polarized grounding outlets with ground fault protection.

6. Interrupter switches and grounding switches shall have a readily visible open gap when in the open position to allow positive visual verification of correct switch position. High impact viewing window(s) shall be provided that permit full view of the position of all switchblades through the closed door.

7. A grounding pad shall be provided on the interior of each cubicle. For switch enclosures that are mounted directly to a transformer, the Contractor shall install a #4/0 AWG, bare copper ground jumper between the two enclosures.

D. Bus Design and Rating

1. All buses shall be silver plated hard drawn copper and shall be mounted on NEMA rated porcelain or glass polyester insulators. All bussing shall be braced for the fault current rating of switch as shown on the Basic Contract Drawing. For switches that are bussed together in pairs, the connecting bus shall be insulated.

2. Splice and tap connections shall be either plated or wire brushed and coated with an oxide-inhibiting compound after drilling or punching. Connections shall be securely bolted to maintain maximum contact pressure and minimum joint resistivity.

3. Provisions shall be made in the design for expansion and contraction of current carrying parts and metal housings due to temperature changes.

4. Bus phasing shall be A, B, C, or 1, 2, 3 from left to right, top to bottom, front to rear, when viewing the switch from the front.

5. A ground connection for a single vertical section assembly or a ground bus for multiple section assemblies shall be provided running the full length of the assembly.

6. Ground bus shall be solidly connected to each assembly section.

7. Compression crimp type cable terminals shall be supplied suitable for copper cable of the number and sizes shown on the Basic Contract Drawing. All splice plates and cable terminations, other than central cables, shall be 2-hole, NEMA spaced, terminal lugs, complete with non-ferrous, non-magnetic stainless steel hardware. Sufficient vertical space, but not less than 15 inches shall be supplied for stress cones termination for cable shown on the Basic Contract Drawing.

8. Ground bus shall consist of copper and connections and splices shall be made in the same manner as the power buses.

9. Two clamp type terminal lugs capable of accommodating #2 AWG through 500 MCM cable shall be provided, one at each end of ground bus, for connection to station ground.

10. Ground lugs shall also be provided to connect incoming cable shield ground wires, and ground switches connection, as required.

11. All buses shall be designed for future extension in either direction.

12. External connections to the power bus and/or switches shall be in accordance with the requirements as shown on the Basic Contract Drawing. Bus pads shall be NEMA drilled and two bolt compression crimp type lugs shall be furnished for the cable size as shown on the Basic Contract Drawing.

13. Insulators shall be porcelain or cycloaliphatic epoxy resin.

E. Air Interrupter Switches

1. Air interrupter switches shall be of quick-make, quick-break, stored energy type utilizing direct acting spring charged mechanism for both the closing and opening functions.

2. The speed and force of opening and closing the switchblades shall be constant and independent of the operator. Blow out forces shall not be transmitted to the operating handle.

3. The switch mechanism shall be equipped with either an operating handle with provisions for locking in the open and closed position, or a removable operating handle to prevent inadvertent operation of the switch. The operating handle shall be located on the front of the unit and shall be provided with position indication. A convenient storage area shall be provided for removable handles.

4. The switch mechanism shall be a one piece assembly with an all welded or bolted fabricated steel support frame to facilitate removal of the entire unit without affecting contact alignment and adjustment.

5. The arcing contacts of the switch shall operate in an arc chute or similar device designed to emit a high dielectric strength gas to assist interruption.

6. Switch operators with motors, where shown on the Basic Contract Drawing, shall:

   a. Open and close the associated interrupter switch electrically;

   b. Have the capability of being decoupled from the switch mechanism to permit testing and exercising, and manual operation; and

   c. Shall be mounted in the low voltage compartment.

7. Interrupter and grounding switch contacts shall be of silver-to-silver construction for optimal current transfer, and shall be backed up by stainless-steel springs to provide constant high contact pressure.

F. Fuses

Fuses shall be of the type shown on the Basic Contract Drawing.

1. Fault protection shall be furnished by fuses of one of the two types specified below.

   a. One Time

      One time type shall utilize refill-unit-and-holder or fuse-unit-and-end fitting construction. This type of fuse will expel gases and vapors but shall be readily refusible with low cost refill units.

b. Current Limiting

Current limiting type of the self-contained design to provide fast interruption with minimum let-through current.

2. The fuse and fused switch ratings shall be as shown on the Basic Contract Drawing.

3. Fusible elements shall be non-aging and non-damageable so that upon fuse operation it shall be unnecessary to replace unblown companion fuses due to suspicion of damage.

4. Fusible elements for refill units shall be helically coiled.

5. Fuse mounts shall be designed for a positive clamp in position while having provisions for easy removal.

6. Fuses shall be capable of detecting and interrupting all faults - large, medium, or small - and have melting time current characteristics which will permit coordination with protective relays, automatic circuit reclosures, and other fuses.

7. If shown on the Basic Contract Drawing a blown fuse indicator shall be provided to show visible evidence of fuse operation while installed in fuse mounting. A double pole double throw 125-volt D.C. contact shall be operated by blown fuse indicator for remote indication.

8. A spare set of fuses or fuse refills shall be provided for each fused switch.

G. Lightning/Surge Arresters

Lightning/surge arrester where shown on the Basic Contract Drawing shall be of the class and rating shown.

H. Grounding Switch

1. Ground switch where shown on the Basic Contract Drawing shall be 3 phase and shall be provided on the line side of the interrupting switch, in order to ground incoming line.

2. Key interlocks used in conjunction with key interlocking of the interrupter switch and the feeder breaker or switch, shall be employed to prevent closing the ground switch while load interrupter switch is closed and when the feeder breaker or switch supplying power to load interrupter switch is closed.

3. Where shown on the Basic Contract Drawing, provide a three (3)-phase grounding switch. Unless otherwise shown on the Basic Contract Drawing, the ground switch shall be provided on the line side of the interrupter switch and mechanically interlocked to permit closing the grounding switch when the interrupter switch is in the open position.

4. Grounding switches shall have the three phases on the load (hinge) side bussed together and grounded to the enclosure ground lugs. Ground bus shall be sized for short circuit current as shown on the Basic Contract Drawing.

I. Automatic Transfer

Automatic transfer shall be installed in switches as shown on the Basic Contract Drawing.

1. Where shown on the Basic Contract Drawing, an automatic transfer feature for split bus, three-switch operation shall be provided.

2. A three position selector switch for "Automatic-Semi Automatic-Manual" control, necessary control switches, relays, timers, and position and source indicating lights shall be provided. Selector switch shall be furnished with 2 normally open and 2 normally closed extra contacts for each position.

3. "Automatic-Semi Automatic-Manual" Selector Switch

   a. In automatic or semi-automatic mode the automatic control system shall continuously monitor the voltage of each of the power sources. Should voltage be lost or reduced to a predetermined level on either source, for a sufficient period of time, to determine that the voltage loss is not transient, the automatic controller shall open the switch associated with the affected source and then close the bus tie switch. A 0-30 second timer shall be furnished for the time delay feature.

   b. In automatic mode, when the voltage is restored to the affected source, the tie switch shall be opened and then the source switch closed.

   c. In semi-automatic mode, upon return of normal conditions to the affected source the load retransfer shall be manual if the second source conditions are also normal. However, should normal conditions return to the affected source while the second source experiences abnormal conditions, such as undervoltage, the retransfer shall be automatic.

   d. Should only one source be energized, undervoltage conditions shall not open the switch; in neither the automatic nor the semi automatic modes.

   e. In the manual mode, total manual control of the switches shall be required.

4. In addition to the control interlocking of the automatic control system which shall prevent more than two switches being closed in either of the three modes, an electromechanical device such as a limit switch or auxiliary switch shall be installed for each of and acting directly from the operating shaft of the interrupter switches.

5. Provided for anti-pumping on transient conditions.

J. Instruments and Controls

1. Instruments and controls shall be installed where shown on the Basic Contract Drawing.

2. Instrument transformers shall be of the dry type. Current transformers shall be either of the wound or bar type and shall have 5-ampere secondaries. The rating and accuracy class of the transformers shall be as shown on the Basic Contract Drawing.

3. Potential transformers shall be of the stationary type and shall have a voltage ratio as shown on the Basic Contract Drawing. They shall be capable of carrying rated load continuously without excessive heating or damage to the unit. The maximum ratio and phase angle errors, when carrying full rated secondary load, shall not exceed ANSI standard classification 0.3W, X, Y. Suitable current limiting fuses shall be provided for the primaries and non-renewable cartridge type fuses for the secondaries.

4. Control power transformers shall have ratings as shown on the Basic Contract Drawing and shall be protected by two (2) current limiting fuses on the primary side and one leg on the secondary shall be fused and the other grounded.

5. Relays and meters shall be furnished for the application and have the characteristics shown on the Basic Contract Drawing.

6. All meters and relays shall be semi-flush mounted on the front door or a panel separated from the high voltage section. Protective relays and watt-hour meters shall be of the drawout type with built in test capabilities. All protective relays shall be equipped with built-in targets, which indicate a trip condition.

7. All controls, such as selector switches, and pilot lights, shall be mounted on a separate inner hinged panel or outer covered panel. Unless otherwise shown on the Basic Contract Drawing, all controls shall be 125V DC.

8. Kirk key interlocks shall be provided as shown on the Basic Contract Drawing.

K. Wiring

1. All control, potential transformer and current transformer wiring shall not be smaller than #12 AWG stranded, single conductor, copper wire, having heat resistant, type SIS switchboard insulation, rated 600 volts. All low voltage wiring shall be isolated and barriered from medium voltage components by rigid steel conduit or grounded metal barriers.

2. Wiring from current transformers shall be #10 AWG minimum. The wiring of current transformer secondaries shall be arranged so that the secondary leads of each current transformer will be brought out to self-shorting terminal blocks in the terminal compartment.

3. Four normally open and four normally closed dry, convertible, auxiliary contacts shall be provided for remote indication of switch position and interlocking. Provisions shall also be made for remote control of motor operated switches. Two normally open and two normally closed contacts shall be provided to indicate ground switch position. Contacts shall be rated for 125V DC application.

4. Terminal blocks shall be of the add-on, barrier, sliding link, with marking strips and plastic covers.

5. Each end of each wire shall be clearly marked for ease of identification and shall be terminated with ring type lugs.

L. Signs and Nameplates

1. Warning signs shall be furnished on door of assembly in accordance with OSHA requirements.

2. Stainless steel or laminated phenolic nameplates with white or silver background and black letters shall be provided identifying each component, and on the front doors of each compartment identifying the switch and indicating the switch ratings and the manufacturer's identification number.

2.03 FABRICATION

A. Each switchgear line-up shall be completely assembled as shown on the Basic Contract Drawing and factory tested as a single unit. After testing it may be separated into convenient shipping splits.

B. Shipping splits shall be kept to the minimum practical for shipping and handling. Wire and cable running between splits shall be disconnected at one end and coiled. Wires and cable shall be tagged for reassembly.

C. Surfaces to be welded shall be clean and free from dirt, rust, or other foreign matter. The welding processes shall be in accordance with the requirements of the current editions of the American Welding Society.

2.04 PAINTING

A. Surfaces to be painted shall be prepared by the removal of all grease, oil, rust, scale, or other foreign material.

B. A prime coat and 2 finish coats of ANSI 61 light gray paint shall be applied.

2.05 FACTORY INSPECTION AND TESTS

A. The switchgear shall be completely assembled, wired, and tested at the factory in accordance with ANSI, NEMA and IEEE standards. Submit a written factory acceptance testing plan, not less than 30 days prior to testing, for review by the Engineer. Equipment shall not be shipped until inspected and accepted by the Engineer.

B. Tests shall include but not be limited to the following:

1. High potential tests of all power and control circuits.
2. Continuity check of all control wiring.
3. Operational tests of all control and instrument circuits.
4. Operational tests of all switch mechanisms and interlock devices.

C. Not less than 30 days prior to factory acceptance testing; submit complete information outlining the test methods and procedures to be followed for review by the Engineer. Furnish copies of test forms and sample computations to be employed.

D. Notify Engineer not less than two weeks prior to the beginning of testing.

E. At the conclusion of the tests, furnish to the Engineer one copy of all original test data. If any data is modified, the Engineer shall be apprised and such modifications shall be subject to review by the Engineer.

F. The accuracy of the calibration of all instruments to be employed during the tests shall be ascertained and recorded at the beginning of the tests. All readings shall be direct and visible.

G. The Engineer will inspect any equipment, material or work to be furnished under this Section and will reject any part(s) considered defective or unsuitable for the uses and purposes intended.

H. Free entry shall be permitted to the Engineer at all times to all parts of the facilities engaged in the manufacture of this equipment. Facilities for any performance tests that may be considered necessary in connection with any inspection shall be furnished free of charge.

PART 3. EXECUTION

3.01 EXAMINATION

The Contractor shall notify the Engineer as soon as he finds conditions that prevent the proper installation of materials or methods specified in this Section.

3.02 INSTALLATION

A. The load interrupter switchgear shall be installed and connected in accordance with the manufacturer's recommendations and as shown on the Basic Contract Drawing.

B. Rubber matting, 36 inches wide, conforming to ASTM D 1278, Type 2, shall be furnished and installed along the entire length, front and rear of the switchgear.

C. All packing materials shall be removed from both inside and outside of the switchgear, switchgear parts, devices and associated equipment.

D. All removable parts, instruments, and devices furnished loose shall be installed and wired, and wiring between shipping splits shall be connected.

E. All feeder cables, control wires, instrument wiring and ground wires shall be pulled into switchgear and terminated.

F. The tightness of all bolted connections shall be checked and tightened as necessary.

G. All fuses shall be checked and installed or replaced as necessary.

H. The equipment shall be vacuumed to remove all dust and dirt.

I. Prior to energizing the switchgear it shall be field-tested.

3.03 FIELD TESTING

A. Prior to energizing the switchgear, the insulation resistance on each bus shall be measured from phase to phase and phase to ground.

B. After installation is completed, all switches shall be functionally tested.

C. All protective functions shall be tested and all remote functions simulated to determine if the units have been wired properly.

D. All testing of the completed installations shall be performed in the presence of and as directed by the Engineer. The Contractor shall notify the Engineer when the equipment is installed and ready for testing.

E. Testing shall be performed in the following manner:

1. All control and power cable connections shall pass inspection for workmanship, tightness, and continuity.

2. All switchgear shall be tested for equipment grounds. Maximum acceptable resistance shall be 1 ohm.

3. The switchgear bus shall be given a phase-to-phase and phase-to-ground megger test with all switches open, all current transformers shorted, all potential transformer fuses removed and all feeder switch load terminals grounded.

4. Megger tests on the bus shall be applied between each phase and ground with phases not under test also grounded.

5. Each switch shall be given a megger test in the open and closed position. A 1000 volt motor-driven megger shall be used. Megger tests shall be applied between each phase to ground and to each other phase. All test readings shall be recorded.

6. All alarm devices shall be adjusted and set.

7. All control circuits shall be given operational tests from the supply source for which they were designed. This shall include normal operation 3 times from each control point, and activation of alarm devices.

8. Ratio and polarity test shall be performed on all instrument transformers.

9. Potential transformers shall also be given a megger test. Each current transformer shall be given a ratio test applying full rated current to the primary winding and measuring both primary and secondary currents. With approximately normal instrument burden on its secondary winding, each potential transformer shall be tested with proper voltmeter for ratio. Megger tests on potential transformers shall be applied between each winding and ground using a 500 volt motor-driven megger and winding not under test grounded. Test results shall be within the manufacturer's recommended values.

10. Voltmeters shall be checked against potential transformer ratios. Pointers shall be set on zero scale, with no voltage, then after energizing, voltmeter reading shall be checked with test voltmeter.

11. Watt meters and watt-hour meters shall be checked for proper current and potential transformer ratios. Pointers shall be set on zero scale with no load and energized to check for proper rotation of meter.

12. All switchgear shall be given operational tests. This shall include mechanical operation, as well as operation by control circuits, and tripping devices. Operating voltage at closing and tripping coils shall be checked to determine that voltage is of proper value.

13. All switches shall be operated through at least 3 open-close cycles by manual operation and by control circuits from each control point. All indication lights, annunciator alarms and targets shall be observed to determine correct operation and switch mechanism shall be observed for correct alignment, freedom of binding and good contact.

14. All test results shall be in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 16315

MEDIUM VOLTAGE LOAD INTERRUPTER SWITCHES

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Mechanical parts and assemblies, including electrical components, complete connection details, torque requirements, and a complete list of parts with full identification.
2. Outline drawings indicating overall dimension, weights, locations of switchgear devices on the panel, aisle space required for drawout equipment, cable entrances and reference tables to other drawings furnished.
3. One-line diagram showing all ratings, main connections and the locations of all current, potential and auxiliary transformers.
4. Complete assembly drawings showing elevations and section views of each non-identical unit.
5. Foundation plan drawings showing locations of channel sills, anchor bolts, and conduit and grounding entrances.
6. Complete three-line diagrams showing all controls and instruments, including terminal wiring designations.
7. Instrument transformer characteristic curves and burdens.
8. Structure drawings showing available space for all conduit and cable connections.
9. Schematic (elementary) control diagrams, both AC and DC, for switch control, interlocks, relays and instruments.
10. Complete point to point wiring diagrams.
11. Family of time-current characteristic curves for all types and sizes of fuses, relays and trip devices furnished with the switchgear.
12. Bills of material of all equipment, devices, components and nameplates, which shall include complete descriptions, ratings and locations.

B. Catalog Cuts

1. High voltage switches.
2. Meters and protective relays.
3. Current and potential transformers.
4. Relays, instruments, transformers and control devices.
5. Key interlocks.

C. Test Reports

Submit 5 certified copies of all test results.

END OF APPENDIX "A"

DIVISION 16

SECTION 16320

DRY - TYPE TRANSFORMERS
GENERAL PURPOSE - 600 VOLTS OR LESS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for general purpose, dry-type transformers 600 volts or less.

1.02 REFERENCES

Not Used.

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The transformers shall be designed, manufactured and tested in accordance with the applicable provisions of the codes, standards and recommendations of the following entities:

American Welding Society (AWS)
American National Standards Institute (ANSI)
Institute of Electrical and Electric Engineers (IEEE)
National Electric Manufacturers Association (NEMA)
National Fire Protection Association (NFPA)
Underwriter Laboratories Inc. (UL)

In addition, specific provisions cited herein and as shown on the Basic Contract Drawing shall govern for the associated specific application.

1.04 QUALITY ASSURANCE

A. The manufacturer of transformers shall have manufactured equipment of the voltage and KVA rating(s) described herein and as shown on the Basic Contract Drawing, and they shall have been satisfactorily used for the purposes similar to those intended herein for a minimum of three years. When directed by the Engineer, the Contractor shall have the manufacturer provide a list of installations and contracts for which he has produced such materials.

B. All Work of this Section shall be performed and completed in a thorough, workmanlike manner and shall follow the best modern practice in the manufacture of high-grade equipment. All Work of this Section shall be performed by mechanics skilled in their respective trades.

C. All parts shall be made accurately to standard gauge, where applicable, for ease of replacement and repairs.

D. All material selected for the manufacture of the transformer units shall be the best available for the purpose for which they are intended to be used, considering strength, ductility, durability and the best engineering practice.

E. All parts shall be readily accessible and like parts shall be interchangeable insofar as possible.

F. Surfaces to be welded shall be clean and free from dirt, rust or other foreign matter. The welding processes shall be in accordance with the requirements specified by AWS.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transformers shall be delivered complete, in the manufacturer's original, unopened protective packaging. All accessories, including but not limited to meters, temperature gauges, lightning arrestors, fan controls and relays, shall be in place and wired. Packing materials shall be such as to prevent damage to components due to vibration, jarring or the like during transportation and handling.

B. Accessories or spare parts shipped loose shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with a non-corrosive tag.

C. The transformers shall be handled in a manner to prevent damage to finished surfaces.

D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

E. Touch up any damage to finishes to match adjacent surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 CONSTRUCTION FEATURES

A. General

Unless otherwise shown on the Basic Contract Drawing, transformers shall conform to the following requirements:

1. Transformers shall be self-cooled, with properly designed steel enclosures. Openings for ventilation or similar use shall be so designed as to deflect foreign objects inserted through these openings away from contact with energized parts. Enclosures shall be suitable for floor or wall mounting, as required to fit within the constraints of each specific application. Transformers larger than 112.5 KVA shall be designed for floor mounting only. Outside dimensions of enclosures shall not exceed the dimensions shown on the Basic Contract Drawing.

2. Transformers shall be provided with four 2 1/2 percent full capacity taps in the primary winding, two above and two below the nominal voltage rating. The taps shall be factory-wired to terminals accessible only by removal of external access plates or panels.

3. The maximum temperature at any spot on the exterior surface of the enclosure shall not exceed 50 degrees C rise above a 40 degrees C ambient.

4. Each transformer as a unit shall be capable of withstanding the stresses resulting from operating conditions, including external and internal short circuits, without distortion or other damage.

B. Core and Coil

1. Core and coil shall be completely isolated from the enclosure by rubber vibration isolating pads. The core shall be visibly grounded to the enclosure by a flexible grounding conductor, sized in accordance with applicable NEMA, IEEE and ANSI standards.

   a. Transformer neutral lead shall be ungrounded and brought-out to an isolated terminal.

   b. The enclosure shall include ground connection lugs for the incoming and outgoing conduits, and provisions for grounding the isolated neutral lead, all as shown on the Basic Contract Drawing.

2. All cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below saturation to allow for a minimum of 10 percent overvoltage excitation. Cores shall be clamped with structural angles and bolted to the enclosure to prevent damage during shipment or rough handling. All laminations shall be cut with the direction of the grain and be free of burrs, core plated and stacked without gaps.

3. Windings shall be copper-formed wire or sheet, continuous from start to finish. Splices in windings will not be permitted. Material incorporated must have at least a minimum of one year of proven field usage. Accelerated laboratory tests will not be acceptable.

4. Internal primary and secondary bus shall be rectangular copper. All buses shall be hot-dipped, silver-plated over the entire area where incoming or internal cable or bus are to be bolted.

5. Transformer impedance shall be within 7-1/2 percent of the impedance value shown on the Basic Contract Drawing.

6. All joints and leads to the transformer terminals shall be braced or welded.

7. The basic impulse level (BIL) windings shall be a minimum of 10 KV.

C. Insulation Systems

Transformers shall be vacuum-impregnated with non-hygroscopic thermosetting varnish.

1. Transformer capacity shall be based upon a temperature rise of 80 degrees C for transformers 30 KVA and larger, and 115 degrees C for transformers less than 30 KVA above an ambient temperature of 40 degrees C.

   a. Transformer design for 115 degrees C rise shall be capable of delivering a 15 percent continuous overload, above nominal rating, without exceeding 150 degrees C rise above a 40 degrees C ambient temperature.

   b. Transformer design for 80 degrees C rise shall be capable of delivering a 30 percent continuous overload, above nominal rating, without exceeding 150 degrees C rise above a 40 degrees C ambient temperature.

2. Transformer insulation systems shall be 220 degrees C for transformers 30 KVA and larger, and 185 degrees C for transformers less than 30 KVA. All insulating materials shall conform to the requirements of NEMA ST 20, for 220 degrees C, UL recognized insulation systems.

D. Sound Levels

Transformers shall operate at sound levels at or below ANSI C 89.1, and as follows:

Transformer Size	Maximum Sound Level
0.1 to 9 KVA	40 db
10 to 50 KVA	45 db
51 to 150 KVA	50 db
151 to 300 KVA	55 db
301 to 500 KVA	60 db

E. Painting

The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed and finished with two coats of ANSI 61 light gray, baked enamel.

2.02 FACTORY INSPECTION AND TESTS

A. The Engineer reserves the right to inspect each transformer 112.5 KVA and larger at the factory and to witness each factory test. The Engineer shall be notified 15 working days in advance of each test. Failure to notify the Engineer of testing may necessitate retesting in the presence of the Engineer at no additional cost to the Authority.

B. The accuracy of the calibration of all instruments to be utilized during the tests shall be ascertained and recorded at the beginning of the tests.

C. Factory tests shall include, but not be limited to, the following:

Submit certified test data of new transformer designs, or of electrically duplicate transformer designs. The required test data shall be:

1. Efficiency at 25, 50, 75 and 100 percent load.

2. Percent regulation at 80 and 100 percent power factor.

3. No load and full loss in watts.

4. Impedance based on reference temperature.

5. Sound level in db of transformer in enclosure.

6. Average temperature rise based on 40 degrees C ambient temperature.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install transformers in accordance with the Basic Contract Drawing, the manufacturer's instructions and in compliance with the applicable requirements of ANSI, IEEE, NFPA and UL.

B. All conduit and bus connections to the transformer enclosures shall be made with flexible or other approved vibrationless connectors.

3.02 FIELD TESTS

A. General

1. Provide all labor and materials for functional tests required. Unless otherwise shown on the Basic Contract Drawing, power for the tests will be furnished by the Authority.

2. Should the tests reveal any defects in transformers installed under this Section, promptly correct such defects and rerun the tests until the entire installation is satisfactory to the Engineer.

B. Perform the following field test in the presence of the Engineer to demonstrate the proper phasing of each transformer installation and submit a written field report to the Engineer for record:

1. Verify that the proper phase sequence is maintained.

2. Use a phase sequence meter or demonstrate the proper rotation of a small 3-phase motor whose direction of rotation was verified prior to the transformer installation.

3. Should the foregoing test reveal any incorrect phasing, promptly correct such defects and retest until the entire installation is satisfactory to the Engineer.

END OF SECTION

SECTION 16320

DRY - TYPE TRANSFORMERS
GENERAL PURPOSE - 600 VOLTS OR LESS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Physical dimensions of each transformer.
2. Nameplate drawing for each transformer.
3. Drawings showing location of all specified accessories.
4. Technical specification for proposed transformer.
5. Wiring diagram of fan cooling provisions.
6. Details of current transformers.

B. Catalog Cuts

1. Temperature gauges.
2. Lightning arrestors.

C. Test Reports

Submit six copies of the certified test reports.

END OF APPENDIX "A"

DIVISION 16

SECTION 16326

CAST COIL, DRY-TYPE TRANSFORMERS (MEDIUM VOLTAGE)

PART 1. GENERAL

1.01 SUMMARY

This section specifies requirements for substation grade, cast coil, dry-type transformers.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

American National Standards Institute (ANSI)

ANSI C 57.12.01	General Requirements for Dry-Type Distribution and Power Transformers Including those with Solid-Cast and/or Resin-Encapsulated Windings
ANSI C 57.12.50	Ventilated Dry Type Distribution Transformer, 1 to 500 KVA, single phase and 15 to 500 KVA, Three-phase, with High Voltage 601 to 34500 Volts, Low Voltage 120 to 600 volts. Requirements for Dry Type Distribution
ANSI C 57.12.51	Dry Type Power Transformer, 501 KVA and Larger, Three-phase, with High Voltage 601 to 34500 Volts, Low Voltage 208Y/120 to 4160 Volts. Requirements for Ventilated Transformers
ANSI C 57.12.54	Recommended Practice for Installation, Application, Operation and Maintenance of Dry Type General Purpose Distribution and Power Transformers
ANSI C 57.12.55	Conformance Standards for Dry-Type Transformers Used in Unit Installations, Including Unit Substations
ANSI C 57.12.60	Procedure for Thermal Evaluation of Insulation Systems for Solid-Cast and Resin-Encapsulated Ventilated Dry Type Power and Distribution Transformers.
ANSI C 57.12.58	Guide for Transient Analysis of Dry Type Transformers
ANSI C 57.12.90	Distribution and Power Transformer, Test Codes
ANSI C 57.12.91	Test Code for Dry Type Distribution and Power Transformer
ANSI C 57.12.96	Guide for Loading Dry Type Distribution and Power Transformers
ANSI C 57.114	Seismic Guide for Power Transformers and Reactors
ANSI C 57.124	Recommended Practice for the detection of Partial Discharge and Measurement of Apparent Charge in Dry-Type Transformers
ANSI C 62.11	Surge Arrestors - Intermediate Class, Metal Oxide Type

ANSI ST 1	Specialty Transformers (Except General Purpose Type)
ANSI Z 55.1	Gray Finishes for Industrial Apparatus and Equipment

American Welding Society (AWS)

AWS D 1.1	Structural Welding Code, Steel

National Electrical Manufacturers Association (NEMA)

NEMA ST 20	Dry Type Transformers for General Application

National Fire Protection Association (NFPA)

NFPA 70	National Electric Code

National Building Code (BOCA)

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The transformer shall be designed, manufactured, and tested in accordance with the latest revision of the applicable ANSI, NEMA and UL Standards. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

1.04 QUALITY ASSURANCE

A. Transformers of the voltage and KVA rating shown on the Basic Contract Drawing shall be of a design that has been in satisfactory use for not less than three years in 20 installations, for purposes similar to those intended herein.

B. Transformers shall conform to ANSI C 5.7.12.01 and be tested in accordance with ANSI C 57.1291. Transformers produced to IEC Standards will not be acceptable.

C. All parts shall be made accurately to standard gauge, where applicable, for ease of replacement and repairs.

D. All materials selected for the manufacture of the transformers shall be the best available for the purpose for which they are used, considering strength, ductility, durability and the best engineering practice.

E. All parts shall be readily accessible and like parts shall be interchangeable, insofar as possible.

F. Surfaces to be welded shall be clean and free from dirt, rust or other foreign matter. The welding process shall be in accordance with AWS D1.1.

G. All Electrical System Equipment, Components Etc. and the means of their attachments and supports shall be designed and constructed to resist the effects of earthquake motion determined in accordance with ANSI C 57.114 and BOCA National Building Code for seismic hazard exposure group III. The Effective Peak Velocity Related Acceleration (A) which shall be utilized to determine seismic forces shall be 0.12. For this purpose of classification, this equipment and its enclosures are considered to be emergency or standby Electrical Equipment as defined in Table 1612.6.4(1) of BOCA National Building Code. Submit certification of the above requirements by a Professional Engineer licensed in the state of installation of the Transformer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Transformers shall be delivered complete, in manufacturer's original, unopened protective packaging. All accessories, including, but not limited to, meters, temperature gauges, lightning arrestors, fan controls and relays shall be in place and wired. Packing materials shall be such as to prevent damage to components due to vibration, jarring, or the like, during transportation and handling.

B. Accessories or spare parts shipped loose shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with a suitable non-corrosive tag.

C. Each box of crate shall be equipped with suitable lifting devices to facilitate unloading and shall contain a detailed packing list.

D. Adequate means shall be provided for lifting by fork lifts and cranes and for moving the equipment on rollers. Lift points shall be marked on each crate.

E. Contractor shall outline measures he shall take with respect to storage and preventive maintenance requirements following delivery of the transformer to the construction site.

F. The transformer shall be handled in a manner to prevent damage to finished surfaces and assemblies. Touch up any damage to finishes to match adjacent surfaces.

G. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

H. After delivery, a final inspection of the materials will be made by the Engineer. If any materials have been damaged or for any reason do not comply with the requirements hereof, the Contractor will be notified in writing and he shall replace the materials at his own expense.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide transformers of manufacturers as shown on the Basic Contract Drawing.

2.02 CONSTRUCTION FEATURES

A. General

1. Locations, sizes, ratings, types and special features shall be as shown on the Basic Contract Drawing. The transformers shall be cast coil type manufactured in accordance with ANSI C 57.12.01-1989 and applicable requirements of ANSI C 57.12.50, C 57.12.51 and C 57.12.55. Unless otherwise shown on the Basic Contract Drawing, the transformers shall be three-phase connected in delta on the primary and in wye on the secondary. The ratings shall be as shown on the Basic Contract Drawing and shall be based on continuous operation in a 30 degrees C average ambient temperature, as defined by ANSI C 57.12.01 over 24 hours and not exceeding 40 degrees C. Unless otherwise shown on the Basic Contract Drawing, the self-cooled temperature rise shall not exceed 80 degrees C. and the maximum hottest spot temperature shall not exceed 110 degrees C. for 150 degree C insulation temperature class. For insulation temperature classes in excess of 150 degrees C, the insulation temperature class shall be determined from a thermal evaluation test of a complete winding assembly in accordance with ANSI C 57.12.60.

2. Transformers shall be provided with full capacity taps in the primary windings as shown on the Basic Contract Drawing. The taps shall be factory-wired to terminals accessible only through removal of external access plates or panels. Links or jumper wires shall be insulated for 133 percent of the rated voltage.

3. The transformer as a unit shall be capable of withstanding the stresses resulting from operating conditions, including external and internal short circuits, without distortion or other damage.

4. The transformer assembly shall have ample strength to withstand, without damage, all stresses incidental to shipping and installation. Lifting hooks or eyes and jacking pads on all four corners of the transformer base shall be provided. The transformer base shall be constructed so as to be suitable for rolling or skidding in any direction and shall also have provisions for being lifted and moved by fork lift. All parts requiring removal during installation shall be clearly marked on the unit and identified in the installation instructions.

5. Unless otherwise shown on the Basic Contract Drawing, each primary coil shall be protected with a solid state intermediate class surge arrestor manufactured in accordance with ANSI C62.11 (General Electric Company, Tranquell type, or equal) suitably sized and coordinated with the rated voltage. The arrestors shall be located in the transformer housing between the incoming feeder connector and the primary coil connection link. Primary coil connection link shall be connected on the line side of each arrestor, and the internal ground bus shall be connected to the ground side of each arrestor.

6. Transformer losses shall be calculated at 20 degrees C above rated temperature, at 100 percent KVA rating of transformer at rated voltage. Maximum core and coil losses shall be as shown on the Basic Contract Drawing. Transformers with losses in excess of those specified will not be accepted.

7. Core and coil shall be completely isolated from the enclosure by cast epoxy supports and spacer blocks or by rubber vibration isolating pads. There shall be no rigid metal-to-metal contact or mechanical connection between them.

8. Transformers shall operate at sound levels at or below the requirements of NEMA ST20 as follows:

Transformer Size	Maximum Sound Level
57 to 150 KVA	55 db
151 to 300 KVA	58 db
301 to 500 KVA	60 db
501 to 700 KVA	62 db
701 to 1000 KVA	64 db
1001 to 1500 KVA	65 db
1501 to 2000 KVA	66 db
2001 to 3000 KVA	68 db
Larger than 3000 KVA	As shown on the Basic Contract Drawing

9. Transformer impedance shall be as shown on the Basic Contract Drawing at rated KVA, at rated voltage tap, with a permitted variance of 7-1/2 percent of specified impedance. The X/R ratio shall not be greater than seven unless otherwise shown on the Basic Contract Drawing. Default value of transformer impedence shall be 5.75%.

10. Transformer neutral lead shall be ungrounded and shall be brought out to an insulated terminal.

11. Enclosure shall include an internal copper ground bus, minimum size to be 1/4 inch by 2 inches, with ground connection pads, lugs for equipment grounding the incoming and outgoing conduits, and provisions for grounding the isolated neutral lead. Ground connection pads shall be copper, minimum size 1 inch by 2 inches by 1/4-inch thick, located near the base, diagonally opposite each other, and supplied with two clamp-type copper ground connectors suitable for terminating #4/0 AWG copper cable.

12. Primary and secondary termination space and bushing locations shall allow sufficient space for proper terminations, but not less than 24 inches between the conduit entry and the termination. Alarm control and indication contacts shall terminate in a separate termination box or compartment with separate access through the enclosure. All wiring of contacts for alarm, control or indication shall be wired to terminal strips.

    a. All current transformers and all contacts for remote connection shall be wired to a terminal board in this box. All current transformers shall be terminated in shorting blocks.

    b. Designation strips shall be provided on each terminal board.

    c. Wiring shall be 600 volts rated, type SIS.

13. Internal primary and secondary bus shall be rectangular copper. All buses shall be hot-dipped, silver-plated over the entire area where incoming or internal cable or bus is to be bolted.

   a. All buses shall be fully insulated up to the cable termination lugs for the full, ungrounded, system voltage. The method to be used may be tape, sleeves, heat shrink material or any other approved method. The type and size of the line and load conductors and the type of termination shall be as shown on the Basic Contract Drawing.

   b. Where fan cooling is shown on the Basic Contract Drawing, buses shall be sized to comply with the fan-cooled rating.

14. Primary cables shall terminate with crimp-type, compression cable connections, UL listed for use on high voltage terminations. Screw type mechanical lugs are not acceptable.

   a. All cable connections shall be bolted to the equipment using a minimum of two non-magnetic stainless steel hex-heads bolts, each including hardware with two flat washers, two Belleville (cupped) washers and a nut.

   b. All bolted connections shall be properly torqued using an automatic self-releasing wrench. The Contractor shall certify that each connection is properly torqued, and shall include the values in a written field report submitted to the Engineer.

   c. After completion of connections, the Contractor shall tape each connection with high voltage insulating tape to the full design voltage value for the equipment. The insulating tape shall be covered with a final layer of non-tracking silicone tape.

B. Enclosure

1. Transformers shall be self-cooled, unless otherwise shown on the Basic Contract Drawing with properly designed, heavy-gauge, sheet steel enclosures. Openings for ventilation, or similar openings, shall be so designed as to deflect foreign objects inserted through the openings away from contact with energized parts in compliance with NFPA 70.

   a. Enclosures shall be suitable for floor mounting. The base shall be constructed of structural steel members to permit skidding or rolling in any direction, with jacking pads designed to be flush with the enclosure, and with removable lifting devices bolted or welded to the base.

   b. Enclosure dimensions shall be coordinated to provide adequate working clearances around the transformer in accordance with NFPA 70.

   c. Unless otherwise shown on the Basic Contract Drawing, the transformer enclosure shall be indoor type, ventilated, with louvered openings backed with a number 8 square mesh made with .035 inch diameter copper wire. The sheet steel shall be a minimum of 11 gauge galvanized steel. The top shall be of turndown construction for proper bolting of removable side panels for front and rear access respectively. Panels shall be equipped for padlocking and be provided with handles for easy opening and/or removal.

d. The transformer enclosure, termination chambers and components shall be shotblasted prior to application of a rust-inhibiting prime coat. The transformer base shall be painted with Minnesota Mining and Manufacturing Company (3M) type undercoat or approved equal. All surfaces shall then be finished with two coats of ANSI 61 light gray paint in accordance with ANSI Z 55.1. The underside of all equipment not readily accessible for repainting shall be coated with bituminous paint.

e. All transformers 500 KVA and larger shall have provisions for future forced air cooling on all units when fan cooling is not shown on the Basic Contract Drawing. Provisions for future forced-air cooling shall include mounting provisions only for fans and bussing sized to comply with the fan-cooled rating. Forced-air cooling shall increase the nameplate KVA rating by at least 33% of the self-cooled KVA.

2. The maximum temperature at any spot on the exterior surface of the enclosure shall not exceed a 50 degree C rise above a 40 degree C ambient temperature.

C. Core and Coil

1. Both the primary and secondary windings shall be individually cast coil construction with the primary to encompass the secondary. The entire coil of each shall be cast in a fiberglass reinforced epoxy resin using a vacuum impregnation process to insure the absence of voids or air bubbles. The primary and secondary coils shall incorporate air convection ducts for optimum cooling and minimizations of overall size.

2. Windings shall be high conductivity copper, and shall be continuous from start to finish. Splices in windings will not be acceptable. Materials incorporated must have at least a minimum of two years of proven field usage. Accelerated laboratory tests will not be acceptable. All joints and leads to the transformer coils shall be brazed or welded.

3. The transformer insulation shall be designed to withstand without flashover or any apparent damage a Basic Impulse Level (BIL) test: One at reduced voltage; one at full wave; and two chopped wave all in accordance with ANSI Test Code C 57.12.90. In addition, the insulation shall be rated 34.5KV for 34.5KV class, 15KV for the 15KV class, 8.7KV for the 5KV class and 2.4KV for the 600-volt class. Windings shall have a minimum basic impulse level (BIL) as follows unless otherwise shown on the Basic Contract Drawing.

Voltage Class	BIL Rating
0.6 KV	10 KV
5 KV	60 KV
15 KV	110 KV
34.5 KV	150 KV

4. All cores shall be manufactured from a high grade, non-aging silicone steel with high magnetic permeabilities, low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below saturation to allow for a minimum of 10% voltage excitation. Cores shall be clamped and bolted to the enclosure to prevent damage during shipment or rough handling. All laminations shall be cut with the direction of the grain and be free from burrs, and shall be core-plated and stacked without gaps.

5. Where shown on the Basic Contract Drawing, an electrostatic shield shall be placed between primary and secondary coils and connected to the enclosure ground.

D. Fan Cooling System

Where shown on the Basic Contract Drawing, the fan cooling system shall include the following:

1. Provide a solid state, temperature control system complying with the requirements of 2.02 E.1 below, with factory preset, three level switching to maintain winding temperature. Unless otherwise shown on the Basic Contract Drawing, branch circuit power for fans shall be 120 volts, single phase, 60 hertz, obtained from a separate auxiliary power transformer internally wired to the outgoing bus of the transformers. The auxiliary transformer shall be provided with primary and secondary overcurrent protection.

2. All low voltage elements of the fan system shall be isolated or barriered from the medium voltage components with conduit and steel boxes and shall be furnished with separate access through the enclosure.

3. Multiple cooling fans shall be provided, at the base of each coil, located front and rear, with a minimum of six fans on a three-phase transformer.

4. Provide thermal sensors in the hot-spot area of each winding, wired to the temperature Control system.

5. The sequence of operation shall be as follows:

   a. When temperature in any phase rises above the normal self-cooled rating, a relay shall be activated and the fans shall start.

   b. Upon reaching the next preset temperature in any phase, a second relay shall operate to initiate a transformer mounted audible alarm and red warning light, and shall simultaneously allow for initiation of remote alarms and indications.

   c. Upon reaching the maximum temperature setting in any phase, a third relay shall be activated. This relay shall be wired to the control termination compartment, for alarms or for shutdown of the transformer.

E. Accessories

Each transformer shall be provided with NEMA standard accessories and maintenance devices. In addition, the following accessories are required.

1. Transformers with a fan cooling system shall be provided with a Three-phase electronic temperature monitor unit accepting input from three (3) thermal sensors. The monitor shall track the temperature of the transformer with automatic digital displays and functions controlled by the signal received from the hottest phase. Unit features shall include temperature monitoring of each transformer coil, hottest phase temperature display, temperature display of any phase, DPDT contacts for both local and remote fan control, temperature alarm, and trip functions, manual fan operation, local alarm with local and remote silence feature, supervision of thermocouple circuits, automatic activation of fail/safe fan and alarm circuits upon loss of supply power. Monitor unit shall be suitable for use on 120 volts single phase AC.

2. If shown, bushing-mount current transformers of the size, type, and class shown on the Basic Contract Drawing, shall be provided.

3. A "Hot Spot" dial type temperature indicator located in each low voltage coil (3 per transformer) each with a manual resettable maximum indicator and two independently, full range adjustable contacts to open on rise of temperature above design normal. The contacts to be rated for 125 volts AC, 10A.

2.03 IDENTIFICATION

Provide a machine-engraved, identification plate on the front of the transformer, with filled black letters, 1/4-inch minimum size, on a silver or brass non-corrosive metal background. Identification plate shall indicate transformer designation, as shown on the Basic Contract Drawing.

2.04 FACTORY INSPECTION AND TESTS

A. Transformers shall be inspected and tested at the place of manufacture in the presence of the Engineer. Tests shall be performed on a completely assembled unit with current transformer secondaries shorted and grounded. Transformers shall not be shipped until they have been inspected and approved. The Engineer shall be notified in writing a minimum of fifteen working days prior to the scheduled date for inspection and tests.

B. The accuracy of the calibration of all instruments to be utilized during the tests shall be ascertained and recorded at the beginning of the tests.

C. The tests shall be conducted in accordance with C 57.12.91 and shall be certified and include, but not be limited to, the following:

1. Resistance measurement for each winding on the rated voltage connections prorated to the reference temperature. Data sheets shall indicate resistance of each individual coil.

2. Turns ratio and rated voltage connection and on all taps.

3. Polarity and phase rotation on the rated voltage connection.

4. Excitation loss at rated voltage and 110 percent voltage.

5. Excitation current at rated voltage and 110 percent voltage.

6. Impedance and load losses (No load and full load).

7. Heat run at rated voltage, conducted on one transformer of each KVA rating. The transformer to be so tested will be selected by the engineer at the time of inspection and test. The test shall incorporate 100 percent of rated voltage core losses at stated temperature. Certified test results of previously built similar units will be accepted in lieu of actual tests.

8. Applied potential.

9. Induced potential.

10. Impulse test on one transformer of each KVA rating. The transformer to be so tested will be selected by the Engineer at the time of inspection and test. If one unit fails the test, all other units shall be tested. Certified test results of previously built similar units will be accepted in lieu of actual tests.

11. Transient voltage analysis test in accordance with ANSI C 57.12.58. Certified test results of previously built similar units will be accepted in lieu of actual tests.

12. Partial discharge test shall be performed on each coil and on each fully assembled unit in accordance with ANSI C 57.124. All transformers shall be partial discharge free at the specified test voltage. All tests to be performed at highest voltage tap.

34.5 KV Class Coils:	55KV, if inception occurs, the extinction voltage must not be less than 41KV
15 KV Class Coils:	23KV, if inception occurs, the extinction voltage must not be less than 18KV
5 KV Class Coils	13.0KV, if inception occurs, the extinction voltage must not be less than 10KV
600 Volt Class Coils:	3.6KV, if inception occurs the extinction voltage must not be less than 3.0KV

13. Short circuit test - Certified test results on previously built similar constructed units will be accepted in lieu of actual tests.

14. Power frequency test at two times insulation system rated voltage.

D. Certified copies of all test results shall be furnished to the Engineer. Calculated hottest-spot temperature rises and time constants of the primary and secondary windings shall be shown on the certified test report. Certification shall be by a licensed professional engineer and so stamped.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install transformers as shown on the Basic Contract Drawing, in accordance with the manufacturer's instructions and in compliance with the applicable requirements of ANSI C 57.12.54, IEEE, NFPA and UL.

B. All conduit and bus connections to the enclosure shall be made with flexible or other approved vibration free connectors.

3.02 FIELD TESTS

A. General

1. Provide all labor and materials for functional tests required. Power for the tests will be furnished by the Authority.

2. Should the tests reveal any defects in the transformer installation under this Contract, promptly correct such defects and rerun the tests until the entire installation is satisfactory to the Engineer in all respects.

B. Perform the following field tests in the presence of the Engineer to demonstrate the proper phasing of each transformer installation:

1. Verify that the proper phase sequence is maintained.

2. Use a phase sequence meter or demonstrate the proper rotation of a small three-phase motor whose direction of rotation was verified prior to the transformer installation.

3. When transformer is used in a "Secondary Selective" or "Network" arrangement, verify that the phases of the transformers match.

END OF SECTION

SECTION 16326

CAST COIL, DRY TYPE TRANSFORMERS (MEDIUM VOLTAGE)

APPENDIX A

SUBMITTAL REQUIREMENTS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - General Provisions:

1. Shop Drawings
   - a. Physical dimensions and weights to each transformer.
   - b. Nameplate drawing for each transformer.
   - c. Drawings showing location of all accessories.
   - d. Technical specifications for each transformer including all ratings.
   - e. Description of Painting procedure.
   - f. Description of Vaccum Impregnation procedure.
   - g. Wiring diagram of fan cooling provisions.
2. Catalog Cuts
   - a. Temperature gauges.
   - b. Lighting arrestors.
   - c. Magnetization curves for current transformers.
   - d. All other specified accessories.

B. Submit six copies of certified test reports.

C. Submit six copies of written field reports for the following:

1. High Voltage Termination torque values
2. Phasing

D. Submit six copies of Operations and Maintenance Manuals with recommended Spare Parts List.

END OF APPENDIX "A"

DIVISION 16

SECTION 16335

LOW VOLTAGE SWITCHGEAR

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the requirements for metal-enclosed, low voltage draw-out type power circuit breaker switchgear.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C 37.13	Low-Voltage AC Power Circuit Breakers used in Enclosures
ANSI C 37.16	Standard for Switchgear - Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C 37.20.1	Standard for Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
ANSI C 37.27	Standard Application Guide for Low Voltage AC Non-integrally Fused Power Circuit Breakers (Using Separately Mounted Current-Limiting Fuses)
ANSI C 37.50	Test Procedures for Low-Voltage AC Power Circuit Breakers used in Enclosures
ANSI C 37.51	Standard for Switchgear - Metal Enclosed Low - Voltage AC Power - Circuit-Breaker Switchgear Assemblies - Conformance Test Procedures
ANSI C 37.90	Standard for Relays and Relay Systems Associated with Electric Power Apparatus
ANSI C 57.13	Standard Requirements for Instrument Transformers
	National Electrical Manufacturers Association (NEMA)
NEMA AB 1	Molded Case Circuit Breakers
NEMA ICS 1	General Standard for Industrial Controls and System
NEMA ICS 2	Standards for Industrial Control Devices and Controllers and Assemblies
NEMA ICS 4	Terminal Blocks for Industrial Equipment and Systems
NEMA SG 3	Low Voltage Power Circuit Breakers
NEMA SG 5	Power Switchgear Assemblies

National Fire Protection Association (NFPA)

NFPA 70	National Electric Code

Underwriters Laboratories (UL)

UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 1066	Low Voltage Power Circuit Breaker
UL 1558	Metal Enclosed, Low Voltage Power Circuit Breaker Switchgear

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The switchgear shall be designed, manufactured, and tested in accordance with the latest revision of the applicable ANSI, NEMA, and UL Standards. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

1.04 QUALITY ASSURANCE

A. Switchgear and all components of types and sizes required shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

B. Entities manufacturing equipment shall have experience on at least two projects involving complexities similar to those required under this Contract.

C. When shown on the Basic Contract Drawing, the switchgear shall be listed and labeled by a "Nationally Recognized Testing Laboratory" (NRTL), as defined by OSHA Regulations.

D. The switchgear and circuit breakers shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 0.75g, and a Zero Period Acceleration (ZPA) of 0.38g. The tests shall fully envelope this response spectrum for all equipment natural frequencies up to at least 35 Hz.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prior to shipment, the switchgear assembly shall be cleaned by wiping with a clean, dry cloth. Oil and grease marks shall be removed and wiped dry. All insulation shall be cleaned thoroughly. Dirt, soot, grease or paint shall be removed from the circuit breaker contacts and surface of the entire current carrying structures.

B. All relays and instruments shall be firmly blocked to prevent damage during shipment.

C. The overall dimensions and weight of each shipping section shall be limited to the maximum allowable by applicable state and local codes governing shipment of materials over public roads or construction site handling limitations, whichever is less. Each shipping section shall have a label indicating dimensions and weight.

D. All equipment and materials shall be suitably wrapped, crated, boxed or otherwise prepared for shipment to prevent damage during handling and shipping. All openings shall be properly protected to prevent the entrance of any dirt or debris. All parts not constructed to be normally exposed to the weather shall be suitably weatherproofed.

E. Each box or crate shall be equipped with suitable lifting devices to facilitate unloading and shall contain a detailed packing list.

F. Packaging shall be labeled and numbered so that each section or assembly may be identified before being uncrated. Any items not fully assembled to the switchgear structure shall be packaged separately. Removable circuit breaker units shall be packaged and shipped separately.

G. Adequate means shall be provided for lifting by fork lifts and cranes and for moving the equipment on rollers. Lift points shall be marked on each crate.

H. Indoor switchgear that cannot be installed immediately shall be stored in a dry, clean location within a heated building. During storage, the switchgear shall be placed on a level surface.

I. Outdoor switchgear that cannot be installed immediately shall have its space heaters temporarily connected and energized so as to prevent condensation of moisture within the housing.

1.06 SPARE PARTS AND SPECIAL TOOLS

A. A minimum of six (6) spare fuses of each size and type used in the switchgear shall be furnished.

B. Furnish one set of all special tools required for the erection, operation, and maintenance of all equipment furnished.

C. Furnish a minimum of three (3) half-pint containers of paint matching the exterior finish of the enclosure.

D. Furnish six (6) spare indicating lamps of each type installed.

E. Furnish one (1) container of contact lubricant.

F. When shown on the Basic Contract Drawing, furnish one (1) portable, breaker-lifting device.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, provide metal-enclosed, low voltage power circuit breaker switchgear products of manufacturers listed on the Basic Contract Drawing.

2.02 RATINGS

The switchgear shall have the following ratings, as shown on the Basic Contract Drawing:

A. Nominal System Voltage.

B. Rated Maximum Voltage.

C. Rated Frequency.

D. Rated Insulation Level.

E. Rated Continuous Current.

F. Rated Short-Time Current.

G. Rated Short-Circuit Current.

H. Short Circuit Current Bus Bracing.

I. Control Voltage.

2.03 CONSTRUCTION FEATURES

A. General

1. Switchgear shall be factory assembled, suitable for indoor or outdoor use, as shown on the Basic Contract Drawing, dead front, metal enclosed, free standing, and completely equipped with removable low voltage power circuit breakers, fuses, instrument transformers, relays, metering, switches, and associated devices as described herein and as shown on the Basic Contract Drawing and conforming to ANSI C 37.13, C 37.16, C 37.20.1, C 37.27, C 37.50, C 37.51, NEMA SG 3, SG 5, NFPA 70, and UL 1066, 1558.

2. When shown on the Basic Contract Drawing, the switchgear shall be arranged for close coupling to the transformer secondary through a transition compartment. Provisions shall be made for extension of the switchgear in both directions.

3. All breakers shall be arranged as shown on the Basic Contract Drawing.

4. No polyvinyl chloride (PVC) materials, insulation or products shall be used in switchgear, except for removable insulating boots on bus work.

B. Assembly Features

1. The switchgear shall consist of rigid self-supporting vertical sections bolted together to form a rigid assembly. Each cubicle shall be completely enclosed with formed steel sheets adequately braced to prevent distortion under normal conditions as well as during interruption of short circuit currents.

2. The structural details of each cubicle for the same breaker rating shall be identical. The cubicles shall be uniform in height and depth, and built to form a continuous structure lining up in front and rear.

3. All louvers or other ventilating openings shall be protected against falling of dust, water, or other foreign material. No louvers or ventilation openings shall be located on top of the switchgear unless they are made drip-proof and approved by the Engineer prior to fabrication.

4. Sheet steel doors shall be provided for access to the circuit breaker compartments, instrument compartments, and cable compartments.

5. Doors shall be furnished with one or more handles, knurled steel screws, or a combination of these in order to firmly hold door closed. Doors shall be padlockable. Doors shall be reinforced with stiffeners to minimize vibration. Stops shall be provided to hold doors in the open position. Doors shall be furnished with galvanized, zinc plated or stainless steel hinges and hinge pins. Doors shall open at least 135 degrees.

6. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

7. All insulating materials used for bus supports, barriers, or covers shall be of high dielectric strength, low moisture absorbing, flame retardant, arc resistant, and high impact strength material.

8. All combustible materials used for barriers, covers and the like shall meet the flammability test criteria of UL 94 for materials classed 94V-0.

9. Space heaters, with mechanical guards to prevent inadvertent contact of personnel with thermal element, shall be provided in each vertical section. Heaters shall be of the low temperature type, rated 240 volts and operated at 120 volts, each protected by an individual single pole molded case circuit breaker of suitable rating. The heaters shall be sized to keep the air inside the cubicle above its dew point. Heaters shall be thermostatically controlled. Thermostats shall be of the differential type and preset by the Contractor.

C. Circuit Breaker Compartment

1. The primary connection between the stationary units and the removable circuit breakers shall be made by means of a set of self-aligning, disconnecting devices mounted on the breaker studs or in the stationary structure, which shall positively engage with solid studs mounted in the stationary structure or on circuit the breaker, respectively. Firm contact pressure shall be maintained by means of steel coil springs. All primary contact surfaces shall be silver plated to prevent corrosion.

2. Each circuit breaker cubicle shall be equipped with an automatic safety shutter to close the entrances of the stationary primary disconnecting devices when the breaker is removed or in the test position.

3. The removable breaker element shall be connected to and disconnected from its operating position by a suitable engaging mechanism. Guides shall be provided to assure perfect alignment of all engaging parts of the removable breaker element with the corresponding parts in the stationary structure. A positive stop shall prevent over-travel of the removable breaker element when it is advanced to the connected and test positions.

4. Each breaker cubicle shall be equipped with a mechanical interlock which shall prevent the circuit breaker from being inserted or withdrawn from the connected position unless the breaker is opened. Another mechanical interlock shall prevent the breaker from being closed unless the primary disconnecting devices are in full contact or separated by a safe distance, such as in the test or disconnected position.

5. Each circuit breaker cubicle shall be furnished with provisions for locking the circuit breaker in the disconnected position

6. Cubicles containing current interrupting devices shall have ventilating provisions to minimize the movement of ionized gases between compartments or to the outside. Ventilating openings shall be rodent proofed by covering with a protective grill or wire mesh securely held in place.

D. Circuit Breaker Fuse Compartment

1. When shown on the Basic Contract Drawing, non-integrally mounted Current Limiting Fuses for the protection of the removable circuit breaker, shall be mounted inside a switchgear cubicle or compartment on a drawout carriage similar to that used for the circuit breaker. The fuses shall be connected to the line side of the circuit breaker.

2. The fuse cubicle or compartment shall be equipped with an automatic safety shutter to cover the line and load disconnects when the carriage is removed from its compartment. A rejection feature shall be furnished so that only the correct carriage can be inserted in the compartment.

3. A hinged panel shall be positioned in front of the fuses so that they cannot be reached if the compartment door is open. The panel shall be interlocked to prevent it from being swung open unless the fuse carriage is fully withdrawn.

4. A key interlock or mechanical interlock system shall be installed in the associated circuit breaker compartment and fuse carriage compartment to prevent racking of the fuse carriage with circuit breaker in the closed position.

E. Cable Compartments

1. Size the cable compartment to accommodate all incoming and outgoing cables in compliance with NFPA 70. Cable compartments shall include cable supports. Where connections are to be made to busways, all necessary bus adapters, bolting, insulating supports, and metal flanges shall be provided. Ground sensing current transformers, when shown on the Basic Contract Drawing, shall be mounted in the respective cable compartments.

2. All cables will enter the equipment as shown on the Basic Contract Drawing. Compression crimp-type cable lugs shall be provided for power cables. Lugs shall have standard NEMA bolt hole spacing.

F. Barriers

1. Each individual vertical section shall be segregated from adjacent sections by means of steel barriers extending all the way to the rear of the section.

2. Each individual cable compartment shall be provided with a steel, or insulating barrier between the cable compartment and the main bus to protect against inadvertent contact with the main or vertical bus bars, and to ensure that no live connections are accessible in the rear of each section except the circuit breaker load connections.

G. Enclosures

1. Indoor switchgear shall be provided with a NEMA 1 enclosure.

2. When specified on the Basic Contract Drawing, outdoor walk-in type switchgear shall be provided with the following features:

   a. Switchgear shall be enclosed in a NEMA 3R enclosure conforming to all applicable requirements of UL. The enclosure shall have a roof sloping toward the rear. Outer sections shall be the same widths as indoor structures, except the end sections of a walk-in enclosure shall be wider than the inner sections to permit opening the inner door. Each end of the outdoor structure shall have an end trim. Front aisle depth for walk-in structures shall be 42 inches, minimum.

   b. The enclosure shall be provided with rear hinged doors for each section. Aisle doors shall be supplied with provisions for padlocking. A steel floor shall be provided in walk-in aisle space and under each vertical section. Ventilating openings shall be provided complete with replaceable fiberglass air filters.

   c. Provide panic door hardware on aisle doors at each end of the line-up. External padlocking of the aisle doors shall not prevent operation of the panic hardware from the interior of the enclosure. The construction of the enclosure shall be modular so future sections can be added without affecting NEMA 3R integrity. Provide interior aisle lights, 3-way switches, and GFI protected receptacles.

   d. The enclosure shall be provided with undercoating applied to all members in contact with the foundation surface to retard corrosion.

   e. Power for the space heaters, lights, and receptacles shall be obtained from a control power transformer (CPT) within the switchgear, unless otherwise shown on the Basic Contract Drawing. Supply voltage shall be 120 VAC.

   f. An overhead traveling hoist for handling circuit breakers shall be provided in the aisle of the enclosure.

3. When specified on the Basic Contract Drawing, outdoor, non-walk-in type switchgear shall be provided with the same features as described above for the outdoor walk-in type switchgear, except for the aisle. In addition, the front of each vertical section shall have a weatherproof door.

H. Utility Metering Section

1. Where indicated on the Basic Contract Drawing, provide a separate barriered-off utility metering compartment complete with hinge sealable door. Bus work shall include provisions for mounting utility company current transformers as required by the utility company.

2. Service entrance switchgear section shall comply with U.L. requirements that include Service Entrance Label, incoming line isolation barriers, neutral connection to switchgear ground for solidly grounded wye systems.

I. Pull Boxes

When shown on the Basic Contract Drawing, provide pullbox with the width and depth of the cable compartment. Provide ventilation features to maintain air temperature in pullbox within same limits as in switchgear. Provide cable supports arranged to facilitate cabling and to support cables indicated on the Basic Contract Drawing.

J. Traveling Hoist

Unless otherwise shown on the Basic Contract Drawing, the switchgear shall be provided with an integral traveling hoist for breaker lifting. Traveling Hoist shall be rail mounted on top of the switchgear, movable and hand operated.

K. Buses

1. Buses shall be supported on isolated supports of high-impact, not-tracking, high quality insulation material and braced to withstand the magnetic stresses developed by currents equal to the largest circuit breaker interrupting ratings. Bus bars shall be high conductivity copper having silver-plated joints. All buses, taps and primary interconnections shall be insulated with an approved insulating material, when shown on the Basic Contract Drawing. Tapes or rigid sleeving are not acceptable as an insulating material for bus.

2. Bolts and associated hardware used with current carrying buses shall be of nonmagnetic, corrosion resistant material.

3. Insulating barriers shall be provided where primary buses pass through from one vertical section to another.

4. Neutral bus shall have the same ampacity as the phase bus, unless otherwise shown on the Basic Contract Drawing.

5. Vertical section bus shall be rated for the cumulative circuit breaker loading, conforming to ANSI C 37.20.1, and calculated assuming spaces for future circuit breakers are fully equipped with circuit breakers carrying current at 100 percent of their maximum frame size current ratings, and spare circuit breakers are loaded to the same degree.

6. A copper ground bus extending the entire length of the switchgear cable compartments shall be provided. All the metal parts of the structure shall be effectively connected to this bus. Ground bus shall be of rectangular cross section, not less than 1/4 inch by 2 inches.

L. Control and Auxiliary Power Wiring

1. Control wiring for each cubicle shall be enclosed in conduit or in compartments isolated from the primary circuits and shall conform to NEMA ICS 2.

2. Control and secondary cable shall be tinned copper, minimum class B stranded. Cable shall have insulation type SIS, rated 90 degrees C, 600 volt, heat resistant, and flame retardant. Wires crossing hinged joints and swing panels shall be flexible class K stranded.

3. All control wiring, leaving the switchgear, shall be wired to terminal blocks. Direct connections between devices located in different vertical sections are not acceptable. Connections made on terminal blocks and on internal devices shall be by means of flanged spade or ring type insulation gripping insulated terminals. On devices that do not permit flanged spade or ring type terminals, control wiring shall be held by screw type compression connectors. Internal wiring shall have no splices, nor shall more than two wires be terminated on one terminal point.

4. Control wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances. All current transformer secondary leads shall first be connected to easily accessible short circuit terminal blocks, before connecting to any other device. All groups of control wires leaving the switchgear shall be provided terminal blocks with suitable numbering strips. Where feasible, provide plug-in terminal blocks for all shipping split wires.

5. Wire markers shall be provided at the end of all control wiring, identified by printing on wire sleeve with "origin" and "destination" markings.

6. Wiring shall be sized for the duty required. Control wiring shall be 14 AWG minimum; current transformer wiring shall be 10 AWG minimum. Wiring crossing hinged joints and swing panels shall be 12 AWG with extra flexible stranding.

7. The control circuit wiring between the stationary units and the removable circuit breakers shall be made by means of self-aligning, multi-contact, devices. Only the stationary contacts shall be energized when the circuit is disconnected. All contact surfaces shall be silver-plated.

   a. Suitable means shall be provided for completing the control circuits between the stationary unit and the removable circuit breaker when the circuit breaker is withdrawn from the connected position to the test position.

8. Unless otherwise shown on the Basic Contract Drawing, auxiliary power circuits shall run the entire length of the switchgear. The circuits shall be one phase, 120 volt AC. The source of power shall be as shown on the Basic Contract Drawing.

9. Protection for control and auxiliary power circuits shall be provided by pull-out-type fuse blocks and dual element time delay fuses.

M. Removable Low Voltage Power Air Circuit Breakers

1. Removable low voltage power circuit breakers shall be as shown on the Basic Contract Drawing, as specified herein, and in Section 16475 of these Specifications entitled "OVERCURRENT PROTECTIVE DEVICES", conforming to ANSI C 37.13 C 37.16, C 37.27, C 37.50, NEMA SG3, and UL 1066.

2. All removable elements of the same type, ampere rating, and tripping characteristics shall be interchangeable to the extent that they can be used, will operate, and give complete relay protection in any stationary element with the same ampere rating.

3. An auxiliary switch (TOC) shall be mounted on the stationary housing (switchgear metal barrier) to indicate the connected position of the removable circuit breaker. In addition to the contacts required for the operation of the circuit breaker, the position switch shall consist of two (2) normally open and two (2) normally closed spare contacts.

4. When additional auxiliary switch contacts are needed than can be provided with circuit breaker auxiliary switches, such contacts shall be provided using auxiliary switches (MOC) mounted on the stationary housing. In addition to the contacts required for the operation of the circuit breaker, the position switch shall consist of two (2) normally open and two (2) normally closed spare contacts.

5. Auxiliary switch contacts shall be adjustable to either the normally open or normally closed position.

6. Mechanical interlocks shall be provided to prevent the removable circuit breaker from being moved to or from the operating position with the circuit breaker closed and to prevent the circuit breaker being closed unless primary disconnecting devices are fully engaged or separated a safe distance.

N. Instrument Transformers and Meters

1. Instrument transformers shall conform to ANSI C 57.13.

2. Voltage transformers shall have 120 volt secondary rating, ratio as shown on the Basic Contract Drawing, accuracy classification 1.2Z at rated voltage for ANSI Standard burdens. Voltage transformers shall be capable of a burden at least double the connected load, to allow for portable instruments. Voltage transformers shall be provided with primary current limiting fuses.

3. Control Power Transformer (CPT) shall be designed for machine tool application and shall have voltage regulation and VA rating to limit the voltage drop to 5 percent, under maximum inrush conditions. The VA rating, along with supporting calculations, shall be submitted to the Engineer for approval. The primary and secondary windings of the transformer shall be protected with current limiting fuses, and shall be sized at 300 percent of the CPT rating. The interrupting rating of the primary fuse shall match the short circuit rating of the switchgear.

4. All current transformers shall be 5 amps secondary, ratio and accuracy class as shown on the Basic Contract Drawing. Current transformers shall not saturate when operated at 20 times rated current. Current transformers shall be capable of a burden at least double the connected load. All current transformers shall be terminated in shorting blocks.

5. All current transformers shall be selected to withstand the thermal and mechanical stresses imposed by the maximum available system fault current. The current transformer rating and supporting calculations shall be submitted to the Engineer for approval.

6. Instrument transformer secondaries shall be grounded with a copper conductor not smaller than #10 AWG and connected to a ground bus located as closely as possible to the transformer.

7. Voltage and control power transformer primaries, where connected to ground, shall be grounded with a copper conductor not smaller than #6 AWG which is insulated for line-to-line voltage and terminates at the grounding bus in a lug. The connection to the bus shall be so designed that it can be easily disconnected and isolated for proof testing. Each ground wire shall be one continuous run without intervening splices or terminal blocks between the transformers and the ground point.

8. Metering system shall be as shown on the Basic Contract Drawing and shall be one of the following:

a. Digital Metering System (DMS)

The Digital Meter System shall be compact, microprocessor based, all-in-one built, panel mounted, for measuring phase and neutral current, volts, KW, KVA, KVAR, HZ and power factor. The DMS shall be installed on each unit of the switchgear where metering is required. It shall be connected through current and potential transformers as shown on the Basic Contract Drawing and in accordance with the manufacturer's instructions. The DMS shall be mounted on the front of the switchgear within reach of an observer near eye-level. The DMS shall be capable of being used as a stand-alone monitoring unit, or as one element of a larger SCADA (supervisory control and data acquisition) network. The DMS shall have the capability to communicate via an RS-232 or RS-485 port. A minimum of three output relays shall be provided in the DMS unit that can implement alarm, control, or protective trip functions. The DMS shall be supplied with the manufacturer's standard software, which shall be capable of adequately representing all of the functions described herein.

b. Conventional Metering System (CMS)

The CMS shall consist of current transformers, voltage transformers, meters, and switches as shown on the Basic Contract Drawing, and as described below.

(1) Instruments and meters shall be of the semi-flush switchboard type, with rectangular dust-proof enclosing cases and anti-glare glass.

