

**PORT AUTHORITY TRANS-HUDSON CORPORATION
TWO MONTGOMERY STREET - 1st FLOOR
JERSEY CITY, NJ 07302**

March 6, 2020

ADDENDUM NO. 2

TO PROSPECTIVE BIDDERS ON CONTRACT **PAT-024.165** – PATH – HARRISON STATION - NORTHWEST STATION HOUSE, PLATFORM, AND PLAZA REPLACEMENT AND CONTRACT **PAT-024.165M** – HARRISON STATION – AGREEMENT TO PERFORM LANDSCAPE MAINTENANCE

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 Bid will nevertheless be construed as though this communication had been so physically annexed and initialled.

CHANGES IN THE CONTRACT BOOKLET

- Page viii - Immediately after "264100 LIGHTNING PROTECTION SYSTEM", insert the following:
"264200 CATHODIC PROTECTION".
- Page ix - Immediately after "271323 FIBER OPTIC CABLING", insert the following:
"275116 PUBLIC ADDRESS SYSTEM".
- Page 1 - In the second line of the first paragraph, change the date for receipt of Bids to "April 2, 2020".
- Page 1191 - Immediately following this page, insert new pages 1191A through 1191N (14 pages) which are attached hereto and made a part hereof.
- Page 1273 - In 1.02, delete the second through sixth lines in their entirety and substitute therefor the following:
- " 1. Division 26 Section 260000 – Electrical General Requirements
 2. Division 26 Section 260526 – Grounding
 3. Division 26 Section 260527 – Electrical Bonding
 4. Division 26 Section 260529 - Supporting Devices
 5. Division 26 Section 260533 - Raceways
 6. Division 26 Section 260534 - Boxes and Fittings
 7. Division 07 Section 078413 – Penetration Firestopping".

- Page 1283 - In 3.06, delete lines B. and C. with no substitution therefor.
- Page 1285 - Immediately following this page, insert new pages 1285A through 1285GG (40 pages) which are attached hereto and made a part hereof.

REVISED CONTRACT DRAWINGS

Drawing CS0001, CS0002, CS0003, A0103 and A0232 have been revised as of 03/02/20. A copy of these drawings are forwarded herewith on CD. Destroy the drawings of these numbers now in your possession and substitute therefor the revised drawings.

PORT AUTHORITY TRANS-HUDSON CORPORATION

James Starace, P.E.
Chief Engineer/Director
The Port Authority of New York and New Jersey

INITIALLED BY THE BIDDER:

DIVISION 26
SECTION 264200
CATHODIC PROTECTION

PART 1. GENERAL

1.01 SUMMARY

This Section specification requirements for corrosion control and grounding. Corrosion control systems shall prevent premature failures due to corrosion; minimize stray current effects on the system and on other underground structures; and be economical to install, operate, and maintain. Grounding systems shall protect equipment from damaging voltages and currents and shall prevent electrical shock hazards to the public, system employees, and Contractor personnel due to lightning, PATH Train power systems, and other adjacent power sources.

Submit the Contractor Team qualifications for the engineer with a list of the team members, resumes, and associated project examples.

All cathodic protection systems and stray current mitigation designs shall be registered with the Greater New York Corrosion Committee.

1.02 REFERENCES

The Following is a listing of publications referenced in this section:

- A. *The National Association of Corrosion Engineers (NACE)*
- B. *The Society for Protective Coatings (SSPC)*
- C. *British Standards European Norm (BSEN)*
- D. *The Institute of Electronic and Electrical Engineers (IEEE)*
- E. *The National Electric Code (NEC)*
- F. *New Jersey Electric Code (NJEC)*
- G. *The Electrochemical Society (IES)*
- H. *The American Concrete Institute (ACI)*
- I. *International Standards Organization (ISO)*

1.03 PERFORMANCE AND/OR ENVIRONMENTAL REQUIREMENTS

All Work shall be in accordance with all Federal, State, and Local Regulations including the following:

- A. National Electrical Code

B. Environmental Protection Agency

1.04 QUALITY ASSURANCE

- A. The Contractor Team shall be responsible for all corrosion control implementation phases of the work. The Contractor is responsible for all corrosion and stray current related activities and is subject to all key personnel requirements in the Contract Documents.
- B. The Contractors Team shall consist of a Subject Matter Experts (SME) in the following disciplines: Concrete Corrosion, Pipeline Corrosion, Stray Current, Coatings, Impressed Current Cathodic Protection (Concrete and Pipelines), and Material Selection. All information provided to the Engineer by the Contractor related to Corrosion Control and Stray Current work shall contain the signature of the Contractor.
- C. The Contractor or its designated Subcontractor shall have been continuously engaged in the field of corrosion control for a minimum of five years and shall have installed and tested a minimum of ten cathodic protection systems for corrosion protection of underground structures. The entity performing supervision and testing shall employ a NACE International Certified Corrosion or Cathodic Protection Specialist to supervise the testing and installation of the cathodic protection system, or approved international expertise or experience.
- D. Record all test results and be submitted to the Engineer for approval.
- E. All aspects of the corrosion control systems, including cathodic protection systems and stray current mitigation, shall be performed by the Contractor who shall have a minimum of 10 years' experience as a certified corrosion control specialist by the National Association of Corrosion Engineers (NACE) or with the equivalent relevant proven expertise. The Contractor shall demonstrate extensive experience in corrosion issues found on transit systems and specific experience with; track systems, superstructure, wayside installations along the superstructure, lightning protection systems, and substructure elements. The Contractor shall also have previous experience with stray current monitoring systems specifically configured for the superstructure and substructure elements.

1.05 DELIVERY, STORAGE

- A. Deliver materials to the construction site in original, unopened, protective packaging. All materials shall be inspected, on site.
- B. Store materials in an approved location in a clean, dry space and protect them from the weather.
- C. Handle in a manner to prevent damage to the materials.
- D. Where possible, maintain protective coverings until the installation is complete and remove such coverings as part of the installation final clean up.

