THE PORT AUTHORITY OF NY & NJ
4 World Trade Center, 150 Greenwich Street,21st Floor,New York, NY 10007

Date 08/01/2016

REQUEST FOR QUOTATION

Vendor Name:

Collective/Bid # **46770**
Bid Due Date **08/17/2016**

Bids must be received no later than 11:00 AM on the above Bid Due Date.

Deliver Goods/Services To:
John F Kennedy International Airport
Building No. 14 - Stockroom
Jamaica NY 11430

Port Authority Buyer:
John Santiago/212-435-4613/john.santiago@panynj.gov

Quantity	Description	Unit Price	Total
	RE-BID: SUPPLY AND DELIVER BARE COPPER COUNTERPOISE CABLE, AS SPECIFIED, TO JOHN F. KENNEDY INTERNATIONAL AIRPORT. THE ATTACHED DIVISION 16 SECTIONS 16000, 16129 AND 16450 SERVE AS AN INTRICAL PART OF THIS PROCUREMENT AS IT RELATES TO THE MANUFACTURING AND COMPLIANCE OF THE MATERIALS. REFER TO FAA AC 150/5340-30H, SECTION 12.5 "COUNTERPOISE (LIGHTNING PROTECTION SYSTEM)". BARE COPPER WIRE IS USED TO INSTALL COUNTERPOISE (LIGHTNING PROTECTION) ABOVE ALL DUCTS/CONDUITS. REFER TO FAA AC 150/5340-30H FOR THE DIFFERENCE BETWEEN COUNTERPOISE AND GROUND CABLE. A price preference of 10 % is available for NY/NJ Minority and Women Business Enterprises (MBE/WBE) or 5% for NY/NJ Small Business Enterprises (SBE) certified by the Port Authority of New York and New Jersey by the day before bid opening for awards not exceeding $1,000,000. My firm was certified as a _____on_____.		
	PLEASE QUOTE FULLY DELIVERED PRICES **PAYMENT TERMS**	**Total Delivered Price**	

This Quotation is subject to the terms and conditions set forth on the back page hereof. Bidder is advised to read these before signing.

We have read the instructions and, if favored with an order, we agree to furnish the items enumerated herein at the prices and under the conditions indicated.

Signed _____
Firm Name _____
Telephone number_____Date_____
Fax Number_____
Federal Taxpayer ID _____

Bidder Must Sign In Two Places

NOTICE TO BIDDERS: Unless the following term of assurance that the above offer is irrevocable is signed, the offer submitted herein shall not be deemed to be complete.

The foregoing offer shall be irrevocable for 90 days after the date on which the Port Authority of New York and New Jersey opens this proposal.

Signed_____Date_____
Firm Name_____

THE PORT AUTHORITY OF NY & NJ
4 World Trade Center, 150 Greenwich Street,21st Floor,New York, NY 10007

REQUEST FOR QUOTATION

Vendor Name:	Collective/Bid #	Bid Due Date
	46770	08/17/2016

Quantity	Description	Unit Price	Total
	THE LOWEST BIDDER SHALL SUBMIT, UPON REQUEST, A CATALOG CUT SHEET OR ANY OTHER DOCUMENTATION FOR EACH ITEM TO FACILITATE AN EVALUATION BY THE PORT AUTHORITY. INDICATE PORT AUTHORITY STOCK ITEM NUMBER ON EACH RECORD. BIDDERS SHALL QUOTE NOT MORE THAN TWO (2) DECIMAL PLACES TO THE RIGHT OF THE DECIMAL POINT. IN THE EVENT THAT THIS REQUIREMENT IS NOT FOLLOWED, THE PORT AUTHORITY WILL NOT CONSIDER ANY EXTENDED DECIMAL VALUES AND WILL DEFAULT TO TWO DECIMAL POINTS. THE PORT AUTHORITY WILL NOT ROUND UP OR DOWN ANY VALUES. QUOTES IN 1000/MFT OR KFT ARE NOT ACCEPTABLE. BIDDERS ARE TO QUOTE PER LINEAR FOOT (LF or FT). ALL ITEM QUANTITIES STATED ARE PER FT. NOTES: ALL PRICES QUOTED SHALL BE FIRM AND FIXED WITHOUT ADJUSTMENT FOR THE ENTIRE IRREVOCABLE BID PERIOD OF 90 DAYS AFTER THE BID OPENING DATE. ALL PRICES SHALL BE FOB DELIVERED ON A FLAT BED TRUCK. CABLE REELS TO BE MARKED WITH PURCHASE ORDER NUMBER, REEL NUMBER, MANUFACTURER NAME, FEET PER REEL. REELS SHALL BE NON-RETURNABLE WOOD AND SHALL NOT BE WOOD FLANGE OR CARDBOARD COVER. PULLING GRIPS ARE NOT REQUIRED.		
	PLEASE QUOTE FULLY DELIVERED PRICES **PAYMENT TERMS**	**Total Delivered Price**	