(2) Indicating instruments shall be 4-1/2 inches in diameter and have white dials with black marking, scales approximately 250 degrees and 7 inches in length, accuracy within plus or minus 1 percent of full scale, and external zero adjustment.

(3) Kilowatt-hour and kilowatt demand meters shall be of the integrating type and shall be draw-out type, with provision for testing, and shall be equipped with potential indicating lights.

O. Relays, Control Switches and Fuses

1. Protective relays, as shown on the Basic Contract Drawing, shall conform to ANSI C 3 7.90 and be of the semi-flush mounted, removable type, with built-in test facilities. Current transformer secondaries shall be automatically short-circuited when the relay is removed from its case. Auxiliary relays shall be surface mounted and front connected, and shall be as specified on the Basic Contract Drawing.

2. Protective relay ranges and types shall be as shown on the Basic Contract Drawing.

3. Lockout relays shall be hand-resettable, panel mounted, with mechanical target on the escutcheon plate for indication of relay position. The contacts rating shall be 20 Ampere continuous. The relay shall be enclosed with a dust cover.

4. Control, transfer, and instrument switches shall be of the heavy duty rotary, multi-position, cam operated, multi-stage type, with dust cover, rated 600VAC, with silver to silver contacts rated for continuous current of 20 amperes. Each circuit breaker control switch shall have red and green target. Each switch shall be equipped with engraved plastic escutcheon or nameplate identifying its function and position. Handle styles shall be pistol grip for control, and oval for instrument or transfer switches.

5. Each Low Voltage Air Circuit Breaker shall be provided with a control switch on the door of each circuit breaker cubicle for performing breaker close and open operations. Mechanical red/green targets shall be incorporated in the switch to indicate breaker "Closed/Open" position. A spring-return mechanism shall return the switch handle to the normal vertical position.

P. Indicating Lamps

Indicating lamps shall be light emitting diodes (LED) of the low voltage, low burden series resistor type, with lens colors as approved by the Engineer. Lamps shall be replaceable from the front of the panel.

Q. Terminal Blocks

Terminal blocks for all external control connections shall be 600 volt, barrier type, having a minimum rating of 20 amperes with identifying marker strips. Terminal strips in each cubicle, shall have at least 20 percent spare terminals and shall be in accordance with NEMA ICS 4. Terminal blocks for current transformer secondary connections shall be of the short circuiting type.

R. Nameplates and Mimic Bus

1. Nameplates shall be provided for each switchgear, for each cubicle, and for all externally and internally mounted devices, including, but not limited to, instruments, meters, control switches, and relays to identify its function, and where applicable, its position.

2. Nameplates shall consist of letters and numbers back engraved on a laminated thermosetting plastic material, providing white letters and numbers on a black background. Size of letters and figures shall be approximately 1/8 inch for device nameplates and 7/16 inch for cubicle nameplates, and 1 inch for switchgear designations.

3. Nameplates shall be fastened with two oval-head stainless steel machine screws.

4. Number, location and designation of nameplates shall be as approved by the Engineer.

5. Mimic bus shall be provided on the face of the switchgear representing actual bus arrangements within the switchgear assembly. Circuit breaker control switches and indicating lights shall be located in the proper position on the mimic bus. The mimic bus shall be 1/8 x 3/4 inch, high strength thermosetting plastic material, secured every twelve (12) inches with self tapping screws.

2.04 SHOP PAINTING

A. Prior to assembly and before shop painting, all surfaces of the switchgear enclosure shall be thoroughly cleaned of rust, oil, grease, dirt and mill scale and receive a phosphatizing treatment, and then be primered with one coat of rust-inhibitor for a dry film thickness of 1-2 mils.

B. The exterior and interior of the switchgear shall be given two or more finish coats of corrosion resistant paint for a final dry film thickness of at least 2-4 mils. The color of the finish on the switchgear shall be ANSI number 61 light gray.

C. Alternative painting process, such as electrostatically applied paint, can be utilized, subject to the approval of the Engineer.

2.05 FACTORY TESTING

A. The switchgear shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchgear shall be tested to assure the accuracy of the wiring, and the functioning of all the equipment.

B. All switchgear components shall be tested in accordance with the Production Test outlined in ANSI C 37.20.1, C 37.50, and C 37.51 and shall include but not be limited to the following:

1. Dielectric Tests
2. Mechanical Operation Tests
3. Grounding of Instrument Transformer Cases Tests
4. Electrical Operation and Control Wiring Tests

C. Factory tests, shall be witnessed by the Engineer. The manufacturer shall notify the Engineer two (2) weeks prior to the date the tests are to be performed.

PART 3. EXECUTION

3.01 FIELD SUPERVISION

Provide the services of a qualified, factory-trained switchgear manufacturer's representative to provide technical field support in the installation and start-up of the equipment specified in this Section for a period shown on the Basic Contract Drawing. The manufacturer's representative shall provide technical direction and assistance in general assembly of the equipment, connections, calibrations, adjustments, and testing of the assembly and components contained therein.

3.02 EXAMINATION

The Contractor is responsible for notifying the Engineer as soon as he finds conditions that prevent the proper installation of materials or methods specified in this Section.

3.03 INSTALLATION

A. Switchgear shall be transported within the construction site, unloaded, uncrated, installed, including assembly of all component parts, and wired in accordance with the manufacturer's instructions and recommendations and the requirements specified herein.

B. Provide all equipment, supervision, labor, rigging, tools, including, but not limited to, special equipment such as cranes.

C. Before setting the switchgear, the floor members and openings for conduits and bus entrances shall be checked for accuracy of position.

D. Switchgear shall be set on foundations at the locations shown on the Basic Contract Drawing. Provide floor sills, and set level in concrete. Follow the manufacturer's recommendations for preparation of the mounting surface and the fastening of the equipment. The switchgear shall be set, aligned, and leveled in place using shims, where necessary, and shipping sections bolted together.

E. Bus splices shall be cleaned and bolted together and insulated either by taping or by use of insulating boots, if provided for that purpose.

F. The removable circuit breakers shall be installed in the housings and the rails adjusted, if required, for smooth travel of the circuit breakers. Main and secondary contacts on the removal and stationary sides shall be checked for tightness and adjusted if loose. Covers or enclosures shall be securely bolted in place.

G. After each item of equipment is installed and connected, the Contractor shall make a thorough inspection of the installation, cleaning all insulators that are exposed, and cleaning all cubicles and compartments of debris and foreign matter. Prior to final completion of the Work and field testing, the Contractor shall clean the equipment of all construction dust and dirt.

H. The Contractor shall complete all internal and external power and control connections.

I. All damaged paint areas shall be properly prepared by the Contractor for an application of primer and finish coats of paint, which shall be supplied by the manufacturer for this purpose. The Contractor shall apply the primer and finish paint coats.

3.04 FIELD TESTS

A. General

1. Field tests shall be performed in accordance with the manufacturer's recommendations, International Electrical Testing Association (NETA), NEMA, UL, ANSI, and as required in this Section and/or as directed by the Engineer.

2. All Work shall be performed with due regard for the protection of personnel and equipment. The Contractor shall provide protection to all personnel during performance of the tests.

3. Tests shall be performed only after equipment has been thoroughly cleaned.

4. All field tests shall be conducted in the presence of the Engineer for the purpose of demonstrating that the equipment and systems comply with the requirements of this Section to assure the Engineer that the entire installation meets applicable codes and standards requirements, and that all systems will function as designed.

5. All controls shall be checked individually by the Contractor prior to operational tests. Wiring diagrams and manufacturer's drawings shall be marked by the Contractor during checkout. Checked items shall be marked in yellow; discrepancies shall be corrected, and modifications shall be recorded in red. Marked wiring diagrams and manufacturer's drawings shall be submitted to the Engineer.

6. Record all test values, settings, and calibrations made by the Contractor and furnish the Engineer with copies of test reports after completion of each individual test. These reports shall include a description of the test procedures. The Contractor shall record all test data for each test required in this Section on test forms.

7. Advise the Engineer, in writing, upon failure of any equipment or material to pass the tests performed or to properly function as intended. The Contractor shall provide all necessary corrective action to render the equipment operational and acceptable.

B. Integrity Tests

The switchgear shall successfully complete the following tests as recommended by NETA and listed under the "Switchgear and Switchboard Assemblies" Section:

1. Visual and Mechanical Inspection

a. Inspect for physical, electrical, and mechanical condition.

b. Compare equipment nameplate information with latest one-line diagram and report discrepancies.

c. Check for proper anchorage, required clearances, physical damage, and proper alignment.

d. Inspect all doors, panels, and sections for paint, debris, scratches, fit, and missing hardware.

e. Verify that fuse and/or circuit breaker sizes and types correspond to the Basic Contract Drawing.

f. Verify that current and voltage transformer ratios correspond to the Basic Contract Drawing.

g. Inspect all bus connections for high resistance. Use low-resistance ohmmeter, or check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels.

h. Test all electrical and mechanical interlock systems for proper operation and sequencing.

(1) Closure attempt shall be made on locked open devices. Opening attempt shall be made on locked close devices.

(2) Key exchange shall be made with devices operating in off-normal positions.

i. Clean entire switchgear using manufacturer's approved methods and materials.

j. Inspect insulation for evidence of physical damage or contaminated surfaces.

k. Verify proper barrier and shutter installation and operation.

l. Lubrication

(1) Verify appropriate contact lubricant on moving current carrying parts.

(2) Verify appropriate lubrication on moving and sliding surfaces.

m. Exercise all active components.

n. Inspect all mechanical indicating devices for proper operation.

2. Electrical Tests

a. Perform tests on all instrument transformers in accordance with NETA published values.

b. Perform ground-resistance tests in accordance with NETA published values.

c. Perform insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground for one (1) minute. Test voltages and minimum resistances shall be in accordance with NETA published values.

d. Perform an overpotential test on each bus section, each phase-to-ground, for one (1) minute at values recommended by the manufacturer.

e. Perform insulation-resistance test on shipping split control wiring. Do not perform this test on wiring connected to solid-state components.

f. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.

g. Perform secondary voltage energization test on all control power circuits and voltage tests as detailed below in paragraph k, and l. Check voltage levels at each point on terminal boards and at each terminal device.

h. Perform current injection test on entire current circuit in each section of switchgear.

(1) Perform current tests by primary injection, where possible, with magnitudes such that a minimum of 1.0 ampere flows in the secondary circuit.

(2) Where primary injection is impractical, utilize secondary injection with a minimum of 1.0 ampere.

(3) Test current at each device.

i. Determine accuracy of all meters and calibrate watt-hour meters per NETA recommendations. Verify multipliers.

j. Perform phasing check on double-ended switchgear to ensure proper bus phasing from each source.

k. Control Power Transformers - Dry Type

(1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

(2) Verify proper primary and secondary fuse ratings or circuit breakers.

(3) Verify proper interlock function and contact operation.

(4) Perform insulation-resistance tests. Perform measurements from winding-to-winding and winding-to-ground. Test voltages and minimum resistances shall be in accordance with NETA published values. Results shall be temperature corrected in accordance with NETA published values.

(5) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check voltage at all devices.

(6) Verify proper secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

l. Potential Transformer Circuits

(1) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check voltage at all devices.

(2) Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

C. Records of Tests

1. Types of Records

Maintain complete and accurate records of all tests. These records shall include the following:

a. Description of test equipment used, including serial numbers.

b. Equipment or circuit identification, description, and location.

c. Complete nameplate data, including serial number.

d. Readings and measurements taken, including temperature and humidity.

e. Description of test, including date and tester's signature.

f. Test results (written description as required).

g. Other observable data applicable to equipment tests.

h. Description of any necessary corrective actions.

i. Certification of satisfactory completion of wiring and installation in accordance with applicable items of this Section.

3.05 PROTECTION

Protect switchgear, equipment, and facilities against damage, mechanical or otherwise and provide maintenance until issuance of the Certificate of Final Completion. The switchgear and equipment shall be kept clean, dry, and protected at all times.

3.06 TRAINING

A. Provide at the construction site training sessions for the number of Authority personnel, as specified on the Basic Contract Drawing, for two (2), eight (8)-hour days.

B. The training sessions shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly.

C. For additional training time requirements, see Section 16000 of these specifications.

END OF SECTION

SECTION 16335

LOW VOLTAGE SWITCHGEAR

APPENDIX "A"

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Legend, Abbreviations, General Notes, and Drawing List
2. Outline drawings indicating overall dimensions, shipping sections, weights, and aisle space requirement for removable equipment
3. Switchgear rigging and installation drawings including anchoring details, locations of sills, and anchor bolts
4. Elementary diagrams (terminal configuration) for removable circuit breakers, relays, control switches, and meters
5. Structural drawings showing available space for busway, conduit, and cable connections
6. Bus arrangement including dimensions and ampere rating of all bus bars
7. Bill of materials for all equipment including item description, rating, and location
8. One line diagram showing all ratings, main connections, and location of all instruments including relays, transformers, and meters
9. Three line diagrams showing all instrument connections including relays transformers and meters
10. Kirk key interlock diagram with functional description
11. Removable circuit breaker's elementary diagrams
12. Front view of each vertical section showing all panel mounted equipment
13. Front view of all internal panels of each cubicle showing all control devices such as relays
14. Complete point to point wiring diagrams or schedules indicating the internal wiring of each component and the interconnections between components
15. Nameplate schedule and details
16. List special tools required for operation and maintenance of all equipment

B. Catalog Cuts

1. Relays
2. Control switches
3. Indicating lamps

4. Control wiring
5. Wire markers
6. Terminal blocks
7. Switchgear space heaters
8. Thermostats
9. Bus insulation materials
10. All types of lugs
11. All types of fuses and circuit breakers
12. Family of time-current characteristics curves for all types of fuses, relays, and trip devices
13. Instrument transformer characteristic curves and burden
14. Conventional metering system (CMS) devices
15. Digital Metering System (DMS) hardware and software

C. Test Reports

1. Submit factory tests and field tests forms for approval prior to implementation of the tests.
2. Submit certified test reports for tests specified in 2.05 and 3.03 of this section.
3. Submit Seismic Certification.
4. Submit certified test report for paint qualification test performed per ANSI C 37.20.1.

D. Operation and Maintenance Manuals

1. Maintenance documentation, including manuals, shall include descriptive material that will enable the Authority to maintain a supplied equipment at the component level. The document shall provide guidelines for isolating the cause of malfunction and for the removal, repair, and replacement of all devices.
2. Each manual, in addition to the information described above, shall contain the following:
   a. Calibration data, curves, wiring diagrams, and other pertinent information for all components provided
   b. Operational procedure, both manual and automatic
   c. Recommended preventive maintenance schedules

E. Spare Parts List

Furnish a list of recommended spare parts, the list shall contain the prices and availability. Recommendation for spare parts shall not obligate the Authority to purchase any such parts.

END OF APPENDIX "A"

DIVISION 16

SECTION 16450

GROUNDING

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for grounding system components.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Grounding System shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

Electrical Code of the City of New York
Grounding specifications of Consolidated Edison Company of New York

American National Standards Institute (ANSI)

ANSI C 2 National Electrical Safety Code

Institute of Electrical and Electronic Engineers (IEEE)

IEEE STD 142-1991 Recommended Practice for Grounding of Industrial and Commercial Power Systems

IEEE STD 1100-1991 Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

National Fire Protection Agency (NFPA)

NFPA 70 National Electrical Code

Underwriters Laboratories Inc. (UL)

UL 467 Grounding and Bonding Equipment

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The grounding system and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 3 years
2. The Manufacturer shall be ISO 9001 certified

B. Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in NFPA 70 article 100

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions. If any electrical devices or accessories must be shipped loose they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with suitable non-corrosive tag.

D. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

E. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 GENERAL

A. Furnish grounding elements for switchgear, transformers, cabinets, panel boards, starters, power factor correction equipment, DC system, ATS units, mimic panel, and miscellaneous electrical equipments, for all non-current-carrying metallic portions of the entire electrical system and for exposed non-electrical systems located in electrical substations or switchgear rooms as required by ANSI C 2, NFPA 70, and building codes which would be applicable, if the Authority were a private corporation.

B. Manufacturers subject to compliance with the requirements of the Section, provide grounding products of manufacturers as shown on the Contract Drawings.

2.02 GROUND RODS

A. Ground rods shall be copper clad steel. Unless otherwise shown on the Contract Drawings, the rods shall be ¾-inch diameter by 10 feet long.

2.03 GROUNDING CONDUCTORS

A. Provide grounding conductors in accordance with the requirements of NFPA 70, Section 16120, Section 16121 entitled "WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)," "WIRES, CABLES SPLICES, TERMINATIONS (MEDIUM VOLTAGE)," as applicable, and as specified on the Contract Drawings. The ground conductor sizes are based on calculated short circuit current, specified over current devices and cable insulation melting point characteristics.

B. Equipment grounding conductors shall be green insulated.

C. Isolated grounding conductors shall be green insulated with yellow striping.

2.04 ABOVE GRADE CONNECTIONS

A. Connectors to piping, fencing, and conduit systems shall be listed and labeled as grounding connectors for the materials used. U bolt or claps shall be used as manufactured by Burndy for grounding connections to piping, fencing, and conduit system.

2.05 BELOW GRADE CONNECTIONS

A. Buried cable and ground rod connections shall be exothermic welds. Welded connections shall be provided in kit form "Cad weld/Burndy or approved equal" and selected for the specific types, sizes, and combinations of conductors shown on the Contract Drawings.

2.06 GROUNDING BUSHINGS

A. Grounding Bushing shall be insulated type.

2.07 LIGHTING PROTECTION COMPONENTS

A. Lighting protection components shall be provided as specified in Section 16670 entitled "LIGHTING PROTECTION SYSTEM". Lighting protection system shall be installed as shown on Contract Drawing.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install grounding elements for switchgear, transformers, cabinets, panelboards, starters, and miscellaneous electrical equipments, for all metallic non-current carrying portions of the entire electrical system and for exposed non-current carrying portions of the entire electrical system and for exposed non-electrical systems located in electrical substations or switchgear rooms as required by ANSI C 2, NFPA 70, and building codes which would be applicable, if the Authority were a private corporation.

B. Install grounding and grid as shown in plans and details on the Contract Drawings.

C. Grounding and bonding equipment for use in connection with interior wiring systems shall conform to UL 467.

D. Install separate insulated equipment grounding conductors with circuit conductors to maintain grounding system at equipotential. Raceway system shall not be utilized as the equipment ground.

E. Connect exposed metallic piping or ductwork of any non-electrical system that is located in an electric substation or switchgear room, to ground in the room. Where the run through the room exceeds 15 feet in length, make ground connections at both the entering and leaving points of the piping or ductwork.

F. Ground all non-current-carrying metallic enclosures of electrical conductors, or exposed non-current-carrying metallic parts of electrical equipment, or of power apparatus.

G. Connections:

1. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

2. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.

3. Make connections with clean bare metal at points of contact.

4. Make all connections of grounding connector cables to ground rods by exothermic welding method. Welds that are puffed up, or that show convex surfaces indicating improper cleaning are not acceptable.

5. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

6. Tighten grounding and bonding conductors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values for connectors and bolts.

7. Where insulated grounding conductors are connected to ground rods, or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

H. All sensitive electronic equipment including computers and other components specified on the Contract Drawings shall be connected to an isolated grounding system. The isolated grounding system shall be installed as specified on the Contract Drawings. The isolated grounding system and the electrical power equipment grounding system must be connected together at a single point, as shown on the Contract Drawings and in accordance with the requirements of NFPA 70, and all applicable local codes. Utilization of a grounding electrode separate from, and not connected to, the electrical power equipment grounding system is not acceptable.

I. All ground rods in grounding loops shall have less than 5 ohms resistance to ground. All individual or isolated ground rods shall have a maximum of 25 ohms resistance to ground. The maximum overall grounding system resistance to ground shall be as shown on the Contract Drawings.

1. All major electrical equipment i.e. switchgear line ups, mimic panel etc shall have two ground connections each at the diagonally opposite ends.
2. HV cable sheaths shall be connected to ground at both ends.
3. Ground cables shall be installed around perimeter of structures at a minimum of 2'-6" below grade.
4. Ground rods shall be driven with the rod top at 2 ft below grade, 2 ft from the building perimeter walls, and shall be driven 10 ft or more as required by adding sectional ground rods.
5. Test points (Pits) shall be installed at locations and in accordance with the details shown on the Contract Drawings.
6. Equipment shall be connected to ground in accordance with the details shown on the Contract Drawing. All steel column and underground connections shall be exothermically welded, except for test points.
7. Provide ¼"x2" copper ground bar bus connected to the grounding system in the Main Building Switchgear Rooms (Both floors) and Main Substation battery rooms and other areas where major equipments are installed, where It is required to facilitate the connection of new equipment grounding cables to the main grounding system.
8. Green insulated grounding cables in PVC conduits (Schedule 40) shall be routed overhead in the Switchgear Room, and in other rooms, where running these cables exposed on the floor will cause tripping hazards.
9. Metal casings or supporting frames of electrical equipment, such as switchgear transformers, panel boards, control panels, shall be grounded, and connected to the new substation in grounding system. All metal conduits leaving all electrical equipment shall be grounded. Grounding type fittings shall be installed on flexible metallic conduits.
10. Green insulated cable for equipment grounding shall be installed with the phase conductors within the conduit for all nominal 120 volt and higher voltage, lighting circuits etc.
11. Add sectional ground rods and coupling to extend the standard 10-ft rods or install approved chemical-filled ground rods, where required to achieve specified round.

3.02 FIELD TESTS

A. After completion of installation make ground resistance tests. Resistance testing shall be made using a Biddle , Nullbalance Earth tester or Associated Research Vibro -ground not less than 48 hours of rain fall at all ground rods to verify that grounding system is at equipotential and to ensure compliance with the requirements specified in 3.01 I above, in the presence of the Engineer, and prepare all test results in tabulated form indicating location and time of each test and soil resistivity measured. If round resistance on a grounding resistance test is higher than the value specified in 3.01 I shall be brought to the Engineer's attention and, either increase the length of the rod or add more rods to the grounding system until the required ground resistance is achieved.

END OF SECTION

SECTION 16450

GROUNDING

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Sealed working drawings showing proposed routing and layout of the grounding system if different from Contract Drawings.

B. Catalog Cuts

1. Catalog cuts for ground rods, connectors, and connection materials, and grounding fittings.

C. Manufacturer Test Reports

1. Ground resistance test results.

END OF APPENDIX "A"

DIVISION 16

SECTION 16470

PANELBOARDS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for electrical panelboards and cabinets.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	National Electrical Manufacturers Association (NEMA)
NEMA PB 1	Panelboard
NEMA PB 1.1	General instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less
NEMA PB 250	Enclosures for Electrical Equipment (1000 Volts maximum)
NEMA AB 1	Molded Case Circuit Breakers and Molded Case Switches
NEMA AB 3	Molded case Circuit Breakers and Their Application
NEMA 280	Application Guide for Ground Fault Circuit Interrupters
NEMA AB 4	Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications
NEMA Z535.4	Product Safety Signs and Labels
	National Fire Protection Association (NFPA)
NFPA 70	National Electric Code
	Underwriters Laboratories Inc. (UL)
ANSI/UL 67	Panelboards
ANSI/ UL 50	Cabinets and Boxes
UL 1059	Electrical Terminal Blocks
ANSI/UL 65	Electric Wired Cabinets
ANSI/ UL 486E	Equipment Wiring Terminals for Use With Aluminum and/or Copper Conductors
ANSI/UL 486A	Wire Connectors and Soldering Lugs for Use With Copper Conductors

ANSI/UL 969	Marking and Labeling systems
ANSI/UL 467	Electrical Grounding and Bonding Equipment
ANSI/UL 437	Key Locks

Federal Specifications

Panelboards, W-P-115a,c

Type 1 - Circuit Breaker Equipped

Class 1- Panelboards

Class 2 - Load Centers

Molded Case Circuit Breakers, W-C-375a,b

Fusible Switches, W-S-865c

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Panelboards shall be designed in accordance with applicable standards of ANSI, NEMA, NFPA and UL. A list of acceptable manufacturers is shown on the Basic Contract Drawing.

B. Unless otherwise shown on the Basic Contract Drawing, Panelboard cabinets shall meet the following environmental requirements:

1. Cabinets located in heated areas shall be NEMA Type 1.
2. Cabinets located in unheated areas or in areas subject to dust or oil, shall be NEMA Type 12.
3. Cabinets located in exterior areas or locations subject to rain, dripping liquid, or hosing shall be NEMA Type 4X, stainless steel.

C. ANSI design test shall have been made on a prototype of each type of panelboard.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Panelboards shall be delivered to the construction site complete. All circuit breakers, other electrical devices, and accessories, shall be in place and wired.

B. Panelboards and accessories shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. If any electrical devices or accessories must be shipped loose they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with suitable non-corrosive tag.

D. Store components and devices in clean and dry space, protected from weather.

E. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

F. Touch up any damage to finishes to match adjacent surfaces.

1.05 SPARE PARTS AND TOOLS

A. One set of all special tools and wrenches required for assembly or disassembly of the panelboard and the installation of breakers shall be furnished.

B. Furnish a list of recommended spare parts for each panelboard. This list shall contain the prices and availability of the spare parts recommended.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 GENERAL

A. List of acceptable manufacturers is shown on Basic Contract Drawing.

B. The size, rating, and number of circuit breaker in the panelboard shall be as shown on the Basic Contract Drawing.

C. All panelboards, for which there are established UL standards, shall bear the UL label.

D. Location of panelboards and their approximate dimensions shall be as shown on the Basic Contract Drawing.

E. Each panelboard shall be factory assembled, tested and shipped as a single complete unit, with all circuit breakers and buses installed, unless written permission is given by the Engineer to disassemble any parts for shipment.

2.02 CONSTRUCTION FEATURES

A. Panelboard interior

1. Panelboard interiors shall be designed and assembled so that individual breakers may be added, removed, or replaced without disturbing adjacent units and without removing main bus or brunch circuit connectors.

2. All parts shall be readily accessible and like parts shall be interchangeable insofar as possible.

3. Modifications and optional features such as silver plated copper bus, subfeed lugs, shunt trips, meters, etc., shall be as shown on the Basic Contract Drawing.

B. Panelboard Enclosures (Cabinets)

1. The panelboard assembly shall be mounted in a galvanized steel or stainless steel enclosure (cabinets) as shown on the Basic Contract Drawing. Cabinets and trims shall be surface-mounted or recessed installation as shown on the Basic Contract Drawing.

2. Cabinets shall be arranged to provide side gutters 6 inches wide. Cabinets shall be provided with top and bottom gutters not less than 6 inches wide. For 400A or 600A mains, top and bottom gutters shall be 8 inches. Where feeder cables supplying the mains of a panelboard are carried through its box to other panelboards, the cabinet shall be provided with adequate additional side gutters space for the riser cable and taps.

3. The cabinet shall have a galvanized sheet-steel one-piece frame with a hinged door.

4. Recessed or flush-mounted cover frames shall extend 3/4 inch beyond each side of the cabinets and shall be set with their backs flush with the finished wall. Covers shall have adjustable trim clamps to compensate for misalignment and shall be completely concealed when door is closed.

5. Surface-mounted cover frames shall be sized to match the overall dimensions of the cabinet or flanged around to cover the edge of the cabinet.

6. Breakers and interior bus shall be covered by a removable framed trim, mounted inside the cabinet.

7. Doors shall close against a rabbet placed all around the inside edge of the frame, with a close-fitting joint between the door and frame

8. Doors shall be fitted with concealed, continuous, flush piano hinges.

9. Fastening screws on front panel shall be stainless steel and shall be of the captive, tamper proof type. Front panels shall not be removable with door in locked position.

10. Provide a metal frame with clear impact resistant plastic cover, mounted inside of each panelboard door to hold circuit directory.

C. Overcurrent protective devices and buses

1. Overcurrent protective devices shall be circuit breakers, fully rated, bolt on, thermal magnetic, inverse time delay, molded case. Breakers shall be 1, 2 or 3 pole with an integral crossbar or an internal common trip element, to assure simultaneous opening of all poles of a multi-pole circuit breaker. All circuit breakers shall meet requirements specified in the section of these Specifications entitled "OVERCURRENT PROTECTIVE DEVICES"

2. Connections of the branch circuits to the main bus shall be of the phase sequence type, that is, adjacent poles shall be of unlike polarity and rotated in sequence. This shall allow complete flexibility of circuit arrangement (1, 2 or 3 poles) to evenly balance the electrical load on each phase.

3. Main bus bars, including full capacity isolated neutral, shall have an ampere rating not less than that of the main breaker or lugs, and shall be braced for a momentary short circuit as specified on the Basic Contract Drawing. The minimum short circuit rating shall be equal or be greater than the rating of the panelboard integrated equipment.

4. Buses shall be designed in such a manner that no machining, drilling, or tapping shall be required to change circuits or add new breakers.

5. All main and branch circuit bus shall be copper with a 1000 Amperes per square inch current density, and contact surfaces shall be silver plated and shall have no more than 200 Amperes per square inch current density.

6. A copper ground bus shall be furnished and installed by the panelboard manufacturer for equipment grounding. When shown on the Basic Contract Drawing the Manufacturer shall install an isolated type grounding bus.

7. Main lugs shall be solderless, mechanical type and shall be secured in line with UL standards to prevent lugs from turning or loosening when incoming cables are installed.

8. Where circuit breakers with ground fault protection are shown on Basic Contract Drawing, they shall be UL class A type and shall be identified on the panelboard.

9. Lighting fixture circuits controlled only by a circuit breaker shall each be identified by a 1 inch long by 3/4-inch high black laminated plastic nameplate with white letters.

10. Circuit breakers used for switching fluorescent lighting shall be rated and identified with a SWD tag.

2.03 ACCESSORIES

A. Nameplates

1. Provide approved nameplates on the front cover of each cabinet, indicating the panel name and number.

2. Unless otherwise shown on the Basic Contract Drawing, fabricate nameplates from an approved type of lamacoid plastic with letters engraved on the plate in white on black background. Where letter sizes are not shown on the Basic Contract Drawing, use 1/2-inch high letters. Nomenclature shall comply with a schedule approved by the Engineer.

3. Secure nameplates on equipment with brass or stainless steel screws with locking hardware.

B. Panelboard cabinet locks

Each locked cabinet shall be furnished with a combination catch and flat lock with spring loaded type door pull. Locks shall be fitted to separate keying for each system. Furnish one key for each cabinet installed and a maximum of 20 keys per system.

C. Provide a typewritten directory identifying each brunch circuit as to the load which it serves, and install the directory in metal frame inside the panelboard door.

2.04 PAINTING

A. Surfaces to be painted shall be prepared by the removal of all grease, oil, rust, scale or other foreign material.

B. A prime coat of zinc chromate paint and two (2) finish coats of enamel paint conforming to ANSI Z 55.1 shall be applied. The gray prime and finish paints shall be a compatible finish system. In public areas the cabinets shall be painted as above, unless otherwise shown on Basic Contract Drawing.

C. Furnish a can of touch-up paint for use after equipment is positioned.

D. Stainless steel panels shall not be painted. Galvanized panels shall be painted if shown on the Basic Contract Drawing.

2.05 SHOP TESTS

A. Shop tests shall be in accordance with NEMA, ANSI and IEEE specifications.

B. During the period of shop drawing submission complete information outlining the test methods and procedures to be followed shall be submitted to the Engineer for approval. A copy of test forms and a set of sample computations to be used shall be furnished at the time.

C. The Engineer shall be permitted to inspect any equipment, material or work to be furnished under this specification and shall have the right to reject any parts considered defective, unsuitable for the purposes or not in accordance with these specifications.

D. The Engineer shall be notified at least two weeks before testing. This notification shall list type and number of units to be tested. The Engineer reserves the right to require additional testing or to waive factory inspection or witnessing of tests.

E. Five (5) certified copies of all test results shall be furnished to the Engineer. Certification shall be by a Professional Engineer licensed in the State in which the tests are performed, and stamped.

F. Circuit breakers shall be tested individually in the following sequence:

1. Calibration test
2. Overload performance test
3. Continuous current test
4. Endurance performance test
5. Calibration test (repeated)
6. Determination of interrupting rating
7. Dielectric test

Results of tests on prototype circuit breakers of each size and type will be acceptable.

G. Panelboards shall be marked with their maximum short circuit rating at the supply voltage. The short circuit rating of each panelboard shall be determined after complete assembly. The short circuit tests on the breakers and panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. The method of testing shall be in accordance with UL 67. The source shall be capable of supplying specified panelboard short circuit current or grater.

H. Release of equipment shall not relieve the Contractor of the responsibility of furnishing equipment conforming to all specification requirements.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the work of this Section in accordance with the Contract Documents.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory work, if any, will be needed to bring the equipment onto the site, and what will be the best and quickest method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where control panels or cabinets are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

3.02 PREPARATION

A. Install any channels, angles or other supports that are required to support or mount the panelboards.

B. Use supports and fasteners as specified in the Section of the Specifications entitled "SUPPORTING DEVICES" or as shown on the Basic Contract Drawing.

3.03 INSTALLATION

A. Surface and flush mounted panelboards shall be installed with tops 6 feet-6 inches above the floor, unless otherwise shown on the Basic Contract Drawing.

B. Panelboards shall be installed true and plumb on supporting struts and shall not be mounted directly on concrete, concrete block walls, or any other walls subject to moisture. Leave a minimum gap of 1/2 inch between the back of the enclosure/cabinet and the wall, using stainless steel hardware.

C. Where mounting directly on the wall is unavoidable the back of the enclosure shall be painted with two coats, minimum, of a bituminous paint.

D. Cables shall be neatly racked and bundled with nonflammable nylon ties, routed and supported within the enclosures/cabinets or gutters. Minimum bending radii as recommended by cable manufacturers shall not be reduced.

E. After conduits and cables are installed, the enclosures/cabinets shall be inspected for foreign materials and shall be vacuumed clean. Prior to energization the panels shall be tested as described below.

F. A typewritten directory shall be furnished and installed in the frame inside the panelboard.

3.04 FIELD TESTS

A. Visually inspect each breaker in the panelboard and operate manually.

B. Check all connections for tightness

C. Check current rating of all circuit breakers. To each pole of the circuit breakers apply current 3 times its rating, recording currents and breaker trip times. Apply rapidly increasing currents and record the value that consistently causes instantaneous tripping of the breaker. Compare these recorded times with manufacturer's time current curves.

D. Perform megger and hi-pot test on each pole.

E. All discrepancies found by the contractor shall be brought to the attention of the Engineer

F. All testing shall be performed in the presence of and as directed by the Engineer. The Contractor shall notify the Engineer when the equipment is installed and ready for testing.

END OF SECTION

SECTION 16470

PANELBOARDS

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit for approval the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

Shop drawings for each enclosure/cabinet shall include:

1. Data sheet for each panelboard with the following information
   - a. Job name
   - b. Item number
   - c. Panelboard nameplate(s) in accordance with the design drawings
   - d. Quantity of this panelboard configuration
   - e. Phase, wire and voltage
   - f. Main and neutral Bus material, continuous current, current density, and momentary capacity.
   - g. Short- circuit rating
   - h. Main connection information:
     - (1) Circuit Breaker - rating, interrupting rating, number of poles, type, manufacturer, and catalog number
     - (2) Lugs per phase, Cables per phase, Cable size range
     - (3) Location (top, bottom)
   - i. Thru feed lugs, subfeed
   - j. Ground bar with main lug on frame
   - k. Branch connection information:
     - (1) Circuit breakers rating, number of poles, type, manufacturer, and catalog number
     - (2) Lugs and cables per phase, Cable size range
   - l. Panelboard circuits breaker's arrangement for left and right side-top to bottom.
   - m. Panelboard overall dimensions H x W x D
   - n. Panelboard NEMA rating
2. Panelboard dimensional drawing. Indicate conduit entrance space at the top and bottom, knockout diagram and mounting details
3. Panelboard directory

B. Catalog cuts

1. Panelboards and Cabinets
2. Circuit breakers
3. Family of time current characteristic curves for all types and sizes of circuit breakers

C. As-built Documentation acceptable to the Engineer, with typewritten copy of completed panelboard directories.

END OF APPENDIX "A"

DIVISION 16

SECTION 16475

OVERCURRENT PROTECTIVE DEVICES (600 VOLTS OR LESS)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for overcurrent protective devices.

B. The types of overcurrent protective devices specified in this Section are:

1. Low Voltage Power Air Circuit Breakers
2. Molded Case Circuit Breakers
3. Safety Switches
4. Fuses

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	American National Standards Institute (ANSI)
ANSI C 37.13	Low Voltage AC Power Circuit Breakers used in enclosures
ANSI C 37.16	Related Requirements and application recommendation for Low Voltage Power Circuit Breakers
ANSI C 37.50	Test Procedures for Low Voltage AC Power Circuit Breakers
ANSI C 97.1	Low Voltage Cartridge Fuses 600 Volts or Less
	National Electrical Manufacturers Association (NEMA)
NEMA AB-1	Molded Case Circuit Breakers and Molded Case Switches
NEMA KS-1	Enclosed Switches
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
	Underwriters Laboratories Inc. (UL)
UL 98	Enclosed and Dead Front Switches
UL 198	Safety Standard for Fuses
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 943	Standard for Ground Fault Circuit Interrupters

Federal Specifications (FS)

W-C-375B/Gen	Circuit Breakers, Molded Case; Branch Circuit and Service
FSW –S-865	Covers Surface-mounted, Air-break, Box or Enclosed Switches for Ratings through 500 Volts, 1200 Amperes and 50 Horsepower

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

The overcurrent protective devices and associated materials shall conform to all applicable standards, and shall also conform to the requirements specified herein and shown on the Basic Contract Drawing.

1.04 QUALITY ASSURANCE

Overcurrent protective devices of types and ratings required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Overcurrent protective devices to be installed in an assembly, as shown on the Basic Contract Drawing, shall be mounted in the assembly and delivered in accordance with the manufacturer's specifications for such assembly.

B. Overcurrent protective devices to be installed in their own enclosures, as shown on the Basic Contract Drawing, shall conform to the following requirements:

1. Enclosures shall be packaged with material to prevent damage to components due to vibration, jarring and the like during transportation and handling.

2. Enclosures shall be delivered in the manufacturer's original, unopened, protective packaging and shall be identified with suitable non-corrosive tags.

C. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of the final cleanup.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 SPARE PARTS

Furnish a minimum of three but not less than 10% spare fuses of each type and rating required and shown on the Basic Contract Drawing.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of this Section, provide low voltage power circuit breakers, molded case circuit breakers, safety switches and fuses of one of the manufacturers specified on the Basic Contract Drawing.

2.02 MATERIALS

A. General

1. Location, types, sizes, ratings and enclosures for overcurrent protective devices are shown on the Basic Contract Drawing.

2. Overcurrent protective devices mounted in their own enclosures as shown on the Basic Contract Drawing shall conform to the requirements of NEMA, UL, and NFPA. Enclosures shall be as specified in the Section of these Specifications entitled "PANELBOARDS ".

3. Overcurrent protective devices, to be installed as part of an assembly unit, shall be installed in accordance with the manufacturer's requirements for the specified assembly or as shown on the Basic Contract Drawing.

4. Overcurrent protective devices and enclosures for which there are established UL standards, shall bear the UL label.

B. Low Voltage Power Air Circuit Breakers

1. General

a. All circuit breakers shall be 3 pole, single throw, 600V AC class, 60 Hz, trip free, with stored energy closing. Controls shall be as shown on the Basic Contract Drawing.

b. Circuit breakers shall be of the draw-out type with self-aligning fingers to engage the line and load primary terminals.

c. The draw-out mechanism shall firmly support the breaker from the fully connected to the fully disconnected positions and shall be so designed as to permit racking the breaker without opening the door in all three positions: connected, test, and disconnected.

d. Interlocks shall be provided to prevent racking the breaker from the connected position to the test or disconnected position, or moving the breaker into the connected position while the breaker is closed.

e. Required circuit breaker sizes and ratings shall be as shown on the Basic Contract Drawing.

f. In addition to all contract requirements to achieve the operation indicated on the Basic Contract Drawing and specifications, provide the following spare contacts rated 125 VDC, 20 amperes continuous.

(1) A minimum of two normally open and two normally closed contacts, which shall operate when the breaker is in the fully connected position.

(2) A minimum of one normally open and one normally closed contacts, which shall operate when the breaker is withdrawn from the fully connected position. Contacts shall be rated 125V DC, 20 amperes continuous.

g. Provide a position indicator visible from the front of the switchgear for each breaker to indicate whether the breaker is open, tripped or closed.

h. Tripping shall be through integrally mounted solid state overcurrent and short circuit trip units with adjustable settings for long time, short time and instantaneous trip unless otherwise shown on the Basic Contract Drawing.

2. Manually Operated Breakers

a. Provide manually operated circuit breakers with a front mounted handle to manually charge the stored energy closing mechanism.

b. Breakers shall be mechanically trip free and shall be furnished with provisions for the future addition of a control solenoid for remote closing.

c. Provide a mechanical trip and close button on the front of each breaker.

d. Provide a maintenance handle for slow closing during contact adjustment.

3. Electrically Operated Breakers

a. Provide electrically operated breakers with a motor- operated, stored-energy, closing mechanism. Motor voltage shall be as shown on the Basic Contract Drawing.

b. Breakers shall be electrically and mechanically trip-free and each shall be provided with an electrically operated spring release to close the breaker.

c. Provide a mechanical trip button on the front of each breaker.

d. Provided an electrical close button or control switch on the front of each breaker.

e. Provide a maintenance handle for slow closing during contact adjustment.

f. Provide breakers with a shunt trip device for remote operation, arranged for both local and remote control of the closing and tripping functions.

4. Fused Circuit Breakers

a. Where shown on the Basic Contract Drawing, fused circuit breakers shall be provided.

b. The fuses shall be current limiting type and shall be integrally or separately mounted units coordinated with overcurrent trip devices so as to avoid unnecessary blowing of the fuses.

c. Fused breakers shall have a blown fuse indicator and lockout device. The lockout device shall trip all phases upon blowing and prevent the breaker from being closed with any fuse element blown. Operation of the breaker shall not be permitted by this device until the fuse is replaced and the lockout reset.

d. The blown fuse indicator shall be visible from the front of the breaker and shall indicate which fuse has blown.

e. When a Protective Device Coordination Study is performed, the fuse rating shall be in accordance with the requirements of the protective study.

C. Molded Case Circuit Breakers

1. General

a. Molded case circuit breakers for panel or individual mounting shall be molded-case type, quick-make and quick-break on manual or automatic operation. The handle mechanism shall be trip-free to prevent holding contacts closed on a fault. Tripping shall be indicated by the handle automatically assuming a position between the manual "off" and "on" positions.

b. Molded case circuit breaker contacts shall be of the high-pressure type and shall be made of a silver composition material. Arc shields shall be provided to confine, cool, and quench the arc drawn at interruption.

c. Continuous ampere ratings and number of poles shall be as shown on the Basic Contract Drawing.

d. Molded case circuit breakers shall be bolt-on type. Unless otherwise shown on the Basic Contract Drawing or as required by the system interrupting rating, all 120V or 208V circuit breakers shall have a minimum short circuit interrupting rating of not less than 10,000 amperes (RMS symmetrical) and all 277V or 480V breakers shall have a minimum short circuit interrupting rating of not less than 18,000 amperes (RMS symmetrical).

e. All molded case circuit breakers feeding 120V or 277V lighting circuits that are not controlled by local wall switches shall be UL approved type "SWD" circuit breakers.

f. Each molded case circuit breaker shall be suitable for the circuit on which it is applied and the load that it controls.

g. Accessories including, but not limited to, auxiliary switches, shunt trips, undervoltage trips, ground fault sensing and tripping shall be as shown on the Basic Contract Drawing.

2. Thermal-Magnetic Circuit Breakers

a. Circuit breakers up to, but not including 400 amperes shall be thermal magnetic trip. Electronic trip circuit breakers rated 100 amperes or higher may be provided in lieu of thermal magnetic type.

b. Automatic operation of the molded case circuit breaker shall be obtained by means of calibrated thermal and magnetic tripping devices for each pole of the breaker. The thermal device shall provide time-delay tripping on overloads, and the magnetic device shall provide instantaneous tripping on short circuits. The instantaneous magnetic trip shall be adjustable and accessible from the front of the breaker on frame sizes above 100 amperes.

3. Electronic Trip Circuit Breakers

a. Circuit breakers rated 400 amperes and higher shall be electronic trip.

b. The integral trip system shall be independent of any external power source and shall contain industrial grade electronic components as a minimum.

c. Circuit breakers shall be equipped with back-up thermal magnetic trip system unless otherwise indicated on the Basic Contract Drawing.

d. Circuit breaker trip system shall be a microprocessor based true rms sensing design.

e. The sensor size rating plug and adjustment positions shall be clearly marked on the face of the circuit breaker.

f. The following time/current adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.

Long time pick up
Long time delay
Short time pick up
Short time delay
Instantaneous pick up
Ground fault pick up
Ground fault delay

g. A means to seal the trip unit adjustments in accordance with NEC shall be provided.

h. Local visual trip indication for overload short circuit and ground fault trip occurrences shall be provided.

D. Safety Switches

1. Safety switches shall conform to NEMA KS-1, UL 98 and FSW-S-865.

2. Safety switches shall conform to the NEMA classification and shall be rated, as shown on the Basic Contract Drawing.

3. Safety switches utilized for service entrance shall include a groundable insulated neutral.

4. Safety switches shall be of the quick-make, quick-break type with terminals suitable for copper conductors, shall be padlockable in the "off" position and shall be equipped with defeatable door interlocks.

E. Fuses

1. Fuses shall be of the class, size and ratings (current, voltage, interrupting capacity, type, NEMA class) as shown on the Basic Contract Drawing.

2. Fuses shall conform to UL 198 and ANSI C97.1 for low voltage fuses.

3. Unless otherwise shown on the Basic Contract Drawing, fuses used in conjunction with motor protection shall be current limiting, dual element, time-delay type.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Unless otherwise shown on the Basic Contract Drawing, overcurrent protective devices shall be installed in conformance with NFPA 70, and UL 98, in accordance with the manufacturer's instructions and in accordance with the requirements of this Section.

B. Fuses

1. All fuses rendered inoperative during the Work shall be replaced before the issuance of the Certificate of Final Completion.

2. All replacement fuses shall be provided in addition to the spare fuses specified in 1.07 herein.

END OF SECTION

SECTION 16475

OVERCURRENT PROTECTIVE DEVICES (600 VOLTS OR LESS)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Fuses; time-current and current-limiting curves for both melting and clearing.
2. Circuit breakers; time-current curves.
3. Fused circuit breakers - time current curves.

B. Catalog Cuts

1. Low Voltage Power Air Circuit Breakers
2. Molded case circuit breakers
3. Safety Switches
4. Fuses

END OF APPENDIX "A"

DIVISION 16

SECTION 16477

PROTECTIVE DEVICE COORDINATION STUDY

PART 1. GENERAL

1.01 REFERENCES

The following is a listing of publications referenced in this Section.

	American National Standards Institute (ANSI)
ANSI C 37.91	Protective Relay Applications of Power Transformers
	Institute of Electrical and Electronics Engineers Inc. (IEEE)
IEEE 242	Protection and Coordination of Industrial and Commercial Power Systems
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code

1.02 QUALITY ASSURANCE

A. The PDCS shall be certified by a Professional Engineer licensed in the State where the installation will take place. The qualifications of the Professional Engineer shall be submitted for review and approval by the Engineer.

B. Entities performing the Work of this Section shall have experience on at least two projects involving complexities similar to those required under this Contract.

1.03 SUBMITTALS

For submittals see Appendix "A".

PART 2. PRODUCTS

2.01 COORDINATION STUDY

Unless otherwise shown on the Basic Contract Drawing, the PDCS shall start from the designated connection point and shall include all protective devices and circuit elements shown on the Basic Contract Drawing. In general, such devices and elements shall include, but not be limited to conductors, high voltage fuses or circuit breakers, transformers, low voltage switch-gear, fuses, circuit breakers, panel boards, motor control centers, transfer switches, and all or switching devices within the distribution system. This requirement shall apply to both AC and DC systems. The PDCS shall conform to the requirements of ANSI C37.91, IEEE 242, NFPA 70, and this Section.

A. Short Circuit Analysis

The Short Circuit Study will be considered a part of the PDCS. The Short Circuit Study shall be performed by using a computer software DAPPER or A_FAULT by SKM Systems Analysis. Results of such a study shall be provided on hard copy as well as on a floppy disk.

1. The short circuit analysis shall study the distribution protective and switching devices and conductors, for both continuous and fault current capabilities. This shall include the ability of the devices and conductors to withstand fault current until the protective devices operate.
2. The short -circuit analysis shall analyze the electrical system, to identify the maximum short circuit values available at each protective device and on the conductors within the system.
3. The short circuit analysis shall be based on the characteristics of the equipment, conductors, raceways and routings actually used in the construction.
4. The short circuit analysis shall be based on the actual available short circuit from the utility at the designated connection point.

B. Protective Device Coordination Analysis

The Protective Device Coordination Analysis shall be performed by using the latest version of the computer software called CAPTOR by SKM Systems Analysis. Results of such a study shall be provided on hard copy as well as on a floppy disk.

1. The analysis shall clearly define the proposed coordination among the devices which include, circuit breakers, overcurrent relays, fuses, transformers, motor sand cable damage curves, magnetizing inrush currents, fault currents and currents related to each device's proposed ratings and settings.
2. The analysis shall establish the settings necessary to selectively isolate faults or failures from the remainder of the electrical system with minimum power interruption.

C. Coordination Plots

The coordination plots shall graphically demonstrate the proposed coordination for the electrical system, plotted on ANSI standard, full-sized, log-log forms such as Time-Current Characteristic forms by Keuffel & Esser Co. The coordination plots shall be plotted on a plotter. No hand drawn plots shall be accepted.

1. The plots shall define the types of protective devices selected, together with the CT ratio selected, proposed taps, time-dial and instantaneous settings.

2. All the coordination plots shall be submitted on hard copies as described above, as well as on computer floppy disks suitable for the approved protective device coordination software as defined section "B" above. In addition, the individual Time-Current Characteristic curves of all the protective devices used in the study shall be provided on a computer floppy disk in the proper format as well as original manufacturer's curves for future reference by the Authority.

3. The coordination plots shall include complete titles, representative one-line diagrams, associated system characteristics, complete parameters for transformers and complete operating bands for distribution circuit breaker trip devices and fuses.

   a. The long-time region of the plots shall designate the pickups required for the circuit breakers.

   b. The short -time region shall indicate the magnetizing inrush, and ANSI transformer withstand parameters, the circuit breaker ground -fault, short -time and instantaneous trip settings, fuse minimum melting and total clearing time, tolerance bands and symmetrical fault currents.

   c. Molded case circuit breakers shall be separated from each other and the associated upstream and downstream protective devices by a current or time margin for coordination and protection in the event of secondary faults.

   d. The protective device characteristics or operating bands shall be suitably terminated to reflect the actual symmetrical fault currents sensed by the device.

   e. Each primary protective device required for delta-to-wye connected transformers shall be selected so that the characteristics or operating bands are within the transformer parameters, which shall include a parameter equivalent to 58 percent of the withstand point to afford protection for secondary line -to-ground faults. The transformer damage curve shall be included for the transformer when the selected protective device is not within the associated parameters.

   f. The coordination plots shall include the damage curves for the transformers, cables and rectifiers. Actual curves provided by the manufacturers of the respective equipment shall be where ever possible.

4. The Authority will furnish settings and fault impedances up to the first level of the upstream protective devices owned by the Authority.

5. The PDCS shall take into account the general characteristics and requirements for the wires, cables, motors, transformers, circuit breakers, rectifiers and any other high and low voltage equipment.

6. All specific equipment characteristics shall be determined in accordance with the results of the PDCS. Report to the Engineer any conditions within the Work, or within equipment not installed under this Contract, where the study recommendations, as approved by the Engineer, require equipment types or sizes other than the requirements of the Specifications, or as shown on the Basic Contract Drawing. The Contractor's compensation for completing such changes, at the direction of the Engineer, will be determined in accordance with the clause of the Contract providing compensation for Extra Work.

7. The study shall include verification of equipment ratings and settings. The results of the study shall be coordinated with the shop drawings required by various other Sections of the Specifications. The Contractor shall maintain the PDCS up-to-date with any Contract changes that affect the study recommendations, and shall submit the revised PDCS for approval by the Engineer.

END OF SECTION

SECTION 16477

PROTECTIVE DEVICE COORDINATION STUDY

APPENDIX "A"

SUBMITTALS

A. Submit in advance, to the Engineer, for approval, the qualifications of the Professional Engineer specified in 1.02 A.

B. Submit six bound copies of an initial protective device coordination analysis and short circuit study. Submit revised copies of the study in accordance with the requirements of 2.01.

END OF APPENDIX "A"

DIVISION 16

SECTION 16510

LIGHTING SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for Lighting Systems.

1.02 REFERENCES

American National Standards Institute (ANSI)

ANSI C 78.379	Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns
ANSI C 82.1	Ballasts for Fluorescent Lamps – Specifications
ANSI C 82.4	Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps

Illuminating Engineering Society of North America (IESNA)

National Equipment Manufacturers Association (NEMA)

NEMA WD6	Wiring Devices - Dimensional Requirements

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code
NFPA 101	Life Safety Code

Administrative Code

NYCEC	Electrical Code of the City of New York

Underwriters Laboratories (UL)

UL 57	Electric Lighting Fixtures
UL 844	Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 924	Emergency Lighting and Power Equipment
UL 935	Fluorescent Lamp Ballasts
UL 1029	High-Intensity-Discharge Lamp Ballasts
UL 1570	Fluorescent Lighting Fixtures
UL 1571	Incandescent Lighting Fixtures
UL 1572	High Intensity Discharge Lighting Fixtures

OSHA Occupation Safety and Health Administration

The Energy Policy Act of 1992

Lamp Efficiency Labeling and Standards

1.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Lighting System shall be furnished, supplied, installed and adjusted in accordance with this Section and as specified on the Contract Documents.

B. Components of the Lighting System manufactured, supplied, and installed shall comply with the requirements of NFPA 70, NFPA 101, all local codes, and the requirements of OSHA.

1.04 QUALITY ASSURANCE

A. Entities manufacturing lighting fixtures, equipment, and components specified herein, and as shown on the Basic Contract Drawing, shall have a minimum of five years of manufacturing experience and shall demonstrate prior experience on at least two projects involving complexities similar to those required under this Contract.

B. Lighting equipment for which there is a nationally recognized standard shall be safety tested and bear the conformance labeling of the third party inspection authority, such as Underwriters Laboratories Inc. (UL), ETL, Factory Mutual, or approved equal, certifying that the lighting fixtures and equipment are listed as suitable for the purpose specified and shown on the Basic Contract Drawing.

C. Lighting equipment shall be manufactured and installed in compliance with applicable articles of NFPA 70, NFPA 101 and NYCEC.

1.05 DELIVERY, STORAGE AND HANDLING

A. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.

B. Deliver materials in manufacturer's original, unopened, protective packaging.

C. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.

D. Handle in a manner to prevent damage to finished surfaces.

E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

1.06 SPARE PARTS

A. Unless otherwise noted on the Contract Document, provide 10% (or minimum of 12) replacement lamps for each type of lamp installed.

B. Unless otherwise noted on the Contract Document, provide 5% (or minimum of 2) replacement ballasts for each type of ballast installed.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. General

All components of the lighting system shall be manufactured by the companies shown on the Basic Contract Drawing.

2.02 MATERIALS

A. General

The location, number, size, and type of all lighting fixtures and accessories to be installed shall be as shown on the Basic Contract Drawing.

B. Lighting Fixtures

Lighting fixtures shall be furnished with lamps, which comply with the requirements of this Section, and as shown on the Basic Contract Drawing. All fluorescent and high intensity discharge lighting fixtures supplied shall come with factory installed ballasts, which comply with the requirements of this Section, and as specified on the Basic Contract Drawing.

Unless otherwise shown on the Basic Contract Drawing lighting fixtures shall comply with the following requirements:

1. Housing

   a. Lighting fixtures shall be of rigid construction and built in accordance with NEMA WD6.

   b. Ferrous components shall be protected from corrosion by plating or finished with white baked enamel unless another color is shown on the Basic Contract Drawing. All paint shall be spray-applied and baked at 350°F, for at least 20 minutes. Interior surfaces of all fluorescent fixtures shall be white enamel of minimum 87% reflectance.

   c. Exposed parts of the lighting fixture housing shall be free from spinning lines, ripples, or other visible marks and manufacturer's stickers.

   d. Outdoor lighting fixture housings shall be constructed of copper-free cast aluminum (copper content less than 0.4%, Alloy 360.4) or stainless steel. Housings shall be properly gasketed to be watertight. All hardware shall be stainless steel.

   e. Recessed lighting fixture housings shall be constructed of a minimum 20-gauge cold-rolled steel and painted with a white, baked enamel finish.

   f. Pendant and surface-mounted, continuous lighting fixture housings shall be constructed of extruded aluminum and treated with the finish specified on the Basic Contract Drawing.

g. Ballast compartment shall be so designed that ballast temperature shall not exceed the UL limit of 105°C at 40°C ambient temperature.

2. Optical System

a. Reflectors

(1) Unless otherwise shown on the Basic Contract Drawing, fluorescent, parabolic louvers shall be constructed of non-iridescent, semi-specular aluminum with a minimum reflectance of 85%.

(2) Diffuser reflectors shall be finished with high-reflectance, baked white enamel with a non-yellowing binder.

(3) Clear reflector inserts for fluorescent lighting fixtures shall be fabricated of aluminum or steel backing with a silver film laminate which shall be guaranteed by the entity manufacturing the lighting fixtures against separation and peeling for a minimum of five years. Minimum reflectance shall be 92%.

(4) The visible clear Alzak reflectors shall be of non-iridescent finish with a minimum reflectance of 90%.

b. Lenses, Diffusers, and Shielding Devices

(1) Lenses, diffusers, and shielding devices shall be properly and securely mounted within the lighting fixture housing. Lay-in lenses, diffusers, or shielding devices shall not be acceptable.

(2) Glass lenses or diffusers shall be constructed of tempered, borosilicate glass.

(3) Plastic lenses or diffusers shall be white opal or clear, prismatic, 100% ultraviolet-stabilized acrylic or high-impact polycarbonate. Plastic lenses shall be installed with the smooth side out.

(4) The shielding and optical materials shall be tightly fitted with no loose parts and shall show no visible leaks of unintentional light.

3. Exit Signs

a. Furnish single and double face Exit Signs with hardware suitable for wall or ceiling mounting as shown on the Basic Contract Drawing.

b. Exit Signs shall be guaranteed by the manufacturer for a minimum of five years.

c. Surface mounted Exit Signs shall be of die-cast aluminum construction with aluminum faceplates and invisible universal arrows and mounting knockouts for field adjustment. Finish of the housing and faceplates shall be as shown on the Basic Contract Drawing. Exit Signs shall be single or double face, and shall be suitable for ceiling, back, or end mounting.

d. Edge-lit Exit Signs shall be of UV stabilized acrylic construction with inbeded, laminated legend and arrows.

e. Exit Signs shall be energized from either 120 VAC or 277 VAC. Exit Signs shall operate on Light Emitting Diode (LED) light sources and shall consume a maximum of six watts per Sign face.

f. Average luminance of the legend "EXIT" shall be no less than 15 cd/m^2 (5 Fl) with uniformity ratio (max/min) no greater than 3/1.

4. Emergency Battery Operated Lights

a. Emergency Battery Operated Lights specified herein shall be:

(1) Fluorescent Fixture with internal or external battery pack

(2) Battery Operated Exit Sign

(3) Incandescent Emergency Lighting Fixture

b. Emergency Battery Operated Lights shall automatically switch "ON" when normal or emergency power supply fails and provide a minimum of 90 minutes of reduced illumination.

c. The fluorescent batteries of fixtures used for both, normal and emergency lighting, shall be of the nickel-cadmium or the lead-calcium type and shall have sufficient electrical capacity to energize the connected lamps at a minimum of 50% of normal light output. The battery shall be guaranteed by the manufacturer for a minimum of five years.

d. The battery charger shall be the dual-rated type and shall have sufficient capacity to recharge the discharged battery to full charge within twelve hours, maximum.

e. Emergency Battery Operated Lights shall be equipped with a test switch and an LED lamp indicating AC power is on.

C. Lamps

1. General

Lamps shall comply with the requirements of the Energy Policy Act of 1992 or it's latest editions.

2. Fluorescent Lamps

Unless otherwise shown on the Contract Document, lamps shall comply with the following requirements:

a. Tubular Type

(1) Lamp tube diameter shall be T8, T10, or T12

(2) Lamps shall have triphosphor coating with a minimum Color Rendering Index (CRI) of 70

(3) Minimum average lamp life at 3 hours per start shall be 20,000 hours

(4) Minimum efficiency shall be 80 lm/W (lumens per Watt).

(5) Maximum lamp lumen depreciation at the end of rated life shall be 20%

b. High Output (HO) and Slimline Type

(1) Lamp tube diameter shall be T8 or T12

(2) Lamps shall have triphosphor coating with a minimum Color Rendering Index (CRI) of 70

(3) Minimum average lamp life at 3 hours per start shall be 12,000 hours

(4) Maximum lamp lumen depreciation at the end of rated life shall be 20%

c. Compact Fluorescent Lamps

(1) Minimum average lamp life at 3 hours per start shall be 10,000 hours

(2) Lamp shall have a triphosphor coating with a minimum Color Rendering Index (CRI) of 82

(3) Minimum efficiency shall be 65 lm/W

(4) Maximum lamp lumen depreciation at the end of rated life shall be 15%

3. Incandescent and Tungsten Halogen Lamps

Unless otherwise shown on the Contract Document, lamps shall comply with the following requirements:

a. Incandescent and tungsten halogen lamps shall have a minimum average lamp life of 2500 hours.

b. Incandescent reflector type lamps shall have beam patterns as shown on the Basic Contract Drawing and conforming to ANSI C 78.379.

4. High Intensity Discharge Lamps

Unless otherwise shown on the Contract Documents, lamps shall comply with the following requirements:

a. High Pressure Sodium (HPS) Lamps

(1) Minimum average lamp life at 10 hours per start: 24,000 hours

(2) Minimum efficiency: 75 lm/W

(3) Maximum lamp lumen depreciation at the end of rated life: 20%

(4) Maximum color shift: ±250 degrees Kelvin

b. Metal Halide (MH) Lamps

(1) MH lamp fixtures shall be connected only to circuits that are turned off for at least 15 minutes a week. Use of MH lamps in uninterrupted 24-hour operation circuits is not permitted.

(2) Minimum average lamp life at 10 hours per start shall be 15,000 hours for lamp burning in a vertical position. For lamps burning in a horizontal position, as follows:

Lamps < 400 W:	10,000 hours
400 W lamps:	20,000 hours
1000 W lamps:	12,000 hours
1500 W lamps:	6,000 hours

(3) Minimum efficiency: 75 lm/W

(4) Maximum lamp lumen depreciation at the end of rated life: 30%

(5) Maximum color shift: ±250 degrees Kelvin.

(6) Minimum Color Rendering Index (CRI): 65

c. Mercury Vapor (MV) Lamps

Unless otherwise shown on the Basic Contract Drawing, MV lamps shall not be permitted for general illumination purposes.

D. Ballasts

1. Fluorescent Lamp Ballasts

a. Fluorescent lamp ballasts shall comply with ANSI C 82.1 and shall be Class 'A' sound rated Class 'P' listed by ETL and UL.

b. Fluorescent lamp ballasts shall be certified for the appropriate for the application minimum starting temperature.

c. Unless otherwise shown on the Basic Contract Drawing, fluorescent lamp ballasts for indoor applications shall be high-frequency, electronic type, suitable for operation in rapid start circuitry and comply with the following requirements:

(1) Minimum Power Factor: 0.950

(2) Total Harmonic Distortion: less than 20%

(3) Lamp Current Crest Factor: less than 1.7

(4) Lamp Current Frequency: greater than 20 kHz

(5) In-rush current: less than 20x normal current

d. Fluorescent lamp ballasts shall be wired and grounded in accordance with NFPA 70 and the manufacturer's written instructions.

2. High Intensity Discharge (HID) Ballasts

a. HID lamp ballasts shall comply with ANSI C 82.4, and shall be the high-power factor, constant wattage auto-transformer (CWA), or similar, type of automatic wattage regulation.

b. The power loss of HID lamp ballasts, as a percentage of lamp wattage, shall not exceed 20%.

c. HID lamp ballasts for indoor applications in public spaces shall be encased and potted for the purpose of noise reduction.

d. HID lamp ballasts shall be wired and grounded in accordance with NFPA 70 and the manufacturer's written instructions.

e. Remote HID lamp ballasts shall be installed in accordance the manufacturer's written instructions.

f. Unless otherwise noted on the Basic Contract Drawing all HPS ballasts, which are not used in 24 hours operations, shall be furnished with automatic protective starters. An automatic protective starter shall apply pulses for no more than 15 minutes and then deactivate if a lamp arc cannot be initiated.

E. Fuses

Fuses and fuse assemblies shall be as shown on the Basic Contract Drawing.

F. Lighting Control

1. Lighting Management System

a. The lighting management system shall automatically switch lights on and off according to a time clock schedule, amount of daylight present, and in accordance with the requirements of this section and as shown on the Contract Documents.

b. A factory-trained field service engineer shall be to functionally test each hardware and software component in lighting management system after installation, and to provide on-site training for Authority personnel. The minimum of 16 hours training session shall consist of the following parts:

(1) general description of the system and operational functions of it's components

(2) hands on training for each of the hardware components (performance, maintenance, repair, parts replacement)

(3) hands on software training (programming, operation, modem connection)

At least two representatives from the facility where the system is being installed, two representatives from the electrical maintenance group and two representatives from the Authority engineering department shall be present for the training.

Manufacturer shall provide a minimum of 6 complete operation manuals.

c. Remote Power Switching Panelboards

(1) The remote power switching lighting panelboards shall be mounted in electrical closets and shall comply with Section 16470 of these Specifications and as specified on the Contract Documents.

(2) The remote power switching panelboards shall consist of a microprocessor-based control module, interface module, control busses, remote-controlled breakers, and Class 2 barriers.

(3) The remote power switching panelboards shall meet or exceed the following capabilities:

(a.) Individual control for up to 42 remotely controllable circuit breakers.

(b.) Eight dry-contact inputs for connection to either 2-wire maintained or 3-wire momentary external control devices.

(c.) Zone creation and control of individual circuit breakers or zones.

(d.) Run/Halt/Hold/All-On operational modes.

(e.) Individual circuit breaker and zone manual override.

(f.) Circuit breaker status monitoring.

(g.) Security access codes.

(h.) Telephone override.

(i.) Diagnostic testing of memory, keyboard, screen, com ports, and circuit breaker.

(j.) Expansion port to connect additional inputs via expansion cabinet.

(k.) RS-232 port for connection to personal computer.

(l.) Non-violable EEPROM memory.

(4) All electronic modules and circuit breakers in the panelboards shall be mounted in the positions and control the loads as indicated on the panel wiring schedules indicated on the Basic Contract Drawing.

(5) Emergency panelboards shall respond to the loss of normal power in the associated normal panel by automatically switching on all emergency circuits.

d. Addressable Relay Panels

(1) Addressable relays shall provide inputs and outputs directly compatible with the existing remote power switching panelboard system.

(2) Each remotely controlled relay panel shall be furnished with at least one manual on/off override.

(3) The addressable relay panels shall meet or exceed the following capabilities:

(a.) Protocol shall be based on a modified ANSI 3.28.

(b.) Run length without repeaters shall be 10,000 feet at 9,600 Baud, full duplex.

(c.) Up to 16 analog inputs and digital inputs. These inputs shall except directly, occupancy sensors and variable output ambient light sensors.

(d.) All information shall be stored internally in register locations and be readable/writeable from any device on the high-speed network.

(e.) Addressable in the range of up to 32 panels.

2. Photoelectric Control Devices

a. The location, number, size, and type of all ambient light sensors, timers, and occupancy sensors to be installed shall be as shown on the Basic Contract Drawing.

b. The ambient light sensor shall have a cadmium sulphide, hermetically sealed photocell, shall be fully temperature-compensated, and shall provide for a time delay of at least 15 seconds to prevent false switching. The ambient light sensors shall be remotely mounted where shown on the Basic Contract Drawing.

c. The ambient light sensor shall meet or exceed the following capabilities:

(1) There shall be different lighting sensors for different tasks (i.e. atrium, skylight and outdoor).

(2) Separately mounted resolution enhancement adjustment.

(3) The photoelectric device shall be a class 2, low voltage type.

(4) Output shall be directly proportional to light measured.

(5) Fully adjustable response in the range between 0 and 10,000 foot-candles with +/-1% accuracy at 21C.

(6) The housing shall be constructed from flame-retardant material, and meet UL984 HB standards.

(7) Outputs shall be 4-20mA or 0-10Volt.

(8) Power supplies shall be available in a range of voltages.

d. The time switch shall function to prevent lighting from being energized at pre-set periods each day. The time switch shall permit different "ON-OFF" settings for each day of the week, with provision for omitting selected days. The time switch shall have at least 4 inputs. Unit shall be capable of retaining memory for no less than 90 days. When permitted by the time switch, photoelectric controls shall operate to energize lighting whenever natural lighting falls below 2,5 lux (25 FC).