1.06 SUBMITTALS

See Appendix "A" for submittal requirements.

PART 2. PRODUCTS

2.01 MATERIALS

A. Prepackaged 48 Pound Magnesium Anodes

Each anode shall weigh 48 pounds, excluding backfill. The anode shall be 5.5 inches in diameter by 30 inches long.

1. Composition of the anode shall be as follows:

Aluminum	0.010% Maximum
Manganese	0.50 to 1.30%
Copper	0.02% Maximum
Nickel	0.001% Maximum
Zinc	0.05% Maximum
Iron	0.03% Maximum
Silicon	0.05% Maximum
Other	0.05% each
Magnesium	Remainder

2. The anodes shall be packaged in an inner cloth bag and in an outer paper bag that are 9.25 inches in diameter by 44.5 inches long.

3. The anode package shall contain a minimum of 55 pounds of backfill. The backfill material shall have the following composition:

Hydrated Gypsum	75%
Bentonite	20%
Sodium Sulfate	5%

4. The anode and backfill shall be prepackaged into a single unit, as described above. The bag shall contain centering devices to maintain the anode in a centered position surrounded fully by the special backfill. A minimum of 10 feet of AWG No. 12 solid copper wire with TW insulation (black) shall be attached to the anode. Wire to anode attachment shall be by silver solder and sealed to prevent any moisture penetration.

B. Impressed Current Anodes

Mixed metal oxide tubular anodes 3/4 inch by 48 inches long (titanium substrate), as supplied by Stuart Steel Protection Corporation (telephone number 731-469-5544) or approved equal. The anodes shall be supplied with 40 feet of AWG no. 8 HMWPE insulated stranded copper cable.

C. Reference Electrodes

Electrochemical Devices, Inc. Model US Slimline copper/copper sulfate permanent, reference electrode shall be used, as manufactured by: Electrochemical Devices, Inc., P.O. Box 355, Belmont, MA 02178, (617) 484-3923 or approved equal. The reference

electrodes shall be supplied with 20 feet of AWG no. 14 HMWPE insulated stranded copper cable.

D. Deep Anode PVC Casing

1. PVC Surface Casing: 8" solid, schedule 40, ASTM D-1785 PVC casing above anode column. Length sufficient to reach the surface as indicated on Contract Drawings.
2. Slotted PVC Casing (well screen/casing) for Anode Column: The perforated casing for the active anode area of the deep anode shall be fabricated of Schedule 40 PVC conforming to ASTM D-1785. The casing shall be fabricated as follows:
 - a. Diameter: 8-inches nominal;
 - b. Length: In 20-foot sections, to make up the total length of the active anode column;
 - c. Width of each slot: 0.02"; spacing of slots: ¼".
 - d. Slotted casing shall be as provided by Atlantic Screen, Inc. (302 684-3197) or approved equal.

E. Anode Backfill for Deep Anode Groundbed

1. The anodes inside the slotted PVC pipe shall be backfilled with a carbonaceous earth contact backfill. The earth contact backfill shall have the following composition:

Fixed Carbon 99.77%
Ash 0.10%
Moisture 0.00%
Volatiles 0.00% (950° C)
Bulk Density 74 lbs./cu. ft.
Particle Size Dust-free with maximum particle size of 1.0 millimeter
2. The anode earth contact backfill material shall be Loresco Type SC-3 as manufactured by Cathodic Engineering Equipment Co. or an approved equal.

F. Environmental Plug Seal for Deep Anode Groundbeds

1. An environmental plug seal shall be installed within the 8-inch diameter PVC casing above the top of the anode column.
2. The plug seal shall be a Loresco Perma Plug Seal, as manufactured by Cathodic Engineering Equipment Co. or an approved equal.

G. Thermite Weld Equipment.

Thermite weld molds and charges shall be suitable for the sizes and types of materials and shapes encountered. Adapter sleeves shall be utilized for all thermite welds. Thermite weld equipment shall be as manufactured by Erico, Inc. or approved equal.

H. Anode Junction Boxes

1. Junction Box

- a. The junction boxes shall be 12 inches by 12 inches by 6 inches, NEMA 12/13, with hinged cover and clamp latches. Junction box shall be Hoffman, catalog number A-1212CH or approved equal.
- 2. Mounting Panel Board
 - a. Each junction box shall be provided with a non-metallic panel board specifically designed for mounting electrical components.
 - 3. Shunt
 - 4. The junction box shall be provided with 0.001, 10A shunts specifically designed for permanently connecting wires to for voltage measurements. Copper Bus Bars
 - a. The junction box shall be provided with 0.25 inch thick by 1 inch wide copper bus bars (length as required for each application) as shown on the Contract Drawings.
- I. Reference Electrode Junction Box
- 1. Junction Box
 - a. The junction boxes shall be 8 inches by 8 inches by 4 inches, NEMA 12/13, with hinged cover and clamp latches. Junction box shall be Hoffman, catalog number A-808CH or approved equal.
 - 2. Mounting Panel Board
 - a. Each junction box shall be provided with a non-metallic panel board specially designed for mounting electrical components to.
- J. Anode Centralizers for Deep Anode Groundbeds
- 1. The steel centering device shall be capable of maintaining each anode in a concentric position within the anode pipe.
 - 2. The anode centralizer shall be by Stuart Steel Corporation, or an approved equal.
- K. Anode Vent Pipe
- 1. One inch diameter PVC anode venting conduit shall be installed the full length of each deep anode bed. Openings of 1.5 inches in length by 0.006 inches in width shall be positioned 1-inch in circumferential distance from one another and 6-inches center-to-center longitudinally. The anode vent material shall be Allvent as manufactured by Cathodic Engineering Equipment Co. or an approved equal.
 - 2. Solid vent pipe for the inactive area of the deep anode shall be without slots, and shall be of the same nominal diameter as the slotted pipe.