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THE PORT AUTHORITY OF NY & NJ
4 World Trade Center, 150 Greenwich Street,21st Floor,New York, NY 10007

Date 08/01/2016

REQUEST FOR QUOTATION

Vendor Name:	Collective/Bid #	Bid Due Date
	46770	08/17/2016

Quantity	Description	Unit Price	Total
	This is a Formal Bid Invitation Bid Submission Instructions: Sealed Bids must be submitted to and received at the following address by the due date and time listed on this Request for Quotation, where they will be publicly opened and read: The Port Authority of NY & NJ Attn: Bid Custodian Procurement Department 4 World Trade Center 150 Greenwich Street, 21st Floor New York, NY 10007 Clearly mark the outside of your envelope/package with "BID ENCLOSED", the Collective/Bid Number and Due Date, and your complete company name and address. Bids are only accepted Monday through Friday, excluding Port Authority holidays, between the hours of 8 A.M. & 5 P.M., via regular mail, express delivery service or hand delivery. Express carrier deliveries by commercial vehicles can be made via vendors approved by Silverstein Properties, the 4 World Trade Center (4WTC) Property Manager, through the Vehicle Security Center (VSC). Presently, UPS is the only delivery vendor with approved recurring delivery times. There is extensive security at the World Trade Center Site. Individuals must present a valid government-issued photo ID to enter 4 WTC. Individuals without packages or carrying small packages or boxes that can be conveyed by hand or on a hand truck may enter through the lobby. **PLEASE QUOTE FULLY DELIVERED PRICES**		
	PAYMENT TERMS	**Total Delivered Price**	

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Firm Name _____

Telephone number_____Date_____

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Signed_____Date_____

Firm Name_____

REQUEST FOR QUOTATION

Vendor Name:	Collective/Bid #	Bid Due Date
	46770	08/17/2016

Quantity	Description	Unit Price	Total
	All envelopes, packages and boxes may be subject to additional security screening. There is no parking available at 4 WTC/150 Greenwich Street, and parking in the surrounding area is extremely limited. The Port Authority assumes no responsibility for delays, including, but not limited to delays caused by any delivery service, building access procedure or security requirement. A valid government-issued photo ID is required to gain access into the building to attend the bid opening or hand deliver a bid. Bids that are not received by the bid custodian by the scheduled bid opening date will be considered late. If any Addenda are posted or sent as part of this Bid, the Bidder shall complete, sign and include with its Bid the addenda form(s). In the event any Bidder fails to conform to these instructions, its Bid will nevertheless be construed as though the Addenda had been acknowledged. If the Bidder downloaded this solicitation document, it is the responsibility of the Bidder to periodically check the Port Authority website at http://www.panynj.gov/business-opportunities/bid-proposaladvertisements.html and download any addenda that might have been issued in connection with this solicitation.		
	PLEASE QUOTE FULLY DELIVERED PRICES	**PAYMENT TERMS**	**Total Delivered Price**

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THE PORT AUTHORITY OF NY & NJ
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Date 08/01/2016

REQUEST FOR QUOTATION

Vendor Name:

Collective/Bid # 46770 | Bid Due Date 08/17/2016

Quantity	Description	Unit Price	Total
77,500 FT	CS0100002 COUNTERPOISE, BARE COPPER, #6 AWG. WIRE SHALL BE SUPPLIED ON NON-RETURNABLE WOOD REELS, 2500 LF OF WIRE PER REEL. OVERDELIVERY TOLERANCE: 5.0%, UNDERDELIVERY TOLERANCE: 0.0%. PER PA SPECIFICATION 16000, 16129, 16450. MANUFACTURER:_____ PLANT LOCATION:_____ MAKE/MODEL/PART NUMBER:_____ LEAD TIME A.R.O.: _____ DAYS		
1,500 FT	CS0100005 COUNTERPOISE, BARE COPPER, #1/0 AWG. WIRE SHALL BE SUPPLIED ON ONE NON-RETURNABLE WOOD REEL. OVERDELIVERY TOLERANCE: 5.0%, UNDERDELIVERY TOLERANCE: 0.0%. PER PA SPECIFICATION 16000, 16129, 16450. MANUFACTURER:_____ PLANT LOCATION:_____ MAKE/MODEL/PART NUMBER:_____ LEAD TIME A.R.O.: _____ DAYS		
	PLEASE QUOTE FULLY DELIVERED PRICES	**PAYMENT TERMS**	**Total Delivered Price**