3. Occupancy sensors

a. The occupancy (motion) sensors shall be designed to control lighting automatically based on the presence or absence of people.

b. The ultrasonic occupancy sensors shall produce a low intensity, inaudible sound (above 22KHz) and detect changes in the acoustic waves caused by motion. The sensors shall not respond to audible sound. If the sensors detect motion, the internal or external relays shall close the contacts and turn on the connected lighting loads. If no motion occurs within a pre-set period of time, the lights shall be automatically turned off.

c. Ultrasonic detectors shall be precision crystal-controlled. Sensors shall not interfere with each other when two or more sensors are placed in the same room.

d. The passive infrared occupancy sensors shall maintain a detection when the person of average size and weight moves within a maximum distance of 8 inches at the speed of 12 inches per second.

e. The occupancy sensors shall be equipped with LED walk indicator, which shall be visible from any area in the room.

f. The occupancy sensors shall be furnished with an adjustable timer for delayed turn-off. The time delay shall be adjustable from 30 seconds to 15 minutes.

g. The occupancy sensors shall be furnished with adjustable sensitivity control. Although, sensitivity shall be high, false triggering by random noises or motions other than human movement shall not be permitted.

h. The occupancy sensors shall be furnished with manual override switch that will enable a bypass of the sensor in the event of failure.

i. The sensors shall be connected to power modules. The power module consumption shall not exceed 2VA in any mode of operation. The power modules shall combine a Class 2 (120V/277V) transformer and heavy duty relay with form A isolated contacts in a single housing. The relay shall be rated for 20A operation.

j. The sensors shall be suitable for ceiling-mounted installation and shall not protrude more than 1-1/2 inches from the ceiling surface.

k. All sensors or equipment supplied shall be accompanied by electronic circuit diagram, component layout, circuit description and installation instructions.

l. All devices shall have a minimum three-year factory warranty for materials and labor.

m. All sensors shall be properly masked and adjusted for required sensitivity and time delay. Coordinate adjustments with manufacturer.

4. Dimmers

a. Wallbox dimmers shall be of linear sliding type and shall be rated for operation with the specified connected load. Dimmer shall be designed to smoothly change light output of the lamps without visible flicker. Rotary type dimmers are not permitted.

b. Wallbox dimmers shall be equipped with built in on/off switch and preset control button.

c. Furnish an appropriate wallbox dimmer for each individual type of load:

(1) Incandescent

(2) Electronic low voltage

(3) Magnetic low voltage

(4) Fluorescent

d. Preset dimming control system shall be as shown on Basic Contract Drawing and shall meet or exceed the following capabilities:

(1) System shall have four preset scenes and off for up to 8 control zones.

(2) System shall be mountable in a standard 2, 3 or 4 gang metal wallbox. Wallbox shall be as specified in Section 16135 of this Specification.

(3) One raise/lower switch with visual display shall be available for each zone.

(4) A temporary master raise/lower switch shall move all light levels up or down.

(5) System shall have smooth fade mode. Switching time between scenes shall be adjustable from 1 second to 90 minutes.

(6) A temporary zone override shall be provided.

(7) Multiple controls and remote wallstations shall be capable of activating each of the preset scenes and shall not interfere with each other.

G. Contactors

1. Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contactors shall be required to make, but not break, the operating coil current.

2. The contactor's main contacts shall be the double break, silver-to-silver type protected by arcing contacts. Contacts shall be self-aligning and renewable from the front of the panel.

3. The contactor's control connections shall be clearly marked "L" for line wire, "C" for closing wire, and "O" for opening wire. A manual operating lever shall be included with the contactor.

4. Each contactor shall be equipped with a control line fuse, a coverplate to conceal contacts, and one normally open auxiliary contact.

5. Unless otherwise shown on the Basic Contract Drawing, contactors shall be mounted separately in a sheet steel, NEMA 12 enclosure. Grouped contactors shall be installed in a common sheet steel, NEMA 12 enclosure.

6. Unless otherwise shown on the Basic Contract Drawing, relays for two-wire control shall be provided, where required, for the operation specified on the Basic Contract Drawing.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all lighting fixtures, equipment, and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing lighting fixtures.

B. Unless otherwise shown on the Basic Contract Drawing, all lighting outlets shall have lighting fixtures. In instances where a specific lighting fixture has not been assigned to a lighting outlet, furnish and install a complete lighting fixture of the type and wattage designated for outlets of similar function and/or type as directed by the Engineer.

C. Unless otherwise shown on the Basic Contract Drawing, lighting fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the lighting fixture. The design of hangers and the method of fastening other than what is shown on the Basic Contract Drawing, or herein specified, shall be submitted to the Engineer for approval.

3.03 INSTALLATION

A. Install all lighting equipment and accessories, as well as all lighting fixtures, complete with lamps, in the locations shown on the Basic Contract Drawing in accordance with the manufacturer's written instructions. All lighting fixtures shall be properly secured to structural elements.

B. Lighting fixtures shall be carefully supported and aligned with necessary hangers, supporting members, and plaster frames for proper installation, all as shown in the Basic Contract Drawing and the Specifications, and as approved by the Engineer. No rivets, springs, or other hardware shall be visible after installation.

C. Lighting fixtures shall be supported to satisfy seismic requirements described in applicable local codes.

D. All lighting fixtures shall be properly wired and connected to branch circuits, tested, and left ready for operation. Bond all lighting fixtures and metal accessories to the branch circuit-grounding conductor.

E. Where a continuous string of lighting fixture is specified to be installed, the lighting equipment shall be installed so as to produce a continuous, straight, unbroken band of light, free of visual imperfections, socket shadows, light gaps, etc.

F. All pendant-mounted lighting fixtures within the same room or area shall be installed plumb, and at a uniform height from the finished floor. Adjustment of a height shall be made during the installation. Unless otherwise shown on the Basic Contract Drawing, stems and canopies shall be matched to the associated lighting fixtures.

G. Install recessed lighting fixtures to permit removal from below. Use accessories and firestopping materials to meet regulatory requirements for fire rating.

3.04 ADJUSTMENTS

A. Prior to final inspection, relamp all fixtures which have failed lamps, or lamps where visible color shift has occurred, and leave all lighting fixtures, equipment, and accessories in good, uniform operating condition. The Contractor shall replace any burned-out lamp during the first 100 days after the completion of the Contract.

B. Aim and adjust all lighting fixtures as shown on the Basic Contract Drawing.

C. Adjust exit sign arrows as shown on the Basic Contract Drawing.

D. Cleaning

1. Clean all components of the lighting system to remove conductive and deleterious materials.
2. Remove dirt and debris from all enclosures.
3. Clean finishes and touch up damage.

END OF SECTION

SECTION 16510

LIGHTING SYSTEMS

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. For each lighting fixture type: Clearly illustrate assembly methods, detailed dimensions, mounting details, materials, finishes, electrical components, and light sources.

2. For each lighting fixture type: Submit independent testing laboratory photometric report, and performance data in IESNA format

   a. Luminaire, ballast and lamp description and manufacturer's complete catalog number

   b. Luminaire drawing with basic dimensions

   c. Candela Distribution Table and Curve

   d. Coefficient of Utilization Table

   e. Visual Comfort Probability Table

   f. Zonal Lumen Summary Table

   g. Luminance Summary Table

   h. Input Watts

   i. Luminaire Efficiency

3. For each lighting fixture type support: Submit verification of compliance with seismic requirements of applicable codes.

4. For each ballast type: Submit manufacturer's data with ballast description, catalog number, lamp type, input voltage, in-rush current, line current, input wattage, ballast factor, power factor, crest factor, minimum starting temperature, total harmonic distortion and wiring diagram.

5. Lighting management system: Submit shematic wiring diagrams, component specifications, enclosure dimensions, installation details, operation manual, and approvals of respective standards.

6. Dimmer system components: Submit schematic diagrams, component specifications, enclosure dimensions, installation details, and approvals of respective standards.

7. Photoelectric Control Devices: Submit manufacturer's data for ambient light sensors, timers, infrared and ultrasonic occupance sensors.

B. Samples

For items indicated on the Basic Contract Drawing submit working samples for review and approval upon request by the Engineer. Install and energize samples as shown on the Basic Contract Drawing or as directed by the Engineer.

C. Mock-up

1. If requested on the Basic Contract Drawing, provide mock-up installation for review and approval by the Engineer. The mock-up shall simulate specified lighting system conditions as shown on the Basic Contract Drawing.

2. For each substitution item which is not specified on the Basic Contract Drawing provide mock-up installation at no cost to the Authority if requested, and as directed by the Engineer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16620

DIESEL-GENERATOR SET (WITH AUXILIARIES)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for a complete diesel-generator set with auxiliaries.

1.02 REFERENCES

The following is a listing of the publications referenced in this section:

	American National Standards Institute (ANSI)
ANSI B 16.5	Pipe Flanges and Flanged Fittings
ANSI B 31.1	Power Piping
ANSI B 40.2	Gauges and Indicators, Pressure and Vacuum -Indicating Digital Type
ANSI C 12.11	Instrument Transformers for Metering Purposes, 15 kV and Less
ANSI C 37.2	Electrical Power System Device Function Numbers
ANSI C 37.90	Relays and Relay Systems Associated with Electric Power Apparatus
ANSI C 39.1	Electrical Analog Indicating Instruments
ANSI C 97.1	Low-Voltage Cartridge Fuses 600 Volts or Less
	American Society of Mechanical Engineers (ASME)
	Boiler and Pressure Vessel Code
	American Society for Testing and Materials (ASTM)
ASTM A 53	Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
ASTM A 106	Seamless Carbon Steel Pipe for High- Temperature Service
ASTM A 120	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
ASTM A 135	Electric-Resistance-Welded Steel Pipe
ASTM A 181	Forgings, Carbon Steel, for General-Purpose Piping
ASTM B 221	Aluminum and Alumina-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM A 234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 527	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality

	Diesel Engine Manufacturers Association (DEMA)
DEMA	Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines
	Federal Specifications (FS)
FS W-B-134	Battery, Storage, (Lead-Acid, Industrial Floating Service)
FS VV-F-800	Fuel Oil, Diesel
FS WW-P-521	Pipe Fittings, and Flange Fittings, and Flanges: Steel and Malleable Iron (Threaded and Butt-Welding) Class 150
FS WW-V-51	Valve, Angle, Check, and Globe, Bronze (125, 150 and 200 Pound) Threaded End, Flange Ends, Solder Ends and Brazed End, for Land Use
FS WW-V-54	Valve, Gate, Bronze (125, 150 and 200 Pound, Threaded Ends, Flange Ends, Solder Ends, and Brazed Ends, for Land Use)
FS ZZ-H-428	Hose; Non-Metallic and Hose; Preformed: (For the Coolant Systems of Automotive and Other Liquid-Cooled Engines)
	Institute of Electrical and Electronics Engineers (IEEE)
IEEE 43	Testing Insulation Resistance of Rotating Machinery
IEEE 115	Test Procedures for Synchronous Machines
	Military Specifications (MIL)
MIL L-2104	Lubricating Oil, Internal Combustion Engine, Tactical Service
MIL T-52777	Tanks, Storage, Underground, Glass Fiber Reinforced Plastic
	Military Standards (MIL STD)
MIL STD 461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL STD 705	Generator Sets, Engine Driven, Methods of Tests and Instructions. Generator Sets, Electrical, Measurements and Instrumentations
	National Electrical Manufacturers Association (NEMA)
NEMA AB 1	Molded Case Circuit Breakers
NEMA EI 2	Instrument Transformers
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA MG 1	Motors and Generators
NEMA MG 2	Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
NEMA PB 2	Deadfront Distribution Switchboards
NEMA PV 5	Constant Potential Type Electric Utility (Semiconductor Static Converter) Battery Chargers
NEMA SG 3	Low-Voltage Power Circuit Breakers
NEMA SG 4	Alternating-Current High-Voltage Circuit Breakers
NEMA SG 5	Power Switchgear Assemblies

National Fire Protection Association (NFPA)

NFPA 30	Flammable and Combustible Liquids Code
NFPA 37	Stationary Combustion Engines and Gas Turbines
NFPA 70	National Electrical Code (NEC)
NFPA 99	Health Care Facilities
NFPA 110	Emergency Power Supplies

National Building Code (BOCA)

1.03 QUALITY ASSURANCE

A. The equipment supplied shall be new and standard product of the diesel-generator manufacturer, who shall be the single source responsibility for warranty, parts, and service.

B. Diesel-generator sets, of the size and type required, shall have been satisfactorily used for purposes similar to those intended herein for not less than five years.

C. Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number and catalog number on a plate secured to the equipment.

D. Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that are of such a nature or are so located as to be a hazard to operating personnel, shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed in such manner that proper operation of the equipment is not impaired.

E. Welding procedures and welders shall be qualified in accordance with Section IX, ASME Boiler and Pressure Vessel Code. Welding procedures qualified by others will be accepted as permitted by ANSI B 31.1.

F. Where materials or equipment are specified to comply with requirements of the referenced publications, evidence of such compliance shall be submitted. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services stating that the items have been tested and conform to the requirements of this Section.

G. The diesel-generator set, all the components, and the means of their attachments and supports shall be designed and constructed to resist the effects of earthquake motion determined in accordance with BOCA National Building Code for seismic hazard exposure group III. The effective peak velocity-related acceleration (AV) which shall be utilized to determine seismic forces shall be 12. For the purpose of classification, this equipment and its enclosures are considered to be emergency or standby electrical equipment, as defined in the Table 1612.6.4(1) of BOCA National Building Code. Submit certification of the above requirements to the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver parts, components, and accessories in manufacturer's original, unopened, protective packaging. All equipment shall be properly packed and mounted on pallets or skids to facilitate the handling.

B. Store parts, components and accessories, including engine-generator set, in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

D. Touch up any damage to finishes to match adjacent surfaces.

E. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

F. Replace engine oil, and fuel-oil filters after completion of all load testing.

G. Top-off fuel storage tank after completion of all testing.

1.05 SPARE PARTS

A. Submit a complete list of spare parts for approval by the Engineer.

B. Furnish spare parts in containers or packaging to protect parts from damage. Clearly mark each package to identify the parts contained therein.

C. Furnish two spare engine oil filters and two spare fuel-oil filters and the associated gaskets.

D. Furnish two spare air filters and associated gaskets, per intake.

E. Furnish ten spare lamps and fuses, for each type provided as part of the equipment.

F. Furnish two engine, fan, alternator or pump belts, for each type provided as part of the equipment.

G. The Contractor, or his authorized representative, shall confirm that there are a minimum of three (3) established agencies within the Port Authority district, which stock a full inventory of spare parts for the system supplied. In the event that there are not three (3) sources of supply, the Contractor warrants that all system components will be made available by the Contractor for a period of ten (10) years from the date of acceptance of the system.

1.06 OPERATION AND MAINTENANCE MANUALS

Furnish ten sets of suitable bound Operation and Maintenance Manuals outlining step-by-step procedures required for system start-up and operation. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of each equipment and component and its basic operating features. Prior to issuance of the certificate of final completion, prepare and submit to the Engineer for approval Operation and Maintenance Manuals in accordance with the requirements of the section 16001, entitled Operation and Maintenance Manuals.

A. Maintenance manuals listing routine maintenance procedures, possible breakdowns, and repairs shall be furnished. The manuals shall include schematic and wiring diagrams for the system as installed.

B. Framed instructions under glass or in laminated plastic, including wiring and control diagrams schematically showing the key mechanical and electrical control elements and complete layout of the entire system, shall be posted where directed by the Engineer. Condensed operating instructions explaining control sequence and preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted for approval by the Engineer, prior to posting. The framed instructions shall be posted before acceptance testing of the systems.

1.07 TRAINING

Prior to the on-site inspection and test of the system, prepare and submit to the Engineer for approval a curricula, in accordance with the requirements of this Section. Topics shall cover all of the items contained in the Operation and Maintenance Manuals, including control operation, schematics, wiring diagrams, meters, indicators, warning lights, shutdown system, and routine. Conduct a training course for Authority operating staff. The training period, of a total of 8 hours of normal working time shall start after the system is functionally completed but prior to final acceptance tests.

1.08 SUBMITTALS

See Appendix A for Submittal Requirements.

PART 2. PRODUCTS

2.01 MANUFACTURER

Subject to compliance with requirements of this Section, provide diesel-generator set(s) of manufacturers as shown on the Basic Contract Drawing.

2.02 RATINGS

Subject to compliance with requirements of this Section the diesel-generator set ratings shall be as shown on the Basic Contract Drawing and in conformance to DEMA standard practices.

2.03 CONSTRUCTION FEATURES

Provide labor, materials, equipment and service for a complete installation of diesel engine-driven generator set(s), equipped with all operating accessories such as: engine/generator control panel, generator output protective circuit breaker, governor, exciter regulator, starting batteries, battery charger, exhaust piping and silencer, vibration isolators, fuel day tank and transfer pump, fuel-oil piping and storage tank, automatic transfer switch, remote annunciator, resistive load bank, weatherproof enclosure.

The diesel engine-driven generator set shall consist of a diesel engine coupled to a single bearing generator, all mounted on a common base of welded fabricated structural steel. Operation shall be fully automatic upon normal source power failure.

A. Engine

1. The engine shall be of the general purpose, stationary, direct injection, full compression-ignition diesel type, liquid cooled, 4-cycle, in-line or V-type with solid cast iron or steel block. The engine shall have not less than 4 nor more than 20 cylinders. The engine shall be equipped with replaceable full length, wet type, heat treated cylinder liners. The engine may be either naturally aspirated, scavenged, or supercharged. The engine shall operate without excessive smoke, overheating, or mechanical damage when driving the generator under the specified conditions.

2. The engine shall develop the required horsepower when operating on DF-2 diesel fuel conforming to FS VV-F-800 and with lubricating oil conforming to MIL L-2104 of the type and grade as recommended by the engine manufacturer. The engine shall be started and stopped, and run on DF-2. The engine shall have a standard published net available continuous horsepower rating which, when corrected for specified operating conditions, generator efficiency and after subtracting power for engine and electric driven accessories, auxiliaries and other losses shall be not less than that required to drive the generator continuously at 100 percent of rated full load and 110 percent of rated load for 2 hours out of any 24 consecutive hours of operation. The 100 percent full load rating of the engine shall be the horsepower that the engine will deliver continuously at its coupling or flywheel when in good operating order and under the specified conditions.

B. Engine auxiliaries

1. Fuel pump shall be of positive-displacement engine-driven type, and shall supply an adequate quantity of fuel under all conditions of operation. A relief valve shall prevent the buildup of excessive pressure in the discharge line.

2. The system shall be pressurized by one or more engine-driven lube-oil pumps, and shall conform to NFPA 30 and NFPA 37. Pressure shall be regulated by an appropriate relief valve or other approved means. Pipe connections shall be provided for draining the engine. Each engine shall have a dip stick oil-level indicator. The engine shall be wet sump type.

   a. The proper amount of clean lube oil conforming to MIL L-2104 shall be furnished for each engine. Oil entering pressurized parts of the engine shall pass through a full-flow filtering system consisting of a strainer, lube-oil pumps and a filter, connected in series and in the order listed. The lube oil system shall permit addition of lubricating oil with the engine operating. The strainers and filters shall be in accordance with the engine manufacturer's recommendations.

   b. Strainer and filter inlet and outlet connections shall be plainly marked. Strainer and filter elements shall be designed to be changed without disconnecting the piping or disturbing other engine equipment. Lubricants and greases shall be provided as required to service the generator sets for initial start up, testing and operation.

3. Jacket-water cooling system shall be of the closed loop type, with radiator factory mounted on engine-generator set skid unless otherwise indicated on the Basic Contract Drawing, and shall be arranged to prevent rust and minimize the formation of scale deposits within the engines, and to circulate jacket-water throughout the engine of the temperature and flow rate recommended by the engine manufacturer.

   a. A self contained fail-open thermostatic control valve shall modulate coolant flow automatically to maintain optimum constant coolant temperature as recommended by the diesel-engine manufacturer. Cooling system coolant shall be a combination of water and ethylene-glycol. Cooling system operation shall be fully automatic while the engine is running. Water temperature differential across engine block shall be not more than 15 degrees F. at full load. Failure of the cooling system resulting in over temperature shall stop the engine.

   b. Jacket-water centrifugal circulating pump shall be engine driven. Pump capacity shall be adequate for the application.

   c. Radiator shall be rated for circulated coolant, and shall be fin-and-tube or stacked corrugated-sheet type and constructed of non-ferrous metals. Size of radiator shall be adequate to contain expansion of total system coolant from cold start to 110 percent load condition, when operating with a cooling air temperature of 100 degrees F. at 500 feet above sea level. Supports shall be as necessary for the mounting indicated. Radiator shall be pressure type incorporating a pressure valve, vacuum valve and a radiator cap. Radiator cap shall be designed for pressure relief prior to removal. Cooling system shall be capable of withstanding a minimum pressure of 7 psig. A strong grille or screen guard shall protect the radiator. Hose shall conform to FS ZZ-H-428, grade B. Tapped holes not less than 3/8 inch NPT shall be located at the lowest points in the cooling system, and shall be plugged or equipped with drain cocks. The engine cylinder head or outlet header shall incorporate a high-coolant-temperature safety device. Radiator fan shall be propeller type with four blades or more. Tip speed shall not exceed 17,000 feet per minute, driven by the engine through a suitable V belt drive or reduction gears. The fan and fan drive system shall be adequately shrouded and guarded to protect personnel from injury. Thermostatic control valves in the jacket coolant, shall maintain temperatures within ranges specified.

   d. Ductwork for the diesel engine air cooling system shall be galvanized iron or steel sheets or aluminum sheets. Gauges, reinforcements, and fabrication, including hangers and supports shall be in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. The ducts shall be straight and smooth on the inside, with joints neatly finished. The ducts shall be anchored securely to the building and shall be installed so as to be completely free from vibration under all conditions of operation. Ducts shall be properly braced and reinforced with angles or other structural members. Internal ends of slip joints shall be installed in the direction of flow. A flexible connection shall connect the diesel engine radiator and the ductwork. Material shall be wire-reinforced glass fabric of suitable weave and weight. The connection shall be rendered practically air tight in a manner approved by the Engineer.

   e. Provide full coolant charge, suitable for operation down to -10 degrees F entering cooling air temperature.

4. Combustion air intake equipment shall include an air filter, in accordance with the engine manufacturer's recommendation. Each type air filter shall have ample capacity and be suitable for connection to the engine air-intake opening element. Expansion elements in air-intake lines shall be rubber.

5. Exhaust piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector, with all necessary flexible sections and hardware, shall connect the engine exhaust outlets to a single exhaust pipe sized to reduce gas velocity to less than 5,000 feet per minute. All pipe and fittings for the exhaust system shall be ASTM A53 schedule 40 steel with sufficient flanged fittings so that the system may be entirely dismantled in sections. Fittings shall be flanged or welded type. Bends shall be long-radius type showing no kinks or wrinkles. Horizontal sections of exhaust lines shall be sloped downward away from the engine to a condensate trap and drain valve.

   a. Flexible exhaust section shall be convoluted seamless tube without joints or packing, designed especially for diesel-engine operation, and capable of absorbing vibration of the engine and of compensating for thermal expansion and contraction. Flanges shall be 125 pound type, plain-faced, drilled, and of dimensions to match the flanged exhaust outlet of the diesel engine. Expansion joints shall be bellows type with flanged connections. Expansion elements shall be stainless steel suitable for exhaust gas temperature as recommended by the diesel-engine manufacturer, but not less than 1,000 degrees F. Expansion joints shall be suitable for relieving stress caused by thermal expansion and contraction and shall be suitable for vibration-isolation service.

   b. Exhaust silencer of the chamber type shall be welded steel, sized as recommended by diesel-engine manufacturer, and designed for inside vertical mounting, as shown on the Basic Contract Drawing. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the silencer shall not exceed the recommendations of the engine manufacturer. Silencer shall be rated for critical application, with measured sound level according to the DEMA, of 85 dBA or less.

   c. Provide a balanced, stainless steel flapper type rain cap on a vertical exhaust.

   d. Finish silencer and supports with a high-temperature aluminum paint.

   e. Starting System

6. Provide an electric starting system, arranged for both manual starting and fully automatic starting actuated by contacts in the automatic transfer switch.

   a. The engine shall be started by means of a 24-volt automatic starting system energized by storage batteries. The automatic starting system shall be mounted in the engine/generator control panel.

b. The engine shall be equipped with a heavy duty positive engagement electric starter motors of sufficient capacity to crank the engine/power generator rotor combination at sufficient speed to allow full diesel starting when conditioned to, and in ambient temperature of 32 degrees F. (indoor) or -10 degrees F.(outdoor), in conjunction with the specified fuel and lubricants. Starting system, including batteries, shall be adequate to crank the engine for a minimum of four cranking periods without overheating. The cranking cycle shall consist of four cranks of 10 seconds each, with three 10 second rest periods between the cranks. If the engine fails to start after the cranking cycle has been completed, the control will lock out, and actuate the overcrank signal light on the control panel and sound an audible alarm. The cranking motor shall be automatically disengaged when the engine accelerates to 600 RPM by means of a suitable speed sensing circuit.

c. Storage battery shall be nickel cadmium cranking batteries complete with battery rack, intercell connectors, and battery-to-engine cables, all in conformance with manufacturer s requirements. The battery capacity shall be compatible with the cranking duty described in preceding paragraph, in an ambient temperature of -10 degrees F. Batteries shall conform to FS W-B-134. Battery capacity shall provide a minimum of 60 seconds of total cold cranking time.

d. Battery charger shall be adequate to recharge the fully depleted battery in not more than 8 hours and shall automatically control the rate of charge, providing a high-charge rate to a depleted battery and reducing to a trickle-charge rate when the battery is fully charged. Charging rate shall be adjustable. Battery charger shall comply with NEMA PV 5. It shall contain a DC ammeter and voltmeter, a fused input and output and completely isolate the AC input from DC output. Battery charger shall be housed in a NEMA 1 enclosure suitable for wall mounting. It shall be provided with battery charger malfunction and low voltage DC alarm relay.

7. The engine shall be provided with thermostatically controlled tank type coolant heaters to maintain engine block coolant temperatures in the range of 100 - 120 degrees F for reliable automatic starting at the ambient temperature range stated herein. The heaters shall automatically disconnect when the engine starts and shall be provided with hand shutoff valves to facilitate service without draining cooling system.

C. Generator

The generator shall be a three phase synchronous type, brushless design, single bearing, with a 4 pole rotor coupled directly to the engine flywheel through a flexible drive disc to maintain permanent alignment. The generator housing shall be bolted directly to the flywheel housing of the engine and shall be capable of withstanding the combined stress of the supported engine weight and anti-torque reactions without distress. Enclosure shall be close coupled, drip proof construction. The generator shall be capable of 10 percent overload for 2 hours in any 24-hour period of operation without exceeding temperature rise indicated in NEMA MG 1. Design shall be such as to protect against mechanical, electrical, and thermal damage due to vibration, 25 percent over-speed, or voltage, and 10 percent overload. The generator shall meet all requirements of NEMA MG-1, Part 22, in design, performance, and factory test procedures.

1. Permanent Magnetic Excitation System: The generator shall be equipped with a permanent magnet generator (PMG) excitation system. The output of the PMG shall be used to supply power to the voltage regulator and to effectively isolate the regulator power circuits from the distortion that occurs when the generator supplies large non-linear loads. Both the PMG and the rotating brushless exciter shall be mounted outboard of the bearing for ease of service. Under short circuit conditions, the system shall be capable of sustaining 300 percent of rated current for 10 seconds. The rotating rectifier shall use a three-phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multi-plate selenium surge protector.

2. Insulation System: The insulation system of both the rotor and the stator shall be NEMA class F or H materials and shall be synthetic, non-hydroscopic, and fungus resistant. The stator winding shall be given multiple dips and bakes of varnish, plus a final coating of epoxy for extra moisture and abrasion resistance.

3. Main Rotor: The rotor shall be dynamically balanced for operating speeds up to 125 percent of rated speed and shall have full amortisseur windings. The main rotor core shall be shrunk-fit and keyed to the shaft.

4. Stator Windings: The stator winding shall be of 2/3-pitch design to minimize the third harmonic and be random wound.

5. Bearing: The rotor bearing shall be pre-lubricated, shielded, ball type with provisions for adding grease.

6. Ventilation and Cooling: The generator shall be self-ventilated and have a one-piece cast aluminum alloy, low noise cooling fan.

7. Conduit Load Connection Box: The generator shall be furnished with a ventilated end mounted load connection box that will allow entry of the load cable conduits through the top, bottom, or either side.

8. Voltage Regulator: The voltage regulator shall be completely solid state with electronic components encapsulated for protection against vibration and atmospheric deterioration. The regulator shall include three phase RMS sensing, true volts per hertz operation with adjustable cut in and provisions for parallel operation. It shall be unit mounted within the generator set terminal box with suitable space for remote connections and control wire terminations.

   A voltage adjusting rheostat shall be provided on the control panel to permit a +/- 10 percent adjustment in generator voltage.

9. Performance: The performance of the generator when driven by the diesel engine shall be as follows:

   a. The unit shall be capable of reaching full rated voltage and frequency within 10 seconds of receiving a start signal and accepting full rated load in one step under the ambient temperature conditions specified herein.

   b. Voltage regulation shall be +/- 0.5 percent maximum deviation from rated generator terminal voltage between no load and full load 0.8 power factor under steady state conditions.

   c. Voltage transient deviation shall be 20 percent maximum from rated generator terminal voltage on one step application or removal of full load when generator is driven by diesel engine.

   d. Frequency regulation shall be +/- 0.25 percent maximum deviation from rated generator terminal frequency at any constant load from no load to rated load.

   e. Frequency transient shall be 12 percent maximum deviation from rated generator terminal frequency on one step application or removal of full load at either 0.8 or 1.0 power factor when generator is driven by diesel engine.

   f. Voltage and frequency transient recovery time shall be 6 seconds maximum for one step application or removal of full load at either 0.8 or 1.0 power factor from the time the generator terminal voltage and frequency leaves the respective regulation limits, to the time the generator terminal voltage and frequency recovers within respective regulation limits when generator is driven by diesel engine.

   g. Electromagnetic interference suppression shall not exceed that specified in MIL-STD-461B, part 9.

   h. The generator waveform harmonic distortion shall not exceed 5 percent total RMS measured line to line at full rated load. The TIF factor shall not exceed 50.

D. Engine/Generator Control Panel

The engine generator shall be provided with a control panel, in a NEMA 1 type 14 gauge steel enclosure, or as shown on the Basic Contract Drawing. It shall be mounted on the generator set, with suitable vibration isolators, and incorporate solid state microprocessor based control circuitry, sealed dust tight, watertight modular components with metal housing and digital instrumentation. Instruments shall be back connected and flush mounted. The panel shall include the following equipment:

1. Generator AC Output Metering Devices

   a. AC Voltmeter, 2 percent accuracy

   b. AC Ammeter, 2 percent accuracy

   c. Combination voltmeter/ammeter selector switch

   d. AC Frequency meter

2. Fault shutdown circuits with individual visual and audible indications for:

   a. High jacket coolant temperature

   b. Low oil pressure

c. Engine overspeed

d. Engine overcrank

e. Low coolant level

3. Engine Control and Monitoring Devices

a. Automatic/manual start-stop control

b. Emergency stop pushbutton

c. Manual-of-auto selector switch

4. Alarm circuits with individual visual and audible indications for:

a. Pre-high jacket coolant temperature

b. Pre-low oil pressure

c. Low coolant temperature

d. Control switch not in Auto

e. Battery charger malfunction

f. Low battery voltage

g. Low fuel level

5. Lamp test switch

6. Alarm horn and silence switch

7. Voltage adjust rheostat

8. Governor speed adjust rheostat

9. Running time meter

10. Remote connection provision for any system fault

11. All necessary control wiring, fuses, fuse blocks, terminal blocks, nameplates, auxiliary contacts, etc.

The mutable alarm horn shall annunciate any alarm condition. At the same time a blinking visual signal shall indicate the cause of alarm. If an emergency device stops the engine, the visual signal shall stop blinking, but remain on and indicate the cause of failure.

Installation shall comply with ANSI B40.2, ANSI C12.11, ANSI C 37.2, ANSI 37.90, ANSI C 39.1, and ANSI C97.1.

E. Generator Circuit Breaker

An enclosed generator mounted main line circuit breaker shall be provided within the generator set terminal box to protect the unit from overcurrent and short circuit conditions. The breaker shall be installed within an enclosure as specified on the Basic Contract Drawing, of suitable size which shall allow for proper bending radius of all conductors as per National Electrical Code. Lugs and supports shall be included. Installation shall comply with NEMA SG3 and NEMA SG4.

Circuit breaker shall be supplied with 24VDC shunt trip device and ground fault trip.

F. Engine Governor System

An engine governor system shall be provided to maintain engine speed within the limits specified herein from no load to rated load. The governor shall be of electronic type. Steady state frequency regulation shall be +/-.25 percent. Governor speed droop shall be adjustable from 0 to 10 percent from no load to full rated load. A remote speed adjusting potentiometer shall be mounted in the control panel.

G. Fuel Oil System

Furnish a complete fuel oil system, as specified in this Section, as shown on the Basic Contract Drawing and in accordance with NFPA 30 and NFPA 37.

1. Provide a main fuel storage tank, with locking fill cap and all necessary tank fittings, as shown on the Basic Contract Drawing and in accordance with MIL T-52777.

2. Provide a day tank, with capacity as shown on the Basic Contract Drawing, installed within the generator enclosure. The day tank containment shall be integral rupture basin with capacity of 150 percent of nominal capacity of day tank. The day tank shall be mounted so as to provide a flooded suction to the engine if so recommended by the manufacturer. Day tank shall be provided with transfer pump and connections for the fuel supply, fuel overflow return, fill, vent and drain pipes. Provide a manual (hand) pump for emergency operation. A double pole float switch on tank shall control a solenoid valve and start the transfer pump on low level and stop it at high level. The solenoid valve shall be installed in the fill line for operation with 120 volt 60 Hz single phase AC. Positive means shall be provided to prevent fuel oil leakage from day tank through injectors into the engine cylinders, when the engine is not running.

3. Provide a high-lift, electric motor-driven fuel-transfer pump to transfer fuel from the fuel storage tank to the day tank. Motor voltage, ratings and characteristics shall be as shown on the Basic Contract Drawing.

4. Provide one duplex, full-flow strainer and one duplex, full-flow filter for each engine. Strainer shall be located on the suction side. When the pump and the high pressure injector equipment are contained in a common housing, the fuel filter may be located between strainer and engine fuel pump. Strainer shall be metal-edge or screen type with a maximum opening of 0.007 inch (80 mesh). Filter case shall be compatible with the filter elements. Strainer and filter shall have inlet and outlet connections plainly marked and shall be mounted in accessible locations. Strainer and filter elements shall be designed to be changed without disconnecting the piping or disturbing other engine components and shall be so valved and arranged as to permit changing without shutting down the engine. An indicating differential pressure gauge shall be provided across the inlet and outlet sides of the filters. A pressure gauge with red line limit shall be provided at the inlet side.

H. Provide complete piping systems for fuel oil and vent from storage tank, to day tank and generator set, and for engine exhaust. Only black iron or wrought steel pipe shall be used for fuel oil and exhaust piping. Galvanized pipe shall not be used.

1. Connections shall ensure unrestricted circulation and permit complete drainage of the system. Changes in supply-main sizes shall be made through eccentric reducing fittings. Pipe shall be cut to measurements established at the project site and shall be worked into place without springing or forcing, clearing all windows, doors, and other openings. Pipe burrs shall be removed by reaming. Pipe supports shall permit free expansion and contraction without damage to joints or hangers. Changes in direction shall be made with fittings. Bending of pipe will not be permitted. Bent pipe showing malformation will not be accepted. Pipes extending through the roof shall be properly flashed. Piping connections to equipment shall be as required for a complete and operating system. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign material out of the system.

2. Metering of pipe to form elbows, notching straight runs to form tees or similar construction will not be permitted. Flanged joints shall be faced true, gasketed, and made up square and tight. Gaskets shall be factory cut in one piece, 1/16-inch thick.

3. Pipe, valves, fittings, and pumps to be installed in the fuel-oil system shall be shipped uncoated with the open ends capped or plugged. Before assembly, pipe interior shall be swabbed to remove any debris. Upon completion of the installation of the fuel oil system, the supply and return pipelines shall be flushed prior to connection to the engine.

4. Pipe, fittings, valves and miscellaneous materials necessary for a complete system shall conform to the applicable requirements of FS WW-P-521, FS WW-V-51, FS WW-F-54, ASTM A 53, ASTM A 106, ASTM A 120, ASTM A 135, ASTM A 181 and ASTM A 234 and ASTM B 16.5.

I. Load Bank

1. The load bank rating shall be as specified on the Basic Contract Drawing. The load bank shall be a completely self-contained unit for mounting in the radiator air stream, unless otherwise shown on the Basic Contract Drawing. The load bank shall include all resistive load elements, load control devices, and protective devices.

2. The resistive elements shall be made of corrosion resistant wire. Resistive elements shall be continuously supported by a ceramic insulated steel rod, securely held at each end. The resistive load steps shall be additive and arranged as shown on the Basic Contract Drawing. The total load shall terminate to a single, 3-phase distribution block.

3. The load bank shall have an over temperature sensor mounted in the top of the core. Load step fusing shall be provided.

4. The controls shall be housed in a Control Panel, including switches for each load step, a master control switch, and power ON-OFF switch. Control Panel is an integral part, located on the side of the load bank.

J. Enclosure for Outdoor Installations

Enclosure shall be pre-engineered and prefabricated sound attenuated, self-contained package, including the generator set, generator circuit breaker, batteries and charger, day tank, air inlet silencer, exhaust silencer and casing ventilation fan and louvers with motor operated dampers.

1. The enclosure design criteria shall be as follows:

   a. Weatherproof and vandal-resistant, walk-in type.

   b. Rigidity for wind loading of 150 mph.

   c. Roof loading of 40 pounds per square foot, reinforced for silencer mounting.

   d. Rain tested for 5 inches of rainfall per hour.

   e. Acoustical attenuated of 25 dBA, measured at three feet form the enclosure.

2. Enclosure shall consist of a roof, underframe, two side walls, and two end walls. It shall be a galvanized steel, metal-clad integral structural steel framed construction, painted inside and out with rustinhibiting primer and an exterior coat of enamel painting, erected on concrete foundation.

3. Provide a thermostatically controlled space heater, which shall operate at one half or less of its rated voltage, and size to prevent condensation.

4. Engine cooling airflow through enclosure shall be adequate to maintain a temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours, with cooling air inlet temperature of 100 degree F. Provide fixed-engine sound-attenuating cooling air inlet and discharge lovers, designed to prevent entry of rain and snow.

5. Provide enclosure ventilation louvers as required, equipped with insect/rodent screen and filters arranged to permit air circulation when engine is not running. There is no need to remove side panels to provide additional circulation.

6. The engine-generator set shall be shock mounted on a welded steel skid.

7. Enclosure s thermal/acoustical insulation shall be of glass fiber, protected by a perforated sheet metal liners. Insulation thickness shall be as required to maintain winter temperature within limits required by engine-generator set components.

8. Wall panels shall be bolt-in, gasketed, removable from the inside only. To prevent tempering, the housing shall have lockable latches.

9. Required instruments and control shall be mounted within enclosure.

10. Personnel door shall be hinged, and shall be gasketed to seal door watertight. Provide panic bar hardware with three point cadmium-plated locks, with provision for external padlock and opening from inside, in locked condition.

11. Provide a minimum of four 35,000-pound steel lift rings, suitable welded to enclosure.

12. Provide motor-operated, fail-open automatic dampers at engine cooling inlet and discharge. Dampers shall close to reduce enclosure heat loss in cold weather, when unit is not operating.

13. Provide factory-wired, vaporproof light fixtures within housing. Switching shall be adjacent to the personnel door. Provide battery-powered emergency lighting. Lighting shall comply with NFPA 110.

14. Provide convenience receptacles, circuited separately from lighting, of the ground fault interrupting type.

15. Provide an auxiliary distribution panel that shall be prewired to the ancillary generator equipment.

16. The exhaust silencer shall be pre-fitted and shipped loose with necessary mounting hardware including flanges, elbows, and raincap.

17. The enclosure shall be prepiped and prewired, so as to require only unit connections within the control area and to the generator. The enclosure shall include vibration isolation pads between the generator subbase and the floor or underframe.

K. Site Condition

The operating environment of the diesel-generator set shall be as follow:

Altitude: 500 Feet Above Sea Level

Max. Ambient Fan: 120 degree Fahrenheit

Min. Ambient Temperature: -20 degree Fahrenheit

Relative Humidity: 20 to 100%

Coolant System Engine Mounted Radiator

2.04 PAINTING

Unless otherwise specified, surfaces of equipment and component items shall be cleaned, primed and finished painted in accordance with the manufacturer's standard practice.

2.05 FACTORY TESTS

A. Prototype Tests

The diesel-generator set design shall have been tested as a complete unit, on representative engineering prototype models, in conformance to the requirements of NFPA 110, IEEE 43, IEEE 115 and MIL STD 705. Certified test data shall be submitted to the Engineer.

B. Production Tests

Fully test the diesel-generator set with all mounted appurtenances prior to the shipment to the job site. Diesel-generator set shall receive the manufacturers standard production test of the completely assembled engine, generator, radiator, control panel, and mounting base. The manufacturer shall provide written certification and documentation supporting compliance with test requirements.

The following equipment shall be tested at the manufacturer s plant before shipment:

1. Diesel-generator set:

   Diesel generator, production test procedure shall be approved by Engineer. The diesel-generator set shall be tested under balance, rated load and 80% power factor for performance and functioning of control and interfacing circuits. Testing at unity power factor only is not acceptable. Test shall include:

   a. Single step load pick-up per NFPA 110

   b. Transient and voltage dip response and steady state voltage and speed (frequency) checks

   c. Visual inspection and functional test for lube-oil pump, cooling system, exhaust system, and starting system

2. Generator Control Panel

   Control panel production test procedure shall be approved by Engineer.

3. Battery charger

   The battery charger test procedure shall be based on NEMA PV-5 standards and shall be approved by Engineer.

   Factory test, as outlined above, shall be witnessed by the Engineer. The Manufacturer shall notify the Engineer two (2) weeks prior to the date the tests are to be performed.

PART 3. EXECUTION

3.01 EXAMINATION

After the system equipment has been delivered, an on-site inspection will be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this section, the Contractor will be notified in writing, and shall be required to replace the equipment at his own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor.

3.02 PREPARATION

The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

The entity manufacturing the equipment shall provide on-site technical supervision and assistance during installation and interconnection of the system equipment installed by the Contractor. Said supervision is to insure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the final acceptance test.

3.03 INSTALLATION

A. Install diesel-generator, auxiliaries and appurtenances as shown on the Basic Contract Drawing, in accordance with manufacturer's instructions, NFPA 70, NFPA 30, NFPA 37, NEMA MG 2, other applicable codes and standards, and as specified herein. In case of conflict, consult the manufacturer before proceeding with installation.

B. Install level concrete foundation and pad, including conduits, piping and anchor bolts, as shown on the Basic Contract Drawing and in accordance with the manufacturer's instructions and approved shop drawings.

C. Interconnect all equipment, for proper operation.

D. Excavation and backfill for fuel storage tank and conduit and piping systems shall be as specified in the Section of the Specifications entitled "EXCAVATION, BACKFILLING AND FILLING".

E. Concrete Work shall be as specified in the Division 3 - Concrete - of the Specifications.

F. Install a complete grounding system for the diesel-generator set and enclosure as shown on the Basic Contract Drawing and as specified in the Section of the Specifications entitled "GROUNDING".

3.04 FIELD TESTS

A. Before being covered, enclosed or placed in use, all fuel-oil piping shall be hydrostatically tested with the normal system fluid to 150 percent of the maximum anticipated pressure of the system, or pneumatically tested to 110 percent of the maximum anticipated pressure of the system, but not less than 5 psig at the highest point of the system. This test shall be maintained for a sufficient time to complete a visual inspection of all joints and connections, but for at least 10 minutes. Upon completion of the testing, the piping shall be properly connected and filled with the fuel oil to be used in the system.

B. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative of the diesel-generator set manufacturer. The engine lubrication oil recommended by the manufacturer shall be provided and installed.

C. Functional Test

Upon completion of initial start-up and system checkout, perform a functional test, in the presence of the Engineer, to demonstrate load carrying capability, operation in accordance with the specifications, and voltage and frequency stability.

D. Operational Test

Perform a full-load test in compliance with NFPA 110, in the presence of the Engineer. The building loads can serve as part of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate KW rating of the diesel-generator set. Transfer, on a temporary basis and for the duration of testing, any normal loads necessary to establish the specified generator loading. The duration of the full-load test shall be for a minimum of two hours.

1. Record, throughout the test, time-of-day, coolant temperature, cranking time until prime mover starts and runs, time required to come up to operating speed, voltage and frequency overshoot, time required to achieve steady-state condition with all switches transferred to the emergency position, voltage, frequency, current, oil pressure, ambient air temperature, kilowatts, power factor, battery charger rate, at 5 minute intervals for the first 15 minutes, and at 15 minute intervals thereafter.

E. Provide all labor and materials for functional and operational tests required and furnish the fuel-oil necessary for the load testing. Top-off fuel storage tank after completion of testing.

F. Should the tests reveal any defects in the diesel-generator equipment or auxiliaries installed under this Contract, promptly correct such defects and rerun the tests until the entire installation is satisfactory to the Engineer in all respects.

G. Report immediately to the Engineer any defect found in portions of the diesel-generator system not installed under this Contract. Do not attempt to rectify any defect found in a component of the system not installed under this Contract unless specifically instructed to do so by the Engineer.

H. Submit all the test results to the Engineer for final approval.

END OF SECTION

DIVISION 16

SECTION 16620

DIESEL-GENERATOR SET (WITH AUXILIARIES)

APPENDIX A

SUBMITTAL REQUIREMENTS

A. Shop Drawings

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

1. Electrical wiring diagrams
2. Coolant system schematic
3. Fuel piping schematic
4. Interconnection wiring diagrams, logic and ladder diagrams
5. General arrangement drawing showing location, size, access, workspace requirements, and dimensions of all components and required interfaces. Drawing shall provide data required to completely design the foundation for the unit, including anchor bolt layout.
6. Transient response data of the engine generator set to 100% block loads at 1.00 power factor. Data shall include maximum voltage dips, maximum frequency dips, and recovery times.
7. Weatherproof enclosure

B. Catalog Cuts

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

1. Engine
2. Radiator
3. Generator
4. Engine/Generator control panel
5. Generator output protective circuit breaker
6. Governor
7. Outdoor weatherproof enclosure (as required)
8. Remote alarm annunciator
9. Vibration isolators
10. Flexible fuel lines

11. Exhaust silencer and flexible connections
12. Fuel day tank and transfer pump
13. Anchor bolts
14. Cranking batteries and rack(s)
15. Battery charger
16. Block heater
17. Battery heater blanket (as required)
18. Voltage regulator
19. Enclosure space heater (as required)
20. Resistive load bank (as required)
21. Automatic transfer switch (as required)

C. Evidence of material or equipment compliance per 1.03

D. Spare Parts: Submit a complete list of recommended spare parts per 1.05

E. Operation and Maintenance Manuals per 1.06

F. Training curricula per 1.07

G. Certified Prototype Test compliance per 2.05 A

H. Certified Production Test compliance per 2.05 B

I. Acceptance Testing Plans per 3.04

1. Prepare and submit to the Engineer for approval an installation acceptance testing plan for the entire system a minimum 30 days in advance of the earliest, approved, scheduled inspection and test date. The system plan shall be divided into the following stages:

   a. Inspection upon arrival at the construction site

   b. On-site inspection and test immediately following the complete installation of the system, to demonstrate compliance with the requirements of this section

   c. Operational test commencing with the successful completion of the on-site inspection and test.

J. Field test reports per 3.04

K. Seismic certification

L. Record Documents

1. Prior to issuance of the certificate of final completion, deliver to the Engineer the following:

   a. One (1) reproducible set of the Basic Contract Drawing and Shop Drawings. Nine (9) set of prints of said Basic Contract Drawing and Shop Drawings shall be supplied to the Engineer, three (3) copies of which shall be marked to the attention of the facility Supervisor of electrical maintenance.

b. Nine (9) copies of the final version of the Operation and Maintenance manuals. Three (3) copies of said Operation and Maintenance manuals shall be marked to the attention and the facility Supervisor of electrical maintenance.

END OF APPENDIX "A"

DIVISION 16

SECTION 16670

LIGHTNING PROTECTION SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for a complete lightning protection system.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	Lighting Protection Institute (LPI)
LPI 175	Lightning Protectors Installation Code
LPI 176	Material Standard
LPI 176	Inspection Guide
	National Fire Protection Association (NFPA)
NFPA 70	National Electrical Code
NFPA 780	Lightning Protection Code
NFPA 781	Lightning Protection Early Streamer Emission Air Terminals Code (Proposed)
	Underwriters Laboratories
UL 96	Lightning Protection Components
UL 96 A	Installation Requirements for Lightning Protection Systems

1.03 DESIGN REQUIREMENTS

A. Unless otherwise specified on the Basic Contract Drawing or in this Section, the Lightning Protection System shall be manufactured, supplied, and installed in conformance with the requirements of all local codes, and the Publications referenced in Article 1.02 herein.

B. The Lightning Protection System shall be composed of all items of hardware, cables and grounding electrodes necessary to dissipate the lightning current into the mass of the earth. In general, the system shall consist of readily available listed components that fully comply with the requirements of this Section and the Basic Contract Drawing.

C. The Lightning Protection system shall be designed to prevent damage to building structures and property, injury to occupants, and protection of electrical systems including electronic equipment.

D. The Lightning Protection system shall include but not be limited to the following:

1. The entire roof system, gutters, leaders ventilators, and all other metal appurtenances shall be made electrically continuous and shall be grounded to the grounding grid or in the case of structural steel frame construction directly to the building steel with approved fasteners at intervals averaging not more than 100 feet around the perimeter of the structure.

2. All metallic objects inside the building within 6 feet of the Lightning Protection System or metal connected to it shall be bonded to the system with approved fittings and conductors.

3. Air terminals shall be no more than 20 feet apart with the end terminals no more than 2 feet from the ends of the building.

4. Lightning protection conductors shall interconnect all metallic objects on the protected structure, and shall be installed to provide a two way path to ground from each air terminal, and shall be bonded to the steel framework at each roof beam and a minimum of every 60 feet along the ridge beam.

5. Down conductors shall be installed at all four (4) corners of the building, at columns near the center of the north and south building walls and at other locations as required by the referenced codes and good design. They shall be installed as directly as possible to ground.

6. The design of the Lightning Protection System, including the down conductors, shall be compatible with the architectural features of the building or structure, as approved by the Engineer.

1.04 QUALITY ASSURANCE

A. The Contractor shall engage the services of a UL certified lightning protection installer, who shall have designed and installed Lightning Protection Systems that have been in satisfactory use for not less than three years in a minimum of 20 installations for purposes similar to those intended herein.

B. The lightning protection system design and installation shall conform to the requirements of LPI 175, LPI 176, NFPA 70, NFPA 780, NFPA 781, UL 96, and UL 96 A.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging. Protective caps shall be removed immediately prior to installation of conduit.

B. Store materials in a clean, dry space and protect them from weather.

C. Handle in a manner to prevent damage to finished surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 SPARE PARTS

A. The Contractor, or his authorized representative, shall confirm that there are a minimum of three (3) established agencies within the Port Authority District, which stock a full inventory of spare parts for the system supplied. In the event that there are not three (3) sources of supply, the contractor warrants that all system components will be made available by the Contractor for a period of ten (10) years from the date of acceptance of the system.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of this Section, provide a lightning protection system of one of the manufacturers specified on the Basic Contract Drawing.

2.02 MATERIAL

A. General

1. All electrical materials and equipment, shall be labeled or listed by UL for use in Master Labeled Lightning Protection systems. Materials shall be sized in accordance with the materials requirements of NFPA 780 and UL 96A.

2. Generally all materials shall be copper, or copper-bronze (in locations where system components are mounted on aluminum surfaces, aluminum materials shall be used) as specified herein and of the size, weight and construction to suit the application shown on the Basic Contract Drawing and shall be used in accordance with UL and LPI and NFPA code requirements, for class II structures and as per manufacturers recommendations.

B. Conductors

1. Conductors shall be sized in accordance with material requirements above. Down conductors shall be copper.

C. Connections, Splices, and Fasteners

1. Connectors, splicers, fasteners, and cable clamps shall be heavy-duty bronze, approved for lightning protection systems.

2. Bonding plates shall be heavy-duty bronze with a minimum bonding surface of 8 square inches.

3. Fittings for connections to metal tracks, gutters, ventilators, etc., shall be of an approved type and shall be made tight by compression under bolt heads or equivalent.

4. Screws, bolts, nuts, washers and nails shall be stainless steel. Galvanized or plated materials are not acceptable.

D. Roof Penetrations

1. The roof penetrations required for down conductors or for connections to structural steel framework shall be made using thru-roof assemblies.

2. Through the roof connectors shall be bronze, right-angle, thru-roof connectors with clamp type top cable connector, 4 inches square roof flashing plate, 1/2 inches diameter by 15 inches long threaded stem, hex nut and washer, and adjustable bottom cable clamp.

3. Roof flashing shall be compatible with the roofing system.

E. Air Terminals

1. The air terminals shall be as follows:

a. Ridge Type

(1) Air terminal shall be pointed, solid, round, heavy duty, bronze rod for concealed in place installation.

(2) Air terminal shall be 1/2 inches in diameter with a 10-inch nickel tipped point and 15-inch long solid copper stem.

(3) Each air terminal shall be furnished with lead washers, a support bracket for attachment to the ridge member, and an adjustable thru-roof clamp type cable connector.

b. Parapet Type

(1) Pointed, solid, round, heavy duty, bronze rod with 5/8 inches inside threaded adapter for mounting on a point support.

(2) 1/2 inches in diameter with a nickel tipped point and a 24-inch long solid copper stem.

(3) Each terminal shall be furnished with an offset point support and a point extension.

(4) Each offset point support shall be bronze with a 5/8 inch outside thread.

(5) Each point extension shall be bronze, 3 inches long, with a 5/8 inches outside top thread and a 5/8 inches inside bottom thread.

F. Ground Terminations

1. The ground terminations shall be as follows:

a. 5/8" x 10'-0" (minimum) copper-clad rod.

b. Bronze clamp (connecting ground rod and down conductor) having at least 1-1/2" of contact between rod and conductor, or by an exothermic welded connection.

c. Conductors from the ground connections to the ground terminations shall be class II copper lightning conductors.

PART 3. EXECUTION

3.01 INSTALLATION

A. The installation shall be in accordance with LPI 175, LPI 76 and UL 96A.

B. The installation shall he completed by an experienced installer who is a certified Master Installer of the LPI or working under the direct supervision of an LPI manufacturer or his authorized LPI certified Master Installer representative.

C. Terminals shall be installed and all openings sealed in accordance with the Basic Contract Drawing and manufacturers recommendations.

D. Connections to steel framework shall be with bonding plates as described above.

E. Conductors shall be held in place with approved fasteners. Spacing of fasteners shall not exceed 3-foot centers on both horizontal and vertical runs.

F. Approved connectors and splicers as described above shall be used for joining conductors. When attached to conductors they shall be sufficiently tight to withstand a tensile force of two hundred (200) pounds.

G. Down conductors shall be connected to building grounding system with approved fittings. Common grounding of all ground mediums entering the structure shall be ensured by interconnecting to the Lightning Protection System using main size conductors and fittings.

H. The offset point supports for the parapet air terminals shall be shimmed to clear the coping.

I. Conductors for the parapet air terminals shall interconnect all the terminals on the parapet and shall be fastened to the parapet with approved fasteners forming a closed loop around the building. Conductors shall be connected to the down conductors via the thru-roof connector described above.

J. Ground rods shall be located two feet below grade, preferably two feet from foundation walls.

K. Ground rods shall extend a minimum of ten feet vertically into the earth.

L. Grounded metal bodies located within the required bonding distance as determined by NFPA 780 shall be bonded to the Lightning Protection System using bonding connections and fittings.

3.02 COORDINATION

A. The Contractor shall insure a correct, neat and unobtrusive installation.

B. The Contractor shall insure a solid mechanical and electrical connection to the building ground system.

3.03 INSPECTION, TESTING, COMPLETION AND APPROVAL

A. The Contractor shall secure and deliver the LPI System certification to the Engineer upon completion of the installation.

B. The Contractor shall also submit copies of as-built shop drawings with LPI Forms 175A, B and C along with the LPI Certificate System Application.

C. Underwriters' Laboratories Master Label shall be furnished as evidence that the installation complies with the UL 96A requirements.

D. If protected structure is an addition to, or is attached to an existing structure the Contractor shall advise the Engineer of any additional work required on the existing Lightning Protection System or structure with current UL requirements.

END OF SECTION

SECTION 16670

LIGHTNING PROTECTION SYSTEM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - "GENERAL PROVISIONS".

A. Shop Drawings

1. Connection Diagrams
2. Layout drawing, including type, size and location of the following:
   a. All equipment
   b. Cable routing
   c. Ground rods
3. Any special equipment that must be manufactured or fabricated.

B. Catalog Cuts

1. Wire and cable
2. Air terminals and other equipment
3. Supports, fasteners and hardware

C. Certifications

1. LPI system Certification
2. UL Master Label
3. LPI Forms
   a. 175A
   b. 175B
   c. 175C

D. Spare Parts: Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of this Section, for approval by the Engineer.

END OF APPENDIX "A"

DIVISION 16

SECTION 16720

FIRE ALARM SYSTEMS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for Fire Alarm Systems.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

Building Officials and Code Administrators, Inc. (BOCA)

National Electrical Manufacturers Association Standards (NEMA)

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code.
NFPA 72	National Fire Alarm Code.
NFPA 90A	Installation of Air Conditioning and Ventilating Systems.
NFPA 13	Installation of Sprinkler Systems.
NFPA 92A	Smoke Control Systems.

Underwriters Laboratories, Inc. (UL)

UL 268	Smoke Detectors for Fire Protective Signaling Systems.
UL 1971	Notification Appliances for Fire Protective Signaling Systems.
UL 864	Control Units for Fire Protective Signaling Systems.

American National Standards Institute (ANSI)

ANSI 117.1	Elevator Operation.

Americans with Disabilities Act, PL 101-336 (ADA)

New York City Building Code NYCBC.

New York City Electrical Code NYCEC.

New York City Fire Prevention Code and Directives.

1.03 QUALITY ASSURANCE

A. Qualifications

1. The entity performing the Work of this Section shall have successfully completed at least three (3) installations for fire alarm system work of similar type, size and complexity, as the Fire Alarm System described in this Specification and the Basic Contract Drawing. Said Installations shall have been in satisfactory operation for a period of not less than one (1) year, and shall have included at least one contract for the installation of a Fire Alarm System in an existing occupied building. The entity shall be licensed to perform this type of Work in the jurisdiction of said Work. Licensure shall be evidenced by a submission from the entity of the following: a copy of the entity's current license, business permit and certifications. The entity performing the Work of this Section shall be an authorized installer approved by the System manufacturer. Proof of such authorization shall be provided to the Engineer prior to the commencement of any Work.

2. System Manufacturer: The System manufacturer shall be one of established reputation and experience in the fire alarm industry. The manufacturer shall have been in business a minimum of five (5) years, show substantial involvement in the development and manufacture of systems similar to the one specified in this Contract and have a minimum of (3) three qualified factory authorized full line distributors and or branch offices within fifty (50) miles of the System location. The manufacturer shall also have an in-house technical support staff accessible to the Authority for technical assistance over the phone, offer detailed technical training courses both on site and at the manufacturer's facility, and be ISO-9001 certified.

3. System Vendor: If other than the System manufacturer, shall be an authorized distributor of the System manufacturer. The distribution agreement by the manufacturer to the vendor must be one that includes full authority to distribute, sell, certify, program and maintain the manufacturer's complete product line whether included in this project or not. Service only, or sales only, System vendors will not be considered as meeting these requirements. The System vendor shall also maintain an in-house engineering department capable and experienced in the preparation of drawings, sketches, calculations and submittals which are required as part of this Contract. The System vendor shall have successfully completed at least three installations, which have included fire alarm system work, of similar type, size and complexity as described in this Specification and the Basic Contract Drawing. Said installations shall be in satisfactory operation for a period of not less than one year, and shall have included at least one contract for the installation of a fire alarm system in an existing occupied building. The System vendor shall also maintain an in-house technical service department staffed with at least three field technicians factory trained and certified by the manufacturer to install, operate, certify and maintain the system to be installed.

4. System Maintainer: For the maintenance of Fire Alarm System required in 3.05 herein, the System maintainer may also be the System manufacturer, the System vendor, or a vendor authorized and certified by the manufacturer to perform testing and maintenance services on the System installed under this Contract. The System maintainer shall maintain an in-house technical service department staffed with at least three (3) field technicians factory trained and certified by the manufacturer to install, operate, certify and maintain the system to be installed. The System maintainer shall be licensed and/or certified to perform fire alarm system maintenance, as required by the jurisdiction where the installed system is located. The System maintainer must maintain a 24 hr. Emergency Field Service Staff, an Inventory of Parts to support the installed system and shall respond at the installed system site within 4 hours of a call for service.

B. Codes and Standard Requirements

1. Conform to the requirements of NFPA 70, all applicable local codes and all other publications referenced in 1.02 herein.

2. All fire alarm equipment, materials, devices and assemblies used on this Contract shall be listed and/or labeled by Underwriter's Laboratories, Inc. (UL), and by other Local jurisdiction as required, for the specific purpose for which they are used. The Contractor shall not alter, install or modify such equipment in any way so as to alter or void the listing or label.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened protective packaging.

B. Store materials in a clean, dry space and protect same from damage.

C. Handle in a manner to prevent damage. Damaged equipment shall be replaced.

D. Where possible protective coverings shall be installed to prevent equipment damage, and shall be remain in place until final testing and commissioning is completed.

E. Touch up damage to finishes to match adjacent surfaces, including recoating of galvanized or plated surfaces where damaged, cut or drilled.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirements of this Section, including but not limited to 1.03 A, provide fire alarm systems of manufacturers as shown on the Basic Contract Drawing.

2.02 GENERAL

A. The System shall consist of those components as shown on the Basic Contract Drawing, including but not limited to Fire Alarm Control Panel(s), Annunciator(s), Initiating Devices, Notification Appliances, Auxiliary and Accessory Devices, Test and Programming software, firmware and hardware, and all wiring and wiring methods as shown on the Basic Contract Drawing and as specified in this Section.

B. Provide a fully operational Code compliant system. Only current equipment manufactured within six (6) months of the installation date shall be utilized.

2.03 MATERIALS

A. Addressable Fire Alarm Systems

1. Addressable Fire Alarm Systems, where required on the Basic Contract Drawing, shall provide discreet identification and status information of system modules and devices via an alphanumeric visual display and hardcopy printer. The system shall be microprocessor based and user software programmable.

2. Fire Alarm Control Panel(s)

   a. Fire Alarm Control Panel(s) shall be of the type shown on the Basic Contract Drawing.

   b. Panel(s) shall have active zones/loops/circuits as required. The spare capacity for zones/loops/circuits shall be at least 20%, or as otherwise shown on the Basic Contract Drawing. Initiating and notification circuit loading shall be limited to 80% of the maximum specified by the manufacturer for the design configuration, with the maximum to comply with code requirements or as specified in the Contract Documents, whichever is more stringent. In no case shall the circuits be loaded as to impede proper system operation.

   c. Panel(s) shall be of modular construction using only solid state components and modules. Panels(s) shall contain all of the necessary components and modules to provide a complete operational code and specification compliant system, including spare capacity, as called for in the Basic Contract Drawing.

   d. All Panel Door(s) shall be painted except those as specified otherwise. All System controls shall reside behind a key locked steel door provided with viewing windows made of any material other than glass accepted as part of the product listings.

   e. The System shall be programmable via an IBM compatible laptop computer and manufacturer-supplied software. The System shall be fully field programmable utilizing the laptop computer via an onboard system programming port with the System fully powered and in operation. Shutdown of the System, loss of System operation, or removal of the System memory chips shall not be acceptable as part of the normal programming method. The System program shall be stored onboard utilizing non-volatile memory IC(s). Upon power up from complete shutdown, the System shall automatically reboot using the last stored program. Operator intervention or reprogramming shall not be required.

f. The System shall provide a text area for each addressable module or device, designated as a "Custom Message Field" which shall be reserved for the Authority's use. The "Custom Message Field" shall be capable of displaying any character of the English alphabet in both upper and lower case and any Arabic numeric digit. The character capacity of the "Custom Message Field" shall be as specified in the Basic Contract Drawing.

g. The System shall incorporate an automatic "watchdog" feature that will reboot the System in any event where the operating system or processor halts. Operation of the watchdog feature shall be both visually displayed and printed at the time of occurrence.

h. The System power supply shall be provided with two (2) sources of energy. The primary supply shall be 120 VAC single phase commercial power. The secondary supply shall be either an emergency standby generator(s) qualified as an emergency power supply for fire alarm systems of the type specified in this Contract or emergency standby batteries of the size and capacity required to meet the standby requirements of the System specified in this Contract. The system power supply shall automatically transfer between the primary and secondary power and vice versa. The power supply shall be monitored for integrity as required by applicable codes, standards and listings for the intended use.

i. The Panel(s) shall be UL listed as a test instrument for the measurement of the sensitivity of connected intelligent ionization and photoelectric smoke detectors to comply with the testing requirements of NFPA 72.

The fire alarm control panel shall provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing.

The fire alarm control panel shall be programmed and the connected ionization and photoelectric light refracting smoke detectors shall be capable of self adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction. The adjustment shall keep the relationship between the sensing chamber and the programmed alarm threshold voltage constant to prevent false indications of the failure to alarm in the presence of smoke.

The fire alarm control panel shall annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarms. The trouble report shall annunciate the specific location of the smoke detector requiring service.

3. Initiating Devices - Pull Stations

Provide manual fire pull stations where indicated on the Basic Contract Drawing. Stations shall be painted red. Where specified on the Basic Contract Drawing the station shall also include either an integral white stripe or an accessory backing plate with white stripe. The white stripe shall be (1) one-inch wide and placed diagonally from top left to bottom right of the station. The stripe shall not obscure the stations operating instructions. The station shall be operable without the use of a special key or other device not part of the station, except in the case of resetting. The station shall be constructed of materials specified in the Basic Contract Drawing. All stations shall be single action unless otherwise specified. The device shall be field programmable.

4. Initiating Devices - Open Area Detectors

Provide automatic detection devices where indicated on the Basic Contract Drawing. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate base assembly. The base assembly shall not include detection electronics which shall be housed in the detector. The detector shall be removable from the base assembly without the use of tools and without disturbing wiring connections. The device shall be field programmable.

5. Initiating Devices - Duct Detectors

a. Provide automatic detection devices where indicated on the Basic Contract Drawing. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate housing assembly. The housing assembly shall not include detection electronics that shall be housed in the detector. The housing assembly may contain an auxiliary local relay. The detector shall be removable from the housing assembly without the use of special tools and without disturbing wiring connections. The device shall be field programmable.

b. Detectors used in air duct applications shall be listed for this use. The air velocity ratings of the housing, sampling tubes or detector shall not be less than the air velocities expected to occur in the air handling system duct at the point of insertion. Duct Housings shall be installed to avoid undesirable flow restrictions and turbulence according to the manufacturer's installation instructions.

c. Duct detection devices shall have provisions for the use of a remote location indicator.

6. Initiating Devices - System Interfaces

a. Provide System interface modules where indicated on the Basic Contract Drawing. System interfaces shall allow for the monitoring of conventional dry contact inputs to the System. The Interface shall supervise the dry contact inputs through use of an end of line device (EOL). EOL devices shall be placed across the contacts being monitored and not at the interface. The device shall be field programmable.

b. The System Interface Modules shall be available in the following versions:

Dual Input
Single input
Single Input and Single Form C Contact Output

7. Notification Appliances

a. Provide system notification appliances where indicated on the Basic Contract Drawing. System notification appliances shall provide either audible, visual or combination audible and visual indication as indicated on the Basic Contract Drawing. Notification appliance field wiring connection shall be accomplished using an integral terminal strip with screw & binding plate fasteners. Each appliance terminal position shall permit (2) single conductor # 14 stranded or solid wires to be attached without the use of wire loops, wire nuts, wire terminals or other methods other than a straight in connection. Appliances employing "pigtail" or "flying lead" field connections shall not be used.

Appliance source voltages shall be 24VDC for visuals, 24 VDC for coded and non-coded bells, and horns, and either 25VAC or 70.7VAC, based on system platform, for voice/tone speaker appliances. All appliances shall be UL Listed and UL Cross-listed for the Base System utilized. Appliances shall be red in color unless otherwise specified on the Basic Contract Drawing.

b. The system notification appliances shall be available in the following versions:

(1) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells.