L. Wire

All wiring, excluding wire provided with the magnesium anodes shall be stranded copper wire of the AWG wire size and color shown on the Contract Drawings. Each wire inside the anode junction box shall be properly identified with permanently stamped plastic tags.

M. Coating for Thermite Welds.

Exposed metal at thermite weld areas shall be coated with 2 coats (10 mils each, 20 mils total) with mastic coating. The mastic coating shall be Royston Roskote A-51 Plus Mastic or approved equal.

N. PVC Conduit

The conduits shall be PVC (polyvinyl chloride) Type 40 Standard Wall and shall conform to ANSI/UL 651.

O. Conduit Straps

The conduit straps shall be two-hole stainless steel straps for conduit sizes shown on Contract Drawings.

PART 3. EXECUTION

3.01 EXAMINATION

Defective materials that are or improperly installed shall be repaired or replaced at no additional cost to the Authority.

3.02 INSTALLATION

A. Excavations

1. The Contractor shall have all utility locations, if any, marked prior to starting any excavations.
2. All excavations shall be performed in a manner that avoids damage to any existing utilities or structures.

B. Thermite Welding

1. All thermite welds shall be made as shown on the Contract Drawings and in accordance with the manufacturer's recommendations using the proper combination of equipment for the structure and wire size being welded. All welding materials and equipment shall be the product of a single manufacturer.
2. Assure that the area where the attachment is to be made is absolutely dry. Remove coating, dirt, grime, and grease from the structure surface at the weld location by wire brushing or by the use of suitable safety solvents. Clean a three-inch square area of the pipe or fitting surface at the weld location to a bright shiny surface, free of all

serious pits and flaws by use of a mechanical grinder.

3. Prepare the wire for welding by assuring that the cable is absolutely dry. The cable shall be free of dirt, grease and other foreign products. Cut the cable in such a way as to avoid flattening or forcing out of round. To prevent deformation of the cable, cut the cable with cable cutters. Remove the insulation in a manner that will avoid damage to strands. Install adapter sleeves to all test wires and anode lead wires prior to welding. Hold the cable at an approximate 30 degree angle to the surface when welding.
4. When the weld has cooled, remove the weld slag and test the weldment for strength by striking a sharp blow with a two pound hammer while pulling firmly on the wire. Reweld unsound welds and retest weldments. Thoroughly clean mold and mold covers after completion of each weld to assure that no slag will penetrate into the next weld.
5. After soundness of the weld has been verified, thoroughly clean with a stiff wire brush and coat with 2 coats (each coat 10 mils thick, 20 mils total) of mastic coating. The mastic shall extend on all four sides beyond the cleaned area. Follow all manufacturers' instructions for applying mastic coating.

C. Prepackaged Magnesium Anodes

1. Prepackaged magnesium anodes, shall be installed at each pipe pile footing as indicated on Contract Drawings. Do not lower the anode into the excavation by its lead wire. Lower the anodes into the excavation with a rope that is wrapped around the anode package. Prior to installation, remove all shipping covers from the anode (the prepackaged paper bag shall not be removed). Install the anodes in existing soils (free from rocks, roots, organic material, trash or other debris) and backfill with existing soil (as described above). Do not install the anode in sand, rock or gravel backfill.
2. Thermit weld the AWG No. 12 solid copper wire supplied with the anode to the pipe pile as indicated on Contract Drawings.

D. Deep Anode Groundbed

1. If any anode hole fails to reach the required depth due to unusual obstruction, notify the Engineer. The Contractor shall measure the depth of the anode holes and shall provide samples of materials recovered before start of installation of the anodes and/or removal of the drilling equipment. The Contractor shall abandon and backfill any holes rendered unusable due to problems with equipment or materials. Drill replacement holes at a location approved by the Engineer at no additional cost to the Authority.
2. Drill anode hole as indicated on the Contract Drawings. Maintain an accurate log of the drilled holes, including the equipment used, date and time of drilling, and a complete log of the materials encountered. Include soil classification, elevation of water table, location of special features such as mud seams, open cracks, soft or broken ground, points where loss or gain of drill water occurred and all other items of interest in connection with the Work. The log shall be submitted to the Engineer within 24 hours of the completion of drilling.

3. Install the deep anode perforated anode casing, the surface casing and the vent pipe as indicated on the Contract Drawings.
4. The deep anode holes shall have a minimum of two feet of clearance with other underground structures.
5. Excess materials from the excavation not required for fill or backfill shall be disposed of from the Authority property in accordance with Specification Section 312323.

E. Impressed Current Anodes

1. Mixed metal oxide anodes shall be installed in each of the deep anode wells shown on the Contract Drawings. Prior to installation, remove all shipping covers from the anode. Install the anodes in the perforated PVC pipe and backfill the area around the anodes with coke breeze. The Work shall be done carefully to avoid damage to the anodes and cables.
2. The anodes shall be lowered into the Perforated PVC pipe by being tied to the 1-inch vent pipe. The anodes and the vent pipe shall be centered into the 8-inch PVC pipe by the use of centralizers.
3. Suspend the anodes in the deep anode hole by tying the anode support ropes to a hanging rod installed at the top of the casing for this purpose.

F. Anode Vent Pipe

Anode vent material shall be installed to the full depth of each deep anode groundbed. The vent shall extend above grade as indicated on the Contract Drawings.

G. Anode Backfill

1. The deep anodes shall be backfilled with coke breeze. The coke breeze shall be mixed with water to form coke breeze slurry. The coke breeze slurry shall be continuously agitated to assure that the coke breeze is maintained in colloidal suspension while being pumped into the deep anode hole. The coke breeze slurry shall be pumped into the bottom of the hole via PVC piping that is installed for this purpose. The PVC slurry piping shall be removed immediately after the coke breeze is installed to the required level and before the slurry can solidify. Do not use the anode vent pipe for this purpose.
2. The depth to the top of the coke breeze column shall be measured to verify proper installation. The coke breeze column shall be allowed to set a minimum of 12 hours after installation before making this measurement. If the top of the coke breeze column is not at the correct depth, finish filling the deep anode hole in the same manner.
3. The Contractor shall utilize a second pump to collect excess material from the deep anode hole during the installation of the coke breeze slurry. The excess material shall be collected and disposed of in such a manner as to avoid spillage onto adjacent pavements.