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Fax Number_____
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Signed_____Date_____
Firm Name_____

PA280/9-03

TERMS AND CONDITIONS

1. The Port Authority (PA) reserves the right to request information relating to seller's responsiblity, experience and capability to perform the work.
2. Unless otherwise provided, complete shipment of all items must be in one delivery FOB delivery point. Payment will not be made on partial deliveries unless authorized in advance by the party to be charged and the discount, if any, will be taken on the total order.
3. PA payment terms are net 30 days. Cash discounts for prompt payment of invoices may be taken but will not be considered in determining award, except in the case of tie bids.
4. Separate unit and total FOB delivered prices must be shown.
5. Sales to the PA and to PATH are currently exempt from New York and New Jersey State and local taxes and generally from federal taxation. The seller certifies that there are no federal, state, municipal or any other taxes included in the prices shown hereon.
6. The PA shall have the absolute right to reject any or all proposals or to accept any proposal in whole or part and to waive defects in proposals.
7. Unless the phrase "no substitute" is indicated, bidder may offer alternate manufacturer / brands, which shall be subject to Port Authority approval. Please indicate details of product being offered with bid.
8. Acceptance of seller's offer will be only by Purchase Order Form signed by the PA. No change shall be made in the agreement except in writing.
9. If the seller fails to perform in accordance with the terms of this purchase order, the PA may obtain the goods or services from another contractor and charge the seller the difference in price, if any, a reletting cost of $100, plus any other damages to the PA.
10. Upon request, sellers are encouraged to extend the terms and conditions of any terms agreement with the PA to other government and quasi-government entities by separate agreement.
11. By signing this quotation or bid, the seller certifies to all statements on Form PA 3764A regarding non-collusive bidding; compliance with the PA Code of Ethics; and the existence of investigations, indictments, convictions, suspensions, terminations, debarments and other stated occurrences to assist the PA in determining whether there are integrity issues which would prevent award of the contract to the seller. The PA has adopted a policy set forth in full on PA 3764A, that it will honor a 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 wage legislation. The Terms and Conditions of PA 3764A apply to this order. A copy can be obtained by calling (212) 435-4600 or at http://www.panynj.gov/business-opportunities/become-vendor.html
12. The vendor may subcontract the services or use a supplier for the furnishing of materials required hereunder to such persons or entities as the Manager, Purchasing Services may from time to time expressly approve in writing. All further subcontracting shall also be subject to such approval.
13. The successful bidder (vendor) shall not issue nor permit to be issued any press release, advertisement, or literature of any kind, which refers to the Port Authority or that goods will be, are being or have been provided to it and/or that services will be, are being or have been performed for it in connection with this Agreement, unless the vendor first obtains the written approval of the Port Authority. Such approval may be withheld if for any reason the Port Authority believes that the publication of such information would be harmful to the public interest or is in any way undesirable.
14.Neither the Commissioners of the Port Authority, nor Directors of PATH, nor any of them, nor any officer, agent or employee thereof, shall be charged personally by the Contractor with any liability, or held personally liable to the Contractor under any term or provision of this Agreement, or because of its execution or attempted execution, or because of any breach, or attempted or alleged breach, thereof.

DIVISION 16

SECTION 16000

ELECTRICAL GENERAL REQUIREMENTS

PART 1. GENERAL

1.01 SUMMARY

Unless otherwise shown on the Contract Drawings, 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 Contract Drawings.

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 Contract Drawings, 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 Contract Drawings, 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 Contract Drawings 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 Contract Drawings, 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 Contract Drawings.

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 Contract Drawings 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 Contract Drawings 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 Contract Drawings 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 Contract Drawings, 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 Contract Drawings.

B. Unless otherwise shown on the Contract Drawings, 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 Contract Drawings, 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 Contract Drawings, 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 Contract Drawings, 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 Contract Drawings.