(2) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells with 15, 30, 15/75, 75, 110 Candela Strobe Lights.

(3) Single and Multitone Electronic Horns.

(4) Single and Multitone Electronic Horns with 15, 30, 15/75, 75, 110 Candela Strobes.

(5) Electronic Strobes, 15, 30, 15/75, 75, 110 Candela Outputs.

(6) Speakers, 25VAC or 70.7VAC MultiTap Wall and Ceiling-Mounted.

(7) Speakers, 25VAC or 70.7VAC MultiTap Wall-Mounted with 15, 30, 15/75, 75, 110 Candela Strobes.

(8) Accessory mounting plates, boxes, trim rings and guards.

B. Conventional Fire Alarm Systems

1. Conventional (Non-Addressable) Fire Alarm Systems, where required on the Basic Contract Drawing, shall provide area or zone type identification of system devices. The visual display may consist of either an LED lamp display, an LED segmented display or a combination of both.

2. Fire Alarm Control Cabinet(s)

a. Fire Alarm Control Panel(s) shall be of the type shown on the Basic Contract Drawing.

b. Panel(s) shall have active zones/loops/circuits as required. The spare capacity for zones/loops/circuits shall be at least 20%, or as otherwise shown on the Basic Contract Drawing. Initiating and Notification Circuit loading shall be limited to 80% of the maximum specified by the manufacturer for the design configuration, with the maximum to comply with code requirements or as specified on the Basic Contract Drawing whichever is more stringent. In no case, shall the circuits be loaded as to impede proper system operation.

c. Panel(s) shall be of modular construction of only solid state components and modules. Panels(s) shall contain all of the necessary components and modules to provide a complete operational code and specification compliant system, including spare capacity as called for in the Basic Contract Drawing.

d. All panel door(s) shall be painted red, except those as specified otherwise. All System controls shall reside behind a key locked steel door provided with viewing windows made of any material other than glass accepted as part of the product listings.

e. The system power supply shall be provided with two (2) sources of energy. The primary supply shall be 110 VAC single-phase commercial power. The secondary shall be either an emergency standby generator(s) qualified as an emergency power supply for fire alarm systems of the type specified in this Contract or emergency standby batteries of the size and capacity required to meet the standby requirements of the System specified in this Contract. The System power supply shall automatically transfer between the primary and secondary power and vice versa. The power supply shall be monitored for integrity as required by applicable codes, standards and listings for the intended use.

3. Initiating Devices - Pull Stations

Provide manual fire pull stations where indicated on the Basic Contract Drawing. Stations shall be painted red. Where specified on the Basic Contract Drawing the station shall also include either an integral white stripe or an accessory backing plate with white stripe. The white stripe shall be (1) one inch wide and placed diagonally from top left to bottom right of the station. The stripe shall not obscure the stations operating instructions. The station shall be operable without the use of a special key or other device not part of the station, except in the case of resetting. The station shall be constructed of materials specified in the Contract Documents. All stations shall be single action unless otherwise specified.

4. Initiating Devices - Open Area Detectors

Provide automatic detection devices where indicated on the Basic Contract Drawing. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate base assembly. The base assembly shall not include detection electronics that shall be housed in the detector. The detector shall be removable from the base assembly without the use of tools and without disturbing wiring connections.

5. Initiating Devices - Duct Detectors

a. Provide automatic detection devices where indicated on the Basic Contract Drawing. All automatic detection devices shall be resettable from the control panel. Detectors shall include the use of a separate housing assembly. The housing assembly shall not include detection electronics that shall be housed in the detector. The housing assembly may contain an auxiliary local relay. The detector shall be removable from the housing assembly without the use of special tools and without disturbing wiring connections.

b. Detectors used in Air Duct Applications shall be listed for this use. The air velocity ratings of the housing, sampling tubes or detector shall not be less than the air velocities expected to occur in the air handling system duct at the point of insertion. Duct housings shall be installed to avoid undesirable flow restrictions and turbulence according to the manufacturer's installation instructions.

c. Duct detection devices shall have provisions for the use of a remote location indicator.

6. Notification Appliances

a. Provide system notification appliances where indicated on the Basic Contract Drawing. System notification appliances shall provide either audible, visual or combination audible and visual indication as indicated on the Basic Contract Drawing. Notification appliance field wiring connection shall be accomplished using an integral terminal strip with screw and binding plate fasteners. Each appliance terminal position shall permit (2) single conductor # 14 stranded or solid wires to be attached without the use of wire loops, wire nuts, wire terminals or other methods other than a straight in connection. Appliances employing "pigtail" or "flying lead" field connections shall not be used.

Appliance source voltages shall be 24VDC for visuals, 24 VDC for coded and non-coded bells, and horns, and either 25VAC or 70.7VAC, based on system platform, for Voice/Tone Speaker appliances. All appliances shall be UL listed and UL cross-listed for the base System utilized. Appliances shall be red in color unless otherwise specified on the Basic Contract Drawing.

b. The system notification appliances shall be available in the following versions:

(1) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells.

(2) 4", 6", 10", 12" Motor or ElectroMechanically Operated Bells with 15, 30, 15/75, 75, 110 Candela Strobe Lights.

(3) Single and Multitone Electronic Horns.

(4) Single and Multitone Electronic Horns with 15, 30, 15/75, 75, 110 Candela Strobes.

(5) Electronic Strobes, 15, 30, 15/75, 75, 110 Candela Outputs.

(6) Speakers, 25VAC or 70.7VAC MultiTap Wall and Ceiling Mounted.

(7) Speakers, 25VAC or 70.7VAC MultiTap Wall-Mounted with 15, 30, 15/75, 75, 110 Candela Strobes.

(8) Accessory mounting plates, boxes, trim rings and guards.

PART 3. EXECUTION

3.01 EXAMINATION

Inspect all system equipment and accessories prior to installation. Replace any damaged items.

3.02 PREPARATION

A. Field verify dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

B. Arrange for the entity manufacturing the equipment to provide on-site technical supervision during installation and interconnection of the system equipment. Said supervision is to ensure the proper installation and operation of the System equipment, prior to the installed System beginning the final acceptance test.

C. After the System has been delivered, an on-site inspection will be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor shall be required to replace the equipment at no additional cost to the Authority, even though the equipment has been previously inspected, tested and approved for shipment. After such satisfactory replacement, the System shall be installed.

3.03 INSTALLATION

A. Install all materials in accordance with the codes and standards referenced in 1.02 and in accordance with the Specifications, Basic Contract Drawing and approved plans, shop drawings and other submittals.

B. Air duct detectors shall be installed in air handling units downstream of filters and shall be provided with a pair of sampling tubes of the length recommended by the manufacturer, for proper sensitivity and operation.

C. Wiring

1. All fire alarm cables shall be type FPLP-UL (fire alarm approved cable), twisted pair #14 gauge (unless otherwise shown on the Basic Contract Drawing), solid copper, 200° C, 600V, shielded (or unshielded as required), insulated conductors, with FEP insulation, and conductors colored black and red. All wiring, raceways, fittings, connectors and enclosures shall be UL Listed for the intended use. Conductor terminations shall be by methods as approved by the Engineer, and as indicated on the Basic Contract Drawing.

2. All fire alarm control and power wiring shall be in hot-dipped galvanized steel (thick wall) conduit, or as specified on the Basic Contract Drawing.

3. Wiring for device circuits, signaling circuits, and indicating appliance circuits shall be power-limited type. System wiring shall not be mixed in raceways with other wiring. Power-limited and non-power-limited circuits shall be run in separate raceways.

4. Minimum conduit size shall be provided as required by NFPA 70, or any other local codes, using the actual cross-sectional area of the wiring to be installed. Unless otherwise noted, minimum conduit size shall be 3/4".

5. All junction boxes, pull boxes, or other appurtenance which permits entry into the conduit system shall be painted red. Insulation or covering of wires and cables shall be factory color coded by use of color compounds. The color code shall be consistent throughout the performance of the work. Each pair of wires shall have a black and a red colored insulated conductor. Red shall be used for circuits with a positive (+) potential and black shall be used for circuits with a negative (-) potential.

6. All wires shall be identified with flame-retardant, low profile, labels as specified on the Basic Contract Drawing.

D. Grounding

1. Install grounding bushings on all conduits penetrating fire alarm enclosures. Ground all equipment, wireways, enclosures and circuits as shown on the Basic Contract Drawing. Measure, record and report shield/drain resistance utilizing an insulation resistance test meter. Submit a copy of the original test report to the Engineer for approval.

3.04 TRAINING

Operation and training for the system shall be a half-day seminar provided to Authority designated personnel through the means of practical demonstrations, technical literature and other related teaching procedures unless otherwise shown on the Basic Contract Drawing. The training shall be conducted at the construction site.

3.05 MAINTENANCE

Furnish full preventive and remedial maintenance service for the fire alarm system, including all labor, parts, materials and supplies until the issuance of the Certificate of Final Completion. The Contractor shall respond to service calls by responding at the site within four hours of the call 24 hours a day, 7 days a week, including holidays.

3.06 FIELD TESTING

A. No system devices, modules, or other system electronics shall be connected to any circuit, prior to or during testing. Any equipment damaged due to testing shall be replaced by the Contractor at no additional cost to the Authority.

B. All wiring not supplied as part of the manufactured control panel shall be tested by the Contractor in accordance with the test criteria listed on the test reports specified in the Section entitled "Field Testing of Wiring". Prior to testing, field wiring shall not be connected to any equipment except external terminal blocks.

C. All testing prescribed by, and within, the test reports shall be accomplished in the presence of the Engineer only after all wiring work is completed. Conduit, condulet, pull box and junction box terminations shall be completed prior to testing. Once testing has been completed, the tested wiring shall not be disturbed. Any connection or wire that must be reworked shall be re-tested. Any conduit that has its contents modified in any way shall have all of its circuit conductors re-tested.

D. Test instruments (Meggers, Volt/Ohm Meters, etc.) used for testing as part of this Contract shall have been tested and calibrated within the last twelve (12) months and shall be evidenced by a certificate. A copy of the calibration certificate for each instrument used shall be submitted.

E. Field Wiring Test Reports shall be submitted, in duplicate, to the Engineer for approval. One copy shall be the original and one copy a photocopy. The reports shall be legibly handwritten. Typewritten reports will not be acceptable.

F. Field wiring will only be connected to the fire alarm equipment and devices once the test reports have been approved by the Engineer. Field wiring shall only be connected to the fire alarm panel(s) in the presence of a factory-trained technician acceptable to the System manufacturer and the Engineer, unless otherwise indicated on the Basic Contract Drawing.

G. All fire alarm equipment, panels, detectors, signals etc. shall be fully pre-tested and shall have passed a 30-day operational test prior to presentation for final acceptance test. All Punch List items, defective or damaged equipment or backordered items shall be replaced, installed and or completed prior to the pre-test and final acceptance test. Upon satisfactory completion of the pre-test, the Engineer shall be notified in writing that the pre-test has been completed and that the system is in full conformance with the Contract Documents and ready for the final acceptance test.

H. The final acceptance test of the fire alarm system shall be performed by the System manufacturer's authorized technicians in the presence of the Engineer and shall consist of but shall not be limited to all fire alarm System panels, notification appliances, initiating devices, interface modules, off premise monitoring, and auxiliary functions. The Engineer will also witness the test. It shall be the sole responsibility of the System vendor to supply, and prepare any and all resources necessary to conduct and document the final acceptance test as prescribed by these Specifications, the Basic Contract Drawing and NFPA 72.

END OF SECTION

SECTION 16720

FIRE ALARM SYSTEMS

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Layout drawings with dimensioned locations and quantities of each device.
2. System riser drawings detailing system equipment location and type, and reference notation to each drawing.
3. Wiring and conduit details indicating numbered wires and terminals, and size and routing of each conduit and wire.
4. System calculations detailing system power requirements, battery standby calculations, voltage drops, resistance, and capacitance limits as set by the manufacturer and wiring size as set by the manufacturer.

B. Catalog Cuts and Installation Sheets

1. Manufacturer's current catalog cut and installation sheet for each product utilized in the System specified including:
   a. Fire Alarm wires.
   b. Speakers.
   c. Horns.
   d. Strobes.
   e. Strobe/horn units.
   f. Pull station.
   g. Power wiring.
   h. Warden telephones.
   i. Standpipe phone jacks.
   j. Air duct detectors.
   k. Heat smoke detectors.
   l. Supervisory switches.
   m. Conduits, fittings, boxes, terminal strip cabinets.
   n. Cutout switch.
   o. Relays.
   p. Interface modules.

q. Fire alarm command station.

r. Fire alarm control panel.

s. Computers and components.

t. Fire alarm accessory equipment.

u. Wire labeling system.

2. Copies of all UL listing documents, as provided by the manufacturer, for each product utilized in the System.

3. Copies of all NYC/MEA listing documents and resolutions (report of Material and Acceptance Test Division), as provided by the manufacturer, for each product utilized in the System.

a. System circuit test results.

b. Factory test reports.

C. Spare Parts

Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of this Section for approval by the Engineer.

D. Test Plans

Prepare and submit to the Engineer for approval a performance testing plan for the entire system a minimum of 30 days in advance of the earliest, approved, scheduled inspection and test date. The system shall be divided into the following stages:

1. Inspection upon arrival at the construction site.

2. On-site inspection and test immediately following the complete installation of the system to demonstrate compliance with the requirements of this Section.

3. A 30-day operational test commencing with the successful completion of the on-site inspection and test.

E. Training

Prior to the on-site inspection and test of the system, prepare and submit to the Engineer for approval a fire alarm system curricula, in accordance with the requirements of this Section.

END OF APPENDIX "A"

DIVISION 16

SECTION 16729

ACCESS CONTROL SYSTEM

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for an expansion of the existing Lenel On-Guard LGA Monitoring and Access Control (MAC) System, to provide LGA with alarm monitoring and access control functions for the East Parking Garage of La Guardia Airport. The Work for the system expansion shall comprise, but not be limited to:

1. Furnish and install the Lenel field interface equipment for connection of all alarm and access control devices to the existing LGA MAC System.
2. Configuration of the existing MAC System to monitor and control the devices installed as Work of this Contract.
3. Furnish and install intrusion detection devices, card access control devices, wire, cable, and conduit; low voltage power supplies; and all other equipment and accessories required for a complete working system, as described in this Section and as shown in the Contract Documents.
4. Connection and interface of field equipment to the LGA data network and SONET to allow communications between equipment installed under this Contract with the existing LGA Lenel servers.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Work specified in this Section shall permit the LGA Monitoring and Access Control devices to integrate with the existing LGA Lenel Monitoring and Access Control System.

B. Furnish all required services for the provision of data and database configuration of the System as required in the LGA Lenel On-Guard System including, but not limited to: input / output point identification, design and uploading of graphical map displays with dynamic icons, incorporation of alarm and access point information into map displays, creating schedules and time zones, care reader/PN pad "ambush" programming, creating matrices for alarm, creating the matrices for CCTV System interfaces (to the extent of the LGA MAC and CCTV integration at the time of installation) and all other tasks necessary in order to provide an operationally complete, integrated MAC System.

C. Unless otherwise specified on the Contract Drawings or in this Section, the MAC components as manufactured, supplied and installed, shall conform to the requirements of NFPA 70, all local codes having jurisdiction, and all other publications referenced in this Section.

D. The electrical and electronic hardware, structural materials, and equipment housings, required for a fully operational, integrated, real-time System shall operate on a 24 hours-per-day, seven days-per-week basis with high system reliability of 99.99 percent, and shall conform to the requirements of this Section.

E. Furnish and install all hardware and software necessary to monitor inputs, generate outputs, and transmit and record system data, all as specified herein and as shown on the Contract Drawings. All system equipment and subsystems shall be submitted to the Engineer for approval.

F. Provide all equipment required for a completely operational expansion of the exiting System, whether the equipment is specifically listed in these specifications or not. The design is functional in nature with specific product references. The Contractor shall be responsible for the installation of a fully functioning expansion of the LGA MAC System

G. Furnish all required services to enable the MAC functionalities in the Station on LGA's existing Lenel On-Guard System. Lenel uses a Graphical User Interface (GUI) for the system-user interface providing monitoring of all system events, user response instructions, and event acknowledgement. Ensure that all information necessary for the configuration of devices added to the MAC System as Work of this Contract is sufficient to provide for the generation and transmission of control signals for all system devices to include intrusion detection/alarms, access control (card readers and door locks) and are defined on maps as the location of readers, access doors, alarm monitored points, output switching relays, and alarm panel devices. Examples of functions required, as a minimum, to be available to the LGA workstations are:

1. Access to and control of the display of all stored floor plans
2. Monitor, Assess, and Control of the status of all doors and other protected openings included in the Access Control System
3. Manual Override of Card Readers
4. Alarm Masking
5. Design and uploading of graphical map displays with dynamic icons; incorporation of alarm and access point information into map displays
6. Alarm and Access event sorting and reporting
7. Monitor, Assess, and Control of the status of all Intrusion Detection System (IDS) sensors including Cameras used for the purpose of detection.
8. Arm / dis-arm sensors, both individually and as groups/zones of sensors
9. Initiate a random guard tour
10. Receive visual and audible notification of all alarms, events and transactions generated by the MAC System and its sub-components.
11. Receive alarm/event specific instructions and procedures for guard action and response
12. Respond to all alarms, events and transactions generated by the System through selection, acknowledgement, and annotation
13. Searching, sorting, and reporting (soft and hardcopy) of all alarms, events.
14. Autocue of release functions for mantrap doors associated with reader events.

15. Access to cardholder data (name, photo, access privileges)

16. Ability to compose and transmit email and text messages

17. Lock / unlock doors

18. Open a window with instructions to operator

    a. Open a window for operator acknowledgement annotation of alarm event

    b. Open one window and display the preconfigured graphical site/floor-mapping associated with the event

19. Access control sequences for the door configurations as shown in the Contract Drawings.

    a. Single portal (single and double doors) equipped with the DESFire card readers configured using Wiegand communications protocols.

    b. A pair of doors interlocked to form a Mantrap configuration. Mantrap sequences of operation shall be configurable as either automated, fully hardware dependent sequences or requiring remote operator intervention to complete the passage of authorized individuals through a Mantrap

    c. Access control operation at any door shall be selectable to operate on card alone, card, or all factors.

H. Furnish Lenel On-Guard system configuration services to ensure the following are available for all field equipment installed as Work of this Section through the GUI of any Lenel workstation connected to the existing LGA Lenel Server:

1. Real time CCTV monitoring and control, and on screen control of recorded CCTV events.

2. Ability to select and tag/bookmark any live video and send clip to video recorder(s)

3. Monitor the status of and control the display of all cameras.

4. Control position, zoom and focus of all PTZ equipped cameras.

5. Where remote camera configuration is available under the camera feature set, control of those configuration parameters.

6. Open two windows and display video from both recorded and live video feeds from the primary camera associated with the alarm event. Two video windows shall be presented:

    a. Recorded video loop from pre-alarm configured set point to post event period of any duration available as requested by the operator, and

    b. Live video feed.

I. The access control system shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

Americans with Disabilities Act (ADA)

ANSI International/Electronic Industries Alliance/Telecommunications Industry Association (ANSI/EIA/TIA)

ANSI/EIA/TIA 232-F - Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

ANSI/EIA/TIA 250-C Electrical Performance for Television Transmission Systems

ANSI/EIA/TIA 310 - Racks, Panels and Associated Equipment

ANSI/EIA/TIA 422B - Electrical Characteristics of Balanced Voltage Digital Interface Circuits

ANSI/EIA/TIA 568-B.2–All Commercial Building Telecommunications Cabling Standards and its addendums

International Standards Organization (ISO)

ISO 7810 - Identification Cards -- Physical Characteristics

ISO 7811 - Identification Cards -- Recording Techniques

ISO 7816 – Identification Cards -- Integrated Circuit Cards

ISO 10373 – Identification Cards -- Test Methods

ISO 14443 – Identification Cards -- Contactless Integrated Circuit Cards -- Proximity Cards

ISO 14496-14 – Information technology – Coding of audio-visual objects – Part 14: MP4 File Format

National Fire Protection Association (NFPA)

NFPA 70 - National Electrical Code

NFPA 130 - Standard for Fixed Guideway Transit System

National Institute of Standards and Testing (NIST)

NIST FIPS 197 - Data Encryption Standard

NIST FIPS 201 - Parts PIV I and PIV II

New York City Building Code (BCCNY)

New York City Electrical Code (NYC EC)

Transportation Security Administration (TSA)

TSA Transportation Workers Identity Credential (TWIC) Rule

Underwriters Laboratories (UL)

UL 294 – Access Control System Units

UL 603 – Power Supplies for Use with Burglar Alarm Systems

UL 639 – Intrusion Detection Units

UL 1076 – Proprietary Burglar Alarm Units and Systems

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The access control system and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 3 years

2. The Manufacturer shall be ISO 9001 certified

B. Installer Qualifications

1. Retain the services of an experienced Systems Integrator and Installer who can demonstrate a minimum of 10 years experience and technical expertise in performing contracts comparable in size and complexity, and whose installation and integration work was performed skillfully in a satisfactory manner and on time.

   a. The Systems Integrator performing the Work of this Section shall be the same Integrator who performs the Work of Sections 16740, 16781, 16777, and 16788.

   b. The Systems Integrator shall furnish all specified components, shall be of established reputation and experience in the field of Monitoring and Access Control Systems and Closed Circuit Television Surveillance, and, shall be qualified by Lenel Systems, Verint and the other manufacturers of the proposed equipment to install, service and maintain each manufacturer's equipment.

   c. The Systems Integrator shall serve as the single point of responsibility for the LGA Monitoring and Access Control System described in this Section, for the LGA Video Surveillance System specified under Specification Section 16710 and for the Emergency Phones described in Specification Section 16790C.

2. Retain the services of personnel certified by the equipment manufacturer to: assist in the installation of the equipment; check the installation before the equipment is placed into operation; assist in the performance of field tests; assist in the hardware configuration, system software programming, and start-up of the equipment; and train the Authority operations and maintenance staff in the care, operation, troubleshooting and maintenance of the equipment.

   a. Unless otherwise authorized by the Engineer, the certified personnel shall have at least five years experience, in-depth knowledge of the equipment to be used in the installation, testing, hardware/software programming and start-up of the equipment of the type provided under this Section. The Manufacturer's sales and marketing personnel will not be accepted as Manufacturer's Representatives.

   b. All System equipment installation, inspection, and testing shall be performed under the direct supervision of personnel certified by the manufacturer of the equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete. Wherever possible, all devices and accessories shall be in place and pre-wired.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. The factory pre-assembled control panels, enclosures/cabinets and terminal boxes shall be shimmed, braced, blocked and tied down to prevent distortion or other damage during transportation.

D. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions.

E. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

F. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

G. Deliver all equipment to the placement and installation Work sites. If equipment is delivered to an off-cite location prior to placement and installation at the Work site, the Contractor shall be responsible for all movement of the equipment form the off-site storage facility to the Work site as well as proper storage, handling and security of the equipment at the off-site storage location.

H. After delivery at the work site, a field inspection of the equipment will be made by the Contractor in the presence of the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements hereof, the Contractor shall be notified in writing, and he shall replace the equipment at his own cost even though this equipment may have been previously inspected and approved for shipment. After such satisfactory replacement and subsequent Engineer written approval, the equipment shall be installed by the Contractor.

1.06 WARRANTY

A. The Manufacturer shall warrant the access control system and accessories to be free from defects in engineering, design, workmanship and materials for a period of 1 year from the date the equipment is satisfactorily passed in service after successfully passing the last field acceptance test and are accepted by the Engineer. During the warranty period, the Contractor shall replace all items or components which fail due to defects in workmanship and material at no additional cost to the Authority.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

1.08 MAINTENANCE

A. Provide 5 per cent spare parts, or a minimum of one, whichever is greater, of all Lenel Intelligent System Controllers, Reader Interface Modules, Input and Output Control Modules, Communications Multiplexers, Card Readers, Motion Detectors and Power Supplies utilized for the Work of this Contract.

B. Submit a list of recommended spare parts, including quantities for approval.

C. After approval of spare parts list, and prior to start of operational Acceptance Testing, furnish spare parts to the Authority.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements of this Section, furnish and install products of one of the following, or approved equal:

A. Monitoring and Access Control System Components

1. Lenel On Guard System components (no substitution)

B. Device Power Supplies

1. Altronix
2. Alarm Safe
3. Lenel
4. Or approved equal

C. Door Monitor Contacts

1. Ademco
2. GRI
3. Sentrol
4. Or approved equal

D. Access Control Reader

1. Card Readers
   a. MIFARE DESFire reader that is FIPS 201 and TWIC Compliant.
      (1) HID
      (2) Or approved equal

E. Access Control Cards

1. Cards will not be furnished under this Section. Existing LGA cards will be used for the Work of this Section.
2. Configure the MAC System controllers for MIFARE DESFire card technology at the Station. Coordinate system configuration with the Engineer to ensure it is in compliance with the card technology and encoding in use at the time of system start-up.

F. Cables

1. Station areas are under the jurisdiction of NFPA 130. Cable jacketing shall be of the low smoke, zero halogen type. PVC insulated or jacketed cable shall not be used.
2. Refer to Contract Drawings for cable types, sizes and manufacturers.

3. Refer to Specification Sections 16120 for General Purpose 600V or less cable requirements, 16126 for Optical Fiber Cable requirements and Section 16127 for Category 5e, multi-conductor, twisted pair and coaxial cable requirements.

G. Enclosures

1. Enclosures and panels shall be in accordance with the Contract Drawings and the requirements of Specification Section 16133.

H. Surge Suppression

1. Ditek
2. Leviton
3. PolyPhasar
4. Or Approved equal

2.02 MATERIALS

A. Lenel On-Guard System components as indicated in the Contract Drawings.

1. Field Hardware as needed

a. Intelligent System Controllers - (ISC) Shall be Lenel LNL-3300.

b. Single Reader Interface Modules - (SRM) Shall be Lenel LNL-1300

c. Dual Reader Interface Module - (DRM) Shall be Lenel LNL-1320

d. Input Modules - (ICM) Shall be Lenel LNL-1100

e. Output Modules - (OCM) Shall be Lenel LNL-1200

f. Communication Multiplexers – Shall be Lenel LNL-8000

g. Ancillary devices as required

2. Intelligent System Controller (ISC)

a. The Intelligent System Controller (ISC) shall link the MAC Software to all "down-stream" field hardware components. The ISC shall provide full distributed processing of access control/Alarm Monitoring rules and operations. A fully loaded and configured ISC with shall respond in less than one-half (0.5) second to grant or deny access to cardholder.

b. The ISC shall continue to function normally (stand-alone) in the event that it loses communication with the MAC software. While in this off-line state, the ISC shall make access granted/denied decisions and maintain a log of the events that have occurred. Up to 50,000 events shall be stored in local memory, and then uploaded automatically to the MAC database after communication has been restored.

c. In addition, the ISC shall incorporate the following features:

(1) UL 294 listed

(2) 32-bit Microprocessor

(3) Support for Host Communications Speed of 38,400 bps

(4) Support for Direct Connect or Local Area Network (LAN) Connection

(5) Support for Dual Path (enabling alternate LAN connection) Host Communications

(6) 8 MB of On-Board Memory

(7) LAN Support shall utilize RJ45 (10/100baseT) Ethernet Interface connectivity

(8) Flash Memory for real time program updates and overall host communications

(9) Memory storage of up to 175,000 card holders with 4 MB memory expansion

(10) Initial base memory download between Server and ISC with standard memory shall require no more than 10 seconds

(11) Support for up to 32 devices consisting of Remote Input Modules, Input Control Modules, and Output Control Modules in any combination with a maximum of 16 Input/Output Control Module devices

(12) Support of up to eight card formats and facility codes

(13) Issue Code Support for both Magnetic and Wiegand Card Formats

(14) Supervised Communications between ISC and MAC Software

(15) AES 128 bit Symmetrical Block Encryption conforming to the FIPS-197 standard between ISC and MAC Software communications driver

(16) Multi-drop support for up to eight ISCs per MAC communications port

(17) Integration to HID card readers

(18) An ISC downstream serial port shall multi-drop 16 access control field hardware devices using an RS-485 UL 1076 Grade A communication format allowing a distance of 4,000 feet using 24 AWG stranded (7 by 32) tinned copper conductor twisted pairs, with 100 percent foil shield coverage and 90 percent overall coverage tinned copper braid shield and 24AWG tinned copper drain wire.

(19) 12 VAC or 12 VDC input power

(20) Individual Shunt Times as required by ADA

3. Input Control Module (ICM)

a. The Input Control Module shall provide 16 UL 1076 Grade B, A or AA alarm input zones and monitor/report line fault conditions, alarm conditions, power faults and tampers. Status LEDs shall provide information about the sixteen alarm zone inputs, cabinet tamper and power fault.

b. In addition, the ICM shall incorporate the following features:

(1) UL 294 Listed.

(2) Alarm contact status scanning at up to 180 times per second for each zone.

(3) Eight configurations DIP switches to assign unit addresses and communications speed.

(4) Variable resistor values for line supervision.

(5) A low power CMOS microprocessor.

(6) Filtered data for noise rejection to prevent false alarms.

(7) Up to 16 Grade B, A or AA Supervised Inputs in any Combination. Apply input circuit supervisory method as per the Contract Drawings

(8) 12 VAC or 12 VDC Input Power.

(9) 2 Form C 5A, 30 VDC Contacts for load switching.

(10) 2 dedicated inputs for tamper and power status.

4. Output Control Module (OCM)

a. The Output Control Modules shall provide 16 Form-C 5A 30 VDC relay contacts for load switching. The relays shall be configurable for fail-safe or fail-secure operation. Each relay shall support "On," "Off" and "Pulse" operation.

b. RS-485 communications, multi-dropped (2-wire or 4-wire RS-485)

c. Up to 16 OCMs per Intelligent System Controller

d. Onboard termination jumpers

e. DIP switch selectable addressing

f. Status LEDs for communication to the host, heartbeat and relay status

5. Single And Dual Reader Interface Modules (SRI, DRI)

a. The SRI or DRI shall provide an interface between the ISC and authentication devices. The SRI or DRI shall operate with any authentication device that produces a standard Wiegand, Data 1/Data 0, or Clock and Data communication output.

b. 12 VDC power supply

c. Reader communications (Clock/Data or Wiegand Data1/Data0)

d. Two Form-C relay outputs (five A Door Strike and one A Aux relays)

e. Up to 16 different card formats (eight card and eight asset)

f. Issue code support for Magnetic and Wiegand formats

g. Door contact Open or Closed, Supervised or Non-supervised

h. REX push-button monitor - Supervised or Non-supervised

i. Strike Control output

j. Dedicated tamper and power failure circuits

k. Bicolor or two wire status LED support

l. Beeper control

m. Support for offline reader access mode

n. UL 294 listed

6. Communication Multiplexers – Shall be Lenel LNL-8000

7. Ancillary devices as required

B. System Detectors

1. Card Readers

a. Furnish the MIFARE DESFire reader or approved equal.

b. Readers shall be ADA compliant and provide audible feedback to the cardholder.

2. Cards

a. No cards shall be furnished as Work of this Section. Existing LGA cards shall be utilized.

b. The Contractor shall obtain all required information from the Engineer in order to configure MAC components reader and controller compatibility with existing LGA MAC System access cards.

3. Magnetic Contacts

a. Install at all doors as described in this Section, and as shown on the Contract Drawings, in accordance with manufacturer's instructions,

(1) For hollow metal and storefront doors use biased, recessed type contacts wherever possible.

(2) Use surface mounted, biased contacts on hollow metal and storefront doors constructed in a way that prevents the use of recessed contacts.

(3) Use a combination of recessed switch and surface mounted magnet on revolving doors.

(4) For rolling grilles, sliding doors, gates and shutters use surface mounted biased contact with stainless steel jacketed lead. Contact must be rated for 3-inch gap.

(5) For access doors use surface mounted contact with stainless steel jacketed lead. Contact must be rated for 3-inch gap.

(6) At door locations indicated on the Contract Drawings furnish and install biased, double pole, double throw contacts providing additional isolated normally open and normally closed contacts to allow for simultaneous monitoring of doors by other systems.

4. Equipment Panel or Enclosure Door Plunger Tamper Switches (as required)

a. Shall be a reed type switch with a metallic press-on mounting clip that will activate when a cabinet door is opened more than 1/4 inch from the jamb side.

C. System Device Low Voltage Power Supplies

1. Power supplies shall be provided with individually fused outputs and relay outputs to indicate loss of AC power, and low battery. Provide tamper switch on power supply enclosure door, with status monitored through connection to LGA Station MAC. Power supplies shall be UL 603 listed and NYC MEA approved.

D. Power Supplies for Electric Locks

1. Provide power supplies compatible with electrified locks furnished under Specification Section 08715. Supplies shall be provided with individually fused outputs and relay outputs to indicate loss of AC power, and low battery. Provide tamper switch on power supply enclosure door with status monitored on the MAC System, Power Supplies shall be UL listed and MEA approved.

2. Dedicated power supplies compatible with electrified locking devices that operate at voltages or amperages unavailable from the supplies described above will be furnished as part of the Finish Hardware under Specification Section 08715.

E. Electric Locks, ADA Power Operated Doors and Controls, Power Transfer Hinges and Knuckles shall be furnished as part of the finish hardware under Specification Section 08715.

F. Fire alarm release relays shall be furnished as part of the Fire Alarm System installation under Specification Section 16721.

G. Wire and Cable

1. Device Signal Cable

a. See Contract Drawings for type and size.

b. All cable used shall be approved by equipment manufacturer prior to submittal to the Engineer for approval. Include proof of manufacturer's approval with cable catalog cuts.

2. Device Power Cable

a. See Contract Drawings for type and size

b. All cable to be UL listed, jacketed, pair, separate color code from any other power circuits.

3. Electric Lock Power Cable

4. Shall be a minimum of No. 14 AWG, and shall be twisted, shielded, stranded, jacketed pair, UL listed separate color code from any other power circuits.

5. Lenel System Field Data Gathering Panels Data Cable:

6. Shall be CAT-5e and verified for a minimum of 100Mbps data throughput.

7. Panel and Enclosure Grounding Cable:

8. Alarm panel and enclosure grounding, lightning suppression, and 120VAC surge suppression drain cable shall be No. 8 AWG, copper cable in accordance with Section 16450.

H. Surge Suppression:

1. Shall be provided for low voltage signal wiring protection and for 120 VAC.

I. Equipment Enclosures:

1. Refer to Contract Drawings for enclosure type requirements.

2. Shall be provided with tamper alarms and have keyed access.

PART 3. EXECUTION

3.01 PREPARATION

A. Make all arrangements required for personnel certified by the equipment manufacturers in their products to provide all field support services required for the preparation, installation, inspection, and testing of the equipment.

B. All equipment installation, inspection and testing shall be performed under the supervision of the certified personnel. Make all arrangements required for the certified personnel to provide all field support services required for the preparation, installation, inspection, and testing of the equipment.

1. Submit a report documenting the presence on the Work Site of the Manufacturer's certified personnel. Reports shall provide complete information regarding the presence of the personnel, including, but not limited to, dates, times, subject equipment, tasks performed, persons contacted, problems corrected, event errors, systems logs, test results and reports, training provided, and other pertinent information.

2. Provide the services of person(s) certified by the Manufacturer to witness the unloading at the Work Site of the System equipment, and to ascertain the condition of said equipment. The Contractor shall submit to the Engineer a report, completed by the person(s) certified by the equipment Manufacturer, documenting the findings.

C. Arrange for the equipment manufacturer to schedule with the Engineer and LGA a survey of the existing system head-end and its sub-components verify the latest hardware, firmware and software versions used.

D. Prepare and submit for approval shop drawings for all equipment, including installation drawings, in accordance with 1.07 of this Section.

E. Coordinate the schedule for the all equipment delivery, installation and testing of equipment. Installation shall follow the Construction Staging identified on the Contract Drawings. If the Contract Drawings or the nature of the installation requires that the equipment be installed, tested, commissioned and placed into service in separate and distinct stages or phases, the Contractor shall coordinate all such work to ensure proper equipment delivery and technical support.

F. Prior to delivery of the equipment to the Work site, prepare and submit for approval an Equipment Placement and Staging Plan. Plan shall be coordinated by the Contractor with all affected trades. The plan shall indicate:

1. General schedule, schedule by stage or phase and schedule for each device. Indicate start dates, end dates and durations. Include major milestones such as Fabrication, Production Testing, Shipment, Delivery, Inspection, site preparation work, installation, energization, and testing.

2. Placement drawings both overall and for each installation stage or phase.

3. The order in which the equipment and devices will be installed. Identify the various installation stages or phases. For each stage or phase, identify which devices will be installed, where they will be installed and in what order.

4. Step-by-step detailed procedures for installation of the equipment including:

a. Pre-delivery of the equipment to the Contractor's storage facility or location.

b. Inspection at the storage facility or location.

c. Pre-delivery assembly and testing (if required).

d. All site work and preparation required for installation of the equipment.

e. Delivery to the Work site.

f. Work site equipment assembly.

g. Equipment installation.

h. Procedures for installation, testing and termination of all power, control and communications wiring and cabling.

i. Number and qualifications of personnel required.

j. Estimated dates and time of day that preparatory work and equipment placement will be performed.

k. Identification of interfaces with others

l. List of activities required from the Engineer or others, if any, to perform the Work.

m. Contingency plans for placement, testing or commissioning delays.

G. Coordination of the Work of this Section with Work by other Sections:

1. Coordinate any required interface of the MAC System with the LGA Station Closed Circuit Television (CCTV) System, furnished under Specification Section 16781. Ensure the Verint DVMS and the Lenel On-Guard systems contain all drivers and scripts required to allow any access control and alarm monitoring event in the Lenel system to trigger the call up of corresponding video, video presets by the DVMS, increase in the video recording frame rate and display of selected video on the Lenel workstation.

2. Coordinate the selection and installation of card readers, door contacts, motion detectors and any other field equipment and accessories with the Engineer. Coordinate the installation of devices and equipment in architecturally finished public areas with the Engineer. Where equipment and devices are installed on or within architectural and structural elements, coordinate the requirements with the entities manufacturing and installing the architectural and structural elements to ensure proper provisions are made for equipment and device installation. Coordinate colors and finishes of devices with the Engineer to minimize its visual impact against the architectural finish.

3. Coordinate selection and installation of door contacts and door lock power supplies with the work of Specification Section 08715.

4. Coordinate all data networking requirements with the data network designer and administrator retained. Ensure that all equipment requiring connection to the data networks is reviewed with the network designer and administrator. Ensure that the network designer and administrator provide IP addresses for all equipment. Ensure that any special network protocols, bandwidth, throughput and recover requirements are coordinated with and provided for by the network designer and administrator.

5. Coordinate the phasing of the system installation, testing and acceptance with the with the data network designer and administrator retained. Ensure that all required data networks will be available to support the system installation, testing and acceptance for each phase. Ensure that all testing is coordinated with the data network administrator to ensure that the testing required for the Work of this Section does not impact network performance or availability or the operation of any other systems that may be utilizing the data network.

6. Coordinate the work of this Section with the selection of the Data Networking equipment provided under Specification Section 16785. Ensure that all switches, firewalls and SONET equipment is compatible with and will fully support the required operation, availability and performance of the Work of this Section.

7. Coordinate any interface with the Vertical Transportation Monitoring System (VTMS) with the work of Specification Section 14350. Coordinate all data protocols and exchanges with the VTMS manufacturer/integrator retained under Section 14350. Furnish all required hardware, Lenel API's, SDK's, and scripts required for interface as part of the Work of this Section.

8. Coordinate any interface with the Fire Alarm System with the work of Specification Section 16720. Coordinate all data protocols and exchanges with the Fire Alarm manufacturer/integrator retained under Section 16720. Furnish all required Lenel hardware, API's, SDK's, and scripts required for interface as part of the Work of this Section.

H. Coordinate with the Engineer all modifications or configuration of LGA's existing Lenel OnGuard MAC to support the Work of this Section. Any modifications or configuration required shall not impact the operation and performance of the existing LGA Lenel OnGuard MAC. All configuration modifications required to LGA's existing Lenel OnGuard MAC shall be performed by the Contractor as part of the Work of this Section, under the direct supervision of LGA.

I. Coordinate all device and equipment installation and power requirements with the equipment installer.

J. Coordinate all device and equipment AC and UPS backed power requirements with the Electrical installer, if a different entity than the installer of Work of this Section.

3.02 CONDUIT AND WIRING

A. All equipment shall be grounded in accordance with local codes, manufacturer's recommendations and in accordance with in Section 16450.

B. All conduit and raceways shall be in accordance with the requirements of Section 16110.

C. All 120VAC power wiring shall be in accordance with Section 16120.

D. All wire and cable installed in an area subject to NFPA130 shall have low smoke, zero halogen insulation. PVC insulation shall not be used in areas subject to NFPA130.

E. Furnish and install all wiring required to all equipment connections required for a complete and fully operational system conforming to the requirements of this section and the Contract Drawings. The Contractor shall advise the Engineer of any required conduit or wiring modifications from those shown on the Contract Drawings, prior to installation, including size, routing, back boxes, junction boxes, pull boxes, to achieve complete coordination with the work of all other trades.

F. Test and certify all Category 6 cables in accordance with the requirements of Specification Section and submit test reports for approval.

G. Insure cabling shield does not touch terminal connections. Unless otherwise recommended by equipment manufacturer, ground all shielded cables at one end only using drain wires at control panels, power supplies, or head end equipment. Insulate shield at device end with shrink tubing to completely cover shield and drain wire. Where multiple devices are served by the same shielded cable, shield continuity shall be maintained and properly insulated to eliminate intermittent grounding. At control panels, power supplies or head end equipment, provide separate instrumentation ground. Do not connect shield grounds directly to building electrical ground. Carefully follow manufacturer's instructions. Coordinate with Specification Section 16450.

H. Lay out conduit and cable runs prior to installation. Wherever possible, maintain 1 foot-0 inches clearance from parallel runs with 120 VAC or larger voltage conduit and wiring

I. All wires shall be color coded to provide separate identification to differentiate intrusion alarm signal, 12 VDC, 24 VAC, intercom, MAC or CCTV system data communication, video signal, CCTV alarm input, zone expansion or relay board power and database or any other system function. Wires shall be similarly coded for each system serviced throughout the entire installation.

J. No intermediate cable splices are allowed.

K. All cabling shall be labeled with self-laminating, thermal transfer printable, permanent adhesive backed tags using indelible marking at the camera and control end with corresponding numbers, such as Tyco self-laminating polyester labels, or approved equal. Patch cords between equipment shall be labeled, wherever possible, with field equipment label designations, to create as uniform a tagging system as possible.

1. All 24 VAC power circuits shall be tagged at each device and 24 VAC power supply fused terminal strip with 12 VDC and 24VAC panel and fused circuit number.

2. Transformers and power supplies shall be identified, along with their cable, at both transformer and load fed end of cable.

3. Install all wiring in accordance with Specification Section 16133, and Terminal. All wiring in panels shall be neatly dressed, run parallel wherever possible, and provided with adequate slack for future maintenance and service terminations.

L. All wiring in panels shall be neatly dressed, run parallel wherever possible, and provided with adequate slack for future maintenance and service terminations.

M. All "unused" wire conductors shall be capped to eliminate shorts and grounds, tagged with their terminal points and identified as "spare" at each end with a unique spare cable tag identification system.

N. Deviations to wire runs shown on Contract Drawings may be required when site conditions affect the equipment's operation, performance, or purpose. All such relocations shall be approved by the Engineer. All relocations required shall be made without additional cost to the Authority.

O. All wiring or cable shall be tested for, and be free of, opens and shorts. All wiring shall test free of grounds with the exception of circuits that are intended to be connected to the ground side of protective circuits.

P. All wire and cables entering equipment cabinets and enclosures shall be grouped and tied inside the enclosures on 6-inch centers with self-locking nylon cable ties. All wiring shall be grouped in an orderly fashion. The use of adhesive tapes (electrical or other) shall not be permitted as a substitute for cable ties or wire management.

Q. All stranded wiring that is connected to equipment that has terminal strips or screw lugs shall be terminated with either nylon insulated crimp-on spade lugs, equal to Thomas & Betts STA-KON fork tongue locking type or equivalent, sized for correct wire and screw sizes or shall be solid bare wire attached to screw terminals. Where compression screws are used to cap stranded wiring, wiring shall be tinned to eliminate destranding and consequent poor connection. Each wire shall be documented on the Shop Drawing wiring diagrams.

R. All wiring that is connected to equipment with solder lug connectors shall terminate wire to lug in a solder joint. The solder joint, lug and any bare wire shall be covered with heat shrink tubing. Multi-conductor bare wire ends shall be soldered to prevent de-stranding.

S. Wiring and cables that are installed shall maintain color-coding from origination point to termination point. Where paired cable is used, the pairs in the cable shall be maintained in the run. Pairs shall not be separated to form different pairs than those in the original cable. Color-coding shall be maintained within the system. Maintaining color-coding applies to all type circuits in the system.

T. Equipment installer shall review approved installation Shop Drawings for wiring type, scheme and tagging for all systems prior to installation, with factory/technical representatives. Advise the engineer of any required modifications prior to wire procurement and installation and obtain approval accordingly. It is the Contractor's responsibility to review the system's wiring with the factory representatives and to supply the cables, which meet their requirements. Where heavier gauge cables are specified, by the Engineer, and such provide enhanced performance reliability, durability or future capacity, they shall be used unless prohibited by the Manufacturer. Where cable gauges must be increased, due to length of runs in the field, they shall be provided at no additional cost to the Authority.

U. Paralleling of multi-conductor cables to "create" a cable of larger wire gauge shall be prohibited.

V. Wiring diagrams shall be provided in all signal and power panels along with cable schedules, in a clear plastic envelope, for future use in system maintenance and service.

W. Wherever possible, maintain a minimum of 6-foot clearance from variable speed drives, transformers, 480V and higher electrical service, and other known sources of RF and EMI.

X. Wherever possible maintain 2-foot clearance from florescent ballasts. Wherever possible, maintain a minimum of 6-foot clearance from variable speed drives, transformers, 480V and higher electrical service, and other known sources of RF and EMI. Wherever possible maintain 2-foot clearance from florescent ballasts.

3.03 INSTALLATION

A. Coordinate all MAC equipment installation including:

1. Conduit and raceways sizes.
2. Wiring and cabling sizes, types and quantities.
3. Verification equipment power requirements.
4. Equipment and device circuiting.
5. Equipment locations and layouts.
6. Anchoring and securing of equipment.
7. Restoration of finishes incidental to the installations.

B. Installation of all Monitoring and Access Control System equipment and materials shall be in accordance with the manufacturer's recommendations, the approved Shop Drawings and the requirements of this section and the Contract Drawings.

1. Locate all equipment which must be serviced, operated or maintained in fully accessible positions, especially when located in concealed locations. If required, for better accessibility, Coordinate the installation with the trade in which the access door will be mounted to furnish access doors for this purpose. All access doors shall be approved by the Engineer.
2. Minor equipment location deviations from the Contract Drawings may be made to allow for better accessibility, but all such deviations shall be approved by the Engineer prior to any work being performed.
3. Minimum clearances in front of or around equipment shall conform to the latest applicable Manufacturers requirements for inspection and testing and all local codes for control panel and junction box access. Treat all control panels, power supplies for access, as though they were 120 VAC leaving a minimum of 3 feet-0 inches clear in front of same, floor to ceiling as required by the NFPA 70.
4. All equipment, except wiring and conduit, shall be completely accessible without the requirement to remove any portion of building structure or other system component, except an appropriately sized access door or ceiling tile.
5. Enclosure access doors shall be hinged and arranged to allow full swing open and complete access to all enclosure components and wiring.
6. Furnish all fittings, conduit associated with panel to panel and panel to trough connections, trough, wireways, boxes, hangers, wiring devices, enclosures, signage, fasteners, connections, control panels, relays, cable trays and miscellaneous accessories necessary for the complete installation of the System and final connections.

7. Contract Drawings are schematic for systems equipment as exact roughing requirements vary slightly with different manufacturers and job conditions. The Contract Drawings represent a schematic, depiction of the Monitoring and Access Control System conduit, cable tray and wire network layout for the system equipment specified. Final conduit, cable tray and wire quantity, size and arrangement, as well as final routing and placement shall be based on system equipment, manufacturer's engineering requirements, field coordination with other trade work, existing building conditions and as a result of other trade equipment which must be connected to. Exact Installation shall be submitted on shop drawings to be approved by the Engineer.

8. Carefully coordinate the Work of this Section with all affected trades to prevent conflict with the work of other trades or delays to the schedule.

9. See Contract Drawings for overall scope and configuration of Monitoring and Access Control system cable, control, and monitoring requirements.

10. Coordinate all cable, conduit and device identifiers with the Engineer. Ensure uniformity and inter-relation of identifiers. Avoid duplication of identification.

C. Monitoring and Control System and Associated Devices

1. Magnetic Contact Switches

a. Provide all contacts with sufficient wire lead length and stainless steel armor sheathing to allow an installation free of exposed conductors, unnecessary splices, and inappropriately placed junction boxes between contact mounting and connection to alarm signal homerun cables and their associated junction box. Contacts are manufactured with standard 1 foot pigtails. Review installation application and conduit and junction box rough-in, prior to purchase and order longer pigtails, as required.

b. Each protected door, or bank of doors at the same portal, shall be a unique designated reporting security zone, wired to its respective intrusion detection system remote input panel, as shown on the Contract Drawings, to permit individual reporting of the condition of the zone, and arming or disarming of the zone by the appropriate system keypad commands.

c. Magnetic contact system to be fully supervised for circuit open, short, normal, and alarm. Provide required end-of-line resistors as required by the MAC System manufacturer to achieve this supervision.

d. Switches to be recess/flush mounted to conceal all elements of switch and wiring wherever possible. Rolling doors, grilles and roof hatches only shall utilize surface mounted contacts.

e. For double doors one pair of switches are required, one switch per door leaf.

f. See Contract Drawings for installation details. Coordinate all doors, frame or other preparation with the Engineer. Frames shall be factory prepared to receive contacts and be coordinated with the door frame manufacturer to achieve exact preparation details per magnetic contact manufacturer's installation instructions.

g. Connect magnetic contact switch to intrusion detection panel for device status signal transmission, and provide one end ground of cable shield at the panel.

h. Magnetic contacts shall be typically placed at the door head. Jamb mounting of contact on strike side of door is also acceptable, based on field conditions and as approved by the Engineer. Mounting of contacts of the hinge side is prohibited.

i. Door contact wiring shall be spliced to homerun wiring in door buck junction box, or through suitable length contact wire, in stainless steel sheathing, to remote junction box, based on field conditions associated with door contact mounting details. Magnetic door contacts shall have sufficient armor clad wire and lead length to reach associated junction box with no intermediate splices. Mount associated junction box in or above ceiling or in wall in protected space as directed by the Engineer. Wherever an accessible ceiling is provided, mount junction box above ceiling. Where drywall ceilings exist, mount junction box with flush, single gang cover at location approved by the Engineer. Use tamper proof screws where fasteners are exposed.

j. Use suitable rubber bush compression fittings to secure miniature armor clad door contact cable entry to junction box if used.

k. Installation of contacts in special conditions at door frames shall be reviewed in the field and a sample installation of each typical condition shall be created in a working session with the Engineer for approval prior to final installation.

2. Intelligent System Controllers (ISC)

a. Installation

(1) Coordinate equipment location with other equipment in the same area. Install to provide maximum maintenance capability.

(2) Connect low voltage power supplies to 120VAC power fed from UPS backed generator circuits as indicated on Contract Drawings via power outlet strips.

(3) Connect card readers, request to exit (REX) devices, electric door locks, door contacts, and lock power supplies to card reader interface, to provide local door access control interface and program system database accordingly.

(4) Connect all ISC panels to dedicated 120 VAC emergency circuits as indicated in the Contract Drawings.

(5) Provide single line alarm input, relay output control and card reader termination directories in each panel to achieve proper test, checkout and maintenance. Directory to be encased in clear vinyl envelopes.

(6) Provide loss of AC power and low battery as security zone inputs using relay interface or internal software features.

b. Data Communication

(1) Provide all necessary installation and supervision over data communication connections to the LGA Station Local Area Network. Match manufacturer's approved data communication interconnect scheme. Verify signal supervision and reporting capabilities as provided by CPU communication network.

3. Card Readers

a. Install onto finished walls adjacent to door to be controlled, using concealed bolts, as required by wall construction and in accordance with Card Reader Manufacturer's instructions.

b. Coordinate final placement and mounting of unit with conduit and cable runs, device operation, and ADA requirements. Refer to Contract Drawings for exact placement requirements.

c. Wire electric lock "energize" circuit through reader interface (RI) output relay to achieve activation of lock. Install diode suppression utilizing diodes of factory recommended type and rating to protect card reader interface electronics from back EMF from lock.

d. Set energize relay adjustable timer between five and 10 seconds to allow adequate time for passage through from access side location. Confer with Engineer and program time accordingly to allow passage but discourage tailgating.

e. Allow valid door exiting and assure detection of forced entry, by use of built-in request-to-exit REX switch in lock, and programming of alarm shunt functions. REX to shunt contact only; not to unlock the lock. Review REX shunt timing with Engineer and program time accordingly to allow exiting but enforce "door forced" alarms.

f. Wire card readers to the Reader Interface (RI), using cable per manufacturer's recommendations and in accordance with this section, and provide separate dedicated RF ground, separate from 120VAC grounding.

g. Review reader mounting with Engineer and manufacturer's instructions, paying special attention to related, adjacent construction material constraints. Review prior to reader rough-in to insure compliance with manufacturer's recommended mounting details and adequate physical blocking to insure strong and secure attachment.

h. Refer to Contract Drawings for specific configuration and special conditions.

4. Device Power Supplies

a. Install in locations shown on Contract Drawings and connect to security devices per Contract Drawings and Manufacturer recommendations.

b. Hard-wire into 120VAC source. Wire loss of "AC" power relay and low battery relay in panel enclosure, and connect as separate alarm zones to intrusion detection input utilizing end-of-line resistors.

c. Wire from 12VDC individually fused terminals to 12VDC security device power circuits. Do not exceed 200 milliamps of connected load to any one fused circuit without the approval of the Engineer.

d. Power to the Monitoring and Access Control System shall be from Uninterrupted Power Supply (UPS) backed circuits, which in turn, are a back up to Emergency Generator backed circuits, as indicated on the Contract Drawings.

e. Additional battery back-up shall not be required for the Device Power Supplies.

f. Mount to provide 3 feet clearance in front of enclosure doors, and provide tamper switch on doors wired to intrusion detection panel as tamper switch zone via end-of-line resistors.

g. Activation of power kill switch shall initiate a "trouble" input to the panel to indicate a protective circuit is temporarily disabled.

h. Coordinate interface to fire alarm system, where required, to ensure that locks identified to be unlocked during a fire alarm condition are denied power to create unlocked condition. Furnish and install all conduit and wiring between the fire alarm relays, and lock power supplies as required.

3.04 TESTING

A. All systems, components, installation, and any associated workmanship or materials are required to be reviewed, tested, and accepted by factory authorized representatives prior to turnover to the Authority.

B. Acceptance Testing shall be divided into three distinct phases as follows:

1. Factory Testing
2. Field Testing
3. 30 Day Operational Testing

C. Prepare and submit a comprehensive Acceptance Test Plan that describes all the activities and tasks associated with testing of the MAC in accordance with the requirements of this Section. The test plan shall include a comprehensive description of the Factory Acceptance, Field Acceptance and Operational Acceptance testing to be performed on the MAC.

1. At a minimum, the Comprehensive Acceptance Test Plan shall contain the following elements:

a. Summary of each test phase (Factory, Field and Operational)

b. A schedule for the accomplishment of each test and identification of the interim milestones.

c. Identification of all components, including the number and type of field devices, to be used during the test.

d. Schematic drawings showing interconnection and types of simulation equipment employed.

e. A description of the hardware and software involved and/or required for the test.

f. A statement of the purpose and goal of each test case and the method of testing.

g. A full step-by-step description of the tests performed including test conditions at the start and end of each test, expected test results with Pass/Fail criteria, and actual test results.

h. A description of the conditions that shall exist at the start of the test, the action and or function to be tested, and the conditions/results expected to exist at the conclusion of the test.

i. A description of the method of simulating processing volumes and transaction frequency during the test.

j. A description of the reports, database listings, statistical analyses, tables, charts, etc. to be provided to the Engineer to document the test results.

k. A description of the procedures to be used to control and resolve all failures encountered during the performance of each test.

l. A plan and schedule to conduct the next iteration of the test phase or a statement that the phase was completed successfully.

m. Each test procedure shall include a sheet for sign off and date by both the person performing the test and the test witness. Space for tester and witness comments shall also be included.

D. All systems, components, installation, and any associated workmanship or materials are required to be reviewed, tested, and accepted by factory authorized representatives prior to turnover to the Authority.

E. System testing shall include coordination and complete testing of each of the individual MAC System's operating programs and integration with the LGA Video Surveillance System.

F. Testing Procedures

1. Prior to gaining approval to conduct witnessed Acceptance Testing, the Contractor must provide the Engineer with a preliminary test report, enumerating each component of each system has been tested and showing satisfactory results.

2. After completion of installation, and prior to witnessed Acceptance Testing, a factory trained technician shall test and certify each system's operation. Test shall also certify that equipment is installed in accordance with approved factory means and methods.

3. A letter of certification indicating that each system functions and conforms to all specifications herein shall be submitted to the Engineer, prior to start of witnessed Acceptance Testing.

4. Prior to witnessed Field Acceptance Testing, the Contractor shall provide one complete set of the approved equipment shop drawings and wiring diagrams for use by the Engineer during the test process.

G. Factory Acceptance Testing:

1. Prepare and submit a comprehensive Factory Acceptance Test Plan that describes all the activities and tasks associated with testing in accordance with the requirements of this Section. The Factory Acceptance Test Plan must be submitted to the Engineer a minimum of 60 calendar days prior to the proposed start of the witnessed Factory Acceptance Testing.

2. The Factory Test shall involve, at a minimum, the inspection by the Authority of all major physical components of the LGA Monitoring and Access Control System furnished under this Contract as well as the testing of the functionality in a controlled environment in accordance with the Factory Test Plan. The Contractor shall assemble all major components and subsystems, at the designated facility. Prior to the initiation of the factory test, the Contractor shall have submitted, and the Authority must have approved, draft copies of hardware, software and operations documentation, training manuals, and any other documentation that is required for full system operation.

3. The Factory Acceptance Testing shall include:

a. Physical inspection of equipment panels and cabinets for conformance with approved Shop Drawings.

b. LAN communications among all major components and System Server running OnGuard furnished by the Contactor for testing

c. Compatibility with the existing LGA MAC System Access Control Credential

d. Sample intrusion and access control violations

e. Sample monitoring circuit states and system supervisory alarms

f. Access System operation under distributed decision making mode

g. Mantrap Operation, automated and with remote operator intervention.

4. Prior to witnessing of testing by the Authority, Contractor shall perform unwitnessed run through of the complete test and submit certification that a complete run through of the test was preformed, the results were satisfactory and the System is ready for formal witnessed Factory Acceptance Testing.

H. Field Acceptance Testing

1. Within 30 days after successful completion of the Factory Acceptance Test, submit detailed Field Acceptance Test Plans that describes all the activities and tasks associated with the field acceptance testing of all elements and functions of the CCTV System in accordance with the requirements in these Specifications and the Contract Drawings.

2. After installation and agreement by the Authority to initiate field testing, the MAC System shall be tested in compliance with the approved Field Acceptance Test plan. The Field Acceptance Test shall be conducted with all devices and components installed through a specific construction phase, integrated as a system at the Authority's site with simulation only used to perform stress and performance testing. The test scripts to be used shall include, but not be limited to, those test scripts used for the Factory Acceptance Test, and any additions as required to encompass all field devices, e.g. local processors, network components, etc.

3. The Field Acceptance Tests submittals shall be in the same general format as the Factory Acceptance Test Documentation. Because the Field Acceptance Testing will be on the installed equipment, properly connected, configured and interfaced to the actual field devices, the test procedures shall be in correspondingly greater detail than the Factory Acceptance Test and will demonstrate the full and complete system functionality. Field Acceptance Test documents shall be submitted a minimum of 30 days prior to proposed start of the Field Acceptance Testing.

4. Field Acceptance Testing shall include:

a. Command, control and monitoring of all Station field interface equipment and sensors through the existing LGA MAC System Server

b. Intrusion and access control violation

c. Monitoring circuit state changes and system supervisory alarms

d. Integration with the LGA CCTV/DVMS System

e. Live and Recorded Video Display functions,

(1) Integrated Alarm functions

(2) Operator demand functions

f. P/T/Z control function

g. Access System operation under distributed decision making mode.

h. Mantrap Operation, automated and with remote operator

5. Due to the phased equipment installation, the Contractor shall divide the Field Acceptance Testing into multiple submittals, one for each phase, as they are being installed and commissioned. There shall be a Field Acceptance Test submittal for all system elements.

6. Preliminary as-built drawings shall be available during the Field Acceptance Testing so their accuracy can be verified by the Engineer in the field.

7. Additional requirements for the field testing of the equipment are as follows:

a. All instruments, ladders, scaffolding, lifts, testing equipment and labor required for all tests shall be furnished by the Contractor.

b. Upon completion of the installation and testing, prior to acceptance, the Contractor shall thoroughly clean (internally and externally) all equipment furnished and/or installed under this Section.

c. All systems shall be restored by the Contractor to full operating capacity and operating capability after testing.

d. The Engineer shall be notified in writing of all scheduled tests within the prescribed time in advance, so that he may witness same. Un-witnessed tests shall be performed again at no additional expense to the Authority.

I. 30 Day Operational Acceptance Testing

1. Prior to the commencement of Operational Acceptance Testing the Contractor shall provide one complete set of the approved equipment shop drawings and wiring diagrams for use by the Engineer during the test process.

2. Operational Acceptance Testing shall commence following notification by the Engineer that the results of the Field Acceptance Testing are satisfactory and following receipt by the Authority of the Contractor's certification that the system is ready for 30 Day Operational Acceptance testing. The Operational Acceptance Tests shall be performed by the Authority with the advice and assistance of the Contractor during a thirty (30) consecutive day period.

3. During the Operational Test period, the Authority will operate the system as specified using the fully configured software and hardware and all applicable manuals, printed guides and procedures submitted by the Contractor. The Contractor shall correct any major failure or malfunction of material significance during the period as it occurs. Said malfunctions include, but are not limited to, equipment failure or failure of the IoIP system to comply with this Section. Major failure is defined for this purpose as any failure of any item of the equipment or software, or both, that prevents the Authority from performing meaningful work based upon the Authority's business needs.

4. All malfunctions encountered during operational Acceptance Testing shall be corrected by the Contractor at no additional cost to the Authority. After correction the Operational Test shall restart at day one, and shall continue until the results meet the conditions and terms of the performance period and the System has operated continuously for 30 consecutive days without error or malfunction.

5. A 30 Day Operational Test shall follow the completion of the Field Acceptance Test for each of the installation phases. At the end of the last installation phase the final 30 Day Operational Test shall be on the completed fully installed System.

J. Extent of Testing

1. Tests shall include at minimum systems components and interfaces including: MAC workstations; Card Readers, Motion Detectors, Duress Buttons, DVMS Integration, off-line and on-line operations. The Contractor shall simulate a fully loaded system if all end devices are not incorporated in the factory test configuration.

2. In some cases, MAC equipment must be integrated with hardware items furnished under other Sections. It shall be the responsibility of the Contractor to ensure that all of the various parties and equipment providers regularly communicate and provide and exchange all of the necessary hardware, software, data communications protocols and all other information that may be required to allow full integration of the hardware items.

3. Conduct the following tests specific to the LGA Station MAC System:

a. Testing, checking and start-up of the system shall be performed under the technical direction of the manufacturer's service engineer. The Contractor, in conjunction with the manufacturer, shall provide, at no additional cost, a start-up service package.

b. Substantial integrated testing will be required to complete and validate operation. The Contractor shall provide all labor to support this testing. The Contractor's support crew shall include at a minimum, each manufacturer's service Engineer, Software Developer and Field Service Technician.

c. Inspection: The Contractor shall perform the following inspections before starting the field testing:

(1) Verify basic MAC operations over the network between the existing Host Servers and the all the operator workstations furnished as Work of this Section.

(2) Verify that all controllers, and other related components are in place and securely mounted in accordance with the applicable Contract Drawings, Specifications and approved submittals.

(3) Check all incoming power connections including main disconnect, fusing, main power supply, and I/O device power.

(4) Verify that all communications cable is installed and correctly corresponds to rack address assignments.

(5) Use an I/O address assignment listing to verify that a connection is made at the module end and at the device end for all listed inputs and outputs.

(6) Apply power to each low voltage power supply to verify that the proper input voltage is at the power supply terminals and that the voltages are within range.

(7) Verify that each output and input is programmed and that no unplanned duplication exists.

(8) Verify communications between the Host Servers, workstations and all field equipment.

4. Conduct the following tests specific to the LGA MAC Systems operating over the LGA SONET Network:

   a. Demonstration of monitoring and control of devices at LGA through the existing LGA MAC System at all workstation locations.

   b. Video call-up on alarm through Verint Integration

   c. All circuit and system supervisory alarms

5. Perform coordinated testing of all CCTV functionalities available through the Lenel/Verint integration. The Field Test Plan followed shall use the final version of all applicable manuals, printed guides and procedures.

6. The test scripts to be used shall include, but not be limited to, those test scripts used for the Factory Acceptance Test, and any additions as required to demonstrate and exercise all operational procedures and to demonstrate that all of the various components that make up the system are integrated as a single, fully functional system.

7. Completely check, test, and calibrate all connected hardware and software to insure that the system performs in accordance with the Specifications and sequences of operation required. Each shall be tested and verified for correct operation and execution.

8. In addition to normal operation, all operating scenarios shall be repeated for the each level and type of the various equipment failure, such as work stations, devices, controllers, and communications network failures.

9. Conduct a validation demonstration which shall consist of, but not be limited to:

   a. Demonstrate address assignments and commands.

   b. Demonstrate system performance.

   c. Demonstrate and alarm responsiveness.

   d. Demonstrate and verify all integrated control functions in operation for each item controlled and each point monitored.

   e. Live and recorded video call-up to workstations.

K. Failure to Complete Acceptance Testing Successfully

1. In the event the LGA MAC System is deemed not to have successfully completed Operational Acceptance Testing within 90 days of the scheduled completion, then the Authority may, in its sole discretion, elect one of the following options, the election of which shall be effective upon written notification of the Contractor by the Authority:

a. The Authority may require the Contractor to install, within such time period as may be mutually agreed in writing by the Authority and Contractor, a direct substitute of equipment or components to meet the applicable period of the Acceptance Testing. The Contractor shall use due care in the removal and substitution of such equipment or components. Such substitutions shall be subject to Acceptance Testing as provided in this section and, in the event such substitute component fails to successfully complete Acceptance Testing by the agreed-upon date, the provisions of this paragraph shall again be applicable.

b. The Authority may permit the Contractor to continue to attempt to successfully complete the Acceptance Testing required by this paragraph; provided, however, that the Authority may revoke its election of this alternative at any time upon not less than five days prior written notice to the Contractor, in which event the Authority may, in its sole discretion, elect any one of the other options specified in this paragraph, the further election of which shall be effective upon written notification of the Contractor by the Authority.

c. The Authority may pursue any other remedy thereunder or available at law or in equity or seek to enforce any damages, in addition to those provided in the section entitled "Liquidated Damages" herein.

L. Exchange and Expansion of Equipment during Factory, Field and Operational Acceptance Testing

1. The Contractor shall certify in writing to the Authority when exchange or expansion equipment, devices, or components are installed and ready for use. For this purpose of this section, "expansion" is used to denote equipment which is not specified in the approved final design Bill of Materials. The Contractor shall provide an Installation Date Certificate for the equipment or component. If this occurs during the Operational Testing, the performance period of thirty consecutive calendar days for the operational test shall recommence on the first Authority work day following acceptance of the Contractor's Installation Date Certificate, at which time operational testing shall commence. It is not required that one Operational Testing period expire in order for another performance period to begin.

M. During the Field and Operational Testing, the Contractor shall perform any re-calibration, re-configuration or re-programming of the LGA MAC System hardware and software required as part of the normal operational configuration and to correct any system bug or errors encountered to insure that the system performs in accordance with the Specifications and required sequences of operation. All changes performed during field and Operational Testing shall be fully documented by the Contractor and shall not be implemented without prior approval by the Engineer.