4. Seal the top of the anode column with an environmental seal as shown on the Contract Drawings.

H. Junction Boxes

1. Junction boxes shall be installed where shown on the Contract Drawings. All junction boxes shall be complete with hinged covers.
2. The Contractor shall comply with all installation requirements of National Electrical Code (NEC) and all other applicable State and Local electrical codes.

I. Reference Electrodes

1. Direct buried reference electrodes shall be installed at the locations shown on the Contract Drawings. The electrode shall be installed horizontally. The excavation shall be through a hole opening on the sheet pile wall as shown on Contract Drawings. The reference electrode shall be backfilled with clean soil free of all debris and foreign material for a minimum distance of 6" on all sides. Sand shall not be used to backfill these reference electrodes. All reference electrode lead wires must be protected from damage during all other operations. No splicing of directly buried reference electrode lead wires shall be allowed. Any damage to the reference electrode lead wires shall require replacement of the reference electrode by the Contractor at no additional cost to the Authority.
2. Each reference electrode shall have a separate corresponding structure lead thermite welded to the adjacent sheet pile as indicated on the Contract Drawings. The reference electrode lead and the structure lead shall be terminated inside the reference electrode junction box.
3. The Contractor shall verify that each reference electrode structure lead is continuous with the sheet piling, that each reference electrode is recording the proper potential, and that each wire is properly labeled. Continuity tests shall entail measurement of voltage between the reference electrode structure lead and a convenient electrical connection to the same structure. The permanent reference electrodes shall be tested by measuring: the potential of the structure to the permanent electrode; the potential of the structure to a portable reference electrode; the potential of the permanent reference electrode to a portable reference electrode; and the potential between adjacent permanent reference electrodes. This test data shall be submitted to the Engineer for approval.

J. Sheet Pile and Pipe Pile Bonding

1. Follow all requirements for thermite welding as described in 3.02.B of this Specification.
2. Install electrical bond cables between each sheet pile and between each pipe pile as shown on Contract drawings.
3. The Contractor shall verify that each bond cable is effective. Ineffective bond cables shall be located and repaired at no additional cost to the Authority.

K. Conduit

1. Install conduits where indicated on the Contract Drawings. All conduits shall be field routed and installed in a manner approved by the Engineer. Conduits shall be supported using stainless steel clamps as indicated on Contract Drawings.

L. Structure Connections

1. All structure cable connections shall be made by thermite welding at the locations shown on the Contract Drawings. Clean the structure surface by scraping, filing or wire brushing to produce a clean, bright, smooth surface. Thermite weld the cable to the structure in strict accordance with the manufacturer's instructions. The proper weld metal charge shall be utilized for the size of the cable to be connected to the tank wall. All thermite weld connections shall be coated with a minimum of 20 mils of mastic coating.

3.03 FIELD QUALITY CONTROL

All Work associated with stray current monitoring and/or cathodic protection system shall be performed by trained individuals working under the direction of the Contractor's NACE International Certified Corrosion/Cathodic Protection Specialist.

A. Testing

Structure-to-earth potential measurements with respect to a permanent and a portable copper/copper sulfate reference electrode shall be made at the area where the pipe pile was exposed and where anodes have been installed, and at the permanent reference electrodes installed at the sheet pile wall. At the pipe piles two sets of potential measurements will be made, one before the anodes are connected to the pipe pile and one after the anodes are installed and connected to the pipe pile. Pipe-to-reference potentials shall be measured using a portable copper/copper sulfate reference electrode and a portable voltmeter having an input impedance of not less than 10 megohms. The current output of the anodes shall also be measured at each pipe pile before the anode wire is permanently connected to the pile.

3.04 POST INSTALLATION TESTING OF THE CATHODIC PROTECTION SYSTEMS

- A. General: Inspect, energize, and adjust the cathodic protection as soon as possible after the equipment has been installed.
- B. Energization: Perform the energizing of the cathodic protection system by a Corrosion Engineer to achieve compliance with the referenced corrosion control standards set forth by NACE.
- C. Notice: Prior to native state, polarized potential testing, and commissioning of the system, give a minimum of 48 hours notice to Engineer to facilitate observation of the tests by an Authority Representative.
- D. Method: The Corrosion Engineer to:
 1. Measure native state pipe-to-soil potentials at all test stations, permanent reference

cells, electrical isolation devices, and locations of exposed pipe prior to energizing the cathodic protection system.

2. Measure casing-to-soil potentials and foreign line potentials, prior to energizing the cathodic protection system.
 3. Energize the cathodic protection system and adjust the DC current output such that the pipe-to-soil potentials near the cathodic protection current source (either transformer-rectifier or sacrificial anodes) is approximately -1000 millivolts to a copper sulfate electrode (CSE). Record the DC voltage and current of the power supply.
 4. Allow sufficient time for the pipeline to polarize.
 5. Using a current interrupter, cycle the power supply "On" and "Off".
 6. Record "On" and "Instant Off" potentials at all pipeline test stations, permanent reference cells, electrical isolation devices, locations of exposed pipe, casings and foreign pipelines.
 7. For steel and ductile iron pipe, adjust the cathodic protection power supplies to satisfy the criteria of a minimum 100 millivolts of polarization or an "Instant Off" potential at least as negative as -850 millivolts CSE.
 8. For concrete cylinder pipe, adjust the cathodic protection power supplies to achieve a minimum 100 millivolt of polarization without any "Instant Off" potentials more negative than -1000 millivolts CSE.
 9. Record all final adjustments of the DC power supplies.
 10. Verify that all electrical isolation devices are operating properly including flange isolators, and casing spacers.
 11. Verify that interference does not exist with foreign pipelines. Perform joint tests and mitigate any interference detected.
- E. After initial energization and after rectifiers have been adjusted as necessary for compliance with NACE RP-0169 (latest revision), perform a walk-through inspection with Engineer to verify that all corrosion control components have been installed in accordance with Contract Drawings and Specifications.
- F. Make a punch list of outstanding work identified during walk-through inspection. Once Contractor has completed the list of open items, pipeline will be allowed to polarize for 30 days before final testing. Perform final testing and adjustment after 30-day polarization period. Repair deficiencies discovered during final testing at no additional cost to Authority.
- G. Equipment: All cathodic protection testing instruments shall be in proper working order and calibrated according to factory specifications.
- H. Final Report