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 Contract Drawings.

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 Contract Drawings.

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 Contract Drawings.

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 Contract Drawings.

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 Contract Drawings, 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 Contract Drawings.

E. Maintenance Manuals

Operation and maintenance manuals, where required by the Specifications or the Contract Drawings.

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"

SECTION 16129

TAXIWAY / RUNWAY WIRES AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies requirements for wires, cables, splices, terminations, and appurtenances for airfield construction.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

A. Wires, cables, splices and terminations for airfield construction furnished and installed in accordance with this Section, and as indicated on the Contract Drawings.

B. Components of the taxiway / runway wires and cables shall be manufactured and installed to meet all of the applicable requirements of FAA Advisory Circulars and all local codes.

1.03 RELATED SECTIONS

A. None

1.04 REFERENCES

A. ASTM International (ASTM)

1. B1 - Standard Specification for Hard-Drawn Copper Wire
2. B2 - Standard Specification for Medium-Hard-Drawn Copper Wire
3. B3 - Standard Specification for Soft or Annealed Copper Wire
4. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
5. B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
6. B189 – Standard Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
7. D2303 – Standard Test Methods for Liquid-Contaminant, Inclined Plane Tracking and Erosion of Insulating Materials
8. D2802 - Standard Specification for Ozone-Resistant Ethylene-Alkene Polymer Insulation for Wire and Cable

B. Federal Aviation Administration, Advisory Circular (FAA-AC)

1. 150/5340-30 – Design and Installation Details for Airport Visual Aids

2. 150/5345-7 – Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

3. 150/5345-26 – FAA Specification for L-823 Plug and Receptacle, Cable Connectors

C. Federal Specifications (FS)

1. SS-S-1401 – Sealant, Joint, Non-Jet-Fuel-Resistant, Hot Applied, for Portland Cement and Asphalt Concrete Pavements

D. Insulated Cable Engineers Association (ICEA)

1. S-96-659 –Nonshielded 2001-5kV Cables

E. Institute of Electrical and Electronics Engineers (IEEE)

1. 383 – IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities

F. National Electrical Manufacturers Association (NEMA)

1. WC-71 –Nonshielded Cables Rated 2001-5000 V for use in the Distribution of Electric Energy

G. Underwriters Laboratories Inc. (UL)

1. 44 – Thermoset-Insulated Wires and Cables

2. 83 – Thermoplastic-Insulated Wires and Cables

1.05 SUSTAINABLE DESIGN REQUIREMENTS

A. Not Applicable

1.06 QUALITY ASSURANCE

A. Tests requiring certified reports and those requiring factory witness or field inspection shall be conducted and reported to the Engineer in conformance with those standards specified in this Section.

B. Installations shall comply with the standards of the Federal Aviation Administration (FAA) where applicable.

C. Wires and cables that have been manufactured more than two years prior to installation shall not be used in the work of this Section.

D. All wires, cables, splices and terminations, for which there are established UL standards, shall bear the UL label.

1.07 SUBMITTALS

See Appendix “A” for Submittal requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Where multi-conductors are to be installed as one cable, single conductor cables shall be combined together by the cable manufacture 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.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General

1. Locations, types, sizes and numbers of wires and cables are shown on the Contract Drawings.
2. Unless otherwise shown on the Contract Drawings, 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. All electrical materials and equipment, for which there are stabled UL standards, shall bear the UL Label.

B. 600-volt Insulated Wires and Cables

1. Power Wires and Cables
   a. Secondary Series Lighting wire and cable shall be watertight thermoplastic rubber insulated.
2. Grounding Wires and Cables

   Unless otherwise shown on the Contract Drawings, 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.
      2) Insulation shall be a continuous green color, double rated THHN-THWN thermoplastic insulated and nylon jacketed, gasoline and oil resistant and conform to UL 83.
   b. Un-insulated
      1) Solid for sizes # 8 AWG and smaller, Class B Stranded for sizes # 6 AWG and larger.
      2) In raceways
         a) Soft-drawn and conforming to ASTM B3
      3) Direct Buried or Encased in Concrete
         a) Soft-drawn, medium-hard-drawn or hard-drawn and conforming to ASTM B3, B2, or B1, respectively.