N. Certified Completed Test Reports:

1. Acceptance Test Reports: Following the completion of each test period, prepare and submit a Final Test Report that describes the results of the test period and the next steps to be taken. The Engineer will review the report and respond, indicating its approval or noting changes required either in the performance of the work or in the report. The Contractor shall make changes or perform additional work as the Engineer may direct prior to the start of the next test phase. No test phase shall be considered complete, nor may the Contractor proceed to the next phase of testing until the Engineer has approved, in writing, the Contractor's test report for the previous phase. The report shall contain, but not be limited to:

a. Summary of the test period results including a statistical analysis of test results.

b. Descriptive narrative of individual test objective(s).

c. Data dictionary of test database.

d. System status prior to testing and after testing.

e. Expected test results.

f. Actual test results.

g. Exception condition report (when applicable).

h. Explanation of exception conditions and Contractor corrections.

i. Before and after database listings.

j. All applicable screen printouts, reports, interim processing dumps and other audit trail physical evidence to validate the test activity for each iteration of the test conducted.

k. Completed Tester and Sign-off Sheets

2. Pre-Acceptance Test Results: Submit certified Pre-Acceptance Test Result documentation no later than 30 days prior to proposed start of the Factory Acceptance Testing. Pre-Acceptance Test documentation shall include procedures for all pre-acceptance tests performed and the results. Submittal shall also contain Contractor Certification that the entire Factory Acceptance Test procedure has been run through, without error, and that the system is ready for witnessed Factory Acceptance Testing by the Authority.

3. Factory Acceptance Test Results: Submit certified Factory Acceptance Test Result documentation no later than 30 days after successful completion of the Factory Acceptance Testing.

4. Field Acceptance Test Results: Submit certified Field Acceptance Test Result documentation no later than 30 days after successful completion of each Field Acceptance Test.

5. 30 Day Operational Test Results Data and Documentation: Submit certified 30 Day Operational Test Result Data and documentation no later than 30 days after successful completion of the final MAC System 30 Day Operational Test.

6. Final 30 Day Operational Test Results: Upon completion of the final 30 Day Operational Test, submit documentation showing the entire system has successfully completed operational testing.

3.05 PROGRAMMING

A. Provide all required services for the re-programming or re-configuration of the existing LGA Monitoring and Access Control System for the end-to-end operation, monitoring, and control of the new MAC devices installed as Work of this Section. All work shall be done under the supervision of LGA. The Contractor's responsibilities extend to the provision of any required high-level database programming which may be required due to any project specific interfaces to allow for a fully functional System.

B. The Contractor shall request programming information relating to response instructions, zone numbers, and any/all special programming information. The request shall be in writing to the Engineer a minimum of four weeks prior to commencement of programming the System. As part of this request, the Contractor shall provide descriptive information of what is to be reported by the system for each device, and identify all required questions which the Engineer must respond to in order to complete System's programming.

C. Use all available database loading forms for system programming and submit as part of the System documentation.

D. Provide coordination services for the complete interface and integration programming between the LGA Monitoring and Access Control System and all associated subsystems, as described in the Section and in the Contract Documents.

E. Program the MAC System's operations incorporating interfaces with the LGA CCTV System and the Fire Alarm System furnished under Section 16721.

F. System Back-ups

1. Furnish an initial back-up of the existing LGA System databases before System programming begins.

2. Furnish daily backups of any changes to the configuration of the System as the programming proceeds.

3. Have database back-up media available at the head-end location for immediate recovery and restoration of the existing System in the event of a system failure.

4. Develop and implement a programming and backup media tracking and management system to ensure that both the Contractor and the Authority have the latest system backup media and to ensure that in the event of a system failure, the latest backups are used for recovery. This management and tracking system shall include having an off-site copy of the latest backup media and secure storage of all copies of physical backup media to ensure that only authorized Authority and Contractor personnel have access to the backup media.

5. Prepare Disaster Recovery Procedures which provide complete and step-by-step instructions for restoring the System to its normal operational state with minimal loss of System operational capability or availability, in the event of System failure or in the event that any subsequent modifications to the System by the Contractor result in System errors or faults.

3.06 OPERATION AND MAINTENANCE MANUALS

A. Prepare and submit System operation and maintenance manuals. If standard manufacturer's reference manuals are be utilized, they shall be enhanced with a site specific introduction and detailed narratives preceding each section to explain how individual section contents relate to the System as installed and configured for operation as Work of this Contract. These manuals shall be made available and utilized during the Factory Acceptance Testing as a means of checking their accuracy and completeness.

B. There shall be separate Operations and Maintenance manuals prepared.

C. Operations Manual: The Operations Manual shall contain custom text, photographs, and drawings for the installed System, with detailed instructions on how to perform day-today operational tasks. Include:

1. Overview of installed system architecture
2. Operations Run Book
3. Detailed description of normal system operation
4. Error and Alarm Handling Procedures
5. System Start up and Shutdown Procedures
6. Use of Various Logs and Output Data by Operator to Improve System Efficiency
7. Description of Operating Procedures
8. Alarm and Access Control sequence of operations
9. Administration terminal and Operator Workstation screenshots
10. Graphic Map Display screenshots
11. Alarm Database reports
12. Access Control Device Database Reports
13. Card Holder Database Reports
14. Guard Tour Groups
15. CCTV/DVMS Interface Sequences (as applicable at the time of installation)

D. Maintenance Manual: The Maintenance Manual shall contain custom text, photographs, and drawings for the installed, with detailed instructions on how to perform diagnostics, regular preventive maintenance and replacement on all components. Include:

1. Detailed description of installed system architecture.
2. Hardware description, including description of all equipment and nameplate data. Include catalog cuts.
3. Drawings showing all equipment locations.
4. Photographs of typical equipment locations with individual rack or enclosure
5. Functional block diagrams.
6. Drawings showing interconnection of all equipment.
7. Operating Procedures.
8. System start-up and shut-down procedures.
9. Diagnostic and test procedures for system and all hardware.
10. System back-up and restoration procedures.
11. Comprehensive factory service manuals shall be provided for individual equipment types showing theory of operation, wiring diagrams, voltages, parts lists including diagnostics, adjustment and configuration procedures.

12. Recommended service and test procedures including hardware replacement, card replacement, adjustments, and preventive maintenance procedures and materials, routine operations, guide to troubleshooting, description of sequence of operation. Include manufacturer's product data with each sheet annotated to clearly identify the data applicable to the installation and delete references to inapplicable information.

13. Recommended routine maintenance procedures and schedules (e.g. daily, weekly, monthly, etc.)

14. Special maintenance requirements (if any)

15. Hardware configuration information, including device naming, model numbers and serial numbers of equipment, MAC addresses, IP addresses and port assignments.

16. Special configuration requirements

17. Include copy of each manufacturer's warranty and give information sheet for proper procedures in the event of failure and instances, which may affect the validity of warranties.

3.07 TRAINING OF PERSONNEL

A. The Contractor shall arrange for training to be conducted by a manufacturer certified representative thoroughly familiar with all aspects of the systems operation for which training is being provided. The Contractor shall submit the names, qualifications and experience of the personnel proposed to conduct the training. Once approved by the Engineer no changes to training personnel shall be permitted without prior approval of the Engineer. If a change is proposed, the Contractor shall submit the same information for the proposed substitute contractor representative for review and approval.

B. The training shall cover the modifications to the existing LGA MAC System, the supporting communications infrastructure and on information regarding the functions and operations of the equipment specific to the LGA Station device installation.

C. Submit the following detailed information regarding the proposed training. If this information is not provided, or not provided in adequate detail, the Contractor shall be required to resubmit the information.

1. A course syllabus with enough detail and information such that the Engineer can evaluate the course material.

2. Sample hand outs, copies of overheads, manuals or other relevant course material.

3. Copies of video instruction material, if applicable.

D. Maintenance Personnel

1. Training shall be provided for maintenance personnel at two training sessions. The objective of the maintenance training is to permit Authority maintenance personnel to make minor adjustments to the various systems, troubleshoot the devices to the board level, replace defective boards, replace field devices and perform other maintenance functions normally associated with board level maintenance activities.

2. The initial training session shall be conducted on site, or at another location mutually agreed upon by the Engineer and the Contractor. The initial training shall be scheduled approximately one month prior to system activation and is subject to final coordination and agreement between all parties. This initial training session shall utilize the operations and maintenance manuals provided by the Contractor for the System provided under this Contract. Further, the Contractor shall provide all test equipment necessary for proper maintenance training. The Contractor shall provide a list of test equipment necessary to perform board level maintenance of the system to the Engineer prior to this training. Training shall, at a minimum, cover such areas as symptom recognition, troubleshooting techniques, proper procedures for performing maintenance (such as removing and replacing boards), and shut down and start up procedures, etc. The training shall include any techniques, procedures or processes normally associated with board level maintenance. This training shall also cover troubleshooting and replacement of devices and equipment, such as: Card Readers, Motion Detectors, electrified locking devices, Power Supplies.

3. The second training session shall be conducted on site within two months after system activation and shall utilize the live system, if possible. This training session shall cover a review of previous maintenance training and shall provide a means for the designated maintenance personnel to ask questions and to review specific problems encountered since system start up and to receive hands on training to solve those problems.

4. The first training session shall be a minimum of 24 hours of classroom training, utilizing test equipment, and all the equipment, devices and components on which a minimum of 10 maintenance personnel are to be trained. The second session shall consist of at a minimum of eight hours of on-premises training.

3.08 WARRANTY AND GUARANTEE

A. Warranty

1. Notwithstanding the Contract Documents, any inspection or approval by the Authority of the equipment or its installation, or the existence of any patent or trade name, the Contractor nevertheless warrants and represents that all equipment and the other items including the software, firmware and other items supplied to the Authority and all workmanship shall be in accordance with this Contract, shall be fully fit for performance and shall operate in accordance with the requirements of the Contract Documents. The Contractor guarantees that all equipment and other items to be supplied meet original manufacturers' specifications. The Contractor guarantees all equipment and other items to be supplied and workmanship against defects or failures in workmanship and materials, excepting to the extent of defects or failures which the Contractor demonstrates to the satisfaction of the Engineer have arisen by reason of accident, abuse or negligence or fault of the Authority, its agents, employees, Licensees or invitees and not due to fault on the Contractor's part. In the event of defects or failures in said equipment, or other items, or workmanship or any part thereof, then upon receipt of notice thereof from the Engineer, the Contractor's warranty obligations for LGA Monitoring and Access Control System shall be to repair or replace and make operational all System components furnished as Work of this Contract within 72 hours of being notified of the condition at no cost to the Authority.

2. The Warranty shall include the procurement and installation of all recommended and required software upgrades and patches.

3. The Warranty shall include routine scheduled and recommended maintenance procedures. Routine and recommended maintenance shall be coordinated with the Engineer.

4. The Warranty shall include replacement of all failed hardware and components.

5. Warranty Period

   a. The obligations of Contractor to remedy defects shall extend through a date one year after successful completion of each 30 Day Operational Acceptance Test.

B. Guarantee

1. Notwithstanding the specifications forming a part of this Contract, any inspection or approval of the Work by the Authority, or the existence of any patent or trade name, the Contractor nevertheless unconditionally guarantees that the equipment and workmanship furnished and installed hereunder shall be of the best quality and shall be fully fit for the purpose for which it is intended. The Contractor shall unconditionally guarantee all equipment and workmanship against defects or failures of any kind, including defects or failures in design, workmanship and materials, for a period extending to a date one year after successful completion of each 30 Day Operational Acceptance Test.

3.09 MAINTENANCE

A. Given the phased nature of construction on this project and the need to have the system provided beneficial use during construction phases, the Contractor shall provide maintenance services for the duration of the Contract.

B. The maintenance period for each construction phase will be for 365 calendar days which shall begin immediately upon successful completion of 30 Day Operational Acceptance Testing for each construction phase.

C. The maintenance services during construction shall include as a minimum the following:

1. Correction and repair of all errors and malfunctions.

2. Replacement of all failed hardware and components.

3. Procurement and installation of all recommended and required software upgrades and patches required to operate the system during construction.

4. Routine scheduled and recommended maintenance procedures required for the installed components to operate in a construction environment. All routine and recommended maintenance shall be coordinated with the Engineer.

5. System administration and configuration

D. Use of Spare Parts for Maintenance

1. The spare parts furnished to the Authority under 1.09 of this Section may be utilized for the performance of system maintenance under the condition that the Contractor immediately replaces all such spares. The Contractor shall continuously restock all Authority spare parts utilized in performance of maintenance.

2. All spare parts shall remain the property of the Authority.

3. The Contractor shall maintain an inventory list of all Authority spare parts. Note approved quantities, quantities in stock and record the serial numbers of all parts (where available). Record which parts were utilized and when, and when they were replaced. Spare part inventory is subject to inspection and audit by the Authority at any time and without prior notice to the Contractor.

4. Upon conclusion of the Contractor's maintenance services, the Contractor shall ensure that the Authority has a complete inventory of spare parts in accordance with the quantities listed in the approved spare parts list described in 1.09 of this Section.

E. The Authority shall assume maintenance responsibility for each installed and operational phase upon conclusion of that phase's maintenance period.

3.10 TURNOVER TO THE AUTHORITY

A. Prior to turnover of any System equipment furnished as Work of this Section to the Authority:

1. Ensure all hardware has proper configurations, provisioning and IP addresses, as approved by the Authority. Ensure there is no duplication of IP addresses.

2. Ensure all security configuration requirements have been met. Where exceptions have been made due to system requirements, identify all such exceptions to the Engineer.

3. Review all system and network connections with the Authority. Remove all non-Authority authorized connections and temporary or unused connections. All temporary and Contractor connections and interfaces utilized for construction, maintenance, or administration that are no longer required, shall be removed.

4. Review all user accounts with the Authority. Delete all non-Authority authorized user accounts. All temporary and Contractor user accounts and associated access privileges shall be deleted. Coordinate with the Authority for any Contractor personnel who will still require user accounts and access privileges after turnover to the Authority (e.g. for example for performing Contract Maintenance services).

5. Ensure all hardware and software updates and patches have been installed and are up to date with the latest Authority requirements.

6. Prepare and submit final as-built shop drawings.

7. Prepare and submit final updated IP addressing, provisioning and connection tables for all equipment.

8. Prepare and submit complete configuration, operation and maintenance documentation.

B. For each server, workstation and notebook computer furnished as Work of this Section, submit:

1. Configuration documentation. Indicate:

a. Server/workstation/notebook local machine name

b. IP address

c. List of local users and corresponding access privileges

d. Complete list of software installed. Indicate software manufacturer, product name and version/release number. Prepare separate lists for Authority supported and non-Authority supported software. For non-Authority supported software, also indicate the function/purpose of each non-supported application.

e. Location of hardware (i.e. where was it installed)

2. Original media for all software installed on each machine.

3. Original hardware registrations and commercial off the shelf standard software license agreements. All hardware and software shall be registered or licensed to the Authority

4. Rescue disks

5. Complete fixed drive backups

C. A minimum of six weeks prior to turnover to the Authority, schedule with the Engineer for the Contractor's System Integrator and maintainer to meet with their Authority counterparts to prepare System turnover plans. Integrator and Maintainers shall provide their Authority counterparts with one-on-one hands-on overview and training on the System, its installation, operation, and maintenance to ensure smooth and seamless transition from the Contractor to the Authority.

END OF SECTION

SECTION 16729

ACCESS CONTROL SYSTEM

APPENDIX "A"

SUBMITTALS

Submittals for the work of this section shall be separate and distinct from the submittals for other applicable Sections 16740, 16777, 16781, and 16788.

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Bill of Materials as per the approved catalog cuts
2. System Block Diagram
3. Detailed System Wiring Diagrams, indicating all field terminal block numbers
4. Point Schedules
5. Device Matrices
6. Complete, site-specific comprehensive, single-line diagrams, including all equipment, devices and cabling completely identified
7. Wire, cable, conduit and connectors
8. Enclosure and device installation details
9. Terminal block connection diagrams for all system components.
10. Detail drawings, which clearly illustrate the typical mounting configuration of each major equipment item. While some drawing details may be "typical," the drawings shall illustrate the installation detail of each unique application.
11. Detailed schematic drawings of all custom work, circuitry, and interfaces to equipment or systems not in Contract Work.
12. Fabrication shop drawings for all custom equipment.
13. Elevation drawings showing all MAC equipment locations and dimensions. These drawings shall also include wiring and power requirements.
14. Wiring diagrams showing the end of line resistor connection for the alarm monitoring system devices.
15. Detailed information and/or drawings concerning grounding and lightning and surge suppression.
16. Engineering calculations concerning wire sizes to ensure that the proper cable sizes have been provided.

17. Equipment Schedules and or details which define all of the equipment used within the System. Door schedule shall include door locations, quantity of door leaves at each portal to be protected, door lock types, and associated cameras

B. Catalog Cuts

1. Card Readers
2. Magnetic Door and Gate Contacts
3. Equipment Enclosures
4. Tamper Switches
5. Low Voltage Power Supplies
6. Lenel On-Guard Field Device Interface Equipment
7. Wire, Cable, and connectors associated with the installation of the Monitoring and Access Control System.

C. Prepare and submit requests for programming information relating to response instructions, zone numbers, and any/all special programming information.

1. The request shall be in writing to the Engineer a minimum of four weeks prior to commencement of programming the system. As part of the request, provide descriptive information of what is to be reported by the System for each device, and identify all required questions which require a response in order to complete the System's programming.
2. Prepare and submit a list of all IP addressable equipment at least 60 days before the start of equipment addressing, to be coordinated with the Engineer and the entity performing the Work of Specification Section 16744.

D. System Configuration Submittals

1. A minimum of 30 days before the start of the MAC system programming, submit complete system configuration information for the approval of the Engineer including, but not limited to, tables, schedules device matrices, screen shots and similar documentation and information to include, but not be limited to: card reader, input/output point identification, cameras, graphical map displays with embedded icons and incorporation of alarm and access point information into map displays. Include information on time zones, access levels, access groups, reader groups, badge templates, card encoding, MAC system set up coordination information, alarm masking groups, global input/output event linkages, strike times, door held open times, guard tours, alarm event operator text instructions, alarm attributes, card reader operations and all additional system operation and configuration information necessary for the completion of the integration and full system operation.
2. Disaster Recovery Procedures
   a. Prepare and submit Disaster Recovery Procedures describing how the existing LGA Lenel MAC will be restored to a previous state of System functionality with minimal loss of System operational capability, in the event that modifications to the System due to the Work of this Section result in System errors or faults.

E. Manuals, Warranties/Guarantees

1. Complete sets of system manuals shall be submitted explaining all system capabilities and options, including but not limited to the installation, set-up, operation and maintenance of all equipment furnished as Work of this Section, in accordance with 3.06 of this Section.

2. Submittal shall be furnished in both hard copy and digital format.

F. Schedules

1. Prepare and submit Equipment Placement and Staging Plan which shall describe how the System expansion shall be implemented with minimal disruption of the existing LGA MAC System, in accordance with 3.01 of this Section.

G. Qualifications

1. Name, address and of the System Integrator

2. Submit a list of a minimum of three installations, at least one of which shall be located in the United States, which shall have included work, comparable in system architecture, size and complexity. Said installations shall be currently in satisfactory operation for the last three consecutive years, at minimum.

3. Furnish references and current contact information for each project.

4. Furnish the resumes of all key project management, integration and installation personnel.

5. Furnish certifications of training of key personnel in the installation and maintenance of the major equipment manufacturers

6. Approval of qualification information is required prior to transmittal of any further submittals of this Section.

H. Acceptance Testing

1. Submit comprehensive Acceptance Test Plans that describe all the activities and tasks associated with testing of the Monitoring and Access Control System in accordance with the requirements of this Section. The test plan shall include a comprehensive description of the Factory Acceptance, Field Acceptance and Operational Acceptance testing to be performed on the Monitoring and Access Control System.

2. Furnish the following:

(1) Preliminary Test Reports

b. Factory Acceptance Test Plan

c. Factory Acceptance Test Results

d. Field Acceptance Test Plan

e. Filed Acceptance Test Results

f. Operational Acceptance Test Plan

g. Operational Acceptance Test Results

I. Upon completion of 30 Day Operational Acceptance Testing, furnish:

1. As-Built Drawings and Shop Drawings, which reflect actual locations and actual wiring details of system equipment and all revisions to the Work of this Section. One set shall be printed on reproducible mylar.

2. Hardware Documentation shall be provided in hard copy and digital format.

   a. A hard copy of all databases and configuration settings.

   b. Electronic backups of database and configuration settings to allow for system restoration.

J. Spare Parts

1. Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of 1.09 of this Section.

K. Training

1. A detailed outline of the training information as described in 3.06 of this Section.

L. Closeout Submittals

1. A report documenting the presence on the Work Site of the Manufacturer's certified personnel.

2. A report, completed by the person(s) certified by the equipment Manufacturer, documenting the findings of equipment unloading processes.

3. A test and certification reports for all Cat-5e cables and fiber optic cables installed as Work of this Section.

END OF APPENDIX "A"

DIVISION 16

SECTION 16784

TELEPHONES AND TELEPHONE SYSTEM EXPANSION EQUIPMENT

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for telephones and telephone system expansion equipment. There are components of the system to be provided:

1. Wired telephone handsets
2. Analog device interfaces
3. Power cords
4. Patch cords
5. Rack mounting brackets and accessories
6. Operating and maintenance software
7. Software licenses

B. Several types of telephones are used: house telephones, passenger assistance telephones, and elevator telephones.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The telephones and telephone system expansion equipment shall comply with the latest revision of the referenced standards listed below.

B. The electrical and electronic hardware, structural materials, and equipment housings, required for a fully operational, integrated, telephone system shall operate on a 24 hours per day, seven days per week basis with high system availability of 99.9 percent, and shall conform to the requirements of this Section.

C. Unless otherwise indicated, the Telephone System shall be composed of all items of hardware necessary to initiate, receive and control voice communications as specified herein and as shown on the Contract Drawings. In general, the Telephone system shall consist of readily available, reliable and proven hardware that fully comply with the requirements of this Section and the Contract Drawings. All equipment, systems and subsystems are required to be submitted by the Contractor and approved by the Engineer.

D. Each telephone shall be wired directly to the nearest Communications Room's telephone panel, or via intermediate panels, as shown on the Contract Drawings. The Contractor shall furnish and install all telephones and equipment required to connect the telephones to the communication rooms including but not limited to: telephone back boxes, telephone jacks, conduits, wiring, telephone terminal blocks, telephone cables and inter communication room telephone cable terminations and telephone cross connections. Any equipment not specifically listed in this section, but that is required to provide connection to the communication room and cable terminations shall be provided by the Contractor

1.03 REFERENCES

U.S. Architectural and Transportation Barriers Compliance Board (Access Board)

Appendix A to Part 1191 - ADA Accessibility guidelines for buildings and facilities

Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)

TIA/EIA 232-F - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

TIA/EIA 310 - Cabinets, Racks, Panels, and Associated Equipment.

TIA/EIA 568-B.2 - Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components

Consumer Electronics Association (CEA)

CEA 422B - Electrical Characteristics of Balanced Voltage Digital Interface Circuits

National Fire Protection Association (NFPA)

NFPA 70 - National Electrical Code

NFPA 130 - Standard for Fixed Guideway Transit and Passenger Rail Stations

Underwriters Laboratories (UL)

UL 1459 - Standard for Safety Telephone Equipment

New York City Building Code (NYCBC)

New York City Electrical Code (NYC EC)

Military Standards (MIL-STD)

MIL STD 810 – Environmental Engineering Considerations and Laboratory Tests

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The telephones and telephone system expansion equipment and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 2 years

2. The Manufacturer shall be ISO 9001 certified

3. All electrical materials and equipment for which there are established UL standards shall bear the UL label.

B. Installer Qualifications

1. Contractor shall utilize supervision and labor experienced in performing the work required hereunder in a skillful, timely and satisfactory manner.

2. System Integrator: The Contractor shall employ a System Integrator, of established reputation and experience, who shall furnish the system and its components and provide technical assistance for their installation. The Telephone System Integrator shall have performed systems integration for the last three consecutive years and shall have prior experience on at least two projects of similar size and complexity to that required under this Contract.

3. The contractor shall coordinate with owner to determine connectivity of the existing VoIP Call Manager.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete. Where ever possible, all devices and accessories shall be in place and pre-wired.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. The factory pre-assembled control panels, enclosures/cabinets and terminal boxes shall be shimmed, braced, blocked and tied down to prevent distortion or other damage during transportation.

D. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions.

E. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

F. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

G. Touch up any damage to finishes to match adjacent surfaces.

H. Replace damaged materials and equipment, as determined by the Engineer, at no additional cost from the Authority.

I. All equipment shall be protected during transportation and installation against damage and stains.

J. Unloading and unpacking of all materials shall be done in a manner to prevent misalignment or damage.

K. Cable shall be stored so that no violation of the minimum bend radius occurs.

1.06 WARRANTY

A. The Manufacturer shall warrant the telephones and telephone system expansion equipment and accessories to be free from defects in engineering, design, workmanship and materials for a period of 1 year from the date the equipment is satisfactorily passed in service after successfully passing the last field acceptance test and are accepted by the Engineer. During the warranty period, the Contractor shall replace all items or components which fail due to defects in workmanship and material at no additional cost to the Authority.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

1.08 MAINTENANCE

A. Provide 5 percent spare parts, or a minimum of one, whichever is greater, of all telephones, including any mounting hardware for Work of this Contract.

1.09 WORK BY OTHERS

A. Horizontal cables from telecommunications room patch panels to outlet receptacles will be furnished, installed and tested by others.

B. Power-over-Ethernet LAN switches to which IP phones connect will be provided by others.

C. Network patching on the network switch end only will be performed by others.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Unless otherwise indicated, the telephone instruments furnished shall be the manufacturer models identified or approved equal, identified in this Section and on the Contract Drawings.

2.02 MATERIALS AND EQUIPMENT TO BE FURNISHED

A. Telephones

1. Elevator telephones

   a. Elevator telephones shall be furnished as part of the elevator installation. Each Elevator telephone shall be wired to a panel in the elevator machine room via the elevator manufacturer's standard traveling cable. As part of the Work of this Section, the elevator machine room panel shall be wired to the nearest telephone panel, as shown on the Contract Drawings.

2. Passenger Assistance telephones

   a. Vandal-Proof Products P/N T 9000/198 or approved equal.

   b. Vandal-Proof Products P/N T2100/197 (ADA compliant), or approved equal.

   c. The number of Passenger Assistance telephones to be supplied shall be as shown on the Contract Drawings. There will be two types of Passenger Assistance telephones, an ADA compliant hands-free unit, and a unit with a handset and a dial pad. Each Passenger Assistance telephone shall be mounted on a back-box as detailed on the Contract Drawings. Passenger assistance telephones shall be installed as shown on the Contract Drawings.

3. House telephones Single Line

   a. Telephone Set - Single-line

   b. Handset: Corded

   c. Speaker: N/A

   d. Display: N/A

   e. Audio: G.722 codec (TIA 920) wideband audio including handset, headset and speakerphone

   f. Keys: Standard dial-pad, volume up/down, hold, redial

   g. Message waiting indicator: N/A

   h. Networking: 10/100Base-T input connection to network

   i. Power: 48VDC, IEEE 802.3af PoE (Class 1)

   j. Signaling: SCCP, SIP

   k. Custom application support: XML support

   l. Manufacturers: Cisco 6901.

4. Mounts

   a. All public area telephone mounts shall include a non-vibrating, adjustable support for telephone and enclosure.

B. MATERIALS

1. The items indicated here within shall not be construed as a "bill of materials". They represent items of significance used in the design of the systems specified herein. Where items do not have a manufacturer or part number listed, no particular item has been selected at the time of issuance. The systems integrator shall submit an item that meets the requirements of the specification for approval.

2. If a newer component is available at that time of bid than the item identified within, the proposer shall identify the newer component and include it in the bid.

PART 3. EXECUTION

3.01 PREPARATION

A. Pre-installation design review

1. Review all design documents to ensure that the system will work according to the design intent. Note any perceived deficiencies and offer value engineering suggestions.
2. Review the architectural floor plan to become familiar with the general layout, total usable area and construction materials.
3. Review the telecommunications cabling plans to become familiar with the locations where outlets are will be installed and devices are expected to be deployed.
4. Review the network design to ensure that all requirements of the system are met and issue a document either acknowledging acceptance of the network design or indicating requirements to be met such as:
   a. Requirements for connectivity to the network (including number and location of ports required).
   b. Allocation of IP addresses
   c. VLAN requirements
   d. Routing requirements

B. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

C. The Contractor shall arrange for a representative of the entity manufacturing the Channel Bank and Intelligent Protection Switch equipment to provide onsite technical supervision and assistance during installation and interconnection of all system equipment installed by the Contractor. Said supervision is to insure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the 30-day operational test.

D. Voice system configuration planning

1. Conduct design meetings with Owner designated contact for database collection and migration into an existing dialing plan. Ensure consistency with existing DID and numbering plan. Ensure 4-digit dialing.
2. Determine system wide class-of-service (COS) and class-of-restriction (COR) settings.
3. Define and implement appropriate Route Groups to best utilize new and existing cluster resources.
4. Define and implement appropriate Route Lists to best utilize new and existing cluster resources.
5. Define and implement appropriate Media Resource Lists and Groups to best utilize new and existing cluster resources.
6. Define hunt groups and call pick-up groups.

7. Define call paths and coverage requirements

8. Define account codes

9. Work with the customer to collect database information and ultimately provide the database to technical staff for installation.

3.02 FACTORY ACCEPTANCE TESTING

A. Prepare and submit a Factory Acceptance Test procedure to the Engineer for approval two weeks before the proposed test starts. The Factory Acceptance Test shall include test acceptance criteria.

B. Factory Acceptance Tests shall include telephones, Digital Signals Cross Connect..

C. Upon successful completion of Factory Acceptance Testing, submit certified test results to the Engineer.

3.03 EXAMINATION

A. After the system equipment has been delivered, an on site inspection shall be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor shall be notified in writing, and shall be required to replace the equipment at his own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor

B. Inspect all Telephones and Telephone System Equipment and accessories prior to installation and shall replace any damaged items.

C. Ensure that the spaces where any electronic equipment is to be stored and/or installed is completely free from any foreign substances, such as concrete dust, water, or any other material that may otherwise be harmful to electronic equipment and connections. No allowances shall be made to the Contractor for equipment damage, or delays due to environmental/security damage.

3.04 INSTALLATION

A. Install all Telephone system equipment in accordance with the manufacturers' written instructions in the locations shown on the Contract Drawings. All telephone locations as coordinated and shown on the Contract Drawings.

B. All telephones shall be connected with 4-pair Category 6, No. 24 AWG cable in accordance with Specification Section 16127 from the nearest telephone panel, as designated on the Contract Drawings. All pairs of these shall be terminated in an RJ-45 connector, within each telephone back-box, that will plug into the RJ-45 connector on the telephone.

C. For Passenger Assistance Phones, run a 120VAC circuit to each phone back box, circuited as indicated on the Contract Drawings. Terminate circuit at a NEMA 5-15R receptacle in the phone back box. For Passenger Assistance Phones that have an illuminated sign above the back box, splice 3-1/c #12 AWG to the receptacle circuit and extend the circuit to the illuminated sign lamps.

D. All control power and data communications wire shall be wired and harnessed within the equipment enclosures shown on the Contract Drawings.

E. All wiring shall be clearly labeled with function and wire identification number corresponding to the manufacturer's wiring diagrams and/or approved Shop Drawings.

F. Where external circuit connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

G. All wiring required to externally connect equipment lineups shall be installed by the Contractor.

H. Contractor interconnection wiring requirements shall be clearly identified on the "AS-BUILT" system drawings.

3.05 CONFIGURATION

A. Install all required software for the voice system and telephone sets including firmware updates. Ensure that at the time of turnover, all software and all device firmware is updated to the latest revision.

B. The Contractor shall enable the existing Unity messaging system to provide Unity services to the phone system. This includes all Auto Attendant functionality, voice mail boxes etc.

C. Program all devices according to the coordinated and approved voice system design, following the manufacturer's SRND guidelines.

D. Connect telephone sets to the assigned access device.

3.06 FIELD TESTS

A. After the system equipment has been installed, an onsite inspection will be made by the Engineer to verify that all wiring and Telephone equipment were installed in accordance with the Contract Drawings and the requirements of this Section.

B. Completely check out, calibrate and test all connected hardware to insure that the system performs in accordance with the requirements of the Contract Drawings and this Section.

C. After installation, the equipment shall be tested to show compliance with this Section. Prepare and submit the proposed Pre-Cutover testing procedure along with the test acceptance criteria to the Engineer for approval two weeks prior to the proposed start date of test. Said testing shall continue until the results are satisfactory to the Engineer. Any repairs, construction, or modifications as required to comply with this Section shall be performed by the Contractor at no additional cost to the Authority.

D. The Pre-Cutover test plan for the phones system shall include, but not limited to:

1. Performance Test

   a. Performance test cases shall include: Dial tone delay, call completion rate and call quality. Performance tests shall be performed on each Telephone.

2. Feature Test

a. Feature test shall be performed on each Telephone and shall verify all Telephone operations features including auto dial, dial pad dialing, speaker functionality and Telephone programming (if applicable). This test shall include outgoing and incoming calls. Also this test shall verify call restriction and call termination to verify that auto dial calls reach the correct Telephone extension.

E. After satisfactory completion of the Pre-cutover testing a 30-day Post-cutover test shall commence. The Contractor shall correct any malfunctions as they occur, said malfunctions including, but not being limited to, equipment failure or failure of the Station Telephone System to comply with this Section. After the Contractor corrects a malfunction, at no additional cost, the 30-day test shall restart, at day one, and shall continue until the results are satisfactory with the written approval of the Engineer. The Post-cutover test shall consist of stability testing and shall also cover problems that users encounter while using the Telephone system. Stability testing shall verify the correct operation of the Telephone system during the 30-day time interval. During this time interval the Authority will utilize the telephone equipment and verify that no in-line errors are generated on the VoIP System from the installed Telephones. At the middle and end of the 30-day time interval selective test cases from the performance, feature and maintenance set of tests shall be executed by the Contractor to verify that all Telephone system components continue to operate during and after the 30-day time interval. The selective test cases for the stability test shall be submitted by the Contractor for approval by the Engineer. In addition, all user-originated trouble tickets shall be investigated and resolved by the Contractor to the satisfaction of the Engineer.

F. Testing shall continue until the results are satisfactory to the Engineer. Any repairs, construction, or modifications as required to comply with this Section shall be performed without additional cost to the Authority.

G. Submit a test report detailing compliance with the requirements of this section, including pass/fail result for each test case for the Pre-cutover and Post-cutover phases.

3.07 TRAINING

A. Provide a Training Course on the use of the Phone System. The Course shall consist of two days of user training for two groups of three people each.

B. Provide all System Documentation and training manuals to all personnel attending the training courses.

END OF SECTION

SECTION 16784

TELEPHONES AND TELEPHONE SYSTEM EXPANSION EQUIPMENT

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Wiring diagrams (block diagrams) of the overall Telephone System
2. Wiring diagrams (block diagrams) for each type of telephone.
3. Mounting details for each type of telephone installation.
4. Phone locations.
5. Cross Connect schedules

B. Catalog Cuts

1. All telephones
2. All Connectors
3. All Cables
4. Software licenses

C. Construction and Installation Procedures

1. Test Procedures

D. Manuals, Warranties/Guarantees

1. Operations and Maintenance Manuals

E. Qualifications of System Integrator

1. Submit proof of qualifications described in section 1.06 of this Section. Include name and address of system integrator.
2. The above must be submitted and approved by the Engineer prior to submittal of any of the ensuing documentation.

F. Record Documents

1. Certified Test Results

G. Closeout Submittals

1. As-built Drawings

END OF APPENDIX "A"

DIVISION 16

SECTION 16785

DATA NETWORK EQUIPMENT

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for data network equipment, including Ethernet switches, Synchronous Optical Network (SONET) Node hardware, and firewalls.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. The Data Network shall be designed using SONET, Ethernet switches and Firewalls as shown on the Contract Drawings.

B. Data network equipment shall be furnished and installed in accordance with this Section and as indicated on the Contract Drawings.

C. The Data Network shall provide redundant paths for all network connections as depicted in the Contract Drawings, such that any single failure will not impact the communication system data transmission.

D. The path protection mechanisms shall be able to protect from any one of the failure types:

1. Hard link fail condition
2. Node failure
3. Degrade condition such as packet loss or CRC errors greater than a threshold.

E. An upper layer protection mechanism shall be designed to work in conjunction with lower layer transport protection mechanisms, such as SONET 1+1/1:1, RPR, etc, as available. Each protection mechanism that is allowed to execute in a network including these lower-layers shall support configuration of the hold-off time such that the lower layer protection mechanism converges before the protection mechanism at the upper layer decides whether to take action.

F. Each protection mechanism shall monitor protection standby resources for failure.

G. A Network Management System shall be furnished which shall include the following functionalities:

1. Status of working and protecting paths.
2. Signaling of events that represent changes of status of the working and protection resources.
3. A failure event, which causes protection switch, shall trigger an alarm to be raised by the Network Management system.

4. Display list of parameters and controls relevant to the protection scheme. The parameters shall include: Hold-Off Time, Revertive/non Revertive mode and Reversion time.

H. The Data Network shall provide the necessary interfaces, resiliency and performance to support the various communications system on the networks as indicated on the Contract Drawings.

I. All communication systems running on the Data Network shall run concurrently and seamlessly. Problems in any system running on the Data Network shall not impact any of the other systems on the Data network.

J. The Data Network shall provide the necessary capabilities and configurations to securely and redundantly connect to other networks as depicted on the Contract Drawings

K. Maintenance and Testing functions running on the networks shall not impact the communications performance of the network.

L. The Data Network shall interface at two distinct locations with existing PATH Unified Network as shown on the Contract Drawings.

M. The Data Network shall have the ability to allow expansion in whole or in part, without interruption of active communication among the operational nodes. Replacement of any single node shall be transparent to the overall system operation.

N. The Data Network equipment shall be standard off-the-shelf products and shall employ route diversity to achieve multi-path physical redundancy.

O. All Data Network equipment shall be of the most highly developed technology currently available and in a state of common usage, in manufacture and performance. All equipment shall utilize standard, commercially available products. Equipment shall be modular with plug-in hardware and cabling to facilitate maintenance and expansion to the fullest extent possible. The equipment shall include necessary components and software required for a complete and operable network. All software products which are not site specific, or otherwise specified commercially available packages (such as operating systems, equipment programming and configuration software, etc.) shall be manufactured by the Data Network equipment manufacturer, as part of their standard product offering and shall not be custom produced for this application. This standard product software shall be modular in structure, enabling future system upgrades for additional capabilities to be easily accomplished, by installation of software updates without requiring modification of the existing system configuration.

P. The Data Network equipment shall be designed for full time, 24-hour, seven days a week operation.

Q. The recovery time within the SONET network shall not exceed 50 ms. The recovery time within the Ethernet network shall not exceed 50 seconds.

R. When connected to any of the existing networks indicated on the Contract Drawings, the Data Network shall not degrade the performance, availability, reliability or manageability of these existing networks.

S. Networks connected to the Data Network shall not degrade the performance, availability, reliability or manageability of the Data Network.

T. The Data Network shall be designed such that equipment within the existing networks does not require upgrades to support new network protocols.

U. In order to connect the Data Network to the existing networks indicated on the Contract Drawings, the Data Network shall conform to the existing network connection specifications.

V. The Data Network shall have the capability to be logically segmented into Permanent Virtual circuits and/or Virtual Private Networks in order to segment traffic based on application and/or priority level such that high volume traffic applications or transient traffic does not impact or degrade other systems performance.

W. The Data Network shall support network access points to physically connect to the existing networks as indicated on the Contract Drawings.

X. The data network equipment shall comply with the latest revision of the referenced standards listed below.

1.03 REFERENCES

American National Standards Institute (ANSI)

ANSI T1.101 - Synchronization Interface Standard (1999)

ANSI T1.102 - Digital Hierarchy – Electrical Interfaces (1993)

ANSI T1.105.03-2003 - Synchronous Optical Network (SONET) - Jitter at Network Interfaces DS3 Wander Supplement.

ANSI T1.105.03a-1995 - Supplement ANSI T1.105.03a

ANSI T1.105.03b-1997 - Supplement ANSI T1.105.03b

ANSI T1.105.04 - Synchronous Optical Network (SONET) – Data Communication Channel Protocol and Architectures

ANSI T1.416.04-2005 - Network and Customer Installation Interfaces – SONET Physical Layer Interface and Mapping Specifications for ATM Applications

Federal Communications Commission (FCC)

FCC CFR Rules and Regulations; Title 47, Part 15

Institute of Electrical and Electronics Engineers (IEEE):

IEEE STD 802.1D - Standard for Local and Metropolitan Area Networks Media Access Control (MAC) Bridges

IEEE STD 802.1P - Traffic Class and Dynamic Multi-Cast Filtering Services in Bridged Local Area Networks (Draft Supplement to 802.1D)

IEEE STD 802.1Q - Virtual Bridged Local Area Networks

IEEE STD 802.1S - Virtual Bridged Local Area Networks - Amendment 3: Multiple Spanning Trees

IEEE STD 802.1w - Rapid Reconfiguration of Spanning Tree Protocol (RSTP)

IEEE STD 802.1X - Local and Metropolitan Area Networks Port-Based Network Access Control (2004)

IEEE STD 802.3 - Information Technology - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer

IEEE STD 802.3AB - Physical Layer Parameters and Specifications for 1000 Mb/s Operation over four pair of Category 6 Balanced Copper Cabling, Type 1000 Base-T

IEEE STD 802.3AC - Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Frame Extensions for Virtual Bridged Local Area

IEEE STD 802.3AD - Standard for Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Aggregation of Multiple Link Segments

IEEE STD 802.3AE - Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications -Media Access Control (MAC) Parameters, Physical Layer and Management Parameters for 10 Gb/s Operation

IEEE STD 802.3AF - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements.

IEEE STD 802.3AH - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method

IEEE STD 802.3I - System Considerations for Multisegment 10 Mb/s Baseband Networks (Section 13) - Twisted-Pair Medium Attachment Unit (MAU) and Baseband Medium, Type 10Base-T (Section 14)

IEEE STD 802.3u - Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications: MAC Parameters, Physical Layer, Medium Attachment Units and Repeater for 100 Mb/s Operation (Version 5.0)

IEEE STD 802.3x - Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Specification for 802.3 Full Duplex Operation

IEEE STD 802.3z - Gigabyte Ethernet Standard

IEEE STD 802.11 - Local and Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications - Includes IEEE 802.11D, 802.11E, 802.11G, 802.11H, 802.11I, 802.11J

IEEE STD 802.17 - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 17: Resilient Packet Ring (RPR) Access Method and Physical Layer Specifications

Internet Engineering Task Force

RMON I and II standards

SNMPv1, SNMPv2c, and SNMPv3

National Fire Protection Association (NFPA)

NFPA 70 - National Electrical Code

NFPA 130 - Standard for Fixed Guideway Transit and Passenger Rail Systems

Network Equipment Building System (NEBS)

NEBS GR-63 NEBS Requirements: - Physical Protection

NEBS GR-1089, Electromagnetic Compatibility and Electrical Safety – Generic Criteria for Network Telecommunications Equipment

NYC Electrical Code

Telecommunications Industry Association (TIA) / Electronics Industries Alliance (EIA)

EIA-310-D - Cabinets, Racks, Panels, and Associated Equipment

TIA-232-F - Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange

TIA/EIA-422-B - Electrical Characteristics of Balanced Voltage Digital Interface Circuits

TIA/EIA-455-6B - FOTP-6 - Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices

TIA/EIA-455-B - Standard Test Procedures for Fiber Optic Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components

TIA-485-A - Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multipoint Systems

TSB-40 - Additional Transmission Specifications for UTP Connecting Hardware

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The data network equipment and all their components of the types and sizes required shall have been satisfactorily manufactured and in satisfactory use for the purpose similar to those intended herein for no less than 3 years
2. The Manufacturer shall be ISO 9001 certified
3. All SONET equipment, Routers, Switches & Hubs shall be manufactured by a single manufacturer.
4. All electrical materials and equipment for which there are established UL standards shall bear the UL label.

B. Installer Qualifications

1. The installer shall be certified by equipment manufacturer to install data network equipment.

2. The installer shall certify that all proposed equipment shall comply completely with all the requirements of this Contract.

3. The Contractor shall retain the services of Cisco Certified Gold Channel Partner integrator for all major backbone communication system equipment components to be furnished, integrated and installed. The networking integrator shall have performed Cisco network integration for the last three consecutive years. Work experience shall include the successful installation of at least three other data networks systems of similar complexity to the Work to be performed under this Contract Credentials shall be submitted demonstrating the integrators qualifications. Qualifications shall include management, administration, configuration and testing of Cisco's SONET and Ethernet switches. Configuration shall include Resilient Packet Ring (RPR), Internet Group Management Protocol (IGMP), Multicasting, Shared Packet Ring (SPR), Resilient Ethernet Protocol (REP) and using Cisco Transport Manager (CTM) to configure Cisco SONET switches.

4. The Data Network equipment installer shall have Manufacturer's training and be certified and factory authorized in the installation of all backbone communications system equipment.

5. The Contractor shall examine the design and specifications of all systems on the Network, in detail, and take responsibility to complete the installation and insure that all systems performance and bandwidth requirements are met.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete. Where ever possible, all devices and accessories shall be in place and pre-wired.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. The factory pre-assembled control panels, enclosures/cabinets and terminal boxes shall be shimmed, braced, blocked and tied down to prevent distortion or other damage during transportation.

D. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions.

E. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

F. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

G. Touch up any damage to finishes to match adjacent surfaces.

1.06 WARRANTY

A. The Manufacturer shall warrant the data network equipment and accessories to be free from defects in engineering, design, workmanship and materials for a period of 1 year from the date the equipment is satisfactorily passed in service after successfully passing the last field acceptance test and are accepted by the Engineer. During the warranty period, the Contractor shall replace all items or components which fail due to defects in workmanship and material at no additional cost to the Authority.

1.07 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. All Data Networking equipment shall be manufactured by Cisco Systems, (One Penn Plaza, 5th Floor Suite 510 New York, New York 10119 Phone: 212-714-4000 Fax: 212-714-4005) without substitution.

2.02 MATERIALS

A. General

1. All equipment and materials furnished as work of this contract shall be new and unused. Equipment shall be of the latest technology, first grade commercial quality and shall be the standard Cisco cataloged products. Only those items specifically shown on the Contract Drawings as existing relocated or Authority furnished, if any, shall be reused. Use of rebuilt or remanufactured equipment shall not be permitted.

2. Provide Cisco network equipment as specified in this section and on the Contract Drawings. If product or series is no longer manufactured or has been designated by Cisco as End of Life, then furnish the latest Cisco update or equivalent. All substitutions shall be approved by the Engineer.

B. Ethernet Switches:

1. The Ethernet switches shall be of the following types as indicated on the Contract Drawings, or in other Sections of these specifications.

   a. Cisco Catalyst 2900 Series Switches

   b. Cisco 3750 Series – low capacity

   c. Cisco 4000 Series – medium capacity

   d. Cisco 6000 Series – high capacity

2. The type and quantities of Ethernet switches used will be shown on the Contract Drawings. All Ethernet Switches, including those listed in this Section, along with their data specifications shall be submitted to the Engineer for approval for review of suitability for the designed application(s).

3. The Ethernet switches shall be provided for networks in support of the communications and computer systems shown on the Contract Drawings.

4. All Ethernet Switches shall include the following requirements:

   a. Shall be rack mountable.

   b. Shall be furnished with redundant power supplies.

   c. Shall support 10BASE-T/100BASE-TX ports: RJ-45 connectors; four-pair Category 6 UTP cabling.

   d. Shall support 100BASE-LX ports: LC connectors; 50/125, 62.5/125 micron for Multi-Mode or 9/125 single-mode fiber-optic cabling.

   e. Shall at a minimum operate in the following environmental conditions:

      (1) Operating Temperature: 32 degrees F to 104 degrees F (0 degrees C to 45 degrees C).

      (2) Storage Temperature: minus 13 degrees F to 158 degrees F (minus 25 degrees C to 70 degrees C).

      (3) Relative Humidity: 10 to 85 percent, non-condensing.

   f. Support the following protocols:

      (1) 802.1D - Standard for Local and Metropolitan Area Networks Media Access Control (MAC) Bridges

      (2) 802.1P - Traffic Class and Dynamic Multi-Cast Filtering Services in Bridged Local Area Networks (Draft Supplement to 802.1D)

      (3) 802.1Q - Virtual Bridged Local Area Networks

      (4) IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) and Per VLAN Rapid Spanning Tree (PVRST plus)

      (5) 802.3AD - Standard for Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Aggregation of Multiple Link Segments

      (6) IGMP snooping for IP Multicast support and Per-port broadcast, multicast, and unicast storm control.

      (7) PIM-SM, PIM-DM and PIM-SM/DM to support Multicast network traffic.

      (8) Resilient Ethernet Protocol (REP)

      (9) Cisco Spanning-Tree Protocol enhancements including: UplinkFast, BackboneFast, and PortFast.

      (10) HSRP (Hot Standby Redundant Protocol)

      (11) The aggregate QoS model by enabling classification, policing/metering, and marking functions on a per-port basis at ingress and queuing/scheduling functions at egress.

      (12) SNMP (Simple Network Management Protocol).

      (13) Non-blocking configuration of simultaneous wire-speed switching across all ports.

(14) Operate from 120VAC, 60Hz.

5. All Cisco 2900 series equivalent Ethernet switches shall include the following requirements:

   a. Management console port: Eight-pin (RJ-45 to DB9) rollover cable for PC connections.

   b. Dual-redundant 24V DC (18V minimum, 32V maximum) power supply inputs.

   c. The switches shall have the following fiber ports:

      (1) 100BASE-FX (MT-RJ connectors at 1,300 nm), Distance shall be greater than or equal 2 km.

      (2) 100BASE-LX (LC connectors at 1,300 nm) Distance shall be greater than or equal 5 km.

6. All Cisco 3750 series equivalent switches shall include the following requirements:

   a. The Ethernet switches shall have the following connectors and shall use cabling as follows:

      (1) 10/100/1000 BASE-T ports: RJ-45 connectors, 2-pair cat 5e unshielded twisted-pair (UTP) cabling.

      (2) 1000 Base BX SFP: 1310 nm single-mode fiber.

      (3) Management console port: RJ-45-to-DB9 cable for PC connections.

   b. Enterprise-class intelligent services delivered to the network edge.

   c. The power supply shall support input voltages between 100 and 240 VAC.

   d. The power connector shall offer connection for an optional Cisco RPS (Redundant Power Supply) 675 that uses 120 VAC input and supplies DC output to the switch.

   e. The power connector shall automatically sense when the internal power supply of a connected device fails and provides power to the failed device, preventing loss of network traffic.

   f. Integrated Power over Ethernet (PoE) IEEE 802.3af Compliant.

7. All Cisco 4000 series equivalent switches shall include the following requirements:

   a. The Ethernet switches chassis shall include the following features:

      (1) Supervisor-Engine redundancy

      (2) Integrated Power over Ethernet (PoE)

      (3) PoE per Line-Card Slot Maximum: 830W

      (4) Power-Supply Redundancy: 1 plus 1

      (5) Mounting: 19 inch rack compatible (19 inch rack and cable guide hardware included)

      (6) Location of 19 inch Rack Mount: Front

   b. The Ethernet switches shall support the following protocols:

      (1) Gigabit Ethernet: IEEE 802.3z.

(2) 1000BASE-X (GBIC): 1000BASE-SX; 1000BASE-LX/LH; 1000BASE-ZX.

(3) Power over Ethernet (PoE): IEEE 802.3af.

c. Redundant hot swappable power supplies.

d. Switching modules used shall be selected from among the following or approved equals:

(1) Switched 10/100 Fast Ethernet (RJ-45), (Port Density: 240).

(2) Switched 10/100 Fast Ethernet (RJ-45) with IEEE 802.3af.

(3) Power over Ethernet (PoE) (Port Density: 240).

(4) Switched 10/100 Fast Ethernet (RJ-21) (Port Density: 240).

(5) Switched 100 FX Fast Ethernet (MT-RJ) (Port Density: 240).

(6) Switched 1000 Gigabit Ethernet (fiber) (Port Density: 244).

(7) Switched 10/100/1000BASE-T Gigabit Ethernet (Port Density: 240).

(8) Switched 10/100/1000BASE-T Gigabit Ethernet with IEEE 802.3af PoE (Port Density: 240).

(9) Switched 10,000 (10 Gigabit Ethernet) (Port Density: 2).

8. All Cisco 6000 series equivalent switches shall include the following requirements:

a. The Ethernet switches chassis shall include the following features:

(1) Supervisor-Engine redundancy with 2 10GbE ports.

(2) Catalyst 6500 48-port GigE Mod:fabric-enabled (Req. SFPs)

(3) Catalyst 6500 48-Port 10/100/1000 Base-T.

(4) Power-Supply Redundancy

(5) Mounting: 19 inch rack compatible (19 inch rack and cable guide hardware included)

(6) Location of 19 inch Rack Mount: Front

b. The Ethernet switches shall support the following protocols:

(1) Gigabit Ethernet: IEEE 802.3z.

(2) Power over Ethernet (PoE): IEEE 802.3af.

c. Equipped with internal temperature sensors that generate alarms when a temperatrue threshold is reached.

d. Redundant hot swappable power supplies.

e. Parts used shall be selected from among the following list or approved equals:

(1) Catalyst 6509-E-Chassis plus Fan Tray plus Sup720-10G-VSS plus IP Base S/w (VS-C6509E-S720-10G)

(2) Cisco CAT6000-VSS720 IOS ADVANCED IP SERVICES SSH (MODULAR) (SV33AIK9M-12233SXH)

(3) Catalyst 6x09 RMON Agent License (WS-C6X09-EMS-LIC)

(4) SP adapter for SUP720 and SUP720-10G (CF-ADAPTER-SP)

(5) Catalyst 6500 Compact Flash Memory 1GB (MEM-C6K-CPTFL1GB)

(6) 10GBASE-LR X2 Module (X2-10GB-LR)

(7) Cat 6500 Supervisor 720 with 2 ports 10GbE and MSFC3 PFC3C (VS-S720-10G-3C)

(8) SP adapter for SUP720 and SUP720-10G (CF-ADAPTER-SP)

(9) Catalyst 6500 Compact Flash Memory 1GB (MEM-C6K-CPTFL1GB)

(10) 10GBASE-LR X2 Module (X2-10GB-LR)

(11) Catalyst 6500 48-port GigE Mod: fabric-enabled (Req. SFPs) (WS-X6748-SFP)

(12) Catalyst 6500 Dist Fwd Card for WS-X67xx modules (WS-F6700-DFC3C)

(13) GE SFP, LC connector LX/LH transceiver (GLC-LH-SM)

(14) Catalyst 6500 48-port GigE Mod: fabric-enabled (Req. SFPs) (WS-X6748-SFP)

(15) Catalyst 6500 Dist Fwd Card for WS-X67xx modules (WS-F6700-DFC3C)

(16) GE SFP, LC connector LX/LH transceiver (GLC-LH-SM)

(17) Cat6500 48-Port PoE 802.3af & ePoE 10/100/1000 w/Jumbo Frame (WS-X6148A-GE-45AF)

(18) Cat6500 6000W AC Power Supply (WS-CAC-6000W)

(19) SMARTNET 8X5XNBD VS-C6509E-S720-10G (CON-SNT-V6509E72)

C. SONET Switches and Hardware:

1. The SONET network shall use the following platforms as indicated on the Contract Drawings:

   a. Cisco ONS 15327

   b. Cisco ONS 15454

2. Cisco ONS 15327

   a. The platform shall operate at OC-12.

   b. The platform shall have fully redundant options.

   c. The platform shall have a rack-mount design.

   d. The platform shall comply with the following requirements:

      (1) Modular, 3RU chassis.

      (2) 4 flexible high-speed slots.

      (3) Temperature range: minus 40 degrees C to 65 degrees C, non-condensing.

      (4) DC power: 130W (for average configuration).

      (5) Operating voltage shall be 120 VAC. Furnish all required power supplies as part of the platform.

e. The platform shall be compatible with the two-port Gigabit Ethernet card, model 15327-E10/100T-4 by Cisco. The 10/100 4 ports Ethernet card shall comply with the following requirements:

(1) Ports: Four full-duplex operation 10/100.

(2) Maximum bandwidth of 200Mbps per port.

(3) Maximum bandwidth of 622 Mbps per card.

(4) Power consumption (maximum): 45W.

(5) Operating temperature: 32 degrees F to 131 degrees F (0 degrees C to 55 degrees C).

(6) Operating humidity: 5 to 95percent, non-condensing.

(7) Storage temperature: minus 40 degrees F to 185 degrees F (minus 40 degrees C to 85 degrees C).

(8) Storage humidity: 5 to 95 percent, non-condensing.

f. The following equipment type or approved equal shall be supported (Exact quantities and locations are detailed on the Contract Drawings):

(1) Backplane_15327: 15327 SONET ATO (includes Shelf,ship kit andFTA)

(2) 15327-OC12-1L15-T: OC12, LR, SC Optics, 1550 nm, ITEMP

(3) 15327-E10/100T-4: 10/100BT, 4 Ckt., RJ45

(4) 15327-XTC-28-3-T: XC 576 STS, 672 VT, 28 DS1, 3 DS3, ITEMP

(5) 15327-MIC-B-1-T: MIC, B-Side, Power Connector Options

(6) 15327-MIC-A-1-T: MIC, A-Side, Power Connector Options

3. Cisco ONS 15454

a. The platform shall operate at OC-48.

b. The platform shall have fully redundant options.

c. The platform shall be 19 inch rack mountable.

d. The platform shall have an input voltage of minus 48 VDC, nominal (minus 40.5 to minus 56.7 operating range), and a current of 5 amps minimum, 22 amps maximum at nominal voltage.

e. The platform shall operate at 120 VAC. Furnish all required power supplies as part of the platform

f. The platform shall operate under the following conditions:

(1) Operating temperature: 32 degrees F to 131 degrees F (0 degrees C to 55 degrees C).

(2) Operating humidity: 5 to 95percent, non-condensing.

(3) Storage temperature: minus 40 degrees F to 185 degrees F (minus 40 degrees C to 85 degrees C).

(4) Storage humidity: 5 to 95 percent, non-condensing.

g. The platform shall use the Cisco ML-Series Ethernet cards: Cisco ML 100T-12, ML 100X-8, and ML 1000-2.

h. The following equipment type or approved equal shall be supported (Exact quantities and locations are detailed on the Contract Drawings):

(1) 15454-SA-ANSI: 15454 SA NEBS3 ANSI w/RCA and Ship Kit, EOS 05-2005(2480)

(2) DS1-14: DS1, 14 Ckt., I-Temp

(3) EC1-12: EC1, 12 Ckt, I-Temp

(4) OC48AS-LR-1550: OC48, LR, 1550, 1 Ckt., Any Slot, SC

(5) TCC2: Timing Communications Control 2. I-Temp, EOS Nov 15,06 (3134)

(6) XC10G: Xconn, 1152 STS, 672 VT

(7) AIC-I: Alarm Interface Card Enh Intl, I-Temp

(8) OC-192SR/STM-64IO: OC192, SR, 1310, 1 Ckt., SC

(9) ML1000-2: Gigabit Ethernet, 2 Ckt, L2/L3, SFP

(10) ML100T-12: 10/100Mbps Ethernet, 12 Ckt, L2/L3

(11) ETH100T-12-G: 10/100BT, 12 Ckt., XC/XC-VT/XC-10G

(12) OC3-IR-4: OC3, IR, 1310, 4 Ckt, SC, I-Temp

(13) FTA: Shelf Fan Tray Assembly,ANSI,15454, HPCFM, I-Temp

(14) AIP: Auxiliary Interface Protection

4. To ensure compatibility with the existing PATH SONET, all SONET equipment utilized for Work of this Contract shall have the same firmware level as the existing SONET equipment utilized by PATH.

D. Firewalls

1. The firewall shall be Cisco ASA 5500 series Enterprise Editions.

2. The exact model for the Cisco ASA 5500 Series Adaptive Security Appliance shall be as shown on the Contract Drawings, along with its software module and Adaptive Security Device Manager requirements.

3. All Firewall switches, along with their data specifications shall be submitted to the Engineer for approval to determine if they are appropriate for the designed application.

4. All firewalls shall include the following features:

a. Logging and notification ability

b. High-volume packet inspection

c. Ease of configuration

d. Device security and redundancy

E. Cat 6 patch panels

1. Cat-6 Patch Panels shall be able to interface to multi-vendor equipment.

2. Each panel shall be equipped with a 110-type termination.

3. Cat 6 Patch Panels shall meet or exceed the EIA/TIA TSB-40 CAT6 connecting hardware specifications.

4. The Patch Panel shall be mountable in 19 inch rack units and shall accommodate top, bottom or side cable entry.

5. Patch panels shall be numbered in the front and back of each panel in a manner to give a quick and easy way to identify cable runs.

2.03 NETWORK MANAGEMENT SYSTEM

A. For networks depicted on the Contract Drawings, provide a Network Management System (i.e., operations, administration and management capabilities) for the Data Network.

B. The Network Management System (NMS) shall monitor the performance of the end-to-end transmission across the network. The type of measurement used for performance monitoring shall include the number of packets lost, number of corrupted packets, and bit-error-rate.

C. The level of end-to-end performance monitoring provided by NMS shall allow a network administrator to determine whether the network is delivering the quality of service required by the user or application.

D. The network equipment shall time-stamp all performance monitoring reports and alarms sent to the Network Management System.

E. The Network Management System shall be CiscoWorks Campus Manager 4.0 or approved equal.

2.04 SECURITY REQUIREMENTS

A. The network shall include all the necessary security to prevent malicious users from modifying the destination of transport entities (e.g., modifying address information).

B. The network shall only allow users access to the network at the network access points based on the inclusion of the user within an access control list maintained within the management system.

C. The access control list within the management system shall indicate the allowable interfaces that a user's transport entity may be transported between.

D. The security/policy criteria (e.g., access control list) shall be configurable.

2.05 SPARE PARTS

A. The Contractor shall confirm that all system components furnished will be available from the manufacturers for a period of five years from the date of acceptance of the system by the Authority. The Contractor shall provide to the Authority spare parts to cover 10 percent of the replaceable system components.

PART 3. EXECUTION

3.01 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions, equipment quantities, equipment locations and coordination of conduit entry and all other installation conditions with the Data Network Manufacturers and the System Integrator.

B. The Contractor shall make all arrangements for a Cisco Certified Gold Channel partner integrator to provide onsite technical supervision and assistance during installation and interconnection of the system equipment. Said supervision is to ensure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the 30-day operational test.

C. The Contractor shall coordinate to provide the Data Network manufacturer and System Integrator with all required information for all systems that will be utilizing the Data Network.

D. After the system equipment has been delivered, an onsite inspection shall be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor shall be notified in writing, and shall be required to replace the equipment at no additional cost to the Authority, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed.

3.02 EXAMINATION

A. Verify that electrical installations, structural, mechanical and other related Work satisfy the requirements for performance of the Work of this Section in accordance with the Contract Drawings.

B. Before delivering the equipment to the site, the Contractor shall investigate the site conditions to determine the best method of shipment, what preparatory work, if any, will be needed to bring the equipment onto the site and method of unloading the equipment and setting it in place.

C. Report immediately to the Engineer any electrical, structural or related construction defects in areas where equipment are to be installed, and do not attempt to rectify any defect unless specifically instructed to do so by the Engineer.

D. Before unloading the equipment it shall be inspected for damage during shipment. Any damage shall immediately be brought to the attention of the Engineer for resolution.

E. Before the Data Network Equipment installation the communication cable infrastructure shall be inspected and tested as part of the Work of Specifications Sections 16126 and 16127. The results of this testing shall be reviewed by the Data Network Integrator, who shall verify its suitability for the Data Network equipment and that losses are within the equipment specs for operations. Any non conformity shall be brought to the attention of the Engineer.

3.03 FACTORY TESTS

A. A factory acceptance test for the backbone communication system shall be conducted. Refer to Specification Section 16744, Data Network Testing, Startup and Administration, for Factory testing requirements.

3.04 INSTALLATION

A. Install all network equipment in accordance with the Manufacturers' written instructions in the locations shown on the Contract Drawings.

B. All control power and data communications wire shall be wired and harnessed within the equipment enclosures as shown on the Contract Drawings.

C. All wiring shall be clearly labeled with function and wire identification number corresponding to the Manufacturer's wiring diagrams and/or approved Shop Drawings.

D. Where network connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

E. All wiring required to externally connect network equipment shall be installed by the Contractor.

F. Contractor interconnection wiring requirements shall be clearly identified on the "AS-BUILT" system drawings.

3.05 FIELD ACCEPTANCE TEST

A. After the system equipment has been installed, an onsite inspection will be made by the Engineer to verify that all wiring and Data Network equipment is installed in accordance with these specifications and the Contract Drawings.

B. The systems shall be partially installed and accepted in conjunction with construction staging. Field acceptance testing shall be conducted for each partially installed section of the network.

C. Refer to Section 16744, Data Network Testing, Startup and Administration, for Field Acceptance Test specifics.

3.06 OPERATIONAL ACCEPTANCE TESTS:

A. The Operational Acceptance Testing phase shall commence following notification by the Authority that the results of the Field Acceptance Testing are satisfactory to the Engineer, and following receipt by the Authority of the Contractor's certification that the system is ready for Operational testing. The Operational Acceptance Tests shall be performed by the Contractor in coordination with the Authority.

B. During Operational Testing, the Contractor shall perform any re- calibration, re-configuration or re-programming of the network hardware and software required as part of the normal operational configuration and to correct any system bug or errors encountered to insure that the system performs in accordance with the Specifications and required sequences of operation in accordance with the requirements of this Section, and with section 16744, Data Network Testing, Startup and Administration.

C. Refer to section 16744, Data Network Testing, Startup and Administration, for Operational Acceptance Test specifics.

3.07 TRAINING

A. Provide a Training Course on the Operation of the networks communication system. The Course shall consist of three days of user training for two groups of ten people each.

B. Provide a Training Course on the Maintenance of the networks communication system. The Course shall consist of three days of maintainer training for two groups of 10 people each.

C. Courses for the Data Network shall be given at the work site or at an alternate location within 20 miles radius of the Work site. Location to be coordinated with the Engineer.

END OF SECTION

SECTION 16785

DATA NETWORK EQUIPMENT

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Upon approval of 1.07 A2 Section, submit Shop Drawings. Shop Drawings shall be completely dimensioned and shall indicate the intended installation configurations and details for each Data Network Ethernet location. Shop Drawings shall include:

   a. Functional block diagrams

   b. Wiring and Point-to-point diagrams

B. Catalog Cuts

1. Catalog cuts and product data for Network Management Software

C. Manuals, Warranties/Guarantees

1. Operation, administration, configuration and maintenance manuals

D. Schedules

E. Qualifications

1. Name, address and qualification data for Data Network equipment integrator stating their capabilities and experience. Include proof of certifications, list of completed projects and other information specified herein.

F. Record Documents

1. Submit System Block Diagrams, Catalog Cuts and functional description of proposed system features for the Data Network system and any ancillary equipment

2. Submit product data, installation manuals, materials, system configuration options and features and accessories for the Data Network. This shall include IP addresses and names as per the Port Authority conventions

3. A chart listing each data circuit with channel port assignment, type of channel, data circuit use or field device number, type connector, data protocol, circuit ends and IP circuit number.

G. Closeout Submittals

1. As-built documents

END OF APPENDIX "A"

SECTION 16790
EMERGENCY PHONES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Work shall include installation and commissioning of the following:

1. Integrated Security Management System (SMS) consisting of:

    1. Emergency Call Stations (EC)

2. Interfaces

    1. Video Surveillance System

1.2 RELATED SECTIONS

1. Division 01 - General Requirements
2. Division 26 - Electrical
3. Division 16 – Communications

1.3 SUBMITTALS

A. Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Shop Drawings" of Division 1 – GENERAL REQUIREMENTS.

1. Qualifications of System Integrator

    1. Submit proof of qualifications described in section 1.06 of this Section. Include name and address of system integrator.

    2. The above must be submitted and approved by the Engineer prior to submittal of any of the ensuing documentation.

2. Catalog Cuts

    1. All telephones
    2. All Connectors
    3. All Cables
    4. Software licenses

3. Shop Drawings

    1. Wiring diagrams (block diagrams) of the overall Telephone System
    2. Wiring diagrams (block diagrams) for each type of telephone.
    3. Mounting details for each type of telephone installation.

4. Phone locations.

5. Cross Connect schedules.

B. Operations and Maintenance Manuals

C. Test Procedures

D. Certified Test Results

E. As-built Drawings

PART 2 - PRODUCTS

2.1 Product description

A. The unit shall be an easily identifiable, vandal resistant communications device that is Americans with Disabilities Act (ADA) compliant, multi-functional, wall mounted and constructed of 12 gauge, stainless steel. The unit shall be aesthetically pleasing and virtually impervious to damage, and shall include a high quality, vandal resistant, hands-free communications device illuminated by a powerful strobe light, and a vivid blue beacon that serves to identify the unit from a great distance.

2.2 Construction

A. The housing front shall be fabricated from a single sheet of 12 gauge, stainless steel that is brushed to a number 4b finish after fabrication and shall be 32"h x 11.9"w x 7.6"d. A separate back plate piece shall be formed out of 12 gauge steel. The back plate shall be welded to the housing front.