A final report shall be prepared by the Contractor's Corrosion/Cathodic Protection Specialist after completion of the installation of the cathodic protection system in accordance with Section 3.02 and 3.04. The final report shall contain at a minimum the following:

1. As-built Drawings;
2. Field Testing Results;
3. Resistance and geological logs
4. Discussion of test results and system Installation
5. Rectifier Operations and Maintenance Manual (O&M)
6. Commissioning Data
7. Contractor/ Supplier Warranty

END OF SECTION

SECTION 264200
CATHODIC PROTECTION

APPENDIX "A"
SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 01 - GENERAL PROVISIONS:

Catalog Cuts

- | | |
|-----------|---|
| 264200B01 | 1. Prepackaged Magnesium Anodes |
| 264200B02 | 2. Impressed Current Anodes |
| 264200B03 | 3. Reference Electrodes |
| 264200B04 | 4. Deep Anode PVC Casing |
| 264200B05 | 5. Anode Backfill for Deep Anode Groundbed |
| 264200B06 | 6. Environmental Plug Seal for Deep Anode Groundbeds |
| 264200B07 | 7. Thermite Weld Equipment |
| 264200B08 | 1. Anode Junction Boxes and Mounting Panel Board |
| 264200B09 | 9. Anode Shunts and Copper Bus Bars |
| 264200B10 | 10. Reference Electrode Junction Boxes and Mounting Panel Board |
| 264200B11 | 11. Anode Centralizers |
| 264200B12 | 12. Anode Vent Pipe |
| 264200B13 | 13. Wire |
| 264200B14 | 14. Coating for Thermite Welds |
| 264200B15 | 15. PVC Conduit |
| 264200B16 | 16. Conduit Straps |

Manufacturer Test Reports

264200F01 E. All Installation Test Results

264200F02 A. Final report.

Qualifications

264200K01 B. Qualifications of independent corrosion control firm

264200K02 C. Qualifications of the NACE International Certified Corrosion/Cathodic Protection Specialist.

Record Documents

264200M01 D. As-Built Drawings

END OF APPENDIX "A"

DIVISION 27
SECTION 275116
PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies requirements for a Public Address System, hereinafter referred to as “the System,” allowing for voice announcements to be heard in designated areas of the facility. This System utilizes a CobraNet audio distribution protocol conveyed over a partition of the PATH Harrison Station Ethernet Local Area Network (LAN) via the structured cable plant. The Fiber Optic Cable and Control Signal Transmission Media are specified in sections 271323 and 282310 and include all standards-based fiber and Unshielded Twisted Pair (UTP) cabling as shown on the Contract Drawings. Microphone and loudspeaker cabling and all non-UTP/fiber connections and devices as shown on the Contract Drawings are included in the Work of this Section.
- B. This Section includes, at a minimum:
1. Speakers
 2. Amplifiers
 3. Digital audio processors
 4. Public Address Microphones.
- C. The new Harrison Station System equipment shall be integrated to the existing PATH System-Wide Public Address System at the Hoban and PTCC monitoring centers as specified on the Contract Drawings.
- D. The work under this contract is specific to the Northwest Quadrant of the PATH Harrison Station. There is a dedicated Communications Equipment Room called for within the Contract Drawings. The Contractor shall furnish, install, test, and commission Public Address amplifiers, digital signal processors, associated speakers, microphone jacks and required ancillary electronics for the Northwest Quadrant as shown on the contract drawings. Upon integration of the Northwest Public Address System into the PATH System-Wide Public Address System, the Harrison Northwest and existing Harrison Eastside Public Address system shall be a complete and functional system. The PATH Harrison Public Address System shall be capable of broadcasting general announcements to all Quadrants as well as directed broadcasts messages to specific quadrants.
- E. The Public Address equipment shown on Contract Drawings for the Harrison Station shall be connected to PATH’s head end monitoring center. Furnished and installed cables and equipment shall be tested prior to commissioning. Refer to Sections 3.02 and Section 3.05 for cable testing criteria. The Contractor shall provide labor to perform testing and commissioning with PATH as directed by the Engineer.

- F. The Contractor shall perform the overall System integration and software configuration locally at Harrison Station and remotely at Hoban and PTCC monitoring centers .
- G. The Contractor shall perform the final overall System operational testing both locally from Harrison Station and remotely from Hoban and PTCC monitoring centers in the presence of the Engineer in accordance with the requirements of this Section.