C. 5000 volt Insulated Wires and Cables:

1. Primary Series Lighting Cable shall be Non-Shielded 5000 Volt Rated, Type 'B', Single Conductor, Coated Copper, Class C, 19 Strands, Ethylene-Propylene-Rubber-Insulated (ASTM D-2802 and ICEA S-96-659) and Chlorinated Polyethylene Jacket (CPE-EPR). The cable shall comply with FAA-AC 150/5345-7 and shall be approved under FAA Specification No. L-824B. Where two cables of a single circuit are indicated on the Contract Drawings, the two cables shall be combined together in one reel, with one of the cables identified with a yellow stripe running the entire length of the cable jacket.6129.

2.02 SPLICING AND TERMINATING MATERIALS

A. General

All materials for making splices and termination shall be specifically designed for use with the type of wire or cable, insulation and installation and operating conditions of the specific application.

B. Power Wire and Cable Splices

1. Connector shall be insulated compression (indenter) type as specified on the contract drawings.
2. Silicone Sealant shall be as specified on the contract drawings.
3. Heat Shrinkable Tubing shall be either irradiated modified polyvinyl-chloride or irradiated polyolefin as specified on the Contract Drawings.

C. Secondary Series Lighting Cable Connectors

1. Double Pole plug and receptacle connectors for the secondary series lighting system shall comply with Section 1.04.B.3 and shall be approved under FAA Specification No. L-823 in accordance with Figure No 1. Plug and Receptacles shall be as specified on the Contract Drawings.

D. Series Lighting Cable Connectors

1. Single Pole plug and receptacle connectors for the primary series lighting cable system shall comply with FAA-AC 150/5345-26 and shall be approved under FAA Specification No. L-823 in accordance with Figure No. 2. Plug and receptacles shall be as specified on the contract drawings. Coordinate the connector size for use with the cable.

E. Cable Tags

1. Stainless steel metal tags, No. 25 gauge, and 3/4 inch wide and length as required by circuit designation, embossed with letters and numerals 1/4 inch high fastened to the cable at both ends of tags with stainless steel cable ties. Circuit designation shall be as specified on Contract Drawings or otherwise directed by the Engineer.

2.03 FACTORY / SHOP TESTS

A. General

1. Factory or in-plant and independent laboratory tests shall be in conformance with the applicable standards and as specified in this Section. All testing, and the results thereof shall be certified, in writing, to the Engineer for approval.

B. Factory or In-Plant Tests

1. 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 factory tests as required, or to waive factory inspection or witnessing of tests.

2. The Contractor shall notify the Engineer 14 days in advance of such factory tests.

3. 600 Volt Insulated Wires and Cables

a. For quantities as shown on the Contract Drawings, regular dielectric-withstand and insulation-resistance in water tests for wires and cables shall be performed in accordance with UL 44.

b. Flame tests for wires and cables shall be performed in accordance with IEEE 383.

4. 5000 Volt Insulated Wire and Cables

a. Tests for wires and cables shall be in accordance with 1.04.B.2 and 1.04.D.1.
b. Independent Laboratory Tests

The following tests shall be performed by an independent test laboratory:

1) Specific Surface Resistivity

The specific surface resistivity of the cable jacket shall have a value greater than 200,000 Mega-ohms under all of the following conditions:

a) As Manufactured
b) After immersion in tap water at 30 Degrees Celsius for 28 days with measurements performed after the first day and then every week.
c) After immersion in a 50/50 solution of potassium acetate (KAc) deicer and tap water at 30 Degrees Celsius for 28 days with measurements performed after the first day and then every week.

2) The values of specific surface resistivity obtained in 2.03 B.4.b.1 shall be plotted to demonstrate stability over time.

3) Drip Track Resistance

Using apparatus described in ASTM Standard D2303, the cable jacket shall pass the following test:

a) No. of Samples: 6 – after immersion for 28 days in KAc / Water Solution.
b) Wetting Solution: 50 / 50 KAc / Water
c) Wetting Rate: 0.2 cm^3 / minute
d) Applied Voltage Steps: 100 Volts / 30 Minutes
e) Initial Tracking Voltage: greater than 1000 Volts(Median Value)

Airport lighting cables that satisfy the above requirements should bear the following jacket printing:

"Cable Manufacturer" FAA-L-824 Type B MOD A

4) Certification and test required under Section 2.03 shall be performed by an independent test laboratory. Submit qualifications and the test procedure of the test lab for approval prior to testing.