B. Tamper resistant proprietary fasteners manufactured for Code Blue Corporation shall be used. It shall not be possible to acquire the custom designed bit from any source other than Code Blue Corporation. It shall not be possible to insert or remove any component without this bit. All other types of fasteners shall not be acceptable under any circumstance.

C. All openings in the housing shall be laser, plasma or water jet cut to provide clean, straight and defect free edges with no stains or discoloration from cutting or welding.

D. The unit shall have a single lens opening cut into the face of the housing 5"h x 11.75"w opening shall be approximately 2.34" from the top of the unit. The corners of the cuts shall be uniformly rounded while the edges of the cuts shall be straight and free of burrs or other visual imperfections. The four edges of the opening shall form a square when viewed in elevation from the front of the unit.

1. A 0.187" thick transparent lens formed of a single sheet of clear polycarbonate shall be inserted into the housing behind the lens opening and shall be mechanically fastened to the housing front.

E. A top cap fabricated from 12 gauge stainless steel shall house the led beacon/strobe assembly and be attached with four (4) 10-24 x .75" stainless steel, tamper resistant proprietary fasteners supplied by the manufacturer.

F. An opening for the communications device shall be cut into the face of the housing at a point approximately 25.5" below the top of the housing.

2.3 Mounting

A. The unit shall be mounted to a wall using four (4) 3/8" x 3" lag bolts and 3" lag bolt anchors included with the unit. The lag bolts shall pass through (4) openings of the back plate and be inaccessible without removing the communications device.

2.4 Electrical

A. All electrical components shall have a modular plug for easy service and replacement. All electrical wiring shall be concealed within the enclosure and shall not be visible from the outside of the unit.

B. All electrical components in the unit shall be equipped with a fuse for protection from transient voltage conditions.

C. The unit shall require 1 ampere at 24v ac standard.

D. The unit shall have the option for power over ethernet for connectivity to a VoIP network switch with 802.3af (minimum) capabilities. Requires the ip5000 phone for connectivity to toolvox communication manager or sip/iax2 compatible VoIP system. Refer to the power over ethernet architectural and engineering specification.

E. The unit shall have the option of a multi-tap transformer for connectivity to 120v ac, 240v ac, 277v ac and 347v ac primary power. Refer to the multi-tap transformer architectural and engineering specification.

F. The installer shall follow all NEC and local electrical codes when installing the unit power systems.

2.5 Lights

A. Led beacon/strobe: a long life, highly visible led beacon/strobe shall be located in the beacon/strobe opening. The led beacon/strobe shall have a factory set flash rate of no less than 60 flashes per minute and be programmable. Factory programming of the beacon portion of the led beacon/strobe will be set to the "on" position. To change the programming mode of the beacon, please refer to the led beacon/strobe programming guide (pr13149). A deep blue uv rated polycarbonate prismatic refractor shall surround the led beacon/strobe and shall be used to distribute the light in a horizontal pattern for maximum brightness and visibility at a distance.

1. The communication device shall be factory programmed to activate the led beacon/strobe for the duration of a call. The led beacon/strobe cannot be deactivated at the unit.

2.6 Communications

A. The unit shall have a high quality vandal resistant and ada-compliant speakerphone communication device.

1. Ip5000 - VoIP: refer to the ip5000 architectural and engineering product specification for further information.

2. Ia4100 - analog: refer to the ia4100 architectural and engineering product specification for further information.

B. EIA/TIA, ANSI, CSA and Bicsi cabling or similar standards shall be adhered to for proper operation of code blue communication devices connected to copper or fiber infrastructure.

2.7 Finish

A. Stainless steel: the unit housing shall be fabricated of stainless steel, and shall be brushed to a number 4b finish after fabrication. The finish shall be uniform and free of visible defects. The unit shall be finished with a highly graffiti and UV resistant coating process.

B. Painted: substrate preparation shall be as required to comply with applicable ASTM impact and adhesion standards:

1. D2794 direct and reverse impact

2. D523 gloss @ 60 degrees

3. D3359b cross hatch adhesion

4. D1654 corrosion creep

5. D714 scribe blisters

6. D714 field blisters

C. The polyurethane finish shall be a multi coat system available in ten (10) standard colors:

1. Safety blue

2. Safety red

3. Safety yellow

4. Midnight blue

5. Gloss white

6. Gloss black

7. Medium bronze

8. Dark bronze

9. British racing green

10. Cardinal red

D. Custom colors shall be available as specified by the user and approved by the manufacturer.

E. The primer coat and finish coat shall each have a minimum coverage thickness of 2.0 mils.

F. No other types of finishes are acceptable.

2.8 Graphics

A. The graphics shall be a durable nikkalite® engineering grade reflective vinyl for high visibility and legibility.

B. Standard 20" inch length graphics text offering shall be:

1. Emergency

2. Assistance

3. Security

4. Courtesy

5. Police

C. Standard graphics color offering shall be:

1. Reflective white

2. Reflective blue

3. Reflective black

4. Reflective green

5. Reflective red

6. Reflective yellow

D. Custom graphics text, length and color shall be available by the manufacturer.

2.9 Warranty

A. The unit shall be warranted for a period of two (2) years. Reference manufacturer's warranty for further details.

2.10 Manufacturer

A. The manufacturer shall be Code Blue Corporation of Holland, Michigan. There are no known equivalents.

B. Code Blue Corporation manufactures its products according to the most recent revision of our product specifications and shall not be held responsible for obsolete or outdated specifications. For the latest revision please refer to www.codeblue.com or contact Code Clue Corporation directly.

PART 3 - EXECUTION

1. PREPARATION

1. Pre-installation design review

1) Review all design documents to ensure that the system will work according to the design intent. Note any perceived deficiencies and offer value engineering suggestions.

2) Review the architectural floor plan to become familiar with the general layout, total usable area and construction materials.

3) Review the telecommunications cabling plans to become familiar with the locations where outlets are will be installed and devices are expected to be deployed.

4) Review the network design to ensure that all requirements of the system are met and issue a document either acknowledging acceptance of the network design or indicating requirements to be met such as:

a) Requirements for connectivity to the network (including number and location of ports required).

b) Allocation of IP addresses

c) VLAN requirements

d) Routing requirements

2. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the equipment.

3. The Contractor shall arrange for a representative of the entity manufacturing the Channel Bank and Intelligent Protection Switch equipment to provide onsite technical supervision and assistance during installation and interconnection of all system equipment installed by the Contractor. Said supervision is to insure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the 30-day operational test.

2. FACTORY ACCEPTANCE TESTING

1. Prepare and submit a Factory Acceptance Test procedure to the Engineer for approval two weeks before the proposed test starts. The Factory Acceptance Test shall include test acceptance criteria.

2. Factory Acceptance Tests shall include telephones, Digital Signals Cross Connect.

3. Upon successful completion of Factory Acceptance Testing, submit certified test results to the Engineer.

3. EXAMINATION

1. After the system equipment has been delivered, an onsite inspection shall be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor shall be notified in writing, and shall be required to replace the equipment at his own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor

2. Inspect all Emergency Telephones and Emergency Telephone System Equipment and accessories prior to installation and shall replace any damaged items.

3. Ensure that the spaces where any electronic equipment is to be stored and/or installed is completely free from any foreign substances, such as concrete dust, water, or any other material that may otherwise be harmful to electronic equipment and connections. No allowances shall be made to the Contractor for equipment damage, or delays due to environmental/security damage.

4. INSTALLATION

1. Install all Emergency Telephone system equipment in accordance with the manufacturers' written instructions in the locations shown on the Contract Drawings. All telephone locations as coordinated and shown on the Contract Drawings.

2. All control power and data communications wire shall be wired and harnessed within the equipment enclosures shown on the Contract Drawings.

3. All wiring shall be clearly labeled with function and wire identification number corresponding to the manufacturer's wiring diagrams and/or approved Shop Drawings.

4. Where external circuit connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

5. All wiring required to externally connect equipment lineups shall be installed by the Contractor.

6. Contractor interconnection wiring requirements shall be clearly identified on the "AS-BUILT" system drawings.

5. CONFIGURATION

1. Install all required software for the voice system and telephone sets including firmware updates. Ensure that at the time of turnover, all software and all device firmware is updated to the latest revision.

2. The Contractor shall enable the existing Unity messaging system to provide Unity services to the phone system. This includes all Auto Attendant functionality, voice mail boxes etc.

3. Program all devices according to the coordinated and approved voice system design, following the manufacturer's SRND guidelines.

4. Connect telephone sets to the assigned access device.

6. FIELD TESTS

1. After the system equipment has been installed, an onsite inspection will be made by the Engineer to verify that all wiring and Telephone equipment were installed in accordance with the Contract Drawings and the requirements of this Section.

2. Completely check out, calibrate and test all connected hardware to insure that the system performs in accordance with the requirements of the Contract Drawings and this Section.

3. After installation, the equipment shall be tested to show compliance with this Section. Prepare and submit the proposed Pre-Cutover testing procedure along with the test acceptance criteria to the Engineer for approval two weeks prior to the proposed start date of test. Said testing shall continue until the results are satisfactory to the Engineer. Any repairs, construction, or modifications as required to comply with this Section shall be performed by the Contractor at no additional cost to the Authority.

4. The Pre-Cutover test plan for the phones system shall include, but not limited to:

1) Performance Test

a) Performance test cases shall include: Dial tone delay, call completion rate and call quality. Performance tests shall be performed on each Telephone.

2) Feature Test

a) Feature test shall be performed on each Telephone and shall verify all Telephone operations features including auto dial, dial pad dialing, speaker functionality and Telephone programming (if applicable). This test shall include outgoing and incoming calls. Also this test shall verify call restriction and call termination to verify that auto dial calls reach the correct Telephone extension.

5. After satisfactory completion of the Pre-cutover testing a 30-day Post-cutover test shall commence. The Contractor shall correct any malfunctions as they occur, said malfunctions including, but not being limited to, equipment failure or failure of the Station Telephone System to comply with this Section. After the Contractor corrects a malfunction, at no additional cost, the 30-day test shall restart, at day one, and shall continue until the results are satisfactory with the written approval of the Engineer. The Post-cutover test shall consist of stability testing and shall also cover problems that users encounter while using the Telephone system. Stability testing shall verify the correct operation of the Telephone system during the 30-day time interval. During this time interval the Authority will utilize the telephone equipment and verify that no in-line errors are generated on the VoIP System from the installed Telephones. At the middle and end of the 30-day time interval selective test cases from the performance, feature and maintenance set of tests shall be executed by the Contractor to verify that all Telephone system components continue to operate during and after the 30-day time interval. The selective test cases for the stability test shall be submitted by the Contractor for approval by the Engineer. In addition, all user-originated trouble tickets shall be investigated and resolved by the Contractor to the satisfaction of the Engineer.

6. Testing shall continue until the results are satisfactory to the Engineer. Any repairs, construction, or modifications as required to comply with this Section shall be performed without additional cost to the Authority.

7. Submit a test report detailing compliance with the requirements of this section, including pass/fail result for each test case for the Pre-cutover and Post-cutover phases.

7. TRAINING

1. Provide a Training Course on the use of the Phone System. The Course shall consist of two days of user training for two groups of three people each.

2. Provide all System Documentation and training manuals to all personnel attending the training courses.

DIVISION 16

SECTION 16859

ELECTRIC HEATING CABLES (SELF-LIMITING TYPE)

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for self-limiting type electrical heating cables and accessories.

1.02 REFERENCES

The following is a listing of publications referenced in this Section:

National Electrical Manufacturer's Association (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum).

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code.

Underwriters Laboratories Inc. (UL)

UL 718K	Pipe Heating Cable.
UL 877Z	Deicing and Snow-Melting Equipment.

1.03 QUALITY ASSURANCE

Heat tracing cables and accessories, of the type required, shall be of the type which have been successfully used for purposes similar to those intended herein for not less than five years.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original unopened protective packaging.

B. Store materials in original packaging in a manner to prevent soiling, physical damage, corrosion, wetting or weather damage prior to installation.

1.05 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with the requirement of this Section, provide self-limiting type electrical heating cable and accessories of one of the following system manufacturers, or approved equal:

Raychem Corporation
Nelson Electric
Thermon

2.02 CONSTRUCTION FEATURES

A. Heat Tracing Cable

1. The heat tracing cable shall consist of an assembly of irradiated self-limiting resistive core material between two parallel circuit conductors, and insulating primary jacket, insulated monitor wire (where shown on the Basic Contract Drawing), tinned copper protective braid and an outer fluropolymer jacket.
2. Cable shall be suitable for 120, 220 or 227 Volt single phase operation; voltage, length and wattage rating shall be as shown on the Basic Contract Drawing.
3. Cable lengths shall be confirmed by field measurements prior to purchase and installation of cable.

B. Thermostat

1. Thermostat shall be complete with a 10-foot length of stainless steel capillary tube and temperature-sensitive bulb. The contacts shall be single pole, double throw, heavy duty, with a maximum non-inductive current capacity of 22 amps, 120 volt AC.
2. Thermostat setting shall be fixed, non-adjustable set point of 40 degrees F with a differential of 3 degrees F and a set point accuracy of $\pm$ 4 degrees F, used on outdoor heat traced water lines.
3. The thermostat shall be housed in a die cast watertight NEMA 4 box.

   Thermostat shall be type "AMC-F5" as manufactured by Raychem Corporation, or approved equal.

C. Power Connection

The self-limiting, heat-tracing cable shall be connected to the source of (cold) power by a Power Connection Kit approved by the manufacturer for that particular application.

D. Indication Light

When an indication light monitoring the heating cable integrity is required and/or shown on the Basic Contract Drawing, it shall have a red lens and be mounted in a copper-free cast aluminum box.

1. This light shall be suitable for cable voltage operation shown on the Basic Contract Drawing and shall be as manufactured by the selected system manufacturer, or approved equal.

E. Monitoring Panel

When a monitoring panel is required and/or shown on the Basic Contract Drawing, it shall be 6, 12, or 24 pilot lights, as required, mounted in a heavy-duty sheet metal NEMA 12 (indoor use) or NEMA 4X (outdoor use) enclosure, with a remote alarm module and a Test/Reset switch. Panel shall be as manufactured by Nelson Electric, or approved equal.

F. Contactor

When a contactor is required and/or shown on the Basic Contract Drawing for an installation of multiple heat-tracing cable sections controlled by a single thermostat, the contactor shall have a Hand-off-Auto selector switch and be similar to Type E304 as manufactured by Raychem Corporation.

G. End Seal, Splice, and Expansion Joint Kits

All necessary electrical components required to complete a particular heating cable installation, such as end seal, splice, and expansion joint kits shall be as approved by the manufacturer of the cable for that particular application.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install heat tracing cable system in accordance with the Basic Contract Drawing, or approved Shop Drawings, and the requirements of this Section.

B. The Contractor shall determine the exact location of the power connection and termination of each heating section.

C. The Contractor shall verify in the field the exact mounting location of the heat-tracing cable.

D. Heat-tracing cable for pipe heating system shall be installed in such a manner as to permit equipment servicing and removal without disturbing the heat tracing cable on the pipeline. Follow typical installation procedures provided by the cable manufacturer.

E. The thermostat-sensing bulb shall be located on the lowest part of the pipeline to be protected.

F. In no case shall the temperature controller touch the heat tracing cable or be located at a point where performance will be influenced by the proximity of flanges, valves or other objects of high heat loss.

G. Splice heat-tracing cable in accordance with manufacturer's recommendation.

H. Secure cables in place with fiberglass tape at 18-inch intervals.

I. Install caution labels on pipeline insulation at five feet intervals.

3.02 FIELD TESTS

A. All tests shall be performed in the presence of the Engineer.

B. Heat tracing cable shall be tested in accordance with manufacturer's start-up and field test instructions:

1. For pipe heating applications, cable shall be tested before and after insulation is applied.

2. For snow melting applications where heat tracing cable is embedded in concrete or pavement, cable shall be tested before (concrete or pavement) surface is applied, after surface is applied but before it has hardened, and after surface hardening.

END OF SECTION

SECTION 16859

ELECTRIC HEATING CABLES (SELF-LIMITING TYPE)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

Entire heat tracing cable system (only when shop drawings are required by the Basic Contract Drawing), including:

1. Size, length and dimensional heating cable layout (including pipeline if pipe heating application), with all connection details and a complete list of parts with full identification.
2. Complete details of construction, wiring diagrams and schematics, connection details and interconnection requirements and parts identification of any electromechanical (control) devices, such as monitoring panels, contactors, if required to be furnished as part of the heat tracing system.

B. Catalog Cuts

1. Heat tracing cable.
2. Power connection kit.
3. Splice kit.
4. End seal kit.
5. Expansion joint kit.
6. Pipe straps.
7. Thermostat.
8. Signal light.
9. Caution labels.

END OF APPENDIX "A"

DIVISION 16

SECTION 16935

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM (FOR POWER MONITORING APPLICATIONS)

PART 1. GENERAL

1.01 SUMMARY

A. This Section specifies requirements for a supervisory control and data acquisition (SCADA) system for power monitoring applications.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. General

1. All SCADA system equipment manufactured, supplied, and installed shall comply with the requirements of NFPA 70, all local codes, and all other publications referenced in Article 1.03 herein.
2. Provide a complete and fully operational SCADA system, hereinafter referred to as the "System," complying with the requirements of this Section. All of the Work of this Section shall be coordinated with the current operation of the facility.
3. The System shall consist of power monitor modules (PMM's), of the quantity shown on the Contract Drawings, integrated on a high-speed communications network encompassing the locations shown on the Contract Drawings. The PMM's shall transmit the information specified in this Section to a remote workstation running standard, off-the shelf power monitoring and control software, furnished and installed in accordance with the requirements of this Section.
4. The System shall provide the operator at the remote workstation with all information available at each PMM. All data and event information shall be displayed and logged automatically and at user-configurable intervals.
5. A standard, high speed, industrially proven Local Area Network (LAN) shall be used to connect all PMM's that support direct connection of multiple remote workstations anywhere on the network.
6. Each remote workstation connected to the LAN shall have equal access to information provided by the PMM's for centralizing data display, data logging, alarming, event recording, and other power monitoring operations.
7. Unless otherwise specified on the Contract Drawings, the System shall consist of all components specified in this Section, and as required to make the System operate in accordance with the requirements of this Section.

B. Power Monitor Module (PMM)

1. Power Monitor Modules (PMM's) shall be installed in circuit breaker enclosures, as shown on the Contract Drawings.

2. Each PMM, within a switchgear line-up, shall be daisy-chained to the PMM in the adjacent circuit breaker enclosure. The daisy chain shall begin at the "head-end" of each switchgear line-up, where it shall be connected to the interface modules for data communication with the remote workstations.

3. Unless otherwise shown on the Contract Drawings, the interface between "head-end" interface modules, within a substation, shall be via a local area network.

4. Where shown on the Contract Drawings, connect the interface module to a telephone modem. Install empty conduit, as shown on the Contract Drawings, at each location to allow leased, dedicated, voice-grade, dial-up type telephone lines to be installed from the telephone interface points to the modems. Telephone service shall be installed by others.

5. Signals sent over the telephone lines shall be received via a modem at the remote workstation located as shown on the Contract Drawings. The remote workstation shall monitor; control, except closing circuit breakers; and receive alarms and data from all PMM's.

6. Where shown on the Contract Drawings, install and connect the fiber optic data cable to communication patch panel. Connection shall be done by others.

C. The remote workstation software shall process the data received from the PMM's and generate CRT display screens showing the data in both graphic and tabular forms.

D. Design Requirements

1. Application software and/or firmware for remote workstations, programmable logic controllers (PLC's), and PMM's shall be provided in accordance with the requirements of this Section.

2. Networking Requirements

a. All data stored in the power monitor modules shall be accessible to external devices by means of serial communications interfaces comforming to EIA-485 standards.

b. The System shall have sufficient telecommunications capacity that 32 PMM's may be connected to form a continuous communications link extending up to 4,000 cable feet at 19,200 Baud. Communications links shall be compatible with the EIA-485 multi-drop communications standards.

c. Communication rates on the links shall be adjustable (preconfigured) up to 19.2K baud to provide acceptable throughput of PMM data.

d. It shall be possible to program up to 99 sites that can be automatically polled at user-defined intervals or schedules, in addition to on-demand monitoring and polling.

e. The high speed, industrially proven, network bus shall form the basic structure for all System communications by linking equipment lineups to the modem output for communication to the remote workstations. All components shall function together in an integrated data communications network.

f. The high-speed network shall operate at speeds of up to 500K baud to provide adequate data throughout; speed shall be adjustable.

g. The high-speed network shall consist of network interface modules that allow man-machine interfaces, remote workstations, programmable logic controllers, and other higher level or sub-networks to access the data being gathered by the PMM's, Electric Trip Units, and Transformer Temperature Monitors, as shown on the Contract Drawings.

h. The network bus shall be wired in accordance with the manufacturer's written instructions.

i. The network interface modules shall be modular in design to allow for easy future expansion or modification of the System.

j. Each network interface module shall allow for the connection of at least 32 PMM's and one local System display unit or other network compatible devices such as programmable logic controllers, remote workstations, etc.

k. It shall be possible to connect at least 100 network interface modules together in a LAN of up to 15,000 cable feet in length to form the high-speed communications network.

l. Modems shall be furnished and installed as shown on the Contract Drawings. Auxiliary hardware, required to interface the modem to the PLC, shall be provided, as required, to make the System operational, in accordance with the requirements of this Section. Use of modems shall be transparent to the System software and PMM's.

m. Modems shall conform to the following:

(1) Protocol - asynchronous

(2) Speed - 9600bps in V.32 mode

(3) Operation - Full duplex over 2-wire dedicated lines

(4) Interface - RS232, CCITTV.24, V.28

(5) Power - 115 VAC, 60 Hertz

E. Remote Workstation Requirements

1. Unless otherwise shown on the Contract Drawings, the System shall include a remote workstation, complete with the required System Application Software, furnished and configured in accordance with the requirements of this Section. The System shall be preconfigured with all software, configuration files, and screen drawings by the System Integrator and ready to connect and operate when delivered to the site.

2. The remote workstations shall display and store all information from the PMM's. It shall be possible to operate more than one remote workstation on the network with each one working independently from the others and having complete access to all information. Each remote workstation shall be based on high performance, graphics terminals using a Windows-NT protocol that allows any terminal to communicate with the PMM's.

3. The System shall be a multi-user system, which shall simultaneously perform program development and process applications. It shall be a priority-scheduled, event driven System with priority and activities assignable such that process activities determine the level of service required. Real-time application functions shall be serviced in accordance with their priority.

4. Data integrity and System availability shall be ensured by both hardware and software protection mechanisms. On-line diagnostics, error detection and logging shall be provided to verify System integrity. Automatic System recovery shall be provided in the event of power failure or hardware or software failure.

5. The System shall be both flexible and expandable. A virtual memory operating system shall be provided to allow large programs to execute in both large and small memory configurations without program modification or definition of overlays. The command language shall allow for easy modification and/or extension of command repertoire and allow applications to present their own command interface to the user.

6. At the remote workstation, the software shall be configured to permit an operator to view only. Operator shall not be able to change or modify any settings or run any non-programmed reports. All alarm and alarm reports shall remain in place.

7. The remote workstation hardware to be furnished and installed shall be as shown on the Contract Drawings.

8. Monitors

   a. Each monitor shall be sized at 21 inches. The autoscanning color monitor shall have a resolution of 1280H x 1024V pixels, display up to 256 colors and utilize the MOTIF graphic user interface to display process and System data.

   b. The latest version of Windows based Operating System display terminal shall provide a resolution of 1280 H x 1024V pixels and up to 256 colors and utilizes the MOTIF graphic user interface to display process and System data. The remote workstation shall use a natural, operator-friendly interface for process monitoring and supervisory control and for engineering-programming and tuning the distributed process controllers. The window display shall allow simultaneous observation of multiple process graphics displays with dynamic update of process data. All remote workstations shall be configured identically.

   c. On all high resolution graphic displays, it shall be possible, by menu selection, to ZOOM IN, ZOOM OUT, ZOOM TO, PAN and SET ZOOM SCALE to allow the operator to amplify selected screen sections.

9. Internal Hard Disk: The remote workstation shall be provided with 1 high-capacity high-performance SCSI Winchester disk drive. The disk drive shall be a 3-1/2" device and shall incorporate 48-bit error correction code (ECC). The formatted capacity of the disk drive shall be a minimum of 1 gigabyte, expandable to 9.5 gigabytes. Average seek time shall be no greater than 14 milliseconds with a maximum seek time of 20.8 milliseconds. Peak transfer rate shall be at least 3.1 Mbytes per second (to bus). Mean time between failure (MTBF) shall be at least 250,000 hours. For improved fault isolation, 90% on board diagnostic coverage shall be provided on power-up. Additionally, to insure data integrity write as well as read diagnostics shall be performed at startup. All errors, hard and soft, shall be reported to the System to aid in monitoring drive condition. The Winchester disk drive shall be installed in the System box of the remote workstation computer. Winchester drive storage unit shall be as shown on the Contract Drawings.

10. Magnetic Tape Unit: A 4 mm digital audio tape (DAT) drive shall be provided with the remote workstation. The capacity of the DAT drive shall be at least 4 Gbytes (with data compression) per cartridge. The DAT drive shall be installed in the CPU enclosure of the remote workstation computer. The DAT tape drive shall be as shown on the Contract Drawings.

11. Communication Interface Device

    a. A multi-channel communication multiplexer shall be provided as the interface to the communication System. Communication data rates shall be programmable.

    b. The communication interface between the PMM and remote workstation shall be via a communications gateway processor connecting directly to the System LAN. An Ethernet gateway device shall be the Peripheral Processor Unit (PPU). The PPU shall support up to 16 individual channels, operating at data rates from 4.8Kb/sec to 115Kb/sec.

    c. PPU gateway devices shall be industrial computers resident on an Ethernet LAN. The motherboard of the PPU shall be a complete Pentium-based personal computer. It shall contain a complete AT kernel with processor, 4MB DRAM and peripheral drivers. On board it has two serial ports, one parallel port, a watchdog timer, keyboard interface, hard disk IDE controller and floppy disk controller. The motherboard shall drive a six-slot passive ISA IEE P996 backplane. The addition of the 40MB 3.5" hard disk, 1.44MB 3.5" floppy drive and an optional monochrome graphics adapter shall make for a complete PC compatible computer capable of local man-machine interface (MMI).

12. Printers

    a. Heavy-duty printers shall be used for System alarm logging, event logging and report printing. Printers and other serial devices shall be served by a terminal server interface unit connected to the LAN or via a SCSI multiplex unit directly connected to the remote workstation. All printers may substitute for another printer's functional assignment. Printers shall be equipped with color ribbons to allow alarm messages to be printed in color, capable of producing color character based screen copies only.

    b. Unless otherwise shown on the Contract Drawings, a total of 4 printers shall be provided. Two at each workstation location, one providing alarm logging and the other event and report printing.

c. Printers shall be provided that are designed for heavy-duty cycle operation in a continuously powered ON mode. They shall be of the impact printing type with full upper/lower case ASCII character set with a minimum of 94 printing characters. Print speed shall be, as a minimum, 240 cps. They shall have adjustable tractor type form feed for up to 14-7/8 inch continuous multi-part forms.

d. A keyboard printer shall be provided as a System console device, logger and CRT hard copy device.

e. A read only printer shall be provided as a System/ alarm logger, report printer, and as a CRT hard copy device.

f. The printer shall have a built-in test & setup routine to verify proper operation. In the event the device goes off-line or can not print, the System shall re-direct printing to the alternate printer (HP Deskjet 500 or compatible).

g. The printer shall be as specified on the Contract Drawings.

F. Software Requirements

1. Application Software Description

a. The PMCS shall be supplied with user friendly application software suitable for operation on computer workstations that serve as central control stations by monitoring the devices in the System, recording events, indicating alarm conditions, and displaying and logging device data.

b. The software shall be configured to accommodate new monitoring devices that may be added to the System later. The user shall be able to add these new devices or make other changes necessary to reflect changes to the electric plant without programming or making extensive changes to configuration files.

c. Any software keys or programming tools the user may need to change the software displays, one-line diagrams, or accommodate new monitoring devices shall be furnished.

2. The System manufacturer shall supply application software which provides the operator user friendly access to all power monitor module data, breaker/contactor/switch status and manual control, communication alarms, captured waveforms and logged data.

3. The software shall be a standard "off-the-shelf" control & automation product capable of being configured and modified to perform the functionality specified in this Section.

4. The remote workstation software shall not be able to perform any control function that shall be accomplished through the software with the appropriate security clearance. (Administrator and Integrators only!)

5. The remote workstation shall, via software commands, be capable of being taken off/on-line without affecting the operation and status of the System. Once off-line, the software on the remote workstation shall alterable and/or upgradable without disrupting normal System operation.

6. The software shall provide four levels of security defined as follows.

a. User: Can operate software and access and view information, can not acknowledge or control equipment.

b. Operator: Allows user with valid password to acknowledge indications and alarms, can not control equipment.

c. Administrator: Allows access to all System functions and control, adding notes, etc.

d. Integrator: Allows user to actually modify System graphics and logic.

7. Provisions shall be included to allow the following number of the types of users identified above:

a. Users: Unlimited, no restriction

b. Operators: 20

c. Administrators: 5

d. Integrators: 3

8. The software shall communicate, control, and display all information provided by the PMM's.

9. Application Software shall be supplied to support System configuration, monitoring of the devices, data logging, alarming, and other operations associated with the PMM's.

G. Data Presentation Format

1. Shall support an unlimited number of System devices, and poll all as required.

2. Shall display information for the System real-time data table format. Shall display status of digital status inputs.

3. The software environment shall be the following:

a. The Operating System - Windows NT, or approved equal

b. Networking Software - TCP/IP

c. Graphic User Interface - Windows-NT/OSF Motif

d. Programming Languages - C and Fortran-77.

4. The database shall be stored in main memory and in disk resident files. Data required for real-time rapid response such as point parameters, control setpoints, etc. shall be stored in tables in memory. Data, used only when requested by an operator or other non-real-time information (history, picture templates, point descriptions, etc.), shall be stored in disk files. The main memory data base shall consist of a number of global data partitions that shall be sized and configured for a specific subsystem application. Partitions (databases) may be simple tables, vectored (variable length entries), keyed (hash-coded table lookup) and/or pooled. Time critical partitions shall be locked in memory while all other shall be disk-resident and paged into memory as required. Size of the databases shall be limited only by available disk storage.

5. The disk database shall be a collection of disk files that shall be either in formatted edit mode for operator creation and modification or direct access, unformatted for fast access. The files shall contain several types of general information.

a. Information on points, groups of points, or RTU's/PLC's

b. Text formats for messages, reports, or displays

c. Messages for logging

d. Menus for MMI display keys

e. Process history

f. Data processing results

6. All data required to define the System shall be entered on-line using a generalized data base entry/modification program from the console device. New data bases for specific applications shall be created off-line using a screen editor. The off-line data base shall then be loaded into the on-line data base structures. Databases shall be automatically saved from memory to disk and from processor to processor as changes are made.

H. Data Acquisition and Communications

1. The data acquisition subsystem shall consist of a general-purpose network interface processor that shall communicate over Ethernet with the front-end processor (PPU). The protocols and data processing required by specific data acquisition and control hardware shall be resident in the PPU.

2. Three color-coded alarm levels shall be supported. Alarms shall be user-defined pickups and dropouts. The user shall be able to select indication including visual, audible, and/or required acknowledgement. Alarms shall be reported by exception.

I. Man-Machine Interface

1. All interaction between the operator and the workstation shall be controlled by the man-machine interface (MMI) environment. All activities initiated at the workstation shall be subsystems under the control of a process dedicated to the workstation.

2. All communications from the keyboard to the CPU shall be funneled through the MMI environment. The MMI environment shall provide the following services:

a. Processing of all inputs from console

b. Clock updates

c. Command line processing

d. Background process activation

e. Screen copy functions

f. Function key processing

g. Alarm banner line updates

3. The Man-Machine Interface process shall provide the operation with a fully interactive set of facilities to perform all monitoring, display, control and reconfiguration activities.

J. System Security Subsystem - MMI processes and pictures available to an operator can be made a function of the password level to ensure process and data base security. In addition, the ability to control or modify points or other database items can be made a function of the categories assigned to operators.

K. Point Definition and Control

1. Provide functions to allow the operator to manipulate the point database. These shall include functions to view and modify point values and attributes, to list points according to operator-defined point groups, to load the data base into memory, and create new data base input files from the current, on-line database.

   a. Data Base Loading: The System data base (point descriptions, calculations, etc.) shall be loaded through interactive CRT screens.

   b. Point Control: To examine a point more closely, send output control to a point, or enter data to a point, the operator shall simply poke the point value or graphic symbol on any picture or table. All operational information on the point shall then be displayed at the top of the screen allowing direct operator interactions.

   c. Database Editor: The database editor function shall allow the user to add, delete and modify database points on line. The program shall consist of display formats for each point type. The MMI shall be designed for easy modification of any of these items, as well as point addition and deletion.

L. Point Display and Definition Subsystem

1. In addition to the display and control points via graphic displays, the Point Log subsystem shall provide tabular lists of points selected from various user-defined groups. Group listings can be based on any criteria such as alarms disabled, points in hand mode and control inhibited points. The user may control any point from these lists, as from a graphic display by poking its entry on the list.

2. Any selected list of points may also be sent to the printer.

M. Point Groups: Point groups shall allow the user to deal with more than 1 point in a convenience manner such as the display and modification of points, alarm summaries, and the use of points as input to an application program.

N. Alarm and Event Logging

1. All messages shall be managed by message spooling. The message subsystem shall receive requests to print a message from a message template file. All messages shall be written at high speed to a large circular spool file and shall be printed on the appropriate printers at full printer speed.

2. Alarm events shall be time stamped when first processed and the full messages text shall be placed in the alarm table by the message subsystem.

O. Report Generator

1. Report formats shall be a full 132 columns by 66 lines report format by selection of 1 of 4 quadrants on the 80 column screen. Calculations may be specified on report tables for summing, averaging, etc. of rows and columns. Minimum, maximum and other data along with text may also be integrated into the report format.

2. The Report program shall be scheduled to generate and print a report, preventative maintenance work requests, etc. on a periodic basis. Scheduler options shall include immediate print, add/change/ delete report, time of next printing, repeat frequency, and output device(s).

3. All reports shall be printed by the report spooling module.

P. Historical Data Recording

1. Software shall include a history editor for editing history files.

2. Provide a function to display the status of the history System and all data entries in the history files. The history data files shall be archived to magnetic tape under operator control.

Q. Data Presentation and Trending

1. Process data may be presented from both the real-time and historical databases.

2. Real-time data shall be displayed on the color CRT in stripchart (value vs. time), scatter plot (value 1 vs. value 2), or histograph (sample count vs. value) mode. The stripchart shall display up to 4, 8 or 16 analog variables as vertical barcharts with alarm levels indicated.

3. Historical information shall be obtained from either the on-line disk files or from the data archived on magnetic tape.

4. Trends shall be displayed on the CRT or printed on a graphic printer. Tabular data shall be output to a CRT or any printer.

5. Statistical routines shall be available for analysis of regular data (e.g., hourly or daily averages) such as x-y correlation, log normal distribution, and least squares curve fitting.

6. Frequently used trends shall be pre-formatted and obtained from poke points on a graphic trend menu display. These trends may be modified and presented in different formats by on-line editing of the various parameters.

R. Workstation CRT Data Display

1. Screen Information

a. The information displayed on the CRT shall be developed based upon the information contained in this specification and on the contract documents. Where graphics are specified they shall be patterned after the plans or similar documents that will be furnished to the contractor by the Authority.

b. There shall be a minimum of 350 display screens developed which shall contain the following information:

(1) An overall site plan shall show the entire boundary of the facility with the location of each substation clearly indicated. The level of detail of this screen shall be equal to that shown on the Contract Drawings.

(2) There shall be one substation screen for each substation shown on the Contract Drawings to indicate the number and designation of each cubicle within each substation. Each circuit breaker shall be identified by its respective designation. The level of detail of these screens shall be as shown on the Contract Drawings and as directed by the Engineer.

(3) There shall be a minimum of 12 single line diagram screens to indicate the circuit breakers contained in each switchboard assembly. The single line diagrams for each of these screens shall be developed from information and plans furnished by the Authority. A single line diagram of each substation shall be included.

(4) Data and report screens shall be formatted to present all data derived from each PMM.

(5) Additional report screens shall be formatted to summarize all available data in spreadsheet and graphical presentation format.

c. All screens shall include information or graphics that shall be shaded or less dense in appearance to allow the Authority to highlight the important areas of the screen to the user.

d. A notepad window shall be available for the Administrator to provide notices. The window shall call up a text file and display its contents. Text file shall be limited by the available storage space connected to the computer. This window shall not lock out notices of change of state and alarms. Upon changes of state and alarm conditions the screen shall be reset tot the overall System layout. There shall be 2 types of notes. One shall be associated with each substation, the other shall be general to be used as a general bulletin board.

e. Each device being monitored shall have its name tag information stored in a relational database. A sub-database shall have provisions to link maintenance information such as date, type of maintenance performed, by whom, and notes.

f. Provisions shall be made to have attached to each device a window with warning messages. Upon selection of the device, or activation of any alarm condition involving the device, if there is information present in the warning "window", it shall also be brought to the forefront.

g. Only Administrators and Integrators shall be allowed to enter and modify warning messages.

h. Provisions shall be made to have a procedure screen attached to each alarm condition associated with each particular device.

i. All monitored characteristics shall have 2 setpoints. These setpoints shall be user configurable. In addition, voltage shall have 2 additional set points for a total of 4 user-configurable set points.

j. The System software shall communicate and control PMM's from the following vendors:

(1) Power Measurement Limited

(2) Square D

k. All System data shall be logged to the hard disk at user specified intervals. Data logs shall be saved on a per month basis. At the end of the month, all data shall be saved to a file identifying the respective month and year. The System software shall store at least 12 months of data on the workstation hard disk. Overflows shall be written to tape. The System software shall provide the ability for the System administrator to save data files to tape both manually and automatically on a periodic interval selected by the user.

2. System Operation and Screen Interaction

a. There shall be programmed into the System screen interaction that allows the user to go from one screen to another by the use of a mouse or the keyboard.

b. The final screen interaction shall be as defined by the Authority.

c. Location of pop-up windows shall be configurable by user with appropriate security clearance (Integrator).

d. Acknowledgement of alarms, warnings, notices, etc., shall be user and password protected (available only to Operators and Administrators).

e. After 1 minute of inactivity, the screen shall refresh to the overall System layout. This default to the overall System layout may be defeated with appropriate security clearance (Operators and Administrators only).

f. Energized equipment shall be shown in red. Equipment that is open or not energized shall be shown in green. Grounded equipment shall be shown in yellow.

g. Insertion and operation of the Ground and Test Device shall be indicated by identifying the equipment grounded in the color yellow.

h. Control of equipment shall be by the selection and activation method. Equipment to be controlled must first be selected by either the mouse or through the keyboard. Upon selection, the System shall ask for confirmation that the equipment selected is correct. Once confirmation is received, a pop-up window shall be shown with the control options available. Once a control option is selected, the System shall ask the operator for confirmation of the action to be performed. Upon receiving confirmation, the System shall execute the desired control function. Pressing the "Esc" key at any time during the process shall nullify all previous selections and return the System to its default state.

i. Each alarm condition shall have an associated procedure file that shall be accessed by pressing the appropriate function key. After 1 minute of inactivity, the procedure file shall close and the display shall return to the alarm annunciation until acknowledged.

j. Context sensitive help shall be provided at any point by pressing an associated function key.

k. The substation distribution system shall be shown in two views. Layout, as previously described, and in a single-line format. An associated function key shall enable the user to toggle from one view to the other.

l. Upon activation of an alarm condition, the System shall be capable of directly displaying the affected substation via an assigned function key. Operation shall be based on the last alarm or through selection of a specific alarm listed on the alarm window.

m. Two keys shall be assigned to allow "upward" and "downward" movement in the distribution system. For example, pressing the "downward" key from the overall substation layout will bring up the layout of the substation presently selected. Pressing the "upward" key will return the operator to the previous display. In addition, the System shall be capable of going directly to any view via the program's function menu.

n. All electrical data for each device shall be displayed in real-time in either view (layout, or single line). Selection of the data to be displayed shall be configurable by Administrators and Integrators only.

o. The System shall have a summary log for each device that will maintain cumulative information such as number of operations, number of hours on-line, number of hours off-line, number of alarms. In addition to the cumulative, all of this information shall be stored and reported on a monthly basis.

p. A printout shall be made of all System operations, alarms, warnings, etc., as they occur. The printout shall include the date and time (hour, minute, second), equipment ID, and a description of the event. The System shall monitor and retain the abnormal condition for as long as it exists. Monthly reports shall be available that identify the alarm condition, date, time, duration, and who acknowledged the alarm.

q. The remote disabling switch at each substation shall be monitored. Upon disabling remote control of the respective substation, a visual indication shall be provided for as long as remote control is disabled.

3. Screen Development

a. During the shop drawing phase of the project, allow 40 hours of interaction with the Authority's representative (at the location designated by the Authority) to develop screen graphic and data display concepts and general configuration. These interactions shall be at the Authority's designated location and time.

4. Automatic Control

a. Data pertaining to the automatic control system shall be transmitted via the System network to the remote workstation (for circuit breaker tripping only).

b. At a minimum the application software at the remote workstation shall provide the following:

(1) Interactive color-graphics one-line of automatic control system (breaker status, relays status, etc.).

(2) All automatic control operations (open breaker, relay operation, etc.) shall be date/time stamped and recorded in an event log.

(3) Setup and display alarm conditions for automatic control operations shall be possible with each alarm condition entered in the event log.

(4) Manual operator intervention via the keyboard or interactive one-line graphics shall be provided such that any point in the process may be controlled.

(5) Manual intervention shall be password protected to prevent inadvertent or unauthorized override of the control scheme.

(6) Protective relaying functions, anti-paralleling interlocks, or load limits shall not be defeatable.

S. Uninterruptible Power System

1. Provide at each workstation, in Building #14, an uninterruptible power system (UPS) to maintain power to the remote workstation in the event of a short power outage.

2. The UPS shall be an on-line system having the following characteristics:

a. Lightning and Surge Protection: In accordance with ANSI/IEEE C62.41, categories A and B.

b. Spike Attenuation: 2000 to 1.

c. Galvanic Isolation: Complete from line. Output neutral bonded to ground.

d. Noise (RF) Isolation: 120 dB common-mode, 60 dB normal-mode.

e. Input: 120V: 96 VAC - 138 VAC.

f. Output Voltage: 120 VAC.

g. Regulation: +3%.

h. Output Waveform: Pure sine-wave, less than 5% THD.

i. Efficiency: 85% to 92% on line.

j. Operating Environment: 0o to 40 o C (32 o to 104 o F), 0 to 95% relative humidity (non-condensing).

3. The UPS shall be as shown on the Contract Drawings.

T. Transient Voltage Surge Suppressors (TVSS)

1. Provide, as shown on the Contract Drawings, transient voltage surge suppressors for telephone lines.

2. Telephone transient voltage surge suppressors shall conform to the requirements of UL 497.

3. Telephone TVSS shall have a clamping voltage of 200V peak +10%, response time of 1 picosecond, and peak transient input voltage of 12KV, microseconds. Input shall be via RJ11 modular jack; output shall be via RJ11 modular plug. Unit shall be as shown on the Contract Drawings.

U. Transducers

1. Provide current transducers as shown on the Contract Drawings. Transducers shall have a 0-5 ampere ac input and 4-20mA output. Transducers shall be as shown on the Contract Drawings.

1.03 REFERENCES

American National Standards Institute (ANSI)

ANSI C37.90 - Relays and Relay Systems Associated with Electric Power Apparatus

ANSI C62.41 - Guide for the Surge Voltages in Low-Voltage AC Power Circuits

Electronic Industries Association (EIA)

EIA 485 - Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

National Fire Protection Association (NFPA)

NFPA 70 – National Electical Code

New York City Building Code (NYCBC)

New York City Electrical Code (NYCEC)

Underwriters Laboratories (UL)

UL 497 - Protectors for Paired Conductor Communication Circuits

UL 508 - Industrial Control Equipment

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The System manufacturer and the System integrator, if applicable, performing the work specified in this Section, and as shown on the Contract Drawings, shall be business entities that are substantially engaged in the type and scope of work specified in this Section, and shall demonstrate that they have been designing SCADA systems, for power monitoring purposes, for that last three consecutive years and shall demonstrate prior experience on at least two projects of similar size and complexity to what is required under this Contract.

2. The System manufacturer and the System integrator, if applicable, shall have authorized maintenance personnel and resources available within the Port Authority District, as demonstrated by existing contracts, to provide maintenance for systems comparable to the System furnished in accordance with the requirements of this Section.

3. The Manufacturer shall be ISO 9001 certified

1.05 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be delivered to the construction site complete. Where ever possible, all devices and accessories shall be in place and pre-wired.

B. The equipment shall be packaged to prevent damage due to vibration, jarring and the like during transportation and handling.

C. All materials shall be delivered in unopened factory packaging and shipping materials. Labels shall be affixed that clearly identify the manufacturer, product name, Port Authority Contract Number, Work Order Number (if applicable), storage requirements and any other special instructions. If any electrical devices or accessories must be shipped loose they shall be delivered in the manufacturer's original unopened protective packaging and shall be identified with suitable non-corrosive tag.

D. All materials shall be properly stored and handled to prevent deterioration or damage due to moisture, temperature, contaminants, vandalism, corrosion or other causes. Store components in clean and dry space protected from weather until installation.

E. Where possible, maintain protective covering until installation is complete and remove such covering as part of final cleanup.

F. Touch up any damage to finishes to match adjacent surfaces, including re-coating of galvanized or plated surfaces where damaged, cut, or drilled.

G. Handle in a manner to prevent damage to finished surfaces.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

1.07 MAINTENANCE

A. The Contractor, or his authorized representative, shall confirm that there are a minimum of three (3) established agencies within the Port Authority District, which stock a full inventory of spare parts for the system supplied. In the event that there are not three (3) sources of supply, the Contractor warrants that all system components will be made available by the Contractor for a period of ten (10) years from the date of acceptance of the system.

B. Submit to the Engineer a priced parts list, with the System manufacturer's recommendations of the type and quantity of spare parts to be stocked for a 20-year design life of equipment. Include names and telephone numbers of the nearest sources of supply for each item.

C. Furnish full preventive service and remedial maintenance of the system including all labor, parts, material, and supplies for one year from the rendering of the Certificate of Final Completion. The Contractor shall respond to a service call by traveling to the construction site within four (4) hours of the call, 24 hours per day, 7 days per week, including holidays.

PART 2. PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of this Section, provide SCADA system equipment of one of the manufacturers specified on the Contract Drawings.

2.02 MATERIALS

A. Power monitor modules

1. The power monitor modules (PMM's) shall be installed in the substation cubicle as shown on the Contract Drawings.

2. The PMM's shall provide true RMS quantities accurate for distorted, non sinusoidal wave shapes beyond the 30th harmonic (fundamental of 50 to 60 hertz). Each shall be equipped with integral data communications for integration into the System network.

3. Information provided by each power monitor module shall include frequency, current, demand current, voltage, real power, reactive power, apparent power, demand power, power factor, accumulated energy and accumulated reactive energy.

4. Each power monitor module shall retain historical circuit data, setup and configuration values, date and time of last power loss, and diagnostics data in the event of a control power failure.

5. Each power monitor module shall capture current and voltage waveforms that may be exported to computer workstations for viewing, storing and waveform analysis.

6. Voltage, current, status, relay and power inputs shall conform to ANSI/IEEE C37.90A-1989 surge withstand and fast transient test.

7. All PMM's shall be listed to UL 508.

8. Characteristics

   a. The PMM's shall accept inputs from industry standard instrument transformers (120 VAC secondary PT's and 5A secondary CT's).

      (1) PT primaries through 5 KV shall be supported.

      (2) CT primaries through 3 kA shall be supported.

   b. The current and voltage signals shall be digitally sampled at a rate high enough to provide valid data for waveform analysis and true RMS metering accurate beyond the 30th harmonic (fundamental of 60 Hz).

   c. The PMM's shall be listed to UL 508, industrially rated for an operating temperature range of 32 o F to 122 o F ambient, and have an overcurrent withstand rating of 500 amps for 1 second.

   d. All setup parameters required by the PMM's shall be stored in nonvolatile memory and retained in the event of a control power interruption.

   e. The power monitor module shall maintain in nonvolatile memory maximum and minimum values for each of the instantaneous values reported as well as the time and date that the minimum or maximum was set.

   f. The power monitor module shall be accurate to 0.2% for voltage and current metering and 0.4% for all power and energy functions. These accuracies shall be maintained for loads from 10-100% of full scale for power factors from 0.5-1.0.

   g. Any power monitor module shall be applicable in single phase, two or three wire configurations; or in three phase, three or four wire systems. In three phase configurations, a fourth CT input shall be available to measure neutral or ground current. If the fourth CT is not used, then it shall be possible to calculate a residual ground or neutral current by connecting the return phase CT's through the fourth current input.

   h. In 4 wire connections, the power monitor module shall utilize the circuit neutral common reference and not earth ground to provide metering accuracy.

   i. The power monitor module shall be capable of being applied without modification at nominal frequencies of 60 hertz.

   j. The power monitor module shall operate properly over a wide range of control power including 90-260 VAC or 70-260 volt DC.

   k. Power Monitor Module Display

      (1) The PMM's shall be equipped with an integral 6-digit LED display to provide local access to the following metered quantities as well as the minimum and maximum value since last reset of each quantity:

         (a.) Current, per phase RMS

         (b.) Voltage, phase to phase and phase to neutral

(c.) Real power, per phase and 3 phase total

(d.) Reactive power, per phase and 3 phase total

(e.) Apparent power, per phase and 3 phase total

(f.) Power factor, 3 phase total and per phase

(g.) Frequency

(h.) Demand current, per phase and three phase average

(i.) Demand real power, three phase

(j.) Demand apparent power, three phase

(k.) Accumulated Energy, (MWH and MVARH)

(l.) THD, current and voltage, per phase

(m.) k-factor, current, per phase

(2) Reset of the following electrical parameters shall also be allowed from the front of the power monitor module:

(a.) Peak demand current

(b.) Peak demand power (kW) and peak demand apparent power (kVA)

(c.) Energy (MWH) and reactive energy (MVARH)

(3) Setup for system requirements shall be allowed from the front of the power monitor module. Setup provisions shall include:

(a.) CT rating 3000:5, 2000:5, 1200:5, 600:5 as shown.

(b.) PT rating 2400:120

(c.) System type three phase 3 wire

(d.) Demand interval (5-60 min)

(e.) Watt hours per pulse

(4) All reset and setup functions shall have a means for protection against unauthorized/ accidental changes.

(5) Displaying each of the power monitor module quantities shall be accomplished through the use of scroll buttons that select the next quantity in the list programmed into the device.

(6) The power monitor module shall be installed so that it can only trip a circuit breaker.

l. The following instantaneous readings as well as their minimum and maximum readings since last reset shall be communicated by the power monitor module:

(1) Frequency

(2) Alternate, scaleable analog input

(3) Current, per phase RMS

(4) Current, 3 phase average RMS

(5) Voltage, phase to phase and phase to neutral

(6) Power factor, per phase

(7) Power factor, 3 phase total

(8) Real power, per phase and 3 phase total

(9) Reactive power, per phase and 3 phase total

(10) Apparent power, per phase and 3 phase total

(11) Demand Current, per phase and three phase average

(12) Demand real power, three phase average

(13) Demand apparent power, three phase average

(14) Accumulated energy, (MWH, MVAH and MVARH)

(15) Total Harmonic Distortion (THD), voltage and current, per phase

(16) K-factor, per phase

m. All power demand calculations shall be done by any one of the following calculation methods, selectable by the user:

(1) Thermal demand using a sliding window updated every 15 seconds. The window length shall be set by the user from 5 to 60 minutes in five minute increments.

(2) Block interval, with optional sub-intervals. The window length shall be set by the user from 5 to 60 minutes in five minute intervals. The user shall be able to set the sub-interval length from 5 to 30 minutes in 5 minutes intervals.

(3) External Pulse Synchronization, utilizing a synch pulse provided externally. An optional status input shall be used to sense the pulse.

(4) The following demand readings shall be reported by the power monitor module:

(a.) Average demand current, per phase

(b.) Peak demand current, per phase

(c.) Average demand for real power, reactive power, and apparent power

(d.) Predicted demand for real power, reactive power, and apparent power

(e.) Peak demand for real power, reactive power and apparent power

(5) The default demand calculation method shall be a 15-minute sliding window thermal demand.

n. Each power monitor module shall receive a broadcast message over the communications network bus that can be used to synchronize demand calculations by several power monitor module. This message need not be addressed specifically to any one power monitor module.

o. Each power monitor module shall be individually capable of operating an output relay to provide the master demand synch pulse for other metering devices.

p. The following energy readings shall be reported by the power monitor module.

(1) Accumulated energy

(2) Accumulated reactive energy

(3) Accumulated apparent energy

(4) For real and reactive energy reported values, separate totals for energy flow in each direction shall be kept, as well as an arithmetic sum.

(5) Each power monitor module shall operate a KYZ output relay to provide output pulses for a user definable increment of reported energy.

q. In addition to the standard power monitor module features previously indicated, all power monitor modules shall include waveform capture capability. Two types of waveform capture shall be supported. One shall record data for one (or more) cycles of input voltage and current (60-cycle nominal), the other shall record 12 cycles of data.

(1) Either type of waveform capture shall be initiated from the workstation running the appropriate System software. In addition, the 12-cycle waveform shall be initiated by an external trigger and/or on board high speed triggers. In the case of the external trigger, it shall be sensed and the waveform capture sequence shall be initiated within 1 millisecond. A user definable delay shall determine how many of the twelve cycles are shown before and after the trigger event.

(2) The power monitor module shall transmit the waveform samples over the network to the computer workstation for display, archival, and analysis.

(3) In the case of the 12 cycle capture, each voltage and current of all phases shall be sampled concurrently so that proper phase relationships are maintained, therefore, the effect of a disturbance can be observed on all phase voltages and currents.

(4) Harmonic analysis performed on the captured waveforms shall resolve harmonies through the 31st.

r. Data logging may be accomplished either within the power monitor module or at the workstation, or both. Each power monitor module shall be able to log data, alarms and events, and multiple waveforms. This information shall be communicated to the workstation upon demand. Logged information to be stored in each power monitor module includes:

(1) Up to 10 separate data logs shall be configurable by the user. Each log entry shall be date and time stamped. Each log entry shall be user configurable to consist from one to a maximum of 12 readings of instantaneous data. It shall be possible to set up each log to take data at a different user defined schedule interval. In addition, it shall be possible for a user to define an event or new min/max condition that will trigger log file entries.

(2) A Min/Max log file shall include the time, date, and value for the minimum and maximum of each metered value.

(3) An alarm and event log shall contain time, date, event information and coincident information for each user-defined alarm or event. This log shall have a capacity of up to 1,000 events.

(4) Waveform logs shall store captured waveforms, both 12 cycle and other as defined by the user. Waveform log entries shall be scheduled at a user-defined interval, externally triggered, or forced in response to a user defined event. Waveform logs shall be either Stop When Full or Circular (FIFO) as defined by the user.

(5) A simple user interface shall be provided to enable the user to allocate power monitor module memory to different log functions.

s. Power monitor module Input/Output (I/O) Options: Power monitor modules shall be equipped with the following I/O options as shown on the project drawings:

(1) Three output relays suitable for KYZ pulse initiation.

(2) Four digital inputs.

t. Alarm events shall be user definable. Alarm events shall include:

(1) The following classes of events shall be available as alarm events:

(a.) Over/under current

(b.) Over/under voltage

(c.) Current imbalance

(d.) Phase loss, current

(e.) Phase loss, voltage

(f.) Voltage imbalance

(g.) Over kVA

(h.) Over kW or kVAR into/out of load

(i.) Over/under frequency

(j.) Under power factor

(k.) Over THD

(l.) Over K factor

(m.) Over demand, current or power

(n.) Reverse power

(o.) Phase reversal

(p.) Status Input change

(2) For each alarm event, the user shall be able to define a pick-up, dropout, and delay.

(3) Indication of an alarm condition shall be possible to be viewed from the front panel.

u. Output Relay Control

(1) Relay outputs shall operate either by user command sent over the communication link, or set to operate in response to user defined alarm event.

(2) Output relays shall close in either a momentary or latched mode as defined by the user.

(3) Each output relay used in a momentary contact mode shall have an independent timer that can be set by the user.

(4) It shall be possible for individual relay outputs to be controlled by multiple alarms in a wired "OR" configuration.

2.03 SHOP TESTING

A. All System equipment, materials, hardware, software, and firmware to be furnished and all work to be performed in accordance with the requirements of this Section shall be subject to inspections and tests by the Authority.

B. No System equipment shall be delivered to the Authority until the system has been inspected, tested, and approved for shipment by the Engineer.

C. Unless otherwise directed by the Engineer, the System equipment shall be tested by the system manufacturer and/or the System integrator, and witnessed by the Engineer, in the place of manufacture.

D. Testing of the System shall be performed in accordance with the requirements of this Section, and shall continue until the results are satisfactory to the Engineer. Each item of System equipment shall be tested in its entirety with the use of simulated inputs and and simulated outputs, as required. All simulation equipment required for the test shall be furnished by the System manufacturer without additional compensation therefor. Any repairs, construction, or modifications required to comply with the requirements of this Section shall be performed by the System manufacturer without any additional compensation therefor.

E. When the manufacture of all System equipment is complete, the Contractor shall notify the Engineer by requesting, in writing, an inspection and test of said equipment. This written request shall be in the possession of the Engineer a minimum of fifteen (15) working days prior to the requested inspection and test dates.

F. Any approval by the Engineer, however, shall be construed merely to mean that at the time he knows of no good reason for objecting to any equipment, and no such approval shall release the Contractor from its obligation to comply with the requirements of this Section.

PART 3. EXECUTION

3.01 EXAMINATION

A. Inspect all System equipment, and accessories prior to installation. Replace any damaged items.

B. Ensure that the spaces where any electronic equipment is to be stored and/or installed is completely free from any foreign substances, such as concrete dust, water, or any other material that may otherwise be harmful to electronic equipment and connections. No allowances shall be made to the Contractor for equipment damage, of delays due to environmental/security damage.

3.02 PREPARATION

A. The Contractor shall be responsible for field verification of dimensions and coordination of conduit entry and all other mounting conditions with the entity manufacturing the system.

B. The entity manufacturing the system shall provide on-site technical supervision and assistance during installation and interconnection of the system equipment installed by the Contractor. Said supervision is to insure the safety of the proper installation and operation of the system equipment, prior to the installed system beginning the 30-day operational test.

C. After the system equipment has been delivered, an on-site inspection will be made by the Engineer. If any equipment has been damaged or for any reason does not comply with the requirements of this Section, the Contractor will be notified in writing, and shall be required to replace the equipment at his own cost and expense, even though the equipment has been previously inspected, tested, and approved for shipment. After such satisfactory replacement, the system shall be installed by the Contractor.

3.03 INSTALLATION

A. Install all System equipment in accordance with the manufacturer's written instructions in the locations shown of the Contract Drawings.

B. All control power, CT, PT, and data communications wire shall be wired and harnessed within the equipment enclosure.

C. All wiring shall be clearly labeled with function and wire identification number corresponding to the manufacturer's wiring diagrams.

D. Where external circuit connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

E. All wiring required to externally connect equipment lineups shall be installed by the electrical contractor.

F. Contractor interconnection wiring requirements shall be clearly identified on the PMCS system drawings.

3.04 FIELD TESTS

A. After installation, the System shall be tested to show compliance with this Section. The PMCS manufacturer shall submit the proposed testing procedure to the Engineer for approval two weeks prior to proposed start of test. Said testing shall continue until the results are satisfactory to the Engineer. Any repairs, construction, or modifications as required to comply with this Section shall be performed by the PMCS manufacturer without additional cost to the Authority.

B. After satisfactory completion of testing, a 30-day operational test shall commence. The PMCS manufacturer shall correct any malfunctions as they occur, said malfunctions including, but not being limited to, equipment failure of failure of the System to comply with this Section. After the PMCS manufacturer corrects a malfunction, at no cost to the Authority, the 30-day test shall restart, at day one, and shall continue until the results are satisfactory with the written approval of the Engineer.

C. The PMCS manufacturer shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequences of operation submitted.

D. The PMCS manufacturer shall conduct a validation demonstration witnessed by the Engineer, which shall consist of, but not limited to:

1. Running each specified report.
2. Display and demonstrate each data entry template to show site specific customizing capability. Demonstrate parameter changes.
3. Execute menu tree.
4. Execute digital commands in English mode.
5. Display graphics.
6. Demonstrate all specified diagnostics.
7. Demonstrate scan, update, and alarm responsiveness.
8. Demonstrate and verify all monitoring and control functions in operation for each equipment item controlled and each point monitored.

E. The PMCS manufacturer shall submit a test report detailing compliance with the requirements of item C and item D above.

F. 30-Day Operational Test

1. Testing shall be performed to verify compliance with the requirements of this Section and shall be performed in accordance with the approved testing plan. Correct any malfunctions as they occur, said malfunctions shall include, but not be limited to, equipment failure or failure of the System to comply with the requirements of this Section. After corrections have been made, the 30-day operational test shall restart and shall continue until the results are satisfactory to the Engineer for a period of 30 consecutive days.
2. Maintain a log during all operational testing. Include a narrative description of corrective measures required and items required or replaced.

3.05 TRAINING

A. Operational and Maintenance Training for the System shall be provided to Authority-designated personnel through the means of practical demonstrations, seminars, and other related technical teaching procedures. The training shall be conducted at the site.

B. The operational training courses shall be conducted during the 30-day operational test. The training shall include but not be limited to "hands-on" operation of all System hardware, explanation of the complete repertoire of System commands, instruction of insertion and retrieval of data, and instruction on the use of reports and alarms. The Contractor shall conduct a minimum of two 8-hour training courses with up to 15 students per course. The Contractor shall provide one up-to-date operational training manual per student plus an additional 15 training manuals for Authority use in conducting future training courses. The operational training courses shall be scheduled to meet the requirements of the Authority.

C. The Maintenance training courses shall be given after the System has passed the 30-day operational test. The Contractor shall conduct a minimum of two 16-hour training courses with up to 8 students per course. The Contractor shall provide one, up-to-date maintenance training manual per student plus an additional 15 training manuals for Authority use in conducting future maintenance training courses. The training shall include, but not be limited to, description of all System equipment, equipment operation, and interfaces between System elements, procedures for System troubleshooting, equipment diagnostic procedures, recommended service and test procedures, and recommended preventive maintenance schedules.

END OF SECTION

SECTION 16935

SUPERVISORY CONTROL AND DATA ACQUISITION

(SCADA) SYSTEM (FOR POWER MONITORING APPLICATIONS)

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 1 - GENERAL PROVISIONS:

A. Estimated progress schedule of dates for the Work to include (but not necessarily be limited to) the following:

1. Project start
2. Shop drawing submittal
3. Shop drawing approval
4. Factory test procedure submittal
5. Factory test procedure approval
6. Factory test of the system
7. On-site rough-in start
8. Training Curricula submittal
9. Training Curricula approval
10. On-site rough-in completion
11. Recommended spare parts list
12. Proof of performance testing
13. Complete system maintenance training
14. Complete system maintenance training
15. Operation and Maintenance Manual submittals
16. Acceptance testing
17. Completion/Resolution of all submittals and/or punch list items
18. Record documents submittal
19. Final AcceptanceComplete
    a. Bill of Materials
    b. Shop Drawings
        (1) Block Diagram
        (2) SCADA Devices and Operating Manuals

(3) Workstation Equipment

(4) Complete Wiring Diagrams, indicating all field terminal block numbers

(5) Complete, comprehensive, single-line diagrams, including all equipment, devices, and cabling completely identified

(6) System Logic Program

(7) Details of Proposed Computer Screen Displays, including descriptions of interactive screen features

(8) Command Description and Language

(9) Conduit and Raceways

(10) Wire

(11) Enclosures and all Devices

B. Catalog Cuts

1. Power Monitor Module

2. Network hardware and software

3. Workstation Hardware and Software

C. Manufacturer Test Reports

D. Samples

1. Color printouts of all workstation screen graphics

2. Report formats

E. Product Data

1. A detailed, written description of the function and operation of the SCADA System Software

F. Manuals, Warranties/Guarantees

1. Operation and Maintenance Manuals:

a. Prior to the issuance of the Certificate of Final Completion, prepare and submit to the Engineer for approval Operation and Maintenance Manuals, in accordance with the requirements of Section 16001, entitled "OPERATION AND MAINTENANCE MANUALS."

G. Record Documents

1. Prior to the issuance of the Certificate of Final Completion, deliver to the Engineer the following:

a. One (1) reproducible set of the Contract Drawings and Shop Drawings, which reflect actual locations and actual wiring details of SCADA system equipment and all revisions to the Work of this Section. In addition, nine (9) sets of prints of said Contract Drawings and Shop Drawings shall be supplied to the Engineer. Three (3) copies of said drawings shall be marked to the attention of the Facility Supervisor of Electrical Maintenance.

b. In addition to quantities of Operation and Maintenance Manuals specified in other Sections of this Contract, three (3) copies of said Operation and Maintenance Manuals shall be supplied to the Engineer and marked to the attention of the Facility Supervisor of Electrical Maintenance.

c. System Documentation

(1) The following shall be included in the complete documentation package on the system which shall be furnished at the time of delivery of the System.

d. Software Documentation

(1) Three complete sets of documentation shall be submitted, explaining all system capabilities and options, including system set-up, operation, and maintenance (software manuals shall be supplied in hard copy only).

e. Hardware Documentation

(1) Three complete sets of system manuals shall be submitted explaining all system capabilities and options, including but not limited to the installation, set-up, operation, and maintenance of all equipment furnished.

f. Operational Documentation

(1) Twelve complete sets of system operations manuals shall be submitted which shall consist of the following:

(a.) Operations Run Book (To be supplied in hardcopy only)

(b.) Detailed description of normal system operation

(c.) Error and Alarm handling Procedures

(d.) System Start up and Shutdown Procedures

(e.) Use of Various Logs and Output Data by by Operator to Improve System Efficiency

(f.) Description of Operating Procedure and Troubleshooting Procedures for each subsystem

(g.) System Backup Procedures

H. Spare Parts List

1. Submit a complete list of recommended spare parts, which shall include those spare parts required to be furnished in compliance with the requirements of this Section, for approval by the Engineer.

I. Inspection Reports

1. Prepare and submit to the Engineer for approval a performance testing plan for the entire system a minimum of 30 days in advance of the earliest, approved, scheduled inspection and test date. The system test plan shall be divided into the following stages:

a. Factory inspection and test of the System, performed by the Contractor and witnessed by the Engineer at the place of manufacture.

b. Inspection of the system upon arrival.

c. On-site inspection and test immediately following the complete installation of the system, to demonstrate compliance with the requirements of this Section.

d. A 30-day operational test commencing with the successful completion of the on-site inspection and test, approved by the Engineer.

J. Training

1. Prior to the on-site inspection and test of the system, prepare and submit to the Engineer for approval a SCADA system user and maintenance training curricula, in accordance with the requirements this Section.

K. Test Procedures

1. Recommended system test procedures shall be no less than thirty days prior to scheduled factory test date.

2. Test shall include the following:

a. Factory test of system as witnessed by the Authority.

b. Field test of system prior to connection to substation components as witnessed by the Authority.

c. 30-day field performance test in which system shall operate without failure. If a failure is encountered, the 30-day test shall be restarted from the beginning.

END OF APPENDIX "A"

DIVISION 16

SECTION 16998

MEDIUM VOLTAGE SYSTEM COMMISSIONING TESTS

PART 1. GENERAL

1.01 SUMMARY

This Section specifies the tests required for commissioning the medium voltage equipment shown on the Basic Contract Drawing. These tests are to be performed in addition to the specified tests outlined in other sections of these Specifications.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

National Electrical Manufacturers Association(NEMA) Standard

National Electrical Testing Association (NETA) "Acceptance Testing Specifications for Electrical power Distribution Equipment and Systems", also Called - NETA ATS.

American National Standards Institute (ANSI)

Occupational Safety and Hazard Administration (OSHA) Safety Rules

Port Authority High Tension Safety Rules

American Society of Testing and Materials (ASTM)

ASTM D877	Test method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
ASTM D923	Method for Sampling Electrical Insulating Liquids
ASTM D924	Test Method for AC Loss Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids

1.03 QUALITY ASSURANCE

A. The Contractor shall secure the services of qualified personnel to perform inspection and testing. The required qualifications include, but are not limited to a minimum of five years experience in testing of this type.

B. The Authority reserves the right to interview the actual personnel who will be assigned to perform the tests. The test personnel will be questioned to ascertain the level of experience attained. Only those personnel interviewed and authorized by the Authority may perform the testing.

If the finding of the panel selected by the Authority's Chief Electrical Engineer conducting the interview is that the personnel interviewed are not qualified, this shall be the cause for rejection.

1.04 SUBMITTALS

For Submittal Requirements, see Attachment "A".