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

- A. The Public Address System shall be a digital, network based distributed system, utilizing the CobraNet® protocol, to provide the audio broadcast, recording, storage, routing and control functionality specified herein and allow users to create the audio messages for broadcast from both workstations and microphone stations. The System shall allow for multiple broadcast zones, individual broadcast to zones and simultaneous broadcast of the same message or different messages to different zones. All zoning, amplification, routing control and signal processing equipment are to be configurable from Operator Workstations.
- B. The System shall operate on a 24 hour per day, seven days per week basis with a high system reliability of 99.99 percent and shall conform to the requirements of this Section.
- C. The System shall incorporate hardware which makes use of modular, plug-in circuit cards to allow custom configurations. The System shall be configurable and expandable by selection and interconnection of modular hardware components over an Ethernet based network. The System shall allow expansion frames to be connected to the main frame to support additional circuit cards or functions. Hardware components and associated circuit cards shall be provided as required to meet the functional requirements and specifications.
 - 1. The System components shall be rack mounted, modular assemblies using slide in circuit boards in plug in card files to allow easy expandability and servicing.
 - 2. Provide equipment using all solid-state components fully rated for continuous duty at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 120VAC, 60 Hz.
- D. The System shall be fault-tolerant, and provide degraded-mode operations.
 - 1. Failed or abnormal performance of any active system component shall generate an alarm for the appropriate user.
 - 2. Standby amplifier channels shall be automatically substituted for failed amplifier channels once a failure is detected.
 - 3. Amplifier outputs shall be protected so they can survive a shorted output line and report the failure condition to the appropriate user.
 - 4. Amplifiers shall be distributed in Communications Rooms as indicated on the Contract Drawings to provide a degree of diversity in the system.
- E. The System shall incorporate a message prioritization system.
 - 1. Messages shall be coordinated such that different messages shall not be distributed within the same zone at the same time. No message shall be lost due to coordination or priority preemption unless they are no longer timely.

2. A minimum of nine priority levels shall be provided.
 3. A message's priority shall only affect the zones to which it is targeted.
 4. The System shall link the prioritizations of adjacent zones. In the event that a message is scheduled to a zone at the same time another message is being broadcast in an adjacent zone, the same priority rules shall apply. The application of these adjacent zone priorities shall be configurable by the System Administrator.
- F. The System shall incorporate a user rights management system.
1. A maintainable user rights management system shall allow for multiple operating groups to access the speakers simultaneously.
 2. Each user level shall be provided with configurable default priorities.
 3. Users shall be assigned to specific operating groups. Each operating group shall have an internal hierarchy based upon function that shall determine the specific user rights within the system.
- G. The System shall implement a zone-based architecture that allows for the logical and physical grouping of output devices, including loudspeakers.
1. Zones shall be user configured based on jurisdiction and geographic area.
 2. Personnel with appropriate user rights shall be able to create, edit, and broadcast audio and visual messages to all zones.
 3. The zones to which users make announcements shall be configurable by selecting any set of amplifier outputs.
 4. Initial Configuration of zones shall be as indicated on the Contract Drawings.
 5. The Public Address System Architecture shall have the capability to be expanded to a minimum of 150 announcement zones.
- H. The System shall allow users to make both live and pre-recorded announcements.
1. Voice pages shall be broadcast from multiple microphone stations to zone groups via keypad numeric code. Public Address Microphone stations shall be located as shown on the Contract Drawings.
 2. The cable patch cord and outlet for each microphone station shall be standard Category 6 UTP conveying Power over Ethernet (PoE). All Paging System connections using the structured cabling system shall utilize Ethernet protocol for CobraNet ® audio networking.
- I. The System shall incorporate Digital Signal Processing (DSP) based parametric equalization for each zone. Setup and configuration of the equalizers shall be from the operator workstations and shall require a password to modify. Functions of the DSP system shall include the following:
1. Facility-wide matrix routing for paging zones as controlled by page station.
 2. Non-user accessible loudspeaker processing functions including equalization (EQ), delay, and dynamics processing.

3. Non-user accessible input processing functions for the page microphone source (EQ, dynamics processing).
 4. User-adjustable zone output level adjustment via protected DSP remote graphical user interface.
 5. User-adjustable tone controls on a per-zone basis via protected DSP remote graphical interface.
 6. User-adjustable system power control via protected DSP remote graphical user interface.
 7. Error logging as provided through hardware diagnostics within DSP.
 8. Control of the DSP hardware shall be through the use of a rack-mounted workstation via wired connection to the Data Network. This workstation shall be located where indicated on the Contract Drawings.
- J. Paging System routing and signal flow shall utilize CobraNet® transmission over a partitioned Virtual Local Area Network (VLAN) on an Ethernet Data Network that will be shared with other systems. The Paging System shall utilize a VLAN to distribute the audio messages and to communicate between its various hardware components.
1. The CobraNet® industry standard shall be utilized for audio distribution among workstations, microphone stations, servers and amplifiers.
 2. The System shall control up to 100 workstations, 120 microphone stations and 150 zone outputs. All microphones shall be assignable to any combination of output zones. Assignments shall be readily changeable by qualified authorized personnel.
 3. Digital audio networking shall be distributed on a 100Mb Ethernet network.
 4. Up to 32 simultaneous channels per VLAN shall be supported. Eight announcements or messages shall be able to be recorded or played back simultaneously, plus one test tone. All audio-switching circuits shall be designed and constructed so that no switching transients, clicks or pops are audible. Channel assignments shall be dynamically assigned and routed and shall not be restricted to static or fixed channel assignments.
 5. Have all programming and configuration of DSP and the Paging System network hardware and software done by the Systems Integrator retained for the Work of this Section. Where Data Network partitioning or provisioning is required, coordinate with the Engineer.
 6. Partition the Paging System LAN via VLAN tagging such that requisite isolation is achieved for CobraNet® and paging-related control network traffic. For all other forms of network partitioning required to be performed for reasons of link tuning or bandwidth allocation, submit such changes for approval in advance of installation.
 7. Ensure that the use of structured cabling via the Communications Room patch fields is coordinated fully with Data Network Integrator. Ensure that all Category 5e and fiber patches required for use by the Paging System are furnished and installed as required for the system interconnections.