5) Testing shall not be required for a previously certified cable if the same manufacturer for the identical cable using identical materials has performed successful testing. The certified test data shall be submitted for approval.

PART 3 - EXECUTION

3.01 PREPARATION

A. Inspect the raceways and conduits prior to installation of wires and cables and notify the Engineer in writing in the event of the finding conditions that would prevent the proper installation of materials using the methods specified in this Section.

B. Prior to puling wires and cables, clean the raceway systems of all foreign matter and perform all operations necessary so not as to cause damage to wires and cables while pulling.

C. 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

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. For the connection of taxiway and runway lights to the secondary side of the isolating transformers as per the latest FAA Advisory Circulars.

   b. Leave sufficient slack in each cable, but in no case less than:

      1) Three feet in base cans
      2) Three feet in light boxes

3. 5000 Volt Series Lighting Cables

   a. For connection of the airport Constant Current Regulator output to the primaries of the isolating transformers.

   b. Leave sufficient slack in each cable, but in no case less than:

      1) Fifteen feet in manholes
      2) Ten feet in handholes
      3) Three feet in light boxes
      4) Three feet in base cans

B. Connections and Terminations

1. General Purpose Wires and Cables

   a. After the cable has been installed, the connections and terminations shall be installed in accordance with the manufacturer's instructions.

2. 5000 Volt Series Lighting Cables

   a. Connections to Transformers

      1) At each isolating transformer for runway and taxiway lights and taxiway signs and as shown on the Contract Drawings, the primary connectors shall consist of an assembly of L-823 Single Pole Plug and Receptacle cable connectors, and heat shrinkable insulation tubing.

         a) Heat shrinkable insulation tubing shall be 12 inches minimum length and its interior shall be coated with elastic mastic to assure a watertight seal after shrinking.
         b) Heat shrinkable insulation tubing may be installed in three sections to accommodate a connector that is not uniform in shape. The lengths of the sections shall be two (2) at six (6) inches long and one (1) at nine (9) inches long.

      2) After the cable has been installed, the connectors shall be installed on the ends of the Series Lighting Cable in accordance with the manufacturer's instructions.

a) The receptacle shall be installed at one end of the cable and the plug at the other end to establish a continuous plug and receptacle sequence through the wiring system and its associated isolating transformers.

b) Precautions shall be taken to release trapped air when inserting the plug in the receptacle. After the joint has been made and wiped clean of excess jelly, a heat shrinkable insulation tube shall be applied over the plug and receptacle in accordance with the manufacturer's recommendations and as approved by the Engineer.

b. Connections

1) Where the Primary Series Lighting Cables are run through or into taxiway light boxes, hand holes, or manholes, without connection to an isolating transformer, a plug and connector type installation as described immediately above, shall be used.

2) The maximum lengths of uncut wires and cables shall depend on the lengths of wire and cable that can be installed without damage.

C. Identification of Wires and Cables

1. Each wire and cable shall be identified by its circuit in all cabinet boxes, manholes, hand holes, wireways and other enclosures or access locations, and at all terminal points.

2. The circuit designations shall be as shown on the Contract Drawings or as directed by the Engineer. Tags shall be attached to wires and cables in such a manner as to be readily visible.

3. Wire and Cable tags shall be fastened to both ends of the series lighting wires and cables.

3.03 FIELD TESTS

In addition to other tests that may be required in other Sections, the Contractor shall perform the following field tests in the presence of the Engineer, to demonstrate the reliability of the electrical installation.

A. Tests on the cables shall be made in accordance with the FAA-AC 150/5340-30.

B. All series lighting cables and circuits shall be tested with a 5000-volt megohmmeter. Insulation resistance test equipment shall be battery operated. All testing shall be performed for one minute durations. Readings shall be taken after circuits have been de-energized for several hours as reading may appear higher immediately after operating the circuit. The following test procedure shall be performed on all series lighting circuits:

1. Remove all electrical power from the cable that shall be tested. Cover one end of the cable with an insulator to prevent the cable from accidentally shorting to ground and thereby giving a false reading.

2. Attach the positive (+) end of the megohmmeter to the exposed end of the bare copper cable. Connect the ground wire from the meter to the ground of the electrical system, a ground wire or ground electrode.

3. Switch the meter to the "on" position. Press the charge button or meter button designated to perform the charge function to commence the testing as described in the operating manual for the megohmmeter. Observe the meter for one minute. Once the readings stabilize, record the final value.