PART 2. PRODUCTS

2.01 TESTING FIRMS

Subject to compliance with the requirements of this Section, provide the services of a Testing Firm selected from the list shown on the Basic Contract Drawing or approved equal.

PART 3. EXECUTION (TESTS)

3.01 GENERAL

A. In addition to the tests outlined in Section 3.02 hereunder, perform all tests recommended by the manufacturer in manufacturer's instructions, shop drawings, as described in various sections of these Specifications and as outlined on the Basic Contract Drawing.

B. All tests must be witnessed by the Engineer. A written notice, at least fourteen days prior to the tests shall be given to the Engineer.

C. Test values shall be considered acceptable as specified by the manufacturer and approved by the Engineer.

3.02 ELECTRICAL TESTS

A. General

1. Prior to the energization of any medium voltage equipment, all tests outlined in 3.01 above, and those outlined below in accordance with NETA ATS, shall have been performed by the Contractor and approved by the Engineer.

2. No voltage other than Megger output shall be applied to control voltage transformers during the performance of any tests, so that no high voltage can be induced on the primary of these transformers or into the high voltage system.

3. All safety precautions shall be exercised per OSHA and Port Authority High Tension Safety Rules to avoid personal injury and damage to equipment under test.

B. Medium Voltage Switchgear

1. Perform the following tests on all the Current Transformers including those located within the ground and test device. Readings are to be taken at each protective relay to confirm wiring connections.

a. Ratio test at all the taps with full primary current injection

b. Polarity test with inductive kick method

c. Measure secondary winding resistance

d. Megger secondary winding at 1000VDC

e. Perform magnetization curve test to the saturation voltage. Plot the curve and verify with the Accuracy Class claimed by the manufacturer.

2. Perform the following tests on all the Voltage Transformers:

   a. Ratio test.

   b. Polarity test

   c. Megger secondary winding at 500VDC.

   d. Over Potential test at voltage recommended by the manufacturer.

3. Perform the following tests on all the switchgear bus sections:

   a. All bus connections shall be inspected. Check for loose connections, missing or damaged components. Torque all connections and terminations to the manufacturer's specifications.

   b. The switchgear bus shall be given a phase-to-phase and phase-to-ground Megger test at 1000VDC, with all the breakers open and all potential transformer fuses removed.

   c. Perform phasing check to ensure proper bus phasing from each source.

   d. Perform an overpotential test on each bus section in accordance with manufacturer's instructions.

4. Perform insulation resistance test on control wiring. (Do not perform this test on wiring connected to solid state components).

5. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control and tripping function.

6. Perform current injection tests on the entire current circuit in each section of switchgear, including the ground and test device, to check in-zone and through-zone fault operation for differential protection.

7. Verify operation of the Directional Overcurrent relays to make sure that the relays trip only in the direction specified in the Basic Contract Drawing.

8. Verify the proper output level and polarity at each transducer.

9. Confirm phasing receptacle connections by the battery pulse method from the primary of the voltage transformer.

10. Check all meters at mid-scale for accuracy. Verify multipliers.

11. All protective relays shall be tripped (either manually or electrically) to determine whether the proper breaker has functioned as intended and any device or devices (including alarm, horns) have also operated correctly.

12. Clean, calibrate and test all protective relays. All relay settings shall be in accordance with the values furnished and/or approved by the Engineer and/or the Authority.

13. Voltmeters shall be checked against potential transformer ratios. Pointers shall be set on zero scale. With no voltage, voltmeter reading shall be checked with test-voltmeter after energizing.

14. Watt meters and watt-hour meters shall be checked for proper current and potential transformer ratios. Pointers shall be set on zero scale with no load and energized to check for proper rotation of meter.

15. All test results shall be in accordance with the requirements of all applicable test standards.

16. All switchgear shall be given operational tests. This shall include mechanical operation as well as operation by control circuit relays and tripping devices. Operating voltage at closing and tripping coils shall be checked to determine that voltage is of proper value.

17. The Contractor shall adjust and set all overcurrent trip devices, shunt trip devices and alarm devices in accordance with values furnished by Engineer.

C. Medium Voltage Circuit Breakers And Ground & Test Devices

The following tests shall be performed on the Medium Voltage Circuit Breakers and Ground & Test Devices. The term "Breaker" in the following tests represents Medium Voltage Circuit Breakers and Ground & Test Devices.

1. Measure contact resistance by a Digital Low Resistance Ohmmeter (DLRO). Any contact resistance over 100 micro-ohms should be investigated and remedial action shall be performed.

2. Perform minimum pick-up voltage tests on the trip and close coils.

3. Each Breaker shall be given a Megger test in the racked-out and closed position. A 1000-Volt, motor-driven Megger shall be used. Megger tests shall be applied between each phase to ground, between phases and between Line and Load sides. All test readings shall be recorded.

4. Perform an Overpotential Test, at a voltage recommended by the Breaker manufacturer, in the closed position. Test each phase to ground with all other phases grounded and across open contacts of each phase.

5. Perform insulation resistance test at 1000 volts DC on the Breaker control wiring. (Do not perform the test on wiring connected to solid state components).

6. With the Breaker in the test position, perform the following tests:

   a. Trip and Close the Breaker with the control switch at least ten (10) times. All indication lights, annunciations, alarms and targets shall be observed to determine correct operation. The Breaker mechanism shall be observed for correct alignment, freedom of binding and good contact.

   b. Trip each Breaker by manually operating each of its protective relays.

   c. Test the Breaker antipump circuit as recommended by the manufacturer.

7. All Breakers shall be operated through at least three (3) Open-Close cycles in the Racked-in position by manual operation and via control circuits, from each control point. All indication lights, annunciations, alarms and targets shall be observed to determine correct operation. The Breaker mechanism shall be observed for correct alignment, freedom of binding and good contact.

D. Medium Voltage Liquid Filled Transformers

1. Perform insulation power factor test and excitation current test using the test procedures outlined by Doble Engineering or approved equal. Furnish values of the Power Factor, Capacitance, Excitation Current and Watt Loss.

2. Perform overpotential test in accordance with the applicable ANSI and NEMA standards.

3. Insulating liquid shall be sampled in accordance with ASTM D-923. Sample shall be laboratory tested for:

   a. Dielectric breakdown voltage

   b. Acid neutralization number

   c. Specific gravity

   d. Interfacial tension

   e. Color

   f. Visual condition

   g. Water content in PPM

   h. PCB content

4. Perform ratio, polarity, insulation resistance and magnetization curve tests on the bushing current transformers.

5. Perform ratio, polarity and insulation resistance on any voltage transformers installed on the transformer.

6. Check all the gauges and protective devices on the transformer for their intended functions.

7. Record Nitrogen pressure and verify with the manufacturer's recommended pressure.

8. Perform Turn-to-Turn ratio test on all the taps of the transformer.

9. Check the operation of the automatic tap changer.

10. Verify the terminal markings with the nameplate and the applicable ANSI standard.

E. Medium Voltage Disconnect Switches

1. Measure contact resistance with a Digital Low Resistance Ohmmeter. If the contact resistance is above 100 micro ohms, repeat the test after cleaning and re-adjusting the contacts.

2. Apply overpotential between each phase and ground with the switch in the closed position. The remaining two phases should be connected to ground while testing the third phase. Test across open contacts of each phase.

3. Apply overpotential between phases and between line and load sides of the switch with the switch in the OPEN position.

4. Operate the switch at least ten (10) times to check its mechanical operation.

5. Check the mechanical, electrical and key interlocking features between the subject disconnect switch, grounding switch and any upstream and downstream circuit breakers or disconnect switches.

6. Verify the fuse size and rating as per specifications and Basic Contract Drawing.

7. Check the operation and intended purpose of the Blown Fuse Indicator.

8. Check the fuse for continuity and damage and check the fuse holder for adequate mechanical support for each fuse.

9. Check blade alignment and arc interrupter operation

F. Medium Voltage Dry Type Transformers

1. Perform insulation power factor test, following the procedures outlined by the Doble Engineering or approved equal. Furnish readings of the Insulation Power Factor, Capacitance, Excitation Current and Watt Loss.

2. Perform over potential test as approved by the manufacturer. Measure insulation resistance at intervals of 30 seconds, 1 minute and 10 minutes. Calculate Dielectric Absorption Ratio and Polarization Index.

3. Perform turn ratio test between windings at each available tap.

4. Verify the terminal markings with the nameplate and applicable ANSI standards.

5. Test the lightning arrestors

6. Measure core to ground resistance

7. Check the operation of the cooling fans.

8. Check the temperature control unit and set the unit for the operation of fans, initiation of alarms and trip functions. Verify each control function.

9. Check the ratio, polarity, insulation resistance and magnetization curves any current transformers installed inside or outside the transformer enclosure.

10. Check the ratio, polarity and insulation resistance of any voltage transformers installed inside or outside the transformer enclosure.

11. Perform winding resistance test for each winding at as found tap position.

G. Medium Voltage Insulated Power Cables

1. All medium voltage cables should be Hi-Potential tested by the following the method outlined herein at a voltage recommended by the manufacturer. It should be noted that these tests shall be performed with all safety precautions and proper preparation of the cable ends.

   "Each phase conductor of the cable shall be subjected to the Hi-Potential test to ground with the other two phases grounded together with the ground shields. Applied potential shall be increased in steps of 5KV by holding the voltage for one minute at each step. At the end of each minute, leakage current shall be recorded.

   After reaching the intended voltage level, the voltage shall be held for at least ten minutes and the leakage current shall be recorded at the end of each minute." If the test indicates excessive leakage current, discontinue the test and notify the Engineer. Discharge each cable of the capacitive charge by grounding the cable till the cable is completely discharged and remains discharged.

2. Check continuity of the cable shield and measure its resistance for the entire length of the cable.

END OF SECTION

SECTION 16998

MEDIUM VOLTAGE SYSTEMS COMMISSIONING TESTS

APPENDIX "A"

SUBMITTAL REQUIREMENTS

A. Submit the name of the NETA Certified proposed testing firm with the following information accompanied:

1. Company resume.
2. List of references.
3. List of testing work completed of similar magnitude.
4. Number of permanent employees with their employment duration.
5. List of test equipment owned or leased with their valid calibration certificates.

B. Submit a list of the proposed personnel with their resumes who shall perform the testing prior to the interview.

C. Submit a sample of test forms to be used for the testing for Engineer's approval. If not approved by the Engineer, the testing firm shall resubmit the forms, with the changes, for the Engineer's approval.

D. Submit test procedures, with sketches to illustrate how the test equipment will be connected to the equipment to be tested, for Engineer's approval. If not approved by the Engineer, the testing firm shall resubmit the test procedures, with the changes, for the Engineer's approval.

E. Once all of the above items A-D have been satisfied, the testing firm shall submit a schedule indicating when the tests shall be performed.

F. After the testing has been completed, submit three (3) copies of the test report for each unit within 15 calendar days of the completed testing to the Engineer for review. All test results and values shall be recorded on the forms approved by the Engineer.

The test sheet shall have all technical characteristics of the unit and all identification data including feeder name, building, substation, location, nameplate information, test date and name of tester. "As found" and "As left" relay settings shall be documented. All discrepancies encountered shall be itemized and clearly described on the test sheet. All tabulations of the test data shall be in the Microsoft Excel format and shall be supplied on a disk as well as two bound hard copies.

A report for each substation shall be provided indicating number of units tested, number of units not available to be tested, discrepancies found and cross references for more information to the specific test sheet. A summary of all reports along with the testing firm's recommendation shall be submitted.

END OF APPENDIX "A"

Introduction to the Prevailing Rate Schedule

Information About Prevailing Rate Schedule

This information is provided to assist you in the interpretation of particular requirements for each classification of worker contained in the attached Schedule of Prevailing Rates.

Classification

It is the duty of the Commissioner of Labor to make the proper classification of workers taking into account whether the work is heavy and highway, building, sewer and water, tunnel work, or residential, and to make a determination of wages and supplements to be paid or provided. It is the responsibility of the public work contractor to use the proper rate. If there is a question on the proper classification to be used, please call the district office located nearest the project. District office locations and phone numbers are listed below.

Prevailing Wage Schedules are issued separately for "General Construction Projects" and "Residential Construction Projects" on a county-by-county basis.

General Construction Rates apply to projects such as: Buildings, Heavy & Highway, and Tunnel and Water & Sewer rates.

Residential Construction Rates generally apply to construction, reconstruction, repair, alteration, or demolition of one family, two family, row housing, or rental type units intended for residential use.

Some rates listed in the Residential Construction Rate Schedule have a very limited applicability listed along with the rate. Rates for occupations or locations not shown on the residential schedule must be obtained from the General Construction Rate Schedule. Please contact the local Bureau of Public Work office before using Residential Rate Schedules, to ensure that the project meets the required criteria.

Paid Holidays

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

Overtime

At a minimum, all work performed on a public work project in excess of eight hours in any one day or more than five days in any workweek is overtime. However, the specific overtime requirements for each trade or occupation on a public work project may differ. Specific overtime requirements for each trade or occupation are contained in the prevailing rate schedules.

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays.

The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Supplemental Benefits

Particular attention should be given to the supplemental benefit requirements. Although in most cases the payment or provision of supplements is for each hour worked, some classifications require the payment or provision of supplements for each hour paid (including paid holidays on which no work is performed) and/or may require supplements to be paid or provided at a premium rate for premium hours worked.

Effective Dates

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. The rate listed is valid until the next effective rate change or until the new annual determination which takes effect on July 1 of each year. All contractors and subcontractors are required to pay the current prevailing rates of wages and supplements. If you have any questions please contact the Bureau of Public Work or visit the New York State Department of Labor website (www.labor.state.ny.us) for current wage rate information.

Apprentice Training Ratios

The following are the allowable ratios of registered Apprentices to Journey-workers.

For example, the ratio 1:1,1:3 indicates the allowable initial ratio is one Apprentice to one Journeyworker. The Journeyworker must be in place on the project before an Apprentice is allowed. Then three additional Journeyworkers are needed before a second Apprentice is allowed. The last ratio repeats indefinitely. Therefore, three more Journeyworkers must be present before a third Apprentice can be hired, and so on.

Please call Apprentice Training Central Office at (518) 457-6820 if you have any questions.

Title (Trade)	Ratio
Boilermaker (Construction)	1:1,1:4
Boilermaker (Shop)	1:1,1:3
Carpenter (Bldg.,H&H, Pile Driver/Dockbuilder)	1:1,1:4
Carpenter (Residential)	1:1,1:3
Electrical (Outside) Lineman	1:1,1:2

Electrician (Inside)	1:1,1:3
Elevator/Escalator Construction & Modernizer	1:1,1:2
Glazier	1:1,1:3
Insulation & Asbestos Worker	1:1,1:3
Iron Worker	1:1,1:4
Laborer	1:1,1:3
Mason	1:1,1:4
Millwright	1:1,1:4
Op Engineer	1:1,1:5
Painter	1:1,1:3
Plumber & Steamfitter	1:1,1:3
Roofer	1:1,1:2
Sheet Metal Worker	1:1,1:3
Sprinkler Fitter	1:1,1:2

If you have any questions concerning the attached schedule or would like additional information, please contact the nearest BUREAU of PUBLIC WORK District Office or write to:

New York State Department of Labor
Bureau of Public Work
State Office Campus, Bldg. 12
Albany, NY 12240

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518
Bureau of Public Work - Newburgh	845-568-5287	845-568-5332
Bureau of Public Work - New York City	212-775-3568	212-775-3579
Bureau of Public Work - Patchogue	631-687-4882	631-687-4904
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Queens County General Construction

Asbestos Worker — 02/01/2013

JOB DESCRIPTION Asbestos Worker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES
Per Hour:

	07/01/2012
Abestos Worker Removal & Abatement Only*	$40.95

NOTE: *On Mechanical Systems that are NOT to be SCRAPPED.

SUPPLEMENTAL BENEFITS
Per Hour:

Abestos Worker Removal & Abatement Only	$8.25

OVERTIME PAY
See (B, B2, *E, J) on OVERTIME PAGE
Hours worked on Saturdays are paid at time and one half only if forty hours have been worked during the week.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8) on HOLIDAY PAGE

REGISTERED APPRENTICES
Apprentice Removal & Abatement Only:
1000 hour terms at the following percentage of Journeyman's rates.

1st	2nd	3rd	4th
78%	80%	83%	89%

SUPPLEMENTAL BENEFIT

Per Hour:

Apprentice Removal & Abatement	$8.25

4-12a - Removal Only

Boilermaker — 02/01/2013

JOB DESCRIPTION Boilermaker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES
Per Hour:

	07/01/2012
Boilermaker	$ 47.98
Repairs & Renovations	$ 47.98

SUPPLEMENTAL BENEFITS
Per Hour:

	07/01/2012
Boilermaker Repairs & Renovations	33% of hourly Wage Paid + $22.25

NOTE: "Hourly Wage Paid" shall include any and all premium(s) pay.

Repairs & Renovation Includes replacement of parts and repairs & renovation of existing unit.

OVERTIME PAY
OVERTIME PAY
See (D, O) on OVERTIME PAGE
HOLIDAY
Paid: See (8, 16, 23, 24) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 12, 15, 25) on HOLIDAY PAGE
NOTE: *Employee must work in pay week to receive Holiday Pay.
**Boilermarker gets 4 times the hourly wage rate for working on Labor Day.
***Repairs & Renovation see (B,E,Q) on HOLIDAY PAGE

HOLIDAY

REGISTERED APPRENTICES
*REGISTERED APPRENTICES

(1/2) Year Terms at the following pecentage of Boilermaker's Wage

1st	2nd	3rd	4th	5th	6th	7th	8th
65%	65%	70%	75%	80%	85%	90%	95%

Supplemental Benefits Per Hour:

Apprentice(s)	07/01/2012 33% of Hourly Wage Paid plus amount below

1st	2nd	3rd	4th	5th	6th	7th	8th
$17.41	$18.10	$18.79	$19.48	$20.17	$20.86	$21.55	$22.25

NOTE: "Hourly Wage Paid" shall includ any and all premium(s)

4-5

Carpenter 02/01/2013

JOB DESCRIPTION Carpenter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per hour: 07/01/2012

Piledriver	$ 46.74
Dockbuilder	$ 46.74

SUPPLEMENTAL BENEFITS
Per hour paid:

Journeyworker	$ 42.45

OVERTIME PAY
See (B, E2, O) on OVERTIME PAGE

HOLIDAY
Paid: See (18,19)on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.
Apprentices See (5,6,11,13,16,16,19,25)

Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wages per houris Pecentage of Journeyworkers Wage

(1)year terms:

1st. 2nd. 3rd. 4th.

	40%	50%	65%	80%

Supplemental benefits per hour:

Apprentices $ 27.77

9-1456

Carpenter **02/01/2013**

JOB DESCRIPTION Carpenter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per hour: 07/01/2012

Carpet/Resilient
Floor Coverer $ 45.34

INCLUDES HANDLING & INSTALLATION OF ARTIFICIAL TURF AND SIMILAR TURF INDOORS/OUTDOORS.

SUPPLEMENTAL BENEFITS
Per hour paid:

Floor Coverer $ 38.58

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18, 19)on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.
Apprentices See (5,6,11,13,16,18,19,25)

Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wage per hour is Pecentage of Journeyworkers Wage

(1) year terms:

1st.	2nd.	3rd.	4th.
40%	50%	65%	80%

Supplemental benefits per hour:

Apprentices $ 25.83

9-2287

Carpenter **02/01/2013**

JOB DESCRIPTION Carpenter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per Hour: 07/01/2012

Marine Construction:

Marine Diver $ 58.95
M.D.Tender 42.10

SUPPLEMENTAL BENEFITS
Per Hour Paid:

Journeyman $ 42.37

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18, 19) on HOLIDAY PAGE
Overtime: See (5, 6, 10, 11, 13, 16, 18, 19) on HOLIDAY PAGE

9-1456MC

Carpenter **02/01/2013**

JOB DESCRIPTION Carpenter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per hour: 07/01/2012

Building
Millwright $ 47.86

SUPPLEMENTAL BENEFITS
Per hour paid:

Millwright $ 44.75

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18,19) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.
Apprentices See (5,6,11,13,16,18,19,25)

Overtime See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wages per hour is Pecentage of Journeyworkers wage

(1) year terms:

1st.	2nd.	3rd.	4th.
55%	65%	75%	95%

Supplemental benefits per hour:

(1) year terms:

1st.	2nd.	3rd.	4th.
$28.19	$31.29	$35.51	$40.62

9-740.1

Carpenter **02/01/2013**

JOB DESCRIPTION Carpenter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
Per Hour:
07/01/2012

Timberman $ 44.03

SUPPLEMENTAL BENEFITS
Per Hour:
07/01/2012

$ 40.62

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18,19) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.
Apprentices See (5,6,11,13,16,18,19,25)

Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wages per hour is Pecentage of Journeymans Wage.

(1) year terms:

1st	2nd	3rd	4th
40%	50%	65%	80%

Supplemental benefits per hour:

Apprentices $ 25.14

9-1536

Carpenter **02/01/2013**

JOB DESCRIPTION Carpenter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Westchester

PARTIAL COUNTIES
Orange: South of but including the following, Waterloo Mills, SlateHill, New Hampton, Goshen, Blooming Grove, Mountainville, east to the Hudson River.
Putnam: South of but including the following, Cold Spring, TompkinsCorner, Mahopac, Croton Falls, east to Connecticut border.
Suffolk: West of Port Jefferson and Patchoque Road to Route 112 tothe Atlantic Ocean.

WAGES
Per hour: 07/01/2012

Core Drilling:

Driller	$ 35.46
Assistant Driller	$ 28.89

Note: Hazardous Waste Pay Differential:
For Level C, an additional 10% above wage rate per hour
For Level B, an additional 10% above wage rate per hour
For Level A, an additional 10% above wage rate per hour
Note: When required to work on water: an additional $ 0.50 per hour.

* May be allocated between wages and benefits.

SUPPLEMENTAL BENEFITS
Per hour paid:

Driller	$ 17.52
Asst. driller	17.52

OVERTIME PAY
OVERTIME: See (B,E,K*,P,R**) on OVERTIME PAGE.

HOLIDAY
HOLIDAY:
Paid: See (5,6) on HOLIDAY PAGE.
Overtime: * See (5,6) on HOLIDAY PAGE.
** See (8,10,11,13) on HOLIDAY PAGE.

Assistant: One (1) year increments at the following percentage of Assistant wages. This is not an apprenticeship for Driller.

1st Year	2nd Year	3rd Year	4th Year
70%	80%	90%	100%

9-1536-CoreDriller

Carpenter **02/01/2013**

JOB DESCRIPTION Carpenter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Putnam, Queens, Richmond

PARTIAL COUNTIES
Nassau: That portion of the county that lies west of Seaford Creekand south of the Southern State Parkway.

WAGES

Per hour:	07/01/2012
Show Exibit/ Carpenter	$ 46.15

SUPPLEMENTAL BENEFITS
Per hour paid:

Show Exibit/ Carpenter	$ 38.58

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid:	See (18,19) on HOLIDAY PAGE.
Paid:for 1st & 2nd yr. Apprentices	See (5,6,11,13,16,18,19,25)
Overtime:	See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wages per hour is Pecentage of Journeyworkers Wage

(1) year terms:

1st.	2nd.	3rd.	4th.
40%	50%	65%	80%

Supplemental benefits per hour:
Apprentices $ 25.83

9-EXHIB

Carpenter - Building / Heavy&Highway 02/01/2013

JOB DESCRIPTION Carpenter - Building / Heavy&Highway **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

PARTIAL COUNTIES
Nassau: Work preformed south of the Southern State Parkway and west of the Seaford Creek.

WAGES

Per hour:	07/01/2012
Building:	
Carpenter	$46.15
Heavy&Highway:	
Carpenter	$54.12*

*Premium pay calculated on hourly wage of $46.74; the balance ($7.38) paid at straight time.

SUPPLEMENTAL BENEFITS
Per hour paid:

Building:	
Carpenter	$ 38.50
Heavy&Highway:	
Carpenter	$ 34.99

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18,19) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.
Apprentices See (5,6,11,13,16,18,19,25)

Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wage per hour:

(1) year terms:

	1st	2nd	3rd	4th
Building	40%	50%	65%	80%
Heavy&Highway*	40%	50%	65%	80%

*Wage calculations to be based off an hourly wage of $46.74
Supplemental benefits per hour for all Apprentices:

Building	$ 25.75
Heavy & Highway	27.69

9-NYC

Electrician **02/01/2013**

JOB DESCRIPTION Electrician **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond, Westchester

WAGES
Per hour Paid: 07/01/2012

Service Technician $ 28.89

Service and Maintenance on Alarm and Security Systems.

Maintenance, repair and /or replacement of defective (or damaged) equipment on, but not limited to, Burglar - Fire - Security - CCTV - Card Access - Life Safety Systems and associated devices. (Whether by service contract of T&M by customer request.)

SUPPLEMENTAL BENEFITS
Per hour:
Journeyworker: $ 11.19
+ $12.00 per day

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 11, 12, 16, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 12, 16, 25, 26) on HOLIDAY PAGE

9-3H

Electrician **02/01/2013**

JOB DESCRIPTION Electrician **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES

Per hour:	07/01/2012	01/01/2013
Electrician		
H - Telephone	$ 25.30	$ 25.30

Maintenance and Jobbing-Electrical work of limited duration and scope, consisting of repairs and/or replacement of electrical and teledata equipment.

- Includes all work necessary to retrofit, service, maintain and repair all kinds of lighting fixtures and local lighting controls and washing and cleaning of foregoing fixtures.

SUPPLEMENTAL BENEFITS

Journeyworker	$ 17.52	$ 18.02

OVERTIME PAY
See (B, H) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 10, 11, 12, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 10, 11, 12, 16) on HOLIDAY PAGE

9-3m

Electrician **02/01/2013**

JOB DESCRIPTION Electrician **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per hour: 07/01/2012

Tree Trimmer	$ 23.92
Ground Person	$ 15.80

Applies to line clearance, tree work, and right-of-way preparation on all new or existing overhead, electrical, telephone, and CATV lines.

SUPPLEMENTAL BENEFITS
Per hour paid:

Tree Trimmer	$ 8.44
Ground Person	5.78

Note: *Plus paid vacation & 4 days sick leave. Vacation based on continous service as follows:

* 40 hours after 1 year
* 80 hours after 2 years
* 120 hours after 5 years
* 160 hours after 15 years

Note: Employee must work atleast 1800 hours in employee's anniversary year . An employee who workes 900 in the employee anniversary year but did not actually worked 1800 hours during that period shall be entitled to a pro rata share of vacation on the basis of 900 hours or more actually worded as a percentage based on 1800 hours.

OVERTIME PAY
See (B, *H, Q) on OVERTIME PAGE
*Worked performed on Sundays & Holidys outside of 7.00am - 4.00pm shall be paid at double time, in addition to the holiday pay if applicable.

HOLIDAY
HOLIDAY:
Paid: See (5,6,10,11,15,16,26) on HOLIDAY PAGE.

(An additional floating holiday after four years' service)

Overtime: See (5,6,10,11,15,16,26) on HOLIDAY PAGE.

9-3T

Electrician **02/01/2013**

JOB DESCRIPTION Electrician **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per Hour:

	07/01/2012	01/01/2013
Electrician and Audio/Sound	$ 51.00	$ 51.00

SUPPLEMENTAL BENEFITS
Per Hour:

Journey Worker	$ 42.45*	$ 43.47*

*This hourly benefit rates applies for cumulative wages for the year up to $113,700 for the same employer; thereafter the benefit rate is $40.31 per hour.

OVERTIME PAY
See (A, H) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages Per Hour:
Apprentices registered
before 05/10/2007
One (1) year terms.

	07/01/2012	01/01/2013
1st term	$ 14.25	$14.25
2nd term	17.05	17.05
3rd term	19.15	19.15
4th term	21.10	21.10
MIJ (5th term)	25.30	25.30

Apprentices registered
after 05/10/2007
One (1) year terms

1st term	$ 11.50	$ 11.50
2nd term	13.50	13.50
3rd term	15.50	15.50
4th term	17.50	17.50
MIJ (5th term)	21.50	21.50

Supplemental Benefits:
Per Hour for Apprentices
registered before 05/10/2007

1st term	$ 11.19	$11.51
2nd term	12.54	12.93
3rd term	13.55	14.00
4th term	14.50	14.98
MIJ (5th term)	17.52	18.02

Suppemental Benefits:
Per hour for Apprentices
registered after 05/10/2007

1st term	$ 9.86	$ 10.12
2nd term	10.82	11.14
3rd term	11.79	12.15
4th term	12.76	13.16
MIJ (5th term)	15.71	16.14

9-3

Electrician **02/01/2013**

JOB DESCRIPTION Electrician **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per hour:

	07/01/2012
Electro pole Electrician	$ 51.00
Electro pole Foundation Installer	38.66
Electro Pole Maintainer	33.10

SUPPLEMENTAL BENEFITS
Per Hour:

	07/01/2012	01/01/2013
Electro pole Electrcian	$ 44.18*	$ 45.20*
Electro pole Foundation Installer	34.12*	35.01*
Electro pole Maintainer	30.84*	31.60*

*Hourly benefit rate applies for cumulative wages for the year up to $113,700.00 for the same employer, thereafter decrease the hourly benefit rate by the hourly amount as noted below:

Electro pole Electrician	$ 2.14	$ 3.16
Electro pole F/installer	1.76	2.64
Electro pole Maintainer	1.50	2.26

OVERTIME PAY
See (A, *B, **E4, F, K) on OVERTIME PAGE
* Applies to the electro pole foundation installer
** MAKE UP DAYS MAY NOT EXCEED FOUR DAYS IN A MONTH; OVERTIME RATE APPLIES AFTER FIVE CONSECUTIVE DAYS WORKED PER WEEK.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 16, 25, 26) on HOLIDAY PAGE

9-3J

Electrician Lineman — 02/01/2013

JOB DESCRIPTION Electrician Lineman — **DISTRICT** 4

ENTIRE COUNTIES
Nassau, Queens, Suffolk

WAGES
For Utility Distribution & Transmission Line Construction:

Per Hour:	07/01/2012
Lineman/Splicer	$ 47.13
Material Man	$ 41.00
Heavy Equip. Operator	$ 37.70
Groundman	$ 28.28
Flagman	$ 21.21

For Natural Gasline Construction:

Per Hour:	
Journeyman U.G.Mech.	$ 39.45

** IMPORTANT NOTICE - EFFECTIVE 04/01/2009 **
Four (4), ten (10) hour days may be worked at straight time during a week, Monday thru Thursday.

NOTE - In order to use the '4 Day/10 Hour Work Schedule,' you must submit an 'Employer Registration for Use of 4 Day/10 Hour Work Schedule,' form PW30R; additionally, there must be a dispensation of hours in place on the project.

SUPPLEMENTAL BENEFITS
Per Hour:
Utility Distribution & Transmission Line Construction:

All Classifications	22.5% of Hourly Wage Paid + $13.04

NOTE: "Hourly Wage Paid" shall include any and all premium(s) pay

Natural Gasline Construction:
Per Hour:

Journeyman U.G.Mech. $ 18.71

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE
OVERTIME for Natural Gas Mechanic:(B,G,P)

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 16, 23, 25, 26) on HOLIDAY PAGE
Same as Above for natural Gas Mechanic.

REGISTERED APPRENTICES
1000 hour Terms at the following Percentage of Journeyman's Wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFIT:

All Terms 22.5% of Hourly Wage Paid + $13.04

Natural Gas Mechanic:

$18.71

4-1049 Line/Gas

Elevator Constructor **02/01/2013**

JOB DESCRIPTION Elevator Constructor **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

PARTIAL COUNTIES
Rockland: Entire County except for the Township of Stony Point
Westchester: Entire County except for the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

WAGES
Per hour:

	07/01/2012	03/17/2013
Elevator Constructor	$55.20	$57.01
Modernization & Service/Repair	$43.79	$45.14

SUPPLEMENTAL BENEFITS
Per Hour:

**PECTENTAGES BASED ON YEARS OF EMPLOYMENT AS FOLLOWS BELOW:
4%-Up to 5 years
6%-6th year to 15 years
8%-15 years or more

	07/01/2012	03/17/2013
Elevator Constructor	$26.54 plus**% of wage per Hour	$28.04 plus**% of wage per Hour
Modernization & Service/Repair	$26.39 plus**% of Wage per Hour	$27.89 plus**% of Wage per Hour

OVERTIME PAY
Constructor. See (D, O) on OVERTIME PAGE.

Modern./Service See (B, H) on OVERTIME PAGE.

HOLIDAY
Paid: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
WAGES PER HOUR:

BASED ON PERCENTAGE OF JOURNEYMANS WAGE IN THE CLASSIFICATION WORKED EITHER ELEVATOR CONSTRUCTOR OR MODERNIZATION,SERVICR/REPAIR

1 YEAR TERMS

1st Term	2nd Term	3rd Term	4th Term
50%	55%	65%	75%

SUPPLEMENTAL BENEFITS

	07/01/2012	03/17/2013
Elevator Constructor		
1st Term	$24.00	$25.41
2nd Term	$24.50	$25.92
3rd Term	$25.51	$26.97
4th Term	$26.53	$28.01
Modernization & Service/Repair		
1st Term	$23.69	$25.10
2nd Term	$24.17	$25.58
3rd Term	$25.12	$26.56
4th Term	$26.06	$27.54

4-1

Glazier **02/01/2013**

JOB DESCRIPTION Glazier **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES

Per hour:	07/01/2012	11/01/2012	05/01/2013 Additional
Glazier	$ 47.75	$ 48.60	$ 1.50*
Scaffolding	$ 48.75	$ 49.60	$ 1.50*
Repair & Maintenance:			
Glazier **	$ 26.50	$ 26.50	$ 1.50*

* To be allocated at a future date

Repair & Maintenance- All repair & maintenance work on a particular building, whenever performed, where the total cumulative contract value is under $100,000.00.

SUPPLEMENTAL BENEFITS

Per hour paid:	07/01/2012	11/01/2012	05/01/2013
Journeyworker...	$ 25.34	$ 25.34	$ 26.60
Repair & Maintenance:			
Glazier **	$ 15.14	$ 15.14	$ 15.64

OVERTIME PAY
OVERTIME: See (C*,D* E2, O) on OVERTIME PAGE.

* If an optional 8th hour is required to complete the entire project, the same shall be paid at the regular rate of pay. If a 9th hour is worked, then both hours or more (8th & 9th or more) will be paid at double time rate of pay.

** For Repair & Maintenance see (B,F, P) on overtime page.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (4, 6, 16, 25) on HOLIDAY PAGE
The Following are paid holidays for the Repair & Maintenance Class:
New Years day, Presidents day, Memorial day, Independents day, Labor day, Thanksgiving day, Day after Thanksgiving, and Christmas day.

REGISTERED APPRENTICES
Wage per hour:
(1) year terms at the following wage rates:

	07/01/2012	11/01/2012	05/01/2013 Additional
1st term	$ 16.00	$ 16.35	$ .60*
2nd term	$ 23.81	$ 24.24	$ .75*
3rd term	$ 28.59	$ 29.10	$ .90*
4th term	$ 38.17	$ 38.85	$ 1.20*

* To be allocated at a future date

Supplemental Benefits:
(Per hour worked)

1st term	$ 12.07
2nd term	$ 17.28
3rd term	$ 18.54
4th term	$ 18.89

9-1281 (DC9 NYC)

Insulator - Heat & Frost **02/01/2013**

JOB DESCRIPTION Insulator - Heat & Frost **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES
Per Hour:

	07/01/2012	12/31/2012
Insulators Heat & Frost	$61.08	*Additional $1.75/Hr

*Additional may be allocated between Wages & Supplements

SUPPLEMENTAL BENEFITS
Per Hour:

Insulators Heat & Frost	$26.59

OVERTIME PAY
See (A, D, O, V) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages:

Apprentice Insulator(s)

1 year terms at the following wage rate.

1st	2nd	3rd	4th

$24.43	$36.65	$42.76	$48.86

Supplemental Benefits per hour:

Apprentice Insulator(s)

1st	2nd	3rd	4th
$10.64	$15.95	$18.62	$21.27

4-12

Ironworker **02/01/2013**

JOB DESCRIPTION Ironworker **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per Hour:	07/01/2012	01/01/2013 Additional	07/01/2013 Additional
IRONWORKER:			
Ironworker Rigger	$ 49.50	$ 1.50*	$ 1.50*
Ironworker Stone Derrickman	$ 49.50	$ 1.50*	$ 1.50*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS
Ironworker: $ 36.53

OVERTIME PAY
See (*A, D1, **E, Q, V) on OVERTIME PAGE
*Time and one-half shall be paid for all work in excess of seven (7) hours at the end of a work day to a maximum of two hours on any regular work day (the eighth (8th) and ninth (9) hours of work) and double time shall be paid for all work thereafter.
**Time and one-half shall be paid for all work on Saturday up to seven (7) hours and double time shall be paid for all work thereafter.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 10, *24, 25) on HOLIDAY PAGE
*Work stops at schedule lunch break with full day's pay.

REGISTERED APPRENTICES
Wage per hour:

(1/2) year terms at the following hourly wage rate:

	1st	2nd	3rd	4th	5th	6th
	$23.75	23.75	34.35	38.40	42.45	42.45
01/01/2013 An additional	$0.75*	$0.75*	$1.05*	$1.20*	$1.35*	$1.358
07/01/2013 An additional	$0.75*	$0.75*	$1.05*	$1.20*	$1.35*	$1.35*

* To be allocated at a future date

Supplemental benefits

Per hour paid:
Registered Apprentice

1st term	$ 19.27
2nd term	$ 19.27
All others	$ 28.15

9-197D/R

Ironworker **02/01/2013**

JOB DESCRIPTION Ironworker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
Per hour:

	07/01/2012
Ornamental	$ 41.00
Chain Link Fence	$ 41.00
Guide Rail Installation	$ 41.00

SUPPLEMENTAL BENEFITS
Per hour paid:

	07/01/2012
Journeyworker:	$40.07

OVERTIME PAY
OVERTIME: See (A*,D1,E**,Q,V) on OVERTIME PAGE.

*Time and one-half shall be paid for all work in excess of seven (7) hours at the end of a work day to a maximum of two (2) hours on any regular work da (8th & 9th hours of work) and double time shall be paid for all work thereafter.
**Time and one-half shall be paid for all work on Saturday up to seven (7) hours and double time shall be paid for all work thereafter.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
1st term represents first 1-4 months, thereafter (1/2) year terms at the following percentage of Journeyman's wage.

APPRENTICES:Employed Prior to 8/01/2008

1st	2nd	3rd	4th	5th	6th
60%	65%	70%	80%	85%	95%

APPRENTICES:Employed After 8/01/2008

1st	2nd	3rd	4th	5th	6th
50%	50%	55%	60%	70%	80%

Supplemental Benefits per hour paid:

	07/01/2012
APPRENTICES:	
1st Term	$ 31.75
2nd Term	31.75
3rd Term	32.58
4th Term	33.41
5th Term	35.08
6th Term	36.74

4-580-Or

Ironworker **02/01/2013**

JOB DESCRIPTION Ironworker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
PER HOUR:

	07/01/2012	01/01/2013	07/01/2013
Ironworker:			
Structural	$45.05	*additional	*additional
Bridges	+ *$2.00	$2.45/Hr	$2.00/Hr
Machinery			

*To be allocated to Wages or Benifits.

SUPPLEMENTAL BENEFITS
PER HOUR:

Journeyman $58.50

OVERTIME PAY
See (B*,E**,Q,V) on OVERTIME PAGE.

* Time and one-half shall be paid for all work in excess of (8) eight hours at the end of a work day to a maximum of two hours on any regular work day (the ninth (9th) and tenth (10th) hours of work)and double time shall be paid for all work thereafter.

** Time and one-half shall be paid for all work on Saturday up to eight (8) hours and double time shall be paid for all work thereafter.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 18, 19) on HOLIDAY PAGE

REGISTERED APPRENTICES
WAGES PER HOUR:

6 month terms at the following rate:

1st Term	$23.62 +*$2.00/Hr	*additional $2.45/Hr for all Terms	*additional $2.00/Hr for all Terms
2nd Term	$24.22 +*$2.00/Hr		
3rd - 6th Term	$24.82 +*$2.00/Hr		

*To be allocated to Wages or Benifits

Supplemental Benefits
PER HOUR:

ALL TERMS $41.86

4-40/361-Str

Ironworker **02/01/2013**

JOB DESCRIPTION Ironworker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

PARTIAL COUNTIES
Rockland: Southern section - south of Convent Road and east of Blue Hills Road.

WAGES

Per hour:	07/01/2012	07/01/2013
Reinforcing & Metal Lathing	$ 49.73	Additional $ 2.00*

*To be allocated at a future date

SUPPLEMENTAL BENEFITS
Per hour paid:

Reinforcing & Metal Lathing	$ 29.98

OVERTIME PAY
See (B, B1, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 13, 18, 19, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1) year terms at the following wage rates:

Wages Per Hour:

Apprentices Registered BEFORE 6/29/2011

1st term	2nd term	3rd term
$ 28.20	$ 32.80	$ 37.86

Apprentices Registered ON or AFTER 6/29/2011

$ 17.71	$ 22.71	$ 27.71

SUPPLEMENTAL BENIFITS

Per Hour:

Apprentices Registered BEFORE 6/29/2011

1st term	2nd term	3rd term
$ 23.17	$ 24.67	$ 25.82

Apprentices Registered On or AFTER 6/29/2011

$ 23.17	$ 24.67	$ 25.82

4-46Reinf

Laborer **02/01/2013**

JOB DESCRIPTION Laborer **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per hour: 07/01/2012

Laborer/Excavation:	
**Asbestos and Lead Abatement & Removal,Hazardous Waste Removal (including soil)	$ 38.70
Basic	38.70
Flagman	38.70
Pipelayer	38.70
*Tree Work, *Landscape	38.70

Notes: *Includes trimming, cutting, planting and/or removal of trees.
** Applies to Heavy & Highway projects

SUPPLEMENTAL BENEFITS
Per hour paid:

Journeyworker	$ 31.75

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE
++ Except for Independence Day, holidays which fall on a Saturday will not be observed on the preceding Friday.When an observed holiday falls on a Saturday,work done shall be paid at double time.

HOLIDAY
Paid: See (2, 20) on HOLIDAY PAGE
Overtime: See (5, 6, 11) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage per hour:

1000 hour terms at the following hourly wage rate.

		07/01/2012
1st	0-1000	$ 19.35
2nd	1001-2000	$ 23.22
3rd	2001-3000	$ 29.03
4th	3001-4000	$ 34.83

Supplemental Benefits per hour paid:

All Apprentices	$ 31.75

9-731Ex

Laborer **02/01/2013**

JOB DESCRIPTION Laborer **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per hour:

GROUP 14: Blasters.

GROUP 16: Tunnel workers *
* (including Miners, Drill Runners, Iron Men, Maintenance Men, Conveyor Men, Safety Miners, Riggers, Block Layers, Cement Finishers, Rod Men, Caulkers, Powder Carriers, Miners' Helpers, Chuck Tenders, Track Men, Nippers, Brake Men,Derail Men, Form Men, Bottom Bell, Top Bell or Signal men, Form Workers, Movers, Concrete Workers, Shaft Men, Tunnel Laborers and Caulkers' Helpers).

GROUP 17**: All others including: Powder Watchmen, Top Laborers and Changehouse Attendants.

Wages: (per hour)	07/01/2012
Laborer (Tunnel)-FREE AIR:	
Group 14	$ 54.59
Group 16	$ 55.23
Group 17**	$ 48.26
Small Bore Micro Tunnel Machines	80% of rates above
For Repairs on Existing Water Tunnels	90% of rates above
For Repairs of Sewer & Drainage Tunnels	85% of rates above
For Repair & Maintenance of all Subway & Vehicular Tunnels	80% of rates above

**An additional $3.00 per day when using an air spade, jack hammer or pavement breaker.

Note: For jobs bid before July 1, 2010 employer shall pay $6.00 per day for each one half (1/2) mile or fraction starting from a point 500 feet from the shaft. For all jobs bid after July 1, 2010, said premium shall be $10.00 per day.

SUPPLEMENTAL BENEFITS
Per hour paid:

GROUP 14	$ 39.79
GROUP 16	$ 38.09
GROUP 17	$ 35.23
Small Bore Micro Tunnel Machines	80% of rates above
For Repairs on Existing Water Tunnels	90% of rates above
For Repairs of Sewer & Drainage Tunnels	85% of rates above
For Repair & Maintenance of all Subway& Vehicular Tunnels	80% of rates above

OVERTIME PAY
OVERTIME: For Laborer (Free Air) See (D, M, R*) on OVERTIME PAGE.
For Repair Categories See (B, F, R*) on OVERTIME PAGE.
& Micro Tunneling

* Straight time first 8 hours, double time after 8 hours.

HOLIDAY
Paid: See (5, 6, 9, 11, 12, 15, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 9, 11, 12, 15, 16, 25) on HOLIDAY PAGE
Good Friday may be exchanged for one of the holidays listed.

9-147Tnl/Free

Laborer 02/01/2013

JOB DESCRIPTION Laborer **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per hour: 07/01/2012

Laborer:
Laborer-Concrete
(including flag person) $ 37.55

SUPPLEMENTAL BENEFITS
Per Hour Worked $ 25.62

OVERTIME PAY
OVERTIME: See (A,E,Q) on OVERTIME PAGE attached.
See (B,E,Q,) for work below street level to top of foundation.

For Work done on Saturdays add an additional $2.75 per hour to Supp. Benefits.
For work done on Sundays & Holidays add an additional $5.50 per hour to Supp. Benefits.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 13, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages per hour:
Terms at the following percentage of Journeyworkers wage.

Term:	1st	2nd	3rd
Hours:	0-500	501-2000	2001-4000
	50%	65%	80%

Supplemental Benefits:
(Per Hour Worked)

0-1000 hrs	Over 1000 hrs
$17.49*	$ 22.87*

Additional Benefits:

Add the following benefits based on the criteria below:

501-2000 hours	2001-4000 hours
$0.83*	$1.65*

*For work on Saturdays add the following amount per term to hourly supp. benefits:

1st	2nd	3rd
$ 1.38	$ 1.79	$ 2.20

*For work on Sundays & Holidays add the following amount per term to hourly supp. benefits:

1st	2nd	3rd
$ 2.75	$ 3.58	$ 4.40

9-6A/18A/20-C

Laborer - Building 02/01/2013

JOB DESCRIPTION Laborer - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES

Per hour:	07/01/2012	01/01/2013
Building Laborer-Demolition:	$ 34.60	$ 35.21

NOTE: Total Demolition Only: Demolition shall be the complete demolition (wrecking) or dismantling of entire buildings or structures. Also may include the removal of all or any portion of a roof in which structural change is to occur. Structural change is defined as the removal of structural slabs, steel members, concrete members and penetration through the structural slab.

SUPPLEMENTAL BENEFITS

Per hour paid:		
Journeyworker:	$ 22.65	$ 23.04

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 13, 15, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage per hour:

(1) year terms at the following wage.

	1st	2nd	3rd	4th
07/01/12	$ 20.81	$ 21.81	$ 23.31	$ 25.81
01/01/12	20.96	22.01	23.56	26.11

Supplemental Benefits per hour paid:

Apprentices:	$ 14.70	$ 15.05

9-79/95

Laborer - Building **02/01/2013**

JOB DESCRIPTION Laborer - Building **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES

Per hour:	07/01/2012
Laborer/ Asbestos, lead and Hazardous Material Abatment	$35.10

SUPPLEMENTAL BENEFITS

Per Hour:	07/01/2012
Laborer	$15.10

OVERTIME PAY
See (B, H) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8) on HOLIDAY PAGE

REGISTERED APPRENTICES
1000 hour terms at the following;

Per Hour:	07/01/2012
1st term	$27.38
2nd Term	$28.08
3rd Term	$29.14
4th Term	$31.25

SUPPLEMENTAL BENIFIT

Per Hour:	07/01/2012
ALL TERMS	$15.10

4-NYDC(78)

Laborer - Building **02/01/2013**

JOB DESCRIPTION Laborer - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES

Per hour:	07/01/2012
Building: Plasterer Tender and Spray Fireproofing.	$ 35.59

SUPPLEMENTAL BENEFITS

Per hour paid:	
Journeyworker	$ 23.35

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage per hour:

1000 hours terms at the following wage.

	1st	2nd	3rd	4th
07/01/2012	$21.08	22.08	23.58	26.08

Supplemental Benefits per hour paid:

Apprentices	$15.41**

** Applies to all Apprentices.

9-30 (79)

Laborer - Building **02/01/2013**

JOB DESCRIPTION Laborer - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES

Per hour:	07/01/2012	01/01/2013	07/01/2013 Additional
Basic Laborer and Mason Tender	$ 35.59	$ 36.20	$ 1.10*
Interior Demolition	34.87	35.07	

* To be allocated at a future date

SUPPLEMENTAL BENEFITS

Per hour paid:	07/01/2012	01/01/2013
Basic Laborer and Mason Tender	$ 23.05	$ 23.44
Interior Demolition	18.22	18.77

OVERTIME PAY
See (B, B2, I, R) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 25) on HOLIDAY PAGE
(Easter is paid at Time and One-half if worked)

REGISTERED APPRENTICES
Wage per hour:

1000 hour terms at the following wage rate:

07/01/2012 - Term:	1st	2nd	3rd	4th
Basic Laborer and Mason Tender	$ 21.08	$ 22.08	$ 23.58	$ 26.08
Interior Demolition	21.23	22.23	23.73	26.23
01/01/2013				
Basic Laborer and Mason Tender	$ 21.23	$ 22.28	$ 23.83	$ 26.38
Interior Demolition	21.38	22.43	23.93	26.43

Supplemental Benefits per hour paid:

All Terms:	07/01/2012	01/01/2013
Basic Laborer and Mason Tender	$ 15.41	$ 15.76
Interior Demolition	14.66	15.01

9-MTDC(79)

Laborer - Concrete & Asphalt Paving 02/01/2013

JOB DESCRIPTION Laborer - Concrete & Asphalt Paving **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Group 1: Slurry Seal Coater, Maintenance Safety Surface, Small Equipment Operator, Small Power Tool Operator, Play Equipment Installer, Landscape Planting & Maintenance, Temporary Fence Installer & Repairs, Laborer.

Group 2: Shoveler, Small Equipment Operator on Asphalt work.

Per hour:	07/01/2012
Concrete Formsetter	$ 42.21
Asphalt Screedman / Micro Paver	44.86
Asphalt Raker	44.37
Group 1	38.34
Group 2	41.08

SUPPLEMENTAL BENEFITS

Per hour paid:	07/01/2012
Journeyman	$ 30.90

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
HOLIDAY:
Paid: See (5,11,12,20)* on HOLIDAY PAGE.
Overtime: See (21,22)** on HOLIDAY PAGE.

*If an employee does not work on said holiday, he will receive single time pay rate for the said day, provided that the said employee has worked one (1) day in the calendar week in which the said holiday occurs. If an employee works on said holiday, he will paid only for the single time rate, plus one (1) days pay for the holiday.

**If an employee does not work on these holidays he shall receive no pay.
If an employee works on any of these holidays he will receive the single rate plus 15% of same.

REGISTERED APPRENTICES
Wage per hour:

One (1) year terms at the following wage rate.

1st	2nd	3rd
$ 25.00	$ 26.50	$ 28.00

Supplemental Benefits per hour paid:

	07/01/2012
1st year	$ 15.55
2nd year	15.55
3rd year	15.55

9-1010H/H

Laborer - Trac Drill **02/01/2013**

JOB DESCRIPTION Laborer - Trac Drill **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per Hour Paid:

	07/01/2012
Hydraulic Trac Drill	$ 46.22
Hydraulic Trac Drill Chuck Tender	40.00
Air Trac, Wagon, Quarry Bar	45.52
Power Tool (Chipper & Jackhammer)	44.59
Chuck Tender & Nipper	39.33
Blaster	50.34
Blaster Hydraulic	51.07
Powder Carrier	41.13
Magazine Keeper	27.05

SUPPLEMENTAL BENEFITS
Per Hour Paid:

	07/01/2012
All Classifications	$ 28.04

OVERTIME PAY
Magazine Keeper See (B,H) on OVERTIME PAGE.

ALL OTHERS SEE (D,E,Q) on OVERTIME PAGE.

HOLIDAY
HOLIDAY:
Paid: For Blaster See (5,6,11,13) on HOLIDAY PAGE.

FOR ALL OTHERS SEE (1) ON HOLIDAY PAGE.

Overtime: See (5,6,11,13) on HOLIDAY PAGE.

9-29

Laborer - Tunnel **02/01/2013**

JOB DESCRIPTION Laborer - Tunnel **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES

GROUP 6: Tunnel Workers* * (including Miners, Drill Runners,Iron Men, Maintenance Men, Inside Muck Lock Tender, Pumpmen, Electricians, Cement Finishers, Rod Men, Caulkers, Carpenters, Hydraulic Men, Shield Drivers, Monorail Operators, Motor Men, Conveyor Men, Safety Miners, Powder Carriers, Pan Men, Riggers, Miner's Helpers, Chuck Tenders, Track Men, Nippers, Brake Men, Form Workers, Concrete Workers, Tunnel Laborers, Caulker's Helpers), Hose Men, Grout Men, Gravel Men, Derail Men and Cable Men.

GROUP 7: Top Nipper

GROUP 8,9: Outside Man Lock Tender, Outside Muck Lock Tender, Shaft Men,Gauge Tender and Signal Men.

GROUP 10: Powder Watchmen, Top Laborers and Changehouse Attendants.

WAGES: (per hour)

Laborer(Compressed Air):	07/01/2012
GROUP 6	$ 55.21
GROUP 7	$ 54.20
GROUP 8,9	$ 53.22
GROUP 10	$ 46.30

Note: For jobs bid before July I, 2010 employer shall pay $6.00 per day for each one half (1/2) mile or fraction starting from a point 500 feet from the shaft. For all jobs bid after July 1, 2010, said premium shall be $10. per day.

SUPPLEMENTAL BENEFITS
SUPPLEMENTAL BENEFITS:
per hour:

GROUP 6	$40.27
GROUP 7	$39.58
GROUP 8,9	$38.83
GROUP 10	$37.20

OVERTIME PAY
See (D, M, *R) on OVERTIME PAGE
NOTE: Time and one-half to be paid for all overtime repair-maintenance work on existing equipment and facilities.

* Straight time first 8 hours, double time after 8 hours.

HOLIDAY
Paid: See (5, 6, 9, 11, 12, 15, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 9, 11, 12, 15, 16, 25) on HOLIDAY PAGE
Good Friday may be exchanged for one of the holidays listed.

9-147Tnl/Comp Air

Mason **02/01/2013**

JOB DESCRIPTION Mason **DISTRICT 4**

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES

Per Hour:	07/01/2012	07/01/2013
Brick/Blocklayer	$51.97	*Additional $1.97/Hr

*Additional to be allocated between Wages and or Benifits

SUPPLEMENTAL BENEFITS
Per Hour:

Brick/Block Layer	$24.06

OVERTIME PAY
See (A, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
(800 hour) Terms at the following Percentage of Journeyworkers Wage:

1st	2nd	3rd	4th	5th
50%	60%	70%	80%	90%

Supplemental Benefits per hour:

All Apprentices $ 13.88

4-1Brk

Mason - Building 02/01/2013

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
Building:

Per Hour:	07/01/2012	07/01/2013 Additional
Mosaic & Terrazzo Mechanic	$ 45.93 plus $ 1.25*	$ 1.25*
Mosaic & Terrazzo Finisher	$ 44.36 plus $ 1.22*	$ 1.23*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS
Journeyworker:

Mechanic	$ 29.75
Overtime*	$ 38.45
Overtime**	$ 47.15
Finisher	$ 29.75
Overtime*	$ 38.45
Overtime**	$ 47.15

* Applies to overtime on weekdays & saturdays
** Apllies to overtime hours on Sundays & Holidays & work on Saurdays over 10 hours

OVERTIME PAY
See (A, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage per hour:
(750 Hour) terms at the following amount of the Terrazzo Mechanic's wage.

1st 1-750	2nd 751-1500	3rd 1500-2250	4th 2251-3000	5th 3001-3750	6th 3751-4500	7th 4501-5250	8th 5251-6000
$22.97	$25.26	$27.56	$29.85	$32.15	$34.45	$39.04	$43.63

Supplemental benefits per hour paid:
(750 hour) terms at the following percentage of Terrazzo Mechanic's benefit.

1st 1-750	2nd 751-1500	3rd 1501-2250	4th 2251-3000	5th 3001-3750	6th 3751-4500	7th 4501-5250	8th 5251-6000
50%	55%	65%	70%	75%	85%	90%	95%

9-7/3

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per hour:	07/01/2012	12/03/2012 Additional
Building:		
Tile Setters	$ 49.64 plus $ 1.43*	$ 1.43*

*to be allocated at a future date

SUPPLEMENTAL BENEFITS
Journeyworker:

Per Hour:

Tile Setters	$ 27.56
Overtime *	37.56*
Overtime**	47.56**

*Applies to overtime on weekdays & Saturdays
** Applies to Sundays & Holidays, & over 10 hours on Saturdays

OVERTIME PAY
See (A, *E, **Q) on OVERTIME PAGE
* Work beyond 10 hours on Saturday shall be paid at double the hourly wage rate.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage per hour:

Tile Setters:
(750 hr)terms at the following wage rate:

Term: 1st 1-750	2nd 751-1500	3rd 1501-2250	4th 2251-3000	5th 3001-3750	6th 3751-4500	7th 4501-5250	8th 5251-6000	9th 6001-6750
$25.45	$28.29	$32.15	$33.79	$36.49	$37.81	$43.32	$48.57	$49.64

07/01/2012 - Apprentices receive an additional amount* based on term.

1st	2nd	3rd	4th	5th	6th	7th	8th
$0.65	$0.72	$0.78	$0.85	$0.91	$0.98	$1.11	$1.24

12/03/2012 - Apprentices receive an additional amount* based on term.

1st	2nd	3rd	4th	5th	6th	7th	8th
$0.65	$0.72	$0.78	$0.85	$0.91	$0.98	$1.11	$1.24

*To be allocated at a future date

Supplemental Benefits per hour paid:

Term: 1st 1-750	2nd 751-1500	3rd 1501-2250	4th 2251-3000	5th 3001-3750	6th 3751-4500	7th 4501-5250	8th 5251-6000	9th 6001-6750
$13.15	$14.17	$14.17	$16.39	$17.55	$20.09	$22.30	$24.79	$27.56

Mason - Building **02/01/2013**

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2012	01/01/2013 Additional
Building-Marble Restoration:		
Marble, Stone & Polisher, etc	$ 37.28 + $ 0.75*	$ 0.75*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS
Per Hour:

Journeyworker:

Building-Marble Restoration: Marble, Stone & Polisher	$ 21.30

OVERTIME PAY
See (A, E, Q, V) on OVERTIME PAGE
ON SATURDAYS, 8TH HOUR AND SUCCESSIVE HOURS PAID AT DOUBLE HOURLY RATE.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
1ST TERM APPRENTICE GETS PAID FOR ALL OBSERVED HOLIDAYS.

REGISTERED APPRENTICES
WAGES per hour:

(900 hour)terms at the following wages:

	1st 0-900	2nd 901-1800	3rd 1801-2700	4th over 2700
07/01/2012	$ 25.50 + $.53*	$ 30.25 + $.60*	$34.00 + $. 68*	$ 37.28 + $ .75*
01/01/2013	Additional $ 0.53*	Additional $ 0.60*	Additional $ 0.68*	Additional $ 0.75*

* To be allocated at a future date

Supplemental Benefits Per Hour:

$ 19.45	$ 20.06	$ 20.69	$ 21.30

9-7/24-MP

Mason - Building 02/01/2013

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Westchester

PARTIAL COUNTIES
Bronx: Entire 5 Boroughs EXCEPT for projects that fall within a fifty-mile radius of Columbus Circle in New York City.
Kings: Entire 5 Boroughs EXCEPT for projects that fall within a fifty-mile radius of Columbus Circle in New York City.
New York: Entire 5 Boroughs EXCEPT for projects that fall within a fifty-mile radius of Columbus Circle in New York City.
Queens: Entire 5 Boroughs EXCEPT for projects that fall within a fifty-mile radius of Columbus Circle in New York City.
Richmond: Entire 5 Boroughs EXCEPT for projects that fall within a fifty-mile radius of Columbus Circle in New York City.

WAGES

Wages:	07/01/2012	01/01/2013 Additional
Building:		

Marble Cutters&Setters	$ 53.20 plus $ 1.30*	$ 1.30*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS
Per Hour:

Journeyworker $ 27.08

OVERTIME PAY
See (A, *E, O, Q, V) on OVERTIME PAGE
* Work beyond 7 hours on Saturday shall be paid at double the hourly wage rate.
** When an observed holiday falls on a Sunday, it will be observed the next day.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 15, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage Per Hour:

750 hour terms at the following wage.

1st 1-750	2nd 751-1500	3rd 1501-2250	4th 2251-3000	5th 3001-3750	6th 3751-4500	7th 4501-5250	8th 5251-6000
$ 26.60	$29.26	$31.92	$34.58	$37.24	$39.90	$45.22	$50.54

07/01/2012 - Apprentices receive an additional amount* based on term of Apprentice:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th
$0.65	$0.72	$0.78	$0.85	$0.91	$0.98	$1.11	$1.24	$1.30

01/01/2013 - Apprentices receive an additional amount* based on term of Apprentice:

$0.65	$0.72	$0.78	$0.85	$0.91	$0.98	$1.11	$1.24	$1.30

*To be allocated at a future date

Supplemental Benefits per hour paid at the following term:

1st	2nd	3rd	4th	5th	6th	7th	8th
$21.10	$21.69	$22.29	$22.89	$23.49	$24.09	$25.29	$26.48

9-7/4

Mason - Building 02/01/2013

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per hour:	07/01/2012	12/03/2012 Addtional
Building:		
Tile Finisher	$ 39.28 plus $1.18*	$ 1.18*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS
Per Hour:

Journeyworker	$ 24.52
Overtime*	33.02*
Overtime**	41.52**

* Applies to weekdays & Saturdays
** Applies to overtime hours on Sunday & Holidays, and work on Saturdays over 10 hours.

OVERTIME PAY
See (A, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

9-7/88-tf

Mason - Building 02/01/2013

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2012	01/01/2013 Additional
Marble, Stone,etc. Finishers	$ 20.15 plus $.50*	$.50*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS
Journeyworker:
Per Hour:

Marble, Stone, etc Finisher	$ 10.86

OVERTIME PAY
See (A, E, Q, V) on OVERTIME PAGE
Double hourly rate after 7 hours on Saturday

HOLIDAY
Paid: See (*5, 6, 11, 15) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15) on HOLIDAY PAGE

REGISTERED APPRENTICES
WAGES per hour:
(750 hour)terms at the following wages:

			07/01/2012
1st term	0-750		$ 14.32
2nd term	750-1500		15.14
3rd trem	1501-2250	15.94	
4th term	2251-3000	16.77	
5th term	3001-3750	17.99	
6th term	3751-4500	19.62	

07/01/2012 - Apprentices receive an additional amount*:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th
$0.25	$0.28	$0.30	$0.33	$0.35	$0.38	$0.43	$0.48	$0.50

01/01/2013 - Apprentices receive an additional amount*:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th
$0.25	$0.28	$0.30	$0.33	$0.35	$0.38	$0.43	$0.48	$0.50

* To be allocated at a future date

Supplemental Benefits:
(Per Hour)

1st term	$ 10.79
2nd term	10.80
3rd term	10.81
4th term	10.82
5th term	10.83
6th term	10.86

9-7/24M-MF

Mason - Building / Heavy&Highway **02/01/2013**

JOB DESCRIPTION Mason - Building / Heavy&Highway **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2012	01/01/2013 Additional
Marble-Finisher	$ 43.15 plus $ 1.00*	$ 0.90*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS
Journeyworker: $ 26.48

OVERTIME PAY
See (A, *E, Q, V) on OVERTIME PAGE

HOLIDAY
Overtime: See (5, 6, 15, 25) on HOLIDAY PAGE
* Work beyond 7 hours on a Saturday shall be paid at double the rate.
** When an observed holiday falls on a Sunday, it will be observed the next day.

REGISTERED APPRENTICES
Wages:

750 hour terms at the following percentage of Journeyworkers wage:

1st 1-750	2nd 751-1500	3rd 1501-2250	4th 2251-3000	5th 3001-3750	6th 3751-4500	7th 4501-5250	8th 5251-6000
50%	55%	60%	65%	70%	75%	85%	95%

Supplemental Benefits:	07/01/2012
1st-6th terms	$ 14.50 + term wage % of $9.83
7th and 8th terms	$ 24.33

9-7/20-MF

Mason - Building / Heavy&Highway **02/01/2013**

JOB DESCRIPTION Mason - Building / Heavy&Highway **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES

Per Hour:	07/01/2012	07/01/2013 Additional
Cement Mason	$ 44.63	$1.00*

* To be allocated at a future date.

** IMPORTANT NOTICE **
Four (4), ten (10) hour days may be worked at straight time during a week, Monday thru Friday. Any make-up day must be paid at the premium rate.

NOTE - In order to use the '4 Day/10 Hour Work Schedule,' you must submit an 'Employer Registration for Use of 4 Day/10 Hour Work Schedule,' form PW30R; additionally, there must be a dispensation of hours in place on the project.

SUPPLEMENTAL BENEFITS
Per Hour:

Cement Mason $ 32.37

OVERTIME PAY
See (*B1, E2, **Q, ***V) on OVERTIME PAGE
* Applies to 9th and 10th hours on Saturday

** "Holidays" only for Building Construction
*** Additional $10.18 to be added to all Time and a Half hours paid

HOLIDAY
Building Construction - See (5, 6 & 25) on HOLIDAY PAGE
Heavy Highway Construction - See (1) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1) year terms at the following Percentage of Journeyworkers Wage.

1st Term	50%
2nd Term	60%
3rd Term	70%

Supplement Benefits per hour paid:
Apprentices:

1st term	$ 22.11
2nd term	24.16
3rd term	26.21

4-780

Mason - Building / Heavy&Highway 02/01/2013

JOB DESCRIPTION Mason - Building / Heavy&Highway **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES
WAGES

NOTE: Shall include but not limited to Precast concrete slabs (London Walks)
Marble and Granite pavers 2'x 2' or larger.
Per Hour:

	07/01/2012
Stone Setter	$ 57.61
Stone Tender	$ 39.28

SUPPLEMENTAL BENEFITS
Per Hour:

Stone Setter	$ 24.96
Stone Tender	$ 16.01

OVERTIME PAY
See (*C, **E, Q) on OVERTIME PAGE
* On weekdays the eighth (8th) and ninth (9th) hours are time and one-half all work thereafter is paid at double the hourly rate.
** The first nine (9) hours on Saturday is paid at time and one-half all work thereafter is paid at double the hourly rate.

HOLIDAY
Paid: See (*18) on HOLIDAY PAGE
Overtime: See (5, 6, 10) on HOLIDAY PAGE
Paid: *Must work First 1/2.

REGISTERED APPRENTICES
Per Hour:

Stone Setter(800 hour) terms at the following wage rate per hour:

1st	2nd	3rd	4th	5th	6th
$28.81	$34.57	$40.32	$46.09	$51.85	$57.61

Supplemental Benefits:
All Apprentices $15.53

4-1Stn

Mason - Heavy&Highway 02/01/2013

JOB DESCRIPTION Mason - Heavy&Highway **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES
Per Hour: 07/01/2012

Pointer, Cleaner & Caulkers $ 44.56

SUPPLEMENTAL BENEFITS
Per Hour:

Pointer, Cleaners & Caulkers $ 20.81

OVERTIME PAY
See (B, E2, H) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages per hour:

One (1) year terms at the following wage rates.

	07/01/2012			
	1st	2nd	3rd	4th
	$25.40	$28.76	$33.43	$39.92
Apprentices Supplemental Benefits: (per hour paid)	$3.05	$7.00	$10.00	$10.00

4-1PCC

Operating Engineer - Building 02/01/2013

JOB DESCRIPTION Operating Engineer - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Wages:

(Per Hour)	07/01/2012	07/01/2013 Addtional
Building Constr:		
Party Chief	$55.74	$2.42
Instrument Man	$43.30	$2.07
Rodman	$27.97	$1.63
Steel Erection:		
Party Chief	$55.74	$2.52
Instrument Man	$43.49	$2.16
Rodman	$29.25	$1.73
Heavy Construction: Foundation, Excavation., etc.		
Party Chief	$60.28	$3.22
Instument man	$44.28	2.61
Rodman	$37.11	2.39

SUPPLEMENTAL BENEFITS
Per Hour: 07/01/2012

All Classifications	$ 29.78
Premium*	
All Catergories	$ 38.47
Premium**	
All Classes	$ 53.16

*Apply to instances where 1-1/2 regular rate are paid
**Applies to instances where 2 times the regular rate are paid

OVERTIME PAY
See (A, B, *E, Q) on OVERTIME PAGE
* Doubletime paid on the 8th hour on Saturday.
Note:Overtime code "A" applies to Building Construction Category.