- K. The System shall be self-monitoring. The System shall include a complete integrated audio monitor system. This monitor system shall allow the setup operator to view the signal level and audibly listen to any point in the signal chain in real time including intra-DSP points. Software shall allow selection of zone output, equalizer output, ambient processor output, delay output, amplifier output and speaker load monitor. Selection shall be instantaneous and not introduce pops or other audio noise. It shall be possible to select a page or message in progress from the main system activity screen and select monitor points for that activity during the page or message.
1. The System shall provide for self-diagnostics that operate in real time under software control. This self-testing shall include testing of logic, audio operation, power supplies, power amplifiers, and network communications.
 2. The appropriate user shall be notified of a failure of any system component. Notification shall be done at the operator workstation. Additionally, the system shall be capable of notifying users of failures via email and fax messages.
- L. The System shall accept a dry contact input from the Fire Alarm system furnished under Section 283100. The Public Address System shall be programmed such that when the Fire Alarm Voice Evacuation (EVAC) is engaged, no public address announcements can be made over the Public Address System to speakers within the affected area of the facility.
- M. All System components, hardware, software, firmware and equipment, furnished as Work of this Section 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 the use of 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, the Contractor shall provide 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 versions available.

- N. The Public Address System shown on the Contract Drawings will be the basis for a system to be expanded, by others, under future Contracts. The System furnished and installed as Work of this Contract shall be capable of expansion to a minimum of four times the number of amplifier locations depicted on the Contract Drawings without requiring any hardware or software upgrades or replacement. All provisions required for system expansion shall be included as part of the System.

1.03 RELATED SECTIONS

- A. Division 26 Section 260519 - Wires, Cables, Splices, Terminations (600 Volts Or Less)
- B. Division 28 Section 282310 – Control and Signal Transmission Media
- C. Division 26 Section 262716 - Control Panels, Enclosures/Cabinets, And Terminal Boxes
- D. Division 26 Section 260534 - Boxes And Fittings
- E. Division 26 Section 260526 – Grounding
- F. Division 26 Section 260527 – Electrical Bonding
- G. Division 28 Section 283100 - Fire Alarm Systems
- H. Division 27 Section 271323 – Fiber Optic Cable

1.04 REFERENCES

- A. Americans with Disabilities Act (ADA)
 - 1. Section 10.3.1, paragraph 14
- B. ANSI International / Telecommunications Industry Association / Electronics Industry Association (ANSI / EIA / TIA)
 - 1. 276-A – Acceptance Testing of Dynamic Loudspeakers
 - 2. 278-B – Mounting Dimensions for Loudspeakers
 - 3. 310-D – Cabinets, Racks, Panels, and Associated Equipment
 - 4. 426-A – Loudspeakers, Optimum Amplifier Power
 - 5. 485 – Serial Line standard for 2-wire, half-duplex, differential line, multi-point communications.
 - 6. 568B – UTP Cable Termination Standard
 - 7. 569 – Commercial Building Standards for Telecommunications Pathways and Spaces
- C. Cirrus Logic Inc
 - 1. Publication DS651PM25 – CobraNet Programmers Reference
- D. Federal Communications Commission (FCC)
 - 1. CFR 47, Part 15, Subpart J

- E. 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
- F. National Fire Protection Association (NFPA)
 - 1. 70 – National Electrical Code
 - a. Article 725 - Class 1, Class 2, And Class 3 Remote Control, Signaling and Power-Limited Circuits
- G. World Wide Web Consortium (W3C)
 - 1. Extensible Markup Language (XML)
 - 2. The Extensible Stylesheet Language Family (XSL)
- H. Underwriters Laboratory (UL)
 - 1. 486A – Standard for Safety for Wire Connectors
 - 2. 864 – Control Units and Accessories for Fire Alarm Systems
 - 3. 1480 – Standard for Safety Speakers for Fire Alarm, Emergency, and Commercial and Professional Use

1.05 QUALITY ASSURANCE

- A. Contractor's Quality Control Responsibilities
 - 1. Products are to be made accessible for quality control inspection at any time during regular shop hours.
- B. The manufacturer of the Public Address System shall meet the following requirements:
 - 1. Be regularly engaged in the business of manufacturing fully integrated Public Address Systems, with a North America based service and support facility.
 - 2. The Public Address System manufacturer shall have maintenance services and related technical assistance available in the New Jersey Area and an established maintenance facility within proximity of the PATH Harrison Station, as evidenced by existing contracts to provide maintenance for the Public Address System and all associated control equipment and electronics comparable to the system to be furnished and installed under this Contract. The Public Address System manufacturer's maintenance staff shall consist of a sufficient number of qualified journeymen, technicians and other technical personnel to perform complete maintenance of the Public Address System and all associated control equipment and electronics.
 - 3. All equipment and electronics of the type furnished under this Contract, shall have been satisfactorily installed and operational in at least three different sites

with similar environmental conditions to those of the construction site and in applications of similar or equivalent complexity to that specified in this Contract, for a period of not less than two years.

4. The Contractor shall submit proof of compliance with the experience requirements. This shall include, but not be 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, the Contractor shall arrange for a demonstration of an installed Public Address System from the manufacturer.

C. Integrator Qualifications

1. The Contractor shall 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 Integrator shall have experience configuring and integrating systems of comparable size and complexity to the system described in this Section.
3. Experience shall include at least two installed systems of similar size and complexity in continuous satisfactory operation for at least one year.
4. The Integrator shall be a factory-authorized sales and service representative.

D. Installer Qualifications

1. The Contractor shall retain the services of an experienced Installer with a minimum of six years of experience and who is a factory-authorized sales and service representative of the Public Address System manufacturer to perform the work described in this Section and the Contract Drawings.

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 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 proper storage and 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 be 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.
- F. Handle all equipment and devices in a manner to prevent damage. Damaged equipment shall be replaced at no additional cost to the Authority.
- G. Where possible, protective coverings shall be installed to prevent equipment damage. Covering shall remain in place until final acceptance testing and remove such coverings 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.

1.07 SPARE PARTS

- A. Provide 5 percent spare parts, or a minimum of one, whichever is greater, of all microphone stations, in-ceiling and wall-mounted speakers, relay interface units, power supplies, amplifier cards, zone output cards, 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 30 Day Operational Acceptance Testing, deliver spare parts to the Authority.