4. The testing shall use the step voltage method, using a minimum of 3 voltage levels; 1000 volts, 2500 volts, and 5000 volts. Sufficient time shall be allowed for charging currents to subside. Minimum insulation values shall be met at any and all voltage levels. (See Appendix "A" for calculation of insulation values.) A written record of all tests shall be furnished to the Engineer before acceptance of the insulation. Records shall include date and time of testing, test voltage levels and megohmmeter reading results.

5. Qualified personnel shall perform tests following strict adherence to the requirements of the Port Authority and the manufacturer of the equipment. All safety and operating rules shall be strictly observed and enforced.

C. After the installation has been completed, the Contractor shall successfully operate all electrical equipment for a continuous 24-hour period.

D. Unless otherwise shown on the Contract Drawings, all labor, materials and power required for the above tests shall be furnished by the Contractor. The Authority will furnish only power for the operating test.

E. Should the foregoing test results reveal any defects, promptly correct such defects and rerun the test until the entire installation is satisfactory to the Engineer in all aspects.

F. If any defects in existing equipment or materials are disclosed by the foregoing tests, the Contractor shall so notify the Engineer. After verification by the Engineer, and upon the Engineer's written order, the Contractor shall correct the installation to the extent directed by the Engineer. Any work so ordered by the Engineer and performed by the Contractor in connection with replacing of existing defective equipment or materials shall be compensated for in accordance with the clause of the Form of Contract entitled "Compensation for Extra Work." Damage to existing equipment or materials caused by the Contractor's acts or omissions shall be repaired at the Contractor's cost.

END OF SECTION

SECTION 16129

TAXIWAY / RUNWAY WIRES AND CABLES

APPENDIX A

SUBMITTAL REQUIREMENTS

Submit Catalog Cuts for the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Shop Drawings

1. Primary Series Lighting Cable
2. Primary Series Lighting Cable Connections and Terminations
3. Secondary Series Lighting Cable
4. Secondary Series Lighting Cable Splices
5. Grounding Cable
6. Single Pole Plug Connector
7. Double Pole Plug Connector
8. Flanged Receptacle Connector
9. Cable Tags
10. Sealer

B. Submit certified factory or in-plant test reports for wires and cables.

C. Submit certified independent laboratory test report for wires and cable.

D. Submit Field Test reports for wires and cables, including all test data and methodology.

E. Submit calculated insulation resistance values for airfield circuits. Utilizing the following formula:

1. The first portion of the circuit analyzed is the single conductor 5000 volt insulated cable from the constant current regulator to the first L-823 connector splice. RC1 calculates the insulation resistance of the cable, which connects the Constant Current Regulator (CCR) to the first L-823 connector in the circuit.

   Measured insulation values shall not be below RC1, computed by the following formula:

$$RC1 = K * \mathrm{Log}\left(\frac{D}{d}\right) * \left(\frac{1000}{Lc1}\right)$$

   Where:

   RC1, Ris, RC2, RC3 = Insulation resistance in mega ohms

K = Specific insulation resistance in mega ohms per 1000 feet at 60˚F, K for Ethylene Propylene Rubber Insulation (EPR) = 20,000 mega ohms, or as per manufacturer specifications.
D = Outer diameter of insulation
d = Outer diameter of bare copper wire
Lc1, Lc4 = Total length of airfield cable in feet for the given portion

2. The second portion of the calculation involves the insulation resistance contribution from the first L-823 connector splice, cables, isolation transformers, L-823 connector splices to the last L-823 connector splice within the circuit.

The measured insulation resistance value shall not be below Ris, computed by the following formula:

$$R1 = \frac{Rit}{Nit}$$

$$R2 = \frac{Rs}{Ns1}$$

$$R3 = \left[K * \text{Log}\left(\frac{D}{d}\right) * \frac{\left(\frac{1000}{Lc2}\right)}{Nc1} \right]$$

$$Ris = \frac{1}{\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}}$$

Where:

R1, R2, R3 = Equivalent insulation resistance of isolation transformer, connection splices and cables.

Nit = Quantity of isolation transformers
Rit = Insulation resistance of each isolation transformer
Ns1, Ns2 = Quantity of L-823 connector splices
Rs = Insulation resistance of each splice
Rit = 7,500 MΩ (FAA AC 150/5345-47) or per manufacturer
Rs = 25,000 MΩ (FAA AC 150/5345-26) or per manufacturer
Lc2, Lc3 = Length of each airfield cable segment for the given portion
Nc1, Nc2 = Number of cable segments

3. The third portion includes the single conductor 5000 volt insulated cable and the L-823 connectors associated with the return cable from the last L-823 connector splice in the last light base back to the first L-823 connector associated with the return cable in the first light base.