HOLIDAY
Paid: See (5, 6, 8, 11, 12, 15, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 12, 25) on HOLIDAY PAGE
** Applies to Building Construction category

9-15Db

Operating Engineer - Building, Maintenance, Steel Erection & Heavy Construction **02/01/2013**

JOB DESCRIPTION Operating Engineer - Building, Maintenance, Steel Erection & Heavy Construction **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
STEEL ERECTION:

Group 1: Derrick, travelers, tower, crawler tower & climbing cranes

Group 2: Oiler (Truck Crane)

Group 3: Oiler (Crawler Crane)

BUILDING CONSTRUCTION:

Group 1: Installing, repairing, maintaining, dismantling of all equipment including Steel cutting& bending machines, mechanical heaters, mine hoists, climbing cranes, tower cranes, Linden Peine, Lorain, Liebherr, Mannes and machines of a similar nature;Well Point system, Deep Well pumps, Concrete mixers with loading devices, Concrete plants, motor generators (When used for temporary power and lights(Driving maintenance trucks and mounted-welded machines)-All Pumps(excluding River Cofferdam Pumps and Well Point Pumps), Motorized Concrete Buggies(When three or more are on jobsite), Skid-Steer and similar machines

Group 2:Maintenance of: Pumps, Generators,Mixers,Heaters

Group 3: Oilers of all gasoline, electric, deisel or air operated Gradalls; Concrete Pumps, Overhead Cranes in Power Houses,Assist in oiling, greasing and repairing of all machines, including: Driving Truck Cranes, Driving and operating Fuel and Grease Trucks, Cherry Pickers(Hydraulic Cranes) over 70,000 GVW and machines of a similar nature

Group 4: Oiler on Crawler Cranes, Backhoes, Trenching Machines, Gunite Machines, Compressors(3 or more in battery)

Group 5: Maintenance on Radiant Mechanical Heaters

HEAVY CONSTRUCTION (Excavation, Foundations, etc)

Group 1:Maintenance of: Generators, Light Towers

Group 2:Maintenance of: Pumps, Mixers including mudsucking

Group 3: Base Mounted Tower Cranes

Group 4: Installing, repairing, maintaining, dismantling(of all equipment including Steel cutting & Bending machines, Fusion Coupling Machines, Vermeer Trenching machines, on-site crushing plant, mechanical heaters(1 through 7),Mine hoists, Tower Cranes, Linden Peine, Lorrain, Lebherr, Mannes or machines of a similar nature, Wellpoints)-Driving maintenance trucks and truck mounted welding machines, burning, welding-operating of accumilator for shield-driven tunnels, in addition to the performance of other duties:Handling,installation, jointing, coupling of all perminent steel and plastic pipe. RIDE UPON MOLES-tunnel boring machines-MICRO TUNNELING SYSTEMS, All temporary pipefitting;When three or more motorized concrete buggies(Ride type)are utilized on the jobsite they shall be serviced, maintained and repaired by the maintenance engineer.The Operating Engineer on autograde(C.M.I.)is to be assisted by the maintenance engineer who shall in addition perform other duties.

WAGES:

Per hour	07/01/2012	07/01/2013 Additional
Steel Erection:		
Group 1	$ 55.44	$ 2.52*
Group 2	51.92	2.42*
Group 3	39.69	2.06*
Building Construction:		
Group 1	$ 52.58	$ 2.37*
Group 2	40.97	2.04*
Group 3	50.01	2.30*
Group 4	37.28	1.94*
Group 5	32.30	1.84*
Heavy Construction:		
Group 1	$ 37.56	$ 2.45*
Group 2	38.53	2.49*
Group 3	74.44	3.77*
Group 4	56.74	3.14*

SUPPLEMENTAL BENEFITS

Per Hour:	07/01/2012
All Classifications	$ 31.12
Premium Time	$ 55.84

OVERTIME PAY
See (D, O) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 7, 11, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages Per Hour:

(1) year terms at the following wage rates:

Apprentices:	1st	2nd	3rd	4th.
07/01/2012	$21.64	$27.05	$29.75	$32.45

Supplemental Benefits:
Per Hour:

All Apprentices:	$ 20.12
Premium Time	$ 33.84

9-15Ab

Operating Engineer - Building / Heavy&Highway 02/01/2013

JOB DESCRIPTION Operating Engineer - Building / Heavy&Highway **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
EQUIPMENT COVERED: Jet-Rodder/Vacuum Truck, Flusher, Sewer Rodder, Stetco Hoist and similar, Sewer Winch/Tugger Hoist and similar, Vacall/Vactor, Closed Circuit Television Inspection Equipment, Chemical Grouting Equipment and similar, John Beame, Meyers and similar.

Per Hour:

	07/01/2012	07/01/2013 Additional
Maintenance Engineer (Sewer Systems)	$ 56.74	$ 3.14*

* To be allocated at a future date

SUPPLEMENTAL BENEFITS

Per Hour:

	07/01/2012
Journeyman	$ 31.12
Premium Time	$ 55.84

OVERTIME PAY

See (D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 7, 11, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

REGISTERED APPRENTICES

Per Hour:

(1) year terms at the following wage rates.

Apprentices:

1st	2nd	3rd	4th
$21.64	$27.05	$29.75	$32.45

Supplemental Benefits:
Per Hour:

All Apprentices:	$ 20.12
Premium Time	$ 33.84

9-15Sewer

Operating Engineer - Building & Steel Erection 02/01/2013

JOB DESCRIPTION Operating Engineer - Building & Steel Erection **DISTRICT** 9

ENTIRE COUNTIES

Bronx, Kings, New York, Queens, Richmond

WAGES

Per Hour: 07/01/2012

Building Construction & Steel Erection:

STEEL ERECTION:

Three Drum Derricks	$ 68.77
Cranes,Two Drum Derricks, Hydraulic Cranes & Fork Lifts, Boom Trucks	$ 66.22
Compressors, Welding Machines, Bridge Inspection Machines, Moog and machines of a similar nature)	$ 40.88
Compressors(Not combined with welding machines)	$ 39.13

BUILDING CONSTRUCTION:

Cranes, Stone Derrick, Boom Trucks, Hydraulic Cranes	$ 67.05
Double Drum	$ 63.25
4 Pole Hoists and Single Drum Hoists	$ 61.06
Fork Lifts,Plaster(Platform Machine)Plaster Bucket, Concrete Pumps and all other equipment used for hoisting	$ 55.46

House Cars and Rack & Pinion	$ 50.60
*House Cars (New Projects)	$ 40.38
Erecting and dismantling of Cranes	$ 61.72

Compressors, Welding Machines(Cutting Concrete-Tank Work), Paint Spraying, Sand Blasting, Pumps(With the exclusion of concrete pumps), House Car (Settlement basis only), All Engines irrespective of power(Power-Vac)used to drive auxiliary equipment Air, Hydraulic,etc.,Boilers, Jacking System $ 41.32

*APPLIES TO PROJECTS STARTED AFTER 07/01/2011.

APPLICABLE TO ALL CATEGORIES:
CRANES: Crawler Or Truck

	In Addition To Above Crane Rates
100' to 149' Boom	$ 1.75/hr
150' to 249' "	2.00/hr
250' to 349' "	2.25/hr
350' to 450' "	2.75/hr
Tower Crane	2.00/hr

SUPPLEMENTAL BENEFITS
Per Hour:

	07/01/2012
All Operator Classes	$ 30.43
Premium Time	$ 55.41

OVERTIME PAY
See (*C, **D, O) on OVERTIME PAGE
*Note:Applies to Building Construction category
**Note: Applies to Steel Erection

HOLIDAY
Paid: See (5, 6, 7, 8, 11, 12, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 8, 11, 12, 16) on HOLIDAY PAGE
Note:
Codes 8 and 12 apply ONLY to Steel Erection
Code 16 applies ONLY to Building Construction

REGISTERED APPRENTICES
Wage Per Hour:

Apprentices (1) year terms at the following rates:

	07/01/2012	
1st	2nd	3rd
$ 26.34	$ 32.93	$ 39.52

Supplemental Benefits Per Hour:

Straight Time	$ 20.43
Premium Time	$ 35.41

9-14 B&S

Operating Engineer - Heavy Construction **02/01/2013**

JOB DESCRIPTION Operating Engineer - Heavy Construction **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per Hour:
Group 1: Tower Crane/Climbing Crane

Group 2: Backhoes (Including all track and rubber tire backhoes over 37,000 lbs), Power Shovels, Steel Erection:Hydraulic Clam Shells,Moles and machines of a similar nature

Group 3: Mine Hoists, Cranes, etc, used as Mine Hoists

Group 4: Gradalls, Keystones, Cranes (With digging buckets), Bridge Cranes, Trenching Machines, Vermeer Cutter and machines of a similar nature

Group 5: Pile Drivers and Rigs (Employing Dock-Builders Foreman), Derrick Boats, Tunnel Shovels,

Group 6: All Drills and machines of a similar nature

Group 7: Back-Filling Machines and Cranes, Mucking Machines, Dual Drum Pavers

Group 8: Mixers (Concrete with loading attachment), Concrete Pavers, Cableways, Land Derricks, Power House (Low pressure units)

Group 9: Concrete Pumps, Concrete Plant, Stone Crushers, Double Drum Hoists, Power Houses (Other than above)

Group 10: Concrete Mixer

Group 11: Elevators

Group 12: Concrete Breaking Machines, Single Drum Hoists, Load Masters, Locomotives and Dinkies (Over 10 tons), Hydraulic Crane-Second Engineer

Group 13: On-Site Concrete Plant Engineers, On-Site Asphalt Plant Engineer and Vibratory Console

Group 14: Barrier Mover, Barrier Transport and machines of a similar nature

Group 15: Compressors (Portable, 3 or more), Truck Compressor (Engineer Driver), Tugger Machines, Well Point Pumps, Churn Drill

Group 16: Boilers(High pressure),Compressors, Pumps(River Cofferdam) and Welding Machines(except where arc is operated by another Operating Engineer) Push Button Machines, All Engines,irrespective of power(Power Pac) used to drive auxiliary equipment, Air, Hydraulic, etc.

Group 17: Utility-Horizontal Boring Rig

Group 18: Utility Compressors

Group 19: Paving-Asphalt Spreader, Autogrades (C.M.I.), Roto-Mill

Group 20: Paving-Asphalt Roller

Group 21 Paving-Asphalt Plant

Group 22: Roller (non paving, all sizes)

Group 23: Cherry Picker (Over 20 tons), Loader (Over 6 yards)

Group 24: Backhoes and Loaders (Up to 37,000lbs), Bulldozers, Scrapers, Turn-A-Pulls, Tugger Hoists, Tractors, Hysters, Rooustabout Cranes, Conveyers, Balast Regulators (Ride On), Track Removal Machine or similar, Motor Graders, Locomotives (10 tons and under),Curb & Gutter Pavers and machines of a similar nature

Group 25:Post Hole Digger,Ditch Winch, Road Finishing Machines, Rollers (5 tons and under, Dual Purpose Trucks,Forklifts, Dempsey Dumpsters, Fireman

Group 26: Oiler (Gradalls, Concrete Pumps, Cold Planers Grader)

Group 27: Oiler (Crawler Cranes, Backhoes, Trenching Machines, Compressors (3 or more in battery)

Group 28:Steam Equipment Operator (Water rigs, steam shovels, power boilers, derrick boats)

WAGES:(per hour)

	07/01/2012	07/01/2013 Additional
Group 1	$ 81.09	$ 3.98*

Group 2	66.70	3.47*
Group 3	68.86	3.55*
Group 4	67.21	3.49*
Group 5	65.86	3.44*
Group 6	63.18	3.34*
Group 7	64.38	3.39*
Group 8	62.51	3.32*
Group 9	61.14	3.27*
Group 10	58.43	3.17*
Group 11	54.50	3.03
Group 12	55.73	3.08*
Group 13	56.19	3.09*
Group 14	50.27	2.88*
Group 15	42.11	2.59*
Group 16	39.03	2.48*
Group 17	59.39	3.21*
Group 18	38.78	2.47*
Group 19	62.51	3.32*
Group 20	60.85	3.26*
Group 21	51.32	2.92*
Group 22	60.95	3.36*
Group 23	58.75	3.21*
Group 24	57.00	3.15*
Group 25	54.09	3.04*
Group 26	51.19	2.94*
Group 27	35.50	2.38*
group 28	52.46	3.04*

* To be allocated at a future date

Cranes: Crawler or Truck

100' to 149'	$0.50 per hour additional to above Crane Rates
150' to 249'	$0.75 per hour additional to above Crane Rates
250' to 349'	$1.00 per hour addiilonal to above crane Rates
350' to 450'	$1.50 per hour additional to above crane Rates

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2012

Groups 1-22

Regular Time	$ 30.43
Premium Time	$ 55.41

Groups 23-28

Regular Time	$ 31.12
Premium Time	$ 55.84

OVERTIME PAY

See (D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 7, 11, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

REGISTERED APPRENTICES

Per Hour:
(1) year terms at the following wage rates:

Apprentices:	1st	2nd	3rd	
Groups 1-22	$26.34	$32.93	$39.52	

Apprentices:	1st	2nd	3rd	4th
Groups 23-28	$21.64	$27.05	$29.75	$32.45

Supplemental Benefits:
Per Hour:

Apprentices:
Groups 1-22

Regular Time	$ 20.43

Premium Time	$ 35.41

Groups 23-28

Regular Time	$ 20.12
Premium Time	$ 33.84

9-14 HC

Operating Engineer - Marine Construction 02/01/2013

JOB DESCRIPTION Operating Engineer - Marine Construction **DISTRICT** 4

ENTIRE COUNTIES
Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES
Per Hour:

DREDGING OPERATIONS	07/01/2012
CLASS A	
Operator, Leverman, Lead Dredgeman	$ 32.89
CLASS A1 Dozer,Front Loader Operator	To conform to Operating Engineer Prevailing Wage in locality where work is being performed including benefits.
CLASS B	
Spider/Spill Barge Operator, Tug Operator(over1000hp), OperatorII, Fill Placer, Derrick Operator, Engineer, Chief Mate, Electrician, Chief Welder, Maintenance Engineer	$ 28.49
Certified Welder, Boat Operator(licensed)	$ 26.84
CLASS C	
Drag Barge Operator, Steward, Mate, Assistant Fill Placer,	$ 26.14
Welder (please add)$ 0.06	
Boat Operator	$ 25.29
CLASS D	
Shoreman, Deckhand, Rodman, Scowman, Cook, Messman, Porter/Janitor	$ 21.09
Oiler(please add)$ 0.09	

SUPPLEMENTAL BENEFITS
Per Hour:
THE FOLLOWING SUPPLEMENTAL BENEFITS APPLY TO ALL CATEGORIES

	07/01/2012
All Classes A & B	$ 8.45 plus 7% of straight time wage overtime hours add $ 0.63
All Class C	$ 8.10 plus 8% of straight time wage overtime hours

add $ 0.48

All Class D — $ 7.85 plus 8% of straight time wage overtime hours add $ 0.33

OVERTIME PAY
See (B, F, R) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 26) on HOLIDAY PAGE

4-25a-MarConst

Painter — 02/01/2013

JOB DESCRIPTION Painter — **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2012	11/01/2012	05/01/2013
Brush	$ 39.85	$ 40.35	$ 41.85
Abatement/Removal of lead based or lead containing paint on materials to be repainted.	$ 39.85	$ 40.35	$ 41.85
Spray & Scaffold	$ 42.85	$ 43.35	$ 44.85
Fire Escape	$ 42.85	$ 43.35	$ 44.85
Decorator	$ 42.85	$ 43.35	$ 44.85
Paperhanger/Wall Coverer	$ 37.44	$ 37.44	$ 39.00

*Before calculating premium pay, deduct $0.10 from hourly wage rate.
Does not apply to paperhanger.

SUPPLEMENTAL BENEFITS

Per hour worked:	07/01/2012	11/01/2012	05/01/2013
Paperhanger	$ 29.71	$ 29.72	$ 29.73
All others	$ 20.97	$ 20.97	$ 20.97
Premium	$ 23.09*	$ 23.47*	$ 23.47*

* Applies only to " All others" catergory, not paperhanger journeyman.

OVERTIME PAY
See (A, H) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Indentured after 5/31/93 (1) year terms at the following wage rate.
(per hour)

	07/01/2012	11/01/2012	05/01/2013
Appr 1st term...	$ 15.05	$ 15.25	$ 15.85
Appr 2nd term...	$ 19.76	$ 19.91	$ 20.76
Appr 3rd term...	$ 23.94	$ 24.24	$ 25.14
Appr 4th term...	$ 31.92	$ 32.32	$ 33.52

Spplemental benefis:
(per Hour worked)

Appr 1st term...	$ 10.23	$ 10.23	$ 10.23
Appr 2nd term...	$ 12.92	$ 12.92	$ 12.92
Appr 3rd term...	$ 15.20	$ 15.20	$ 15.20
Appr 4th term...	$ 19.70	$ 19.70	$ 19.70

9-NYDC9-B/S

JOB DESCRIPTION Painter **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

PARTIAL COUNTIES
Nassau: Atlantic Beach, Ceaderhurst, East Rockaway,Hewlett, Hewlett Bay, Hewlett Neck, Hewlett Park, Inwood, Lawrence, Lido Beach, Long Beach, parts of Lynbrook, parts of Oceanside, parts of Valley Stream, and Woodmere. Starting on South side of Sunrise Hwy in Valley Stream running east to Windsor and Rockaway Ave, Rockville is the boundary line up to Lawson Blvd, turning right going west all the above territory. Starting at Union Turnpike &Lakeville Rd going north to northern Blvd. the west side of Lakeville Rd to Northern Blvd. At Northern Blvd doing east the district north of Northern blvd to Port Washington blvd. West of Port Washington blvd to St.Francis Hospital then north of first traffic light to Port Washington & Sands Point, Manor Haven, & Harbour Acres.

WAGES
Per hour:

	07/01/2012	12/26/2012	06/26/2013	01/01/2014
Drywall Taper	$ 47.48	$ 47.98	$ 48.48	$ 48.98

SUPPLEMENTAL BENEFITS
Per Hour:

Journeyworker: $ 18.22

OVERTIME PAY
See (A, H) on OVERTIME PAGE
Before calculating premium pay subtract $ 4.16 from hourly wage rate

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (4, 6, 8, 11, 18, 19, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage per hour:

One (1) year terms at the following percentages of journeyworker rate (year consists of 1500 hours).

	07/01/2012	12/26/2012	06/26/2013	01/01/2014
1st term	$ 17.43	$ 17.63	$ 17.83	$ 48.98
2nd term	$ 28.53	$ 28.83	$ 29.13	$ 29.43
3rd term	$ 38.01	$ 38.41	$ 38.81	$ 39.21

Note: Before calculating premium pay, deduct the amount shown below from Apprentice hourly wage.

1st term	$ .10 from hourly wage rate
2nd term	$ 2.54 from hourly wage rate
3rd term	$ 3.35 from hourly wage rate

Supplemental Benefits per hour worked:

One (1) year term at the following dollar amount:

1st term	$ 10.35
2nd term	$ 14.17
3rd term	$ 16.20

9-NYC9-1974-DWT

Painter - Bridge & Structural Steel 02/01/2013

JOB DESCRIPTION Painter - Bridge & Structural Steel **DISTRICT** 9

ENTIRE COUNTIES
Albany, Bronx, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Kings, Montgomery, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES
Per Hour Worked:

		07/01/2012	10/1/2012
STEEL:			
	Bridge Painting	$ 51.23	$ 52.23
	Power Tool/Spray	Additional $6.00 per hour above hourly rate, whether straight time or overtime	

Note: Generally, for Bridge Painting Contracts, ALL WORKERS on and off the bridge (including Flagmen) are to be paid Painter's Rate; the contract must be ONLY for Bridge Painting.

SUPPLEMENTAL BENEFITS
Per Hour Worked:

	07/01/2012	10/1/2012
Journeyworker	$ 26.80* $ 31.04**	$ 27.05
Hourly Rate after 40 hours from May 1st to Nov. 15th	$ 6.75 only	
Hourly Rate after 50 hours from Nov. 16th to April 30th	$ 6.75 only	

*For the period of May 1st to November 15th:
This rate shall be paid up to maximum of forty (40) hours worked per week. For all hours exceeding 40, the hourly rate shall drop to the hourly rate shown above by date.
EXCEPT for the first and last week of employment on the project, and for the weeks of Memorial Day, Independence Day and Labor Day, this rate shall be paid for the actual number of hours worked.

**For the period of November 16th to April 30th:
This rate shall be paid up to a maximum of fifty (50) hours worked per week. For all hours exceeding 50, the hourly rate shall drop to the hourly rate shown above by date.

OVERTIME PAY
See (A, F, R) on OVERTIME PAGE
NOTE: Calculate overtime rate as follows: Bridge Painting and Power Tool/Spray titles subtract $4.98 from the hourly rate.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (4, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES
(Wage per hour Worked):

Apprentices: (1) year terms

	1st	2nd	3rd
07/01/2012	$ 20.55	$ 30.78	$ 41.00
10/01/2012	$ 20.95	$ 31.38	$ 41.80

Supplemental Benefits per hour worked:

07/01/2012	$ 8.35	$ 19.00	$ 22.90
10/01/2012	$ 8.70	$ 19.15	$ 23.10

9-DC-9/806/155-BrSS

Painter - Line Striping **02/01/2013**

JOB DESCRIPTION Painter - Line Striping **DISTRICT** 9

ENTIRE COUNTIES
Albany, Bronx, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Kings, Montgomery, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES
Per hour:

Painter (Striping-Highway):	07/01/2012
Striping-Machine Operator*	$26.61 plus an additional $0.50**
Linerman Thermoplastic	$31.87 plus an additional $0.50**

** To be allocated at a future date

Note: * Includes but is not limited to: Positioning of cones and directing of traffic using hand held devices. Excludes the Driver/Operator of equipment used in the maintenance and protection of traffic safety

SUPPLEMENTAL BENEFITS

Per hour paid:	07/01/2012
Journeyworker:	
Striping-Machine operator	$ 14.18
Linerman Thermoplastic	$ 14.55

OVERTIME PAY
See (*B, **B2, E, E2, P, S) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 20) on HOLIDAY PAGE
Overtime: See (5, 8, 11, 12, 15, 16, 17, 20, 21, 22) on HOLIDAY PAGE

9-8A/28A-LS

Painter - Metal Polisher 02/01/2013

JOB DESCRIPTION Painter - Metal Polisher **DISTRICT** 9

ENTIRE COUNTIES
Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

	07/01/2012
Metal Polisher	$ 26.11
Metal Polisher**	$ 27.02
Metal Poilsher***	$ 29.61

**Note: Applies on New Construction & complete renovation
*** Note: Applies when working on scaffolds over 34 feet.

SUPPLEMENTAL BENEFITS

Per Hour:	07/01/2012
Journeyworker:	
All classification	$ 12.92

OVERTIME PAY
See (B, E, Q, T) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 9, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages per hour:
One (1) year term at the following wage rates:

1st	2nd	3rd
$13.50	$15.00	$18.00

Supplentals benefits:
Per hour paid:

1st	2nd	3rd
$10.27	$10.39	$10.63

9-8A/28A-MP

Plasterer 02/01/2013

JOB DESCRIPTION Plasterer **DISTRICT** 9

ENTIRE COUNTIES
Kings, Nassau, Queens, Suffolk

PARTIAL COUNTIES
New York: Includes work in all Islands in New York City, except Manhattan.

WAGES
Per hour:

	07/01/2012
Building:	

Plasterer/Traditional	$ 35.53

SUPPLEMENTAL BENEFITS
Per hour worked:

Journeyworker	$ 21.80

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 13, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages:
(per hour)

(1) year terms at the following % Journeyworkers wage rate.

First year:	1st 6 months	2nd 6 months
	40%	45%
Second year:	1st 6 months	2nd 6 months
	55%	60%
Third year:	1st 6 months	2nd 6 months
	70%	75%

Supplemental Benefits:
(per hour paid):
(1) year term broken down into six month periods:
1st year:

1st six months	$ 8.37
2nd six months	9.35
3rd six months	11.35
4th six months	12.33
5th six months	14.33
6th six months	15.33

9-530-Z1

Plumber **02/01/2013**

JOB DESCRIPTION Plumber **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per hour worked:

	07/01/2012
Plumber	$ 52.04
Repairs & Alterations*	$ 33.24

*Repair & alteration work is any repair and/or replacement of present plumbing system that does not change existing roughing or water supply lines.

THERE ARE NO HELPERS UNDER THIS CLASSIFICATION; WHEN USING APPRENTICES, MUST FOLLOW RATIO FOR PLUMBERS.

On tower work, bridges, elevated highway, or buildings, where pipe is being installed, fifty (50) or more feet vertically in a free drop from its base,
an additional $1.00 per hour.

SHIFT WORK:
Shift work,when directly specified in public agency or authority contract documents, and continues for a period of not less than ten (10) consecutive work days. A shift shall consist of seven(7) hours with one-half (1/2) hour for lunch after the first four (4) hours of each shift.
A premium of thirty percent (30%) for wages and supplemental benefits on shift work performed Monday through Friday on the 4 P.M.and midnight shifts.
For shift work performed on weekends the shift premium shall be fifty percent (50%) of wages and supplemental benefits.
For shift work performed on holidays designated below, double time wages and supplemental benefits shall be paid. Also noted that the normal workday Monday through Friday 8:00 A.M. to 3:00 P.M. is not considered shift work, and therefore not subject to shift premium.

SUPPLEMENTAL BENEFITS

Per hour worked:	07/01/2012
Plumber: Journeyworker	$36.91
Repairs & Alerations	$15.65

OVERTIME PAY

OVERTIME:

Plumber	See (C, O, V) on OVERTIME PAGE.
Repairs & Alterations	See (B, H) on OVERTIME PAGE.

Before calculating premium pay, subtract $ 0.28 from regular hourly wage rate.

HOLIDAY

HOLIDAY:

Plumber

Overtime:	See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE.

Repairs & Alterations

Paid:	See (1) on HOLIDAY PAGE.
Overtime:	See (5, 6, 25) on HOLIDAY PAGE.

REGISTERED APPRENTICES

Wages:
(Per Hour)
(1/2) year terms at the following wage:

*Apprentices:	1st&2nd	3rd&4th	5th&6th	7th&8th	9th	10th
07/01/2009	$14.28	$18.44	$20.34	$23.19	$24.59	$36.66

Supplemental Benefits per hour paid:
(1/2) year term at the following dollar amount:

07/01/2009	1st	2nd	3rd-10th
	$.43	$2.68	$15.97

*Note: The Repairs & Alterations Category has NO Apprentices.

9-1

Roofer **02/01/2013**

JOB DESCRIPTION Roofer **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Dutchess, Kings, New York, Orange, Putnam, Queens, Richmond, Rockland, Sullivan, Ulster, Westchester

WAGES

Per Hour:	07/01/2012
Roofer/Waterproofer	$ 39.00

SUPPLEMENTAL BENEFITS

Journeyworker	$ 27.92

OVERTIME PAY
See (B, H) on OVERTIME PAGE
Note: An observed holiday that falls on a Sunday will be observed the following Monday.

HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6, 13, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1) year terms at the following percentage of Journeyworkers hourly wage.

1st	2nd	3rd	4th
35%	50%	60%	75%

Supplements per hour paid at the following rates:

Apprentice:	1st	2nd	3rd	4th
	$ 4.24	$ 14.13	$ 16.88	$ 21.03

9-8R

Sheetmetal Worker **02/01/2013**

JOB DESCRIPTION Sheetmetal Worker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per Hour:	07/01/2012
Sign Erector	$43.30

*NOTE: Overhead Highway Signs and Structurally Supported Signs
(See IRON WORKER CLASS)

SUPPLEMENTAL BENEFITS

Per Hour:	07/01/2012
Sign Erector	$41.44

OVERTIME PAY
See (A, F, S) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 11, 12, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 10, 11, 12, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Per Hour:
6 month Terms at the following percentage of
Sign Erectors wage rate:

1st Term	35%	2nd Term	40%
3rd Term	45%	4th Term	50%
5th Term	55%	6th Term	60%
7th Term	65%	8th Term	70%
9th Term	75%	10th Term	80%

SUPPLEMENTAL BENIFITS
Per Hour:

1st Term	$13.20	2nd Term	$14.69
3rd Term	16.19	4th Term	17.69
5th Term	23.27	6th Term	24.89
7th Term	27.17	8th Term	28.80
9th Term	30.47	10th Term	30.47

4-137-SE

Sheetmetal Worker **02/01/2013**

JOB DESCRIPTION Sheetmetal Worker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES

Per Hour:	07/01/2012
Sheetmetal Worker	$48.90
Temporary Operation or Maintenace of Fans	$39.77

SUPPLEMENTAL BENEFITS

Per Hour:	07/01/2012
Sheetmetal Worker	$39.16
Maintenance Worker	$39.16

OVERTIME PAY
See (A, E, E2, Q) on OVERTIME PAGE
For Maintenance See Codes B,E & Q

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Per Hour:
6 Month Terms as Follows:

1st Term	$16.41
2nd Term	$18.80
3rd Term	$21.35
4th Term	$24.04
5th Term	$25.30
6th Term	$27.43
7th Term	$33.35
8th Term	$35.95
9th Term	$38.98

Supplemental Benifits as Follows:

1st Term	$18.01
2nd Term	$19.76
3rd Term	$21.47
4th Term	$23.21
5th Term	$24.77
6th Term	$26.81
7th Term	$30.23
8th Term	$31.34
9th Term	$32.45

4-28

Steamfitter **02/01/2013**

JOB DESCRIPTION Steamfitter **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES
Per Hour: 07/01/2012

Steamfitter/Maintenance & AC Service Work $36.55

Refrigeration, A/C, Oil Burner and Stoker Service and Repair.
Refrigeration Compressor installation up to 5hp (combined).
Air Condition / Heating Compressor installation up to 10hp (combined).

SUPPLEMENTAL BENEFITS
Per Hour

Steamfitter/Maintenance & AC Service Work $ 9.35

OVERTIME PAY
OVERTIME:....See (B, E, Q*, S**) on OVERTIME PAGE.

HOLIDAY
HOLIDAY:
Paid:.....See (2, 6, 9, 10, 11, 15, 17, 26,Memorial Day) on HOLIDAY PAGE.
Overtime:.... * (2, 6, 9, 15, 17)
** (10, 11, 26, Memorial Day)

4-638B-StmFtrRef

Steamfitter **02/01/2013**

JOB DESCRIPTION Steamfitter **DISTRICT** 4

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

WAGES

Per Hour:	07/01/2012	12/26/2012
Steam/Sprinkler Fitter	$56.81	*Additional $0.75/Hr
Temporary Heat & AC	$43.19	*Additional $0.75/Hr

*Additional to be allocated to either Wages or benefits.

NOTE: Add 30% to Hourly Wage for "Contracting Agency" Mandated Off Shift Work.

SUPPLEMENTAL BENEFITS

Per Hour:

Steam/Sprinkler Fitter	$44.96
Temporary Heat & AC	$36.24

OVERTIME PAY

See (C, *D, O, V) on OVERTIME PAGE
(*D) ON ALL HVAC AND MECHANICAL CONTRACTS THAT DO NOT EXCEED $15,000,000.00 and ON ALL FIRE PROTECTION/SPRINKLER CONTRACTS THAT DO NOT EXCEED $ 1,500,00.00

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

1 year Terms at the Following:

WAGES per hour:

1st Term	2nd Term	3rd Term	4th Term	5th Term
$22.76	$28.44	$36.95	$45.46	$48.30

SUPPLEMENTAL BENEFIT
Per Hour:

1st Term	2nd Term	3rd Term	4th Term	5th Term
$18.83	$23.20	$29.72	$36.35	$38.43

4-638A-StmSpFtr

Survey Crew Consulting **02/01/2013**

JOB DESCRIPTION Survey Crew Consulting **DISTRICT** 9

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

PARTIAL COUNTIES

Dutchess: Only the portion south of the north city line in Poughkeepsie.

WAGES

Feasibility and preliminary design surveying, line and grade surveying for inspection or supervision of construction when performed under a Consulting Engineer agreement.

Categories cover GPS & underground surveying.

WAGES: (per hour)

	07/01/2012
Survey Rates:	

Party Chief.....	$ 33.70
Instrument Man..	$ 28.38
Rodman.....	$ 25.02

SUPPLEMENTAL BENEFITS
Per Hour:

All Crew Members:	$ 11.70

OVERTIME PAY
OVERTIME:.... See (B, E*, Q, V) ON OVERTIME PAGE.
*Doubletime paid on the 9th hour on Saturday.

HOLIDAY
Paid: See (5, 6, 7, 11, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

9-15dconsult

Teamster - Heavy Construction **02/01/2013**

JOB DESCRIPTION Teamster - Heavy Construction **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond

WAGES
Per Hour: 07/01/2012

Truck Driver/Chauffer (Debris Removal, Street Level and below)

Truck Drivers	$37.005
Tractor Trailers	$37.005
Euclid/Turnapull	$37.57

SUPPLEMENTAL BENEFITS
Per Hour:

All Classifications	$29.30+ *$9.4525

* This Portion Calculated at
Same Premium as Shown for Overtime.

OVERTIME PAY
See (B, E, Q, *T) on OVERTIME PAGE
* Applies to Holidays that fall in codes 5 and 6 below

HOLIDAY
Paid: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE
Note: Employees receive 2 hours of Holiday Pay for each day worked in holiday week (not to exceed 8 hours)

4-282

Welder **02/01/2013**

JOB DESCRIPTION Welder **DISTRICT** 1

ENTIRE COUNTIES
Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES
Per hour 07/01/2012

Welder (To be paid the same rate of the mechanic performing the work)

OVERTIME PAY

HOLIDAY

1-As Per Trade

Overtime Codes

Following is an explanation of the code(s) listed in the OVERTIME section of each classification contained in the attached schedule. Additional requirements may also be listed in the HOLIDAY section.

(A)	Time and one half of the hourly rate after 7 hours per day
(AA)	Time and one half of the hourly rate after 7 and one half hours per day
(B)	Time and one half of the hourly rate after 8 hours per day
(B1)	Time and one half of the hourly rate for the 9th & 10th hours week days and the 1st 8 hours on Saturday. Double the hourly rate for all additional hours
(B2)	Time and one half of the hourly rate after 40 hours per week
(C)	Double the hourly rate after 7 hours per day
(C1)	Double the hourly rate after 7 and one half hours per day
(D)	Double the hourly rate after 8 hours per day
(D1)	Double the hourly rate after 9 hours per day
(E)	Time and one half of the hourly rate on Saturday
(E1)	Time and one half 1st 4 hours on Saturday Double the hourly rate all additional Saturday hours
(E3)	Between November 1st and March 3rd Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather, provided a given employee has worked between 16 and 32 hours that week
(E2)	Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
(E4)	Saturday and Sunday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
(F)	Time and one half of the hourly rate on Saturday and Sunday
(G)	Time and one half of the hourly rate on Saturday and Holidays
(H)	Time and one half of the hourly rate on Saturday, Sunday, and Holidays
(I)	Time and one half of the hourly rate on Sunday
(J)	Time and one half of the hourly rate on Sunday and Holidays
(K)	Time and one half of the hourly rate on Holidays
(L)	Double the hourly rate on Saturday
(M)	Double the hourly rate on Saturday and Sunday
(N)	Double the hourly rate on Saturday and Holidays
(O)	Double the hourly rate on Saturday, Sunday, and Holidays
(P)	Double the hourly rate on Sunday
(Q)	Double the hourly rate on Sunday and Holidays
(R)	Double the hourly rate on Holidays
(S)	Two and one half times the hourly rate for Holidays, if worked
(S1)	Two and one half times the hourly rate the first 8 hours on Sunday or Holidays One and one half times the hourly rate all additional hours.
(T)	Triple the hourly rate for Holidays, if worked

(U) Four times the hourly rate for Holidays, if worked

(V) Including benefits at SAME PREMIUM as shown for overtime

(W) Time and one half for benefits on all overtime hours.

NOTE:BENEFITS are PER HOUR WORKED,for each hour worked, unless otherwise noted

Holiday Codes

PAID Holidays:

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

OVERTIME Holiday Pay:

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays. The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Following is an explanation of the code(s) listed in the HOLIDAY section of each classification contained in the attached schedule. The Holidays as listed below are to be paid at the wage rates at which the employee is normally classified.

(1)	None
(2)	Labor Day
(3)	Memorial Day and Labor Day
(4)	Memorial Day and July 4th
(5)	Memorial Day, July 4th, and Labor Day
(6)	New Year's, Thanksgiving, and Christmas
(7)	Lincoln's Birthday, Washington's Birthday, and Veterans Day
(8)	Good Friday
(9)	Lincoln's Birthday
(10)	Washington's Birthday
(11)	Columbus Day
(12)	Election Day
(13)	Presidential Election Day
(14)	1/2 Day on Presidential Election Day
(15)	Veterans Day
(16)	Day after Thanksgiving
(17)	July 4th
(18)	1/2 Day before Christmas
(19)	1/2 Day before New Years
(20)	Thanksgiving
(21)	New Year's Day
(22)	Christmas
(23)	Day before Christmas
(24)	Day before New Year's
(25)	Presidents' Day
(26)	Martin Luther King, Jr. Day
(27)	Memorial Day

NOTIFICATION
OF
MINORITY BUSINESS ENTERPRISES
AND
WOMEN'S BUSINESS ENTERPRISES
ON-LINE DIRECTORY
AND
FORMS

The Port Authority has a long-standing practice of making its contract available to as many firms as possible and has taken affirmative steps to encourage Minority Business Enterprises (MBEs) and Women's Business Enterprises (WBEs) to seek business opportunities with it. The Port Authority's on-line Directory of Qualified MBE/WBEs lists the firms that are registered to assist Contractors in meeting and exceeding their Good Faith Goals.

The MBE/WBE Directory specifies the firms the Authority has determined to be (1) MBEs/WBEs and (2) experienced in performing work in the trades and contract dollar ranges indicated.

Contractors are provided with an interactive directory and the ability to view and print a current listing of M/WBE contractors. Information may be selected and sorted according to categories, state, dollar range, and type (MBE, WBE, DBE, and SBE).

To view the directory, type in www.panynj.gov/business-opportunities/mwsbe-search.cfm. For further information about MWBE Qualified Vendors, contact the Office of Business Diversity and Civil Rights at (212) 435-7802.

Revised 12/17/2008

THE PORT AUTHORITY OF NY & NJ

Certification Application for the Minority and Women-owned Business Enterprise Program

PLEASE PRINT OR TYPE CLEARLY

General Instructions:

- DO NOT LEAVE ANY SPACES BLANK ON THE APPLICATION - if a question is not applicable to your business insert "N/A" in the space provided for your answer
- Whenever the space is insufficient to answer the questions completely, attach additional sheets as necessary. Use the question number to identify any answer continued on an additional sheet
- For questions, call the Certification Helpline at 212-435-7808 or E-mail objocert@panynj.gov.
- Once you have completed the application, please return it and all required documentation to:

The Port Authority of NY & NJ
Office of Business & Job Opportunity - Certification Unit
233 Park Avenue South, 4th floor
New York, NY 10003

SECTION I: MAIN COMPANY INFORMATION

1. Business Name

Legal name of company applying to be certified

2. D.B.A.

"Doing Business As"- Complete if company does business under a name which is different from its legal name.

3. Business Address (must represent a physical location; cannot be a Post Office Box)

Street Address | Suite / Apt / Room/ Unit

City | State | Zip/Zip+4

County

4. Business Mailing Address (complete only if different from the address given in Question 3)

Street Address | Suite / Apt / Room/ Unit

City | State | Zip/Zip+4

5. Business Phone ( ) —

5a. Business Fax ( ) —

6. Business Website

7. Your E-mail Address

7a. Your Cell Phone Number ( )

8. Federal EIN or SSN

Schedule A

9. Name/title of an authorized representative to contact during the application review process:

Mr./Miss/Mrs./Ms. First Name : Last Name

Title Phone Ext. E-Mail Address

10. This company is applying for certification as ("X"all that apply)

Minority-owned Business Enterprise (MBE) ☐

Women-owned Business Enterprise (WBE) ☐

Refer to page _____ of the Application Guidelines to determine the appropriate designation for your company.

11. Are you currently involved in the bidding process or other contract/purchase order negotiations with the Port Authority or Port Authority tenants?

Yes_____ No_____

If "Yes", identify the department within the Port Authority and/or name of tenant and contact name

12. Has your company ever applied for certification as an M/W/SBE, or a DBE (whether SBA 8(a), Transportation, or other) with another governmental agency, department, or authority?

Yes_____ No_____

If "Yes", provide the following details

Name of Governmental Entity	Program (MBE, WBE, SBE, DBE)	Status (Pending, Certified, Decertified, Denied, Rejected, Revoked, On Appeal)	Date (mm/yy)

13. How did you first hear about The Port Authority of NY & NJ's M/W/DBE Certification program(s)? (please choose only one)

Letter/Call/E-mail ☐

Port Authority Web site ☐

Event ☐

Please specify name or sponsor of event and date

Other ☐

Please specify what and when

SECTION II: COMPANY OWNERSHIP

14. Business Structure

Sole Proprietorship	☐	Partnership (including LLP)	☐
Limited Liability Company (LLC)	☐	Corporation (including S-Corp.)	☐

15. Date company was established _____/ _____/ _____

16. Has the business existed under a different type of business structure prior to the Date Established indicated in question? 16

    Yes_____ No_____

    If "Yes", please provide copy of original Business Certificate

17. Has your Certificate of Incorporation, Business Certificate, or Certificate of Trade Name been amended?

    Yes_____ No_____

    If "Yes", please provide copy of amended Business Certificate

18. Method of Business Origination or Acquisition (check all applicable)

Started New Business	☐	Secured Franchise	☐
Bought Existing Business	☐	Secured Concession	☐
Merger or Consolidation	☐	Inherited Business	☐
Other	☐	_____	

19. Date of origination (or acquisition, if later) _____/ _____/ _____

For the remaining questions in Section II which ask for ethnic identification of owners, shareholders, officers, board members, and managers, please use the following group codes to identify the ethnicity of each individual where required.

01	Black	02c	Spanish	04	Native American
02a	Hispanic	03a	Asian-Pacific	05	White (Non-Minority)
02b	Portuguese	03b	Asian-Indian	06	Other

20. Please provide the following information for all person(s) with ownership interest in the company (all proprietors, partners, and members OR, in the case of a corporation, all shareholders).

Name (First and Last)	Position In Company	% Owned	Date Ownership Established (mm/yy)	Gender (M/F)	Ethnicity (see group code table)	US Citizen or Permanent Resident Alien (Y/N)

*** QUESTIONS 22-24 APPLY ONLY TO CORPORATIONS. *** *** IF YOUR COMPANY IS NOT A CORPORATION, SKIP TO QUESTION 25 ***

21. If the company is a corporation, please provide the following information for all shareholders identified in Question 21

Name (First and Last)	Position In Company	Number of Shares Owned	Unit Share Price Paid When Purchased

22. State the number of company shares in each of the following

Common Authorized _____ Common Issued _____

Preferred Authorized _____ Preferred Issued _____

23. Name and position of current Officers and/or Board of Directors

Name (First and Last)	Position	Position Effective Date (mm/yy)	Gender (M/F)	Ethnicity (see group code table)

** ALL APPLICANTS SHOULD RESUME COMPLETING THE APPLICATION HERE **

24. Please identify the capital contributions to the company by each person identified in Question 21, including cash, equipment, property, and expertise

Name (First and Last)	Type of Contribution	Total Dollar Value	Date of Contribution (mm/yy)

25. If your company is owned in whole or in part by another company, please identify the company and the percentage of ownership interest. Include venture capitalists and other similar investors

Company Name	Percentage Owned	Date Ownership Established (mm/yy)

SECTION III: COMPANY MANAGEMENT

26. Identify individuals responsible for managerial operations (*state if owner or non-owner*). Refer to group code definitions on prior page.

Name & Title	Gender (M/F)	Group Code	Owner? (Y/N)
a) Financial Decisions			
b) Estimating			
c) Preparing Bids			
d) Negotiating Bonding			
e) Marketing & Sales			
f) Hiring & Firing			
g) Supervising Field Operations			
h) Purchasing Equipment/Supplies			
i) Managing & Signing Payroll			
j) Negotiating Contracts			
k) Signatures for Business Accounts			

27. Do any principals, officers, employees and/or owners of the firm have an affiliation, i.e. business interest or employment with any other firm?

Yes_____ No_____ (If "Yes", complete the following)

Name (First and Last)	Name and Address of Affiliated Firm	Nature of Business	Nature of Affiliation

28. Number of Employees (if necessary, average over the past year)

Permanent		Temporary		Field	
Full-Time	_____	Full-Time	_____	Full-Time	_____
Part-Time	_____	Part-Time	_____	Part-Time	_____

SECTION IV: COMPANY FINANCES

29. Does your company have a Line of Credit?

Yes_____ No_____ If "Yes", please provide details:

_____

Bank Dollar Limit Name of Guarantor(s)

30. Please list all major current lenders to the company

Name of Lender	Amount of Loan	Terms of Repayment

31. Identify bank(s) where company accounts are maintained

Bank Name	Address	Contact Name	Contact Title	Type of Account

32. Please provide gross receipts (sales) for each of the last three fiscal years. (If in business for less than three years, complete as applicable)

Current Year _____ $_____

Last Year _____ $_____

Previous Year _____ $_____

SECTION V: COMPANY OPERATIONS

33. Check the industry which best describes your PRIMARY line of business

- ☐ Construction-related
- ☐ Consultants
- ☐ Consumer Service
- ☐ Manufacturer/Supplier
- ☐ Professional Service
- ☐ Purchasing
- ☐ Technical Service
- ☐ Other _____

34. If a license, permit or certification (e.g. Master Electrical License, PE for engineers, CDL for truck drivers, etc.) is required to conduct any part of your company's business, please identify the individual(s) holding the license, permit or certification and provide a copy

Name of the Holder/Registrant	Type of License/ Permit/Certification	Issued by	Issue Date (mm/yy)	Exp. Date (mm/yy)

35. Is your company bonded? Yes_____ No_____

If "Yes", please provide detail:

Name of Agent/Broker	Surety Co.	Bonding Limit	
		Single $	Aggregate $

36. Is your company insured? Yes_____ No_____ If "Yes", please provide detail:

Carrier Name _____ $ Amount of Liability Insurance _____

37. Please list the company's major equipment or machinery

Type	Depreciated $ Value	Acquisition Date (mm/yy)	Owned or Leased

38. List rented, leased or owned warehouse, plant and office facilities – Submit copy of lease, deed or mortgage

Facility Type	Owner or Name of Lessor and/or rental agent	Amt of yearly payment

39. Does your company share office space, personnel or equipment with any other company?

Yes_____ No_____

If "Yes", please provide details.

Company Name	Phone	Personnel (X)	Office Space ("X")	Yard Space (X)	Equipment ("X")	Machinery (X)

ACKNOWLEDGEMENTS AND VERIFICATION

FIRST, this certification application form, the supporting documents, and any other information provided in support of the application is considered part of the application. Any false statements or misrepresentations in the application may result in the applicant's disqualification from certification as Minority and/or Woman-owned Business Enterprise (M/WBE) by The Port Authority of New York and New Jersey for him/herself and its subsidiaries, which are included in the term "Port Authority".

SECOND, the information contained herein is subject to the Port Authority's Freedom of Information policy as reflected in the resolution adopted by the Committee on Operations of the Port Authority on August 13, 1992.

THIRD, the Port Authority may require further proof of eligibility for certification in addition to the information disclosed in this application and the applicant shall cooperate with the Port Authority in supplying the additional information. By completing this application, the applicant agrees to submit the additional proof required and acknowledges that the Port Authority may decide to deny the application if the additional proof is not submitted within 30 days after it is requested.

FOURTH, by filing this application, the applicant consents to examination of its books and records and interviews of its principals and employees by the Port Authority for the purpose of determining whether the applicant is, or continues to be, an eligible M/WBE. The applicant acknowledges that its certification may be denied if such examinations or interviews are refused or if the Port Authority determines, as a result of the examinations or interviews, that the applicant does not qualify for certification as a M/WBE.

FIFTH, by filing this application, the applicant consents to inquiries being directed by the Port Authority to the applicant's bonding companies, banking institutions, credit agencies, contractors, clients and other certifying agencies for the purpose of ascertaining the applicant's eligibility for certification. If the applicant fails to permit such inquiring to be made, such failure may be grounds for denying or revoking the applicant's certification.

SIXTH, the applicant agrees that it will advise the Port Authority of any change in the ownership or operational and managerial control of applicant's business after the certification application has been filed within 30 days of such change.

SEVENTH, certification is normally granted for a period of five (5) years. However, the Port Authority may require submission of a new application, additional information, examinations of the applicant's principals and employees at any time before the expiration of the five-year certification period. The applicant's failure to submit such material or to consent to such examinations and interviews will be grounds for revocation of certification.

EIGHT, the filing of this application, its acceptance by the Port Authority, and any subsequent certification of the applicant by the Port Authority, is not intended to and does not create any procedural or substantive rights enforceable at law by the applicant against the Port Authority, its Commissioners, officers, agents or employees and any such certification is only intended to facilitate the identification of qualified and bona fide M/WBEs.

NINTH, the Code of Ethics certification attached hereto shall be considered part of this certification application and the applicant is advised to familiarize him/herself with the terms of the certification prior to submitting this application.

TENTH, in submitting this application the applicant and each person signing on behalf of the applicant certifies that, to the best of their knowledge and belief, the following statements are true and correct:

A) No individual who is current or former employee of the Port Authority or its subsidiaries (i.e., Port Authority Trans-Hudson Corporation (PATH), Newark Legal and Communications Center Urban Renewal Corporation) other than those individuals identified in the space immediately below (1) owns an interest in; or (2) has involvement in a relationship with the applicant firm (a) from or as a result of which the individual has received within the past year, or is entitled to receive in any future year, more than $1,000 or its equivalent; or (b) which has a market value in excess of $1,000. *(List here any such current or former Port Authority Employee (s))

_____

B) No individual who is a current or former employee of the Port Authority or its subsidiaries other than those individuals identified in the space immediately below (1) holds a position in the applicant firm such as an officer, director, trustee, partner, employee, or a position of management: or (2) acts as a consultant, agent or representative of the firm in any capacity. *(List here any current or former Port Authority Employee (s))

_____

*Included within the scope of this certification are the individuals identified by the applicant in response to questions 4, 4a, 8d, 9, 10, 10a, 17, 18, 19, 24 and 25.

ELEVENTH, the criteria for certification by the Port Authority as a Small Business Enterprise are outlined in the documentation entitled "Small Business Enterprise Program (SBE) Administered by The Port Authority of New York and New Jersey" which accompanies this application. If the applicant believes that he/she is eligible for SBE certification, he/she may request that this application also be treated as
an SBE certification application by signing below. If signature is provided, all acknowledgments and provisions of this M/WBE certification shall also apply.

Applicant _____ Date _____

VERIFICATION

STATE OF _____)

SS:

COUNTY OF_____)

(A) (For Sole Proprietorships, Partnerships, and Limited Liability Partnerships)

_____, being duly sworn, states that he or she is the owner of (or a Partner in) the entity making the foregoing application and that the statements and representations made in the application are true to his/her own knowledge.

_____ _____
Signature Date

(B) (For Corporations and Limited Liability Companies)

_____, being duly sworn, states that he/she is the
Name of Corporate Officer

_____ of _____,
Title of Corporate Officer Name of Corporation

the entity making the foregoing application, that he/she has read the application and knows its contents, that the statements and representations made in the application are true to his/her knowledge, and that the application is made at the direction of the Board of Directors of the Corporation.

Corporate Seal _____
Signature Date

Sworn to before me this _____ day of _____, 20_____

_____
Notary Public

Mail to: ***The Port Authority of New York and New Jersey***
Office of Business & Job Opportunity – Certification Unit
233 Park Avenue South, 4th Floor
New York, NY 10003

CODE OF ETHICS CERTIFICATION

In signing and submitting the annexed Certification Application, each applicant and each person signing on behalf of any applicant certifies that they have not made any offers or agreements or given or agreed to give anything of value or taken any other action with respect to any employee or former employee of The Port Authority of New York and New Jersey or any of its subsidiaries (hereinafter referred to as the "Authority") or any immediate family member of either which would constitute a breach of ethical standards under the Code of Ethics and Financial Disclosure dated as of July 18, 1994 (a copy of which is available upon request to the Office of Regional and Economic Development /Business & Job Opportunity), nor do they have any knowledge of any act on the part of such employee or former employee relating either directly or indirectly to the applicant which constitutes a breach of the ethical standards set forth in said code.

> As used herein, "anything of value" shall include but not be limited to any (a) favors, such as meals, entertainment, transportation (other than that contemplated by an Authority contract), etc., which might tend to obligate the Authority employee to the Contractor and (b) gift, gratuity, money, goods, equipment, services, lodging, discounts not available to the general public, offers or promises of employment, loans or the cancellation thereof, preferential treatment or business opportunity. Such term shall not include compensation contemplated by any Authority contract.

The foregoing certification shall be deemed to have been made by the applicant as follows: If the applicant is a corporation, such certification shall be deemed to have been made not only with respect to the application itself, but also with respect to each director and officer, as well as, to the best of the certifier's knowledge and belief, each stockholder with an ownership interest in excess of 10%; if the applicant is a partnership, such certification shall be deemed to have been made not only with respect to the applicant itself, but also with respect to each partner. Moreover, the foregoing certification, if made by a corporate applicant, shall be deemed to have been authorized by the Board of Directors of the applicant, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of such certification as the act and deed of the corporation.

In any case where the applicant cannot make the foregoing certification, the applicant shall so state and shall furnish with the application, a signed statement that sets forth in detail the reasons thereof.

The foregoing certification or signed statement shall be deemed to have been made by the applicant with full knowledge that it would become part of the records of the Authority and that the Authority will rely on its truth and accuracy in granting certification.

Applicants are advised that knowingly providing a false certification or statement pursuant hereto may be the basis for prosecution for offering a false instrument for filing (see e.g., New York Penal Law, Section 175.30 et. Seq.). Applicants are also advised that the inability to make such certification will not, in and of itself disqualify an applicant, and that in each instance the Authority will evaluate the reasons therefore provided by the applicant.

Supporting Documentation Checklist

REQUIRED FOR ALL APPLICANTS Attach copies of the following documents, as applicable. Indicate documents submitted by checking appropriate boxes. PLEASE PROVIDE COPIES OF SUPPORTING DOCUMENTS ONLY - NOT THE ORIGINALS. The minimum documentation required for certification is listed below, but is not limited to this list. A representative may request additional documents during the application review process, if warranted.

- ☐ 1 Résumés for all principals, partners, officers and/or key employees of the firm. Provide home address, telephone number, education, training, and employment with dates and specific duties with the company
- ☐ 2 Proof of ethnicity for each person with ownership interest (valid passport, ethnic birth certificate)*
- ☐ 3 Proof of U.S. Citizenship (valid U.S. passport, ethnic birth certificate, naturalization certificate)*
- ☐ 4 Proof of permanent resident alien status (valid permanent resident alien "green" card showing expiration date)*
- ☐ 5 Bank signature card, bank resolution or letter from bank identifying persons authorized to conduct transactions on each account
- ☐ 6 Lease agreement or proof of ownership (deed/mortgage) for business location(s)
- ☐ 7 Proof of any certification (including SBA 8(a)), decertification, or denial from another governmental agency, department, or authority
- ☐ 8 Copies of any licenses, permits and/or accreditations required for conducting business
- ☐ 9 Proof of sources of capitalization/investments (purchase receipts, any loan agreements)
- ☐ 10 Any employment agreements
- ☐ 11 All third party agreements including: equipment rental, purchase agreements, management service agreements, etc.
- ☐ 12 Vehicle registration(s) for any vehicle used for business purposes
- ☐ 13 Current financial statement (statement of cash flows, balance sheet, or profit and loss statement)
- ☐ 14 Most recent three years' business Federal, State and City tax returns (all pages, all schedules); Prior two (2) years of personal tax returns (1040's) for each person with ownership interest, including all applicable W-2 forms and schedules if in business less than three years

If you have one document that satisfies the requirements for numbers 2 – 4, submit only one copy.

REQUIRED FOR A SOLE PROPRIETORSHIP

☐ Copy of Business Trade Name or Certification Trade Name filed with County Clerk (If doing business under an assumed name)

REQUIRED FOR A PARTNERSHIP AND JOINT VENTURE PARTNERSHIP

Attach copies of the following: (Indicate documents submitted by checking appropriate boxes)

☐ 1. Business Certificate

☐ 2. Partnership Agreement

REQUIRED FOR A LIMITED LIABILITY COMPANY (Check appropriate boxes below)

☐ 1. Sole Proprietorship

☐ 2. Corporation

☐ 3. Partnership Agreement

Attach required documents and indicate documents submitted by checking appropriate boxes

☐ 1. Certificate of formation and/or organization

☐ 2. Operating and/or managing agreements

☐ 3. Franchise and/or third-party agreement

REQUIRED FOR A CORPORATION

Attach documents of the following: (Indicate documents submitted by checking appropriate boxes)

☐ 1. Articles of incorporation, including date approved by State

☐ 2. Corporation By-Laws

☐ 3. Minutes of first corporate organizational meeting and amendments

☐ 4. Copies of all issued stock certificates front and back, as well as next un-issued certificate

☐ 5. Copy of stock ledger

☐ 6. If applicable, furnish copies of agreements relating to:

a. stock options
b. shareholder agreements
c. shareholder voting rights
d. restriction on the disposal of stock loan agreements
e. facts pertaining to the value of shares
f. buy-out rights
g. restrictions on the control of the corporation

SMALL BUSINESS ENTERPRISE PROGRAM
ADMINISTERED BY
THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

The Small Business Enterprise Programs are designed to promote New York and New Jersey businesses and to provide them with the advantage of competing against firms of like size and expertise in a limited competitive environment. In order to be eligible to participate in opportunities set-aside for the programs, the Port Authority must certify a firm as a Small Business Enterprise. To be eligible for certification, firms at a minimum:

- Must have a principal place of business in either New York or New Jersey.
- Must have operated that specific type of business for at least three (3) years.
- Must not exceed the average annualized gross revenue limitations cited below for the last three (3) fiscal years.

Average Annualized Gross Revenue Limitation and other Port Authority Pre-requisites by Procurement Category.

- **Construction - $14 million**
  The Port Authority's Engineering Department must also qualify construction firms. This requires the submittal of acceptable references for completed contracts. A minimum of three acceptable references is required for each construction specialty area.

- **Architectural & Engineering (A&E) - $4.5 million**
  - ***Landscape Architectural Services - $7 million***
  - ***Marine Engineering & Naval Architecture - $18.5 million***

  In addition to adhering to maximum gross revenues Thresholds, A&E firms must also have minimum average annual revenues of more than $100,000 over the last three (3) fiscal years.

- **Commodity - $7 million**
  Commodity firms eligible to participate are provided a five percent (5%) price preference in designated contracts solicited by the Port Authority's Procurement Division.

- **Janitorial Maintenance - $16.5 million**

- **Unarmed Guard Service - $18.5 million**

- **Financial Services - $7 million**

INFORMATION FOR DETERMINING JOINT VENTURE ELIGIBILITY

Return your submittal to:	*The Port Authority of NY & NJ* *Office of Business and Job Opportunity* *233 Park Avenue South, 4th Floor* *New York, NY 10003*
	Firms not currently certified should call (212) 435-7808 for information

**(NOTE: This form need not be completed if all joint venture firms are *M/W/DBEs*
The Joint Venture approval is valid through the duration of the Port Authority contract)**

1. NAME OF JOINT VENTURE: _____

2. ADDRESS OF JOINT VENTURE: _____

_____

_____

3. TELEPHONE NUMBER (S) OF JOINT VENTURE: _____

_____

4. (A) IDENTIFY THE FIRMS WHICH COMPRISE THE JOINT VENTURE. (THE MINORITY OR WOMAN-OWNED OR DISADVANTAGED BUSINESS ENTERPRISE PARTNER MUST COMPLET A UNIFORM CERTIFICATION APPLICATION – SCHEDULE A)

_____

_____

(B) DESCRIBE THE ROLE OF THE M/W/DBE IN THE JOINT VENTURE:

_____

_____

_____

5. NATURE OF THE JOINT VENTURE'S BUSINESS: _____

_____

_____

6. PROVIDE A COPY OF THE JOINT VENTURE AGREEMENT.

SCHEDULE B

7. WHAT IS THE CLAIMED PERCENTAGE OF MBE OR WBE OF DBE OWNERSHIP? _____

8. OWNERSHIP OF JOINT VENTURE: (THIS NEED NOT BE FILLED IN IF DESCRIBED IN THE JOINT VENTURE AGREEMENT)

(A) PROFIT AND LOSS SHARING: _____

_____

(B) CAPITAL CONTRIBUTIONS, INCLUDING EQUIPMENT:

_____

_____

_____

(C) OTHER APPLICABLE OWNERSHIP INTERESTS:

_____

_____

_____

9. CONTROL OF AND PARTICIPATION IN THIS CONTRACT. IDENTIFY BY NAME, RACE, SEX AND "FIRM" THOSE INDIVIDUALS AND THEIR TITLES WHO ARE RESPONSIBLE FOR DAY-TO-DAY MANAGEMENT AND POLICY DECISION-MAKING, BUT NOT LIMITED TO, THOSE WITH PRIME RESPONSIBILITY FOR:

NAME & TITLE	SEX		GROUP CODE*	FIRM
FINANCIAL DECISIONS				
_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____
MANAGEMENT DECISIONS, SUCH AS:				
ESTIMATING				
_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____
MARKETING AND SALES				
_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

HIRING AND FIRING OF MANAGEMENT PERSONNEL

_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

PURCHASING OF MAJOR ITEMS OR SUPPLIES

_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

SUPERVISION OF FIELD OPERATIONS

_____	☐M	☐F	_____	_____
_____	☐M	☐F	_____	_____

***GROUP CODE KEY**

01 – BLACK	02A – HISPANIC	03A – ASIAN-PACIFIC	04 – NATIVE AMERICAN
	02B – PORTUGUESE	03B – ASIAN-INDIAN	05 – NON-MINORITY
	02C – SPANISH		06 - OTHER

Affidavit

"The undersigned swear that the foregoing statements are correct and include all material information necessary to identify and explain the terms and operation of the joint venture and the intended participation by each joint venturer in the undertaking. Further, the undersigned agree to provide to the grantee current and complete information and any proposed changes to the joint venture arrangement. The undersigned also agree to permit authorized representatives of the grantee or the Federal-funding agency to audit and examine the books, records and files of the joint venture, or those of each joint venturer relevant to the joint venture. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under Federal or State laws concerning false statement."

_____	_____
NAME OF FIRM	NAME OF FIRM
_____	_____
SIGNATURE	SIGNATURE
_____	_____
NAME	NAME
_____	_____
TITLE	TITLE
_____	_____
DATE	DATE

State of _____ **County of** _____

On this _____ **day of** _____, **20**____, **before me appeared (name)** _____ **to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm)** _____ **to execute the affidavit and did so as his or her free act and deed.**

_____
Notary Public

State of _____ **County of** _____

On this _____ **day of** _____, **20**____, **before me appeared (name)** _____ **to me personally known, who being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm)** _____ **to execute the affidavit and did so as his or her free act and deed.**

_____
Notary Public

-4-

CONSTRUCTION MWBE PARTICIPATION PLAN

D-3240 (08/09)

Office of Business and Job Opportunity

PAGE _____ OF _____

NOTE: The Contractor is required to submit to the Engineering Dept. a MODIFIED PLAN for any changes to the original plan: i.e.; subcontractor, dollar amount or work performed.
If more than 1 page is used, complete totals on last page.

Contract Number: _____ **Contract Description:** _____

Contractor Name: _____

Mailing Address: _____ **Contract Amount:** _____

Telephone Number: _____ **Contract Goals:** **MBE** _____ **WBE** _____ **DBE** _____

Name, Address, _Phone Number of PA Certified MBE/WBE/DBE subcontractor (including name of contact person)	Indicate MBE, WBE Or DBE	Description of Work, Services to be provided. Where applicable, specify, "supply" or "install or both "supply" and "install."	Anticipated date work will start and finish	*Approximate $ amount of M/W/DBE Subcontract	MBE/WBE/DBE % of Total Contract Amount
			TOTAL:		

Signature of Contractor: _____

Print Name: _____

Title: _____ Date _____

FOR OBJO USE ONLY
Contract Goals: ☐ Approved ☐ Waived ☐ Rejected
Reviewed by: _____
OBJO Business Development Representative
Print Name: _____ Date _____

Distribution: Original – OBJO; Copy 2 – Engineer of Construction; Copy 3 – Contractor; Copy 4 – Line Department
*Please Note: supplies, equipment and material men are only credited 60% towards the M/W/DBE goal. Please adjust calculations accordingly.

Schedule C

1391

INSTRUCTIONS

CONTRACTOR INSTRUCTIONS: Contractor is required to submit a MBE/WBE Participation Plan and/or best efforts documentation to the designee identified in the contract book within 7 days after the opening of the Proposals for this Contract.

ENGINEER OF CONSTRUCTION INSTRUCTIONS: After the review of the submitted MBE/WBE Participation plan, forward to the Office of Business and Job Opportunity via fax at (212) 435-7828 or PAD to 233 PAS 4th Floor for review and approval. Approved/waived/rejected plan will be returned within 10 business days of receipt of this document. Engineer of Construction will advise vendor of the results of the MBE/WBE Participation Plan review.

PA 3749 A/ 5-07

THE PORT AUTHORITY OF NY & NJ
Office of Business and Job Opportunity

CONSTRUCTION
MBE/WBE/DBE PARTICIPATION PLAN
MODIFIED

PAGE _____ OF _____

Contract Number: _____

Contractor Name: _____

Mailing Address: _____

Telephone Number: _____

Contract Description: _____

Contract Amount: _____

Contract Goals: **MBE** _____ **WBE** _____ **DBE** _____

Name, Address, _Phone Number of PA Certified MBE/WBE/DBE subcontractor (including name of contact person)	Indicate MBE, WBE Or DBE	Description of Work, Services to be provided. Where applicable, specify "supply" or "install or both "supply" and "install."	Anticipated date work will start and finish	*Approximate $ amount of M/W/DBE Subcontract	MBE/WBE/DBE % of Total Contract Amount
			TOTAL:		

Signature of Contractor: _____

Print Name: _____

Title: _____ Date _____

FOR OBJO USE ONLY
Contract Goals: ☐ Approved ☐ Waived ☐ Rejected
Reviewed by: _____
OBJO Business Development Representative
Print Name: _____ Date _____

Distribution: Original – OBJO; Copy 2 – Engineer of Construction; Copy 3 – Contractor; Copy 4 – Line Department
*Please Note: supplies, equipment and material men are only credited 60% towards the M/W/DBE goal. Please adjust calculations accordingly.

Schedule C

1393

STATEMENT OF PAYMENTS TO M/W/DBE SUBCONTRACTORS/LESSORS/SUPPLIERS

Contract No: _____ Period Reporting: _____ (Example: 10/1/98 - 10/31/98)

Contract Title: _____ Payment Appl #: _____

Contractor: _____ % Project Completed: _____

SUBCONTRACTOR'S NAME	(Indicate) MBE WBE DBE	ESTIMATED TOTAL SUBCONTRACT AMOUNT	Column A AMOUNTS PAID Prior Statement	+ Column B This Statement	= Column C Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0

SUPPLIERS/LESSORS	(Indicate) MBE WBE DBE	TOTAL AMOUNT SUPPLIER AGREEMENT	AMOUNTS PAID (Amounts entered should reflect 100% paid. The 80% check will be handled by the office.) Prior Statement	This Statement	Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0

Date Prepared: _____

Prepared by: _____

Title: _____

Officer's Signature: _____

The Port Authority of NY & NJ
Resident Engineer's Office

Date Received: _____

Reviewed By: _____

Title: _____

Schedule D

FINAL

STATEMENT OF PAYMENT
TO M/W/DBE SUBCONTRACTORS/LESSORS/SUPPLIERS

Contract No:		Period Reporting:	(Example: 10/1/98 - 10/31/98)
Contract Title:		Payment Appl #:	& Final
Contractor:		% Project Completed:	100%

SUBCONTRACTOR'S NAME	(Indicate) MBE WBE DBE	TOTAL SUBCONTRACT AMOUNT	Column A AMOUNTS PAID & TO BE PAID: Prior Statement	+ Column B This Statement	= Column C Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0

SUPPLIERS/LESSORS	(Indicate) MBE WBE DBE	TOTAL AMOUNT SUPPLIER AGREEMENT	AMOUNTS PAID & TO BE PAID (Amounts entered should reflect 100% paid. The 60% credit will be handled by this office.) Prior Statement	This Statement	Cumulative To-Date
					$0
					$0
					$0
					$0
					$0
					$0

Date Prepared:		The Port Authority of NY & NJ Resident Engineer's Office	
Prepared by:			
Title:		Date Received:	
Officer's Signature:		Reviewed By:	
		Title:	

Schedule D