1.08 SUBMITTALS

- A. See Appendix "A".

PART 2 - PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements, products shall be of one of the following manufacturers listed below or approved equal. New deployments shall match existing, not a mix of different manufacturer's products. The contractor shall avoid impedance matching/balancing of channels issues caused by deploying speakers from different manufacturers.

- A. Public Address System
 - 1. Biamp Systems, Beaverton, OH
 - 2. Mediamatrix, Peavey Electronics, Meridian, MS
 - 3. Innovative electronic Designs, Louisville, KY
- B. Loudspeakers
 - 1. JBL

2. Duran Audio
3. Bose
4. Atlas Sound, Phoenix, AZ
5. TOA Electronics, Burlington, CA

C. Public Address Microphone Jack

1. Atlas IED SG-XLR-F1

2.02 MATERIALS

A. General

1. Submit for approval detailed equipment specifications, catalog cuts and system block diagrams detailing the manufacturers' system and hardware platform.

B. Digital Signal Processor (DSP)/ Multichannel Power Amplifiers

1. The DSP/Multichannel Power Amplifier ("Amplifier") shall be a digital networked, multi-channel amplifier which allows for receiving audio and audio control via an Ethernet based network, converting the digital data to an audio signal and broadcasting the audio over multiple speaker zone circuits.
2. Each Amplifier shall be a modular, rack mountable backplane chassis that accepts a CobraNet® Interface Card and multiple Amplifier Module Cards with software configurable power levels. Each Amplifier shall accommodate a minimum of 8 Amplifier Module Cards per frame at a typical rating of 100 to 600W per card for a maximum rating of 2400W per chassis.
3. The Amplifiers shall provide control data and digital audio over CobraNet® Interface. The amplifier shall have dual CobraNet Ethernet ports for redundant network connections.
4. The Amplifiers shall have the following features:
 - a. Front panel LED identification of amplifier and card failure, signal present, clip present, fan stuck rotor fault, heat sink temperature fault and provide additional software monitoring features including short circuit on output fault.
 - b. Software-configurable signal processing including volume control, filters, compressor/limiting, delay, speaker equalization, and output sensitivity.
 - c. Channel to channel and chassis-to-chassis failover.
 - d. Support up to 8 speaker zones per Amplifier, which can be addressed and activated both individually or in groups.
5. The Amplifiers shall be UL listed.
6. The Amplifiers shall be Biamp Vocia VA-8600, or Crown Audio DC14300N/CTS 8200 or approved equal.
7. The Audio Processor shall be SoundWeb LONDON BLU-806 or approved equal.

8. Furnish and install Amplifiers in quantities and at locations shown on the Contract Drawings.

C. Amplifier Module Cards

1. Each Amplifier backplane rack shall accept multiple amplifier module output cards for connection to speaker circuits. Each card shall be rated for 100 to 600 Watts per output and software configurable for driving audio output circuits at 70V or 100V constant voltage direct drive, or low-impedance (4 or 8Ω) operation. Software configuration shall be through the CobraNet Interface Card.
2. Amplifier cards shall be configurable for amplifier redundancy, allowing two cards to drive the same audio output circuit. In the event of a failure of any one amplifier card, the remaining card shall automatically drive the entire audio output circuit.
3. Furnish, install and configure Amplifier Module Cards in each Digital Signal Processor (DSP)/Multichannel Power Amplifier in quantities required to support the number of speaker zone circuits plus the number of spares indicated on the Contract Drawings.
4. Amplifier Module Cards shall be Biamp Vocia AM-600, or approved equal.

D. CobraNet Interface Cards

1. The CobraNet Interface Card module shall provide Ethernet connectivity for the Digital Signal Processor (DSP)/Multichannel Power Amplifiers to allow for configuration, control and transmission of audio to the Amplifiers via a CobraNet data protocol. Each CobraNet Interface Card shall have two CobraNet ports for redundancy and failover functionality. Each CobraNet port shall be compatible with a 10/100/1000 BaseT Ethernet interface.
2. One dual port CobraNet Interface card shall be furnished and installed within each DSP/Multichannel Power Amplifier.
3. CobraNet Interface Cards shall be Biamp Vocia NM-1, or approved equal.

E. Line Input Device

1. The Line input device shall be a networked audio input expansion device allowing the addition of up six channels of background music or any other line level analog audio source, such as a microphone, to an Amplifier.
2. The Line Input Devices shall be rack mountable units (1RU) and provide audio and control via CobraNet.®. They shall receive Power over Ethernet (PoE) utilizing a single (Category 5e) network cable to a rear panel RJ45 connector.
3. The Line Input device shall have the following features:
 - a. Four sets of dual RCA connectors and removable terminal blocks for connection of line level inputs
 - b. Two microphone/line inputs with phantom power
 - c. Six CobraNet outputs
 - d. Four control inputs
 - e. Four control outputs
 - f. Front panel LED identification of device failure, signal present, clip present

4. The Line Input device shall have embedded local digital audio signal processing (DSP), on-board memory to process and store all device-specific configuration information.
5. The Line Input device shall be UL listed.
6. The Line Input devices shall be Biamp Vocia VI-6, or approved equal.
7. Furnish, install and configure Line Input Devices in the quantities and at locations shown on the Contract Drawings.

F. Fire Alarm Override Interface

1. The Fire Alarm Override Interface shall provide a networked emergency interface to the Fire Alarm System for over-ride and shutdown of the Paging System audio output when the Fire Alarm Voice Evacuation System is activated.
2. Each Fire Alarm Override Interface shall be capable of being powered from up to three sources:
 - a. A 24V DC power source
 - b. Power over Ethernet (PoE) via either of two network ports.
3. Each Fire Alarm Override Interface shall have a redundant power supply and network connections. The power supply shall be UL 1481 listed.
4. The Fire Alarm Override Interface shall have 8 monitored outputs and 8 monitored inputs and