The measured insulation resistance value shall not be below Ris1, computed by the following formula:

$$R4 = \frac{Rs}{Ns2}$$

$$R5 = \left[K * \text{Log}\left(\frac{D}{d}\right) * \frac{\left(\frac{1000}{Lc3}\right)}{Nc2}\right]$$

$$Ris1 = \frac{1}{\frac{1}{R4}+\frac{1}{R5}}$$

Where:

R4, R5 = Equivalent insulation resistance of connector splices and cables.

4. The fourth portion includes the length of single conductor 5000 volt return cable from the first L-823 connector in the first light base associated with the return cable in the circuit back to the CCR.

   The measured insulation resistance value shall not be below RC2, computed by the following formula:

$$RC2 = K * \text{Log}\left(\frac{D}{d}\right) * \left(\frac{1000}{LC4}\right)$$

5. The final circuit after all splices are completed must have an insulation resistance value of not less than Rt. Rt is the final equivalent insulation resistance of the four parts of the calculation.

   Rt is computed by the following formula:

$$Rt = \frac{1}{\frac{1}{RC1} + \frac{1}{Ris} + \frac{1}{Ris1} + \frac{1}{RC2}}$$

END OF APPENDIX "A"

DIVISION 16

SECTION 16450

GROUNDING

PART 1. GENERAL

1.01 SUMMARY

This Section specifies requirements for grounding.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

	Administrative Code
	Electrical Code of the City of New York
	American National Standards Institute (ANSI)
ANSI C 2	National Electrical Safety Code
	Institute of Electrical and Electronics Engineers (IEEE)
IEEE Std 142-2007	Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE Std 1100-2005	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

1.03 QUALITY ASSURANCE

A. Components and installation shall comply with NFPA 70, "National Electric Code."

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.

1.04 SUBMITTALS

See Appendix A for Submittal Requirements.

PART 2. PRODUCTS

2.01 GENERAL

Furnish grounding elements for switchgear, transformers, cabinets panelboards, starters, and miscellaneous electrical equipment, 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.

2.02 MANUFACTURERS

Subject to compliance with the requirements of this Section, provide grounding products of manufacturers as shown on the Contract Drawings.

2.03 GROUND RODS

Ground rods shall be copper clad steel. Unless otherwise shown on the Contract Drawings, the rods shall be 3/4-inch diameter by 10 feet long.

2.04 GROUNDING CONDUCTORS

A. Provide grounding conductors in accordance with the requirements of NFPA 70, and Sections entitled "WIRES, CABLES, SPLICES, TERMINATIONS (600 VOLTS OR LESS)," "WIRES, CABLES, SPLICES, TERMINATIONS (MEDIUM VOLTAGE)," and "TAXIWAY/RUNWAY WIRES AND CABLES," as applicable, and as specified on the Contract Drawings.

B. Equipment grounding conductors shall be green insulated.

C. Isolated grounding conductors shall be green insulated with yellow striping.

2.05 ABOVE GRADE CONNECTIONS

Connectors to piping, fencing, and conduit systems shall be listed and labeled as grounding connectors for the materials used.

2.06 BELOW GRADE CONNECTIONS

Buried Cable and ground rod connections shall be exothermic welds. Welded connections shall be provided in kit form and selected for the specific types, sizes, and combinations of conductors shown on the Contract Drawings.

2.07 GROUNDING BUSHINGS

Grounding Bushing shall be insulated type.

2.08 NOT USED.

PART 3. EXECUTION

3.01 INSTALLATION

A. General

Install grounding elements for switchgear, transformers, cabinets, panelboards, starters, and miscellaneous electrical equipment, for all metallic 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 as shown 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. General

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.

3.02 FIELD TESTS

Make ground resistance tests 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 ground resistance on a grounding resistance test is higher than the value specified in 3.01 I, 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"

SUBMITTAL REQUIREMENTS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts, and Samples" of Division 1 - GENERAL PROVISIONS:

A. Catalog Cuts for ground rods, connectors and connection materials, and grounding fittings.

B. Ground Resistance Test Results.

END OF APPENDIX "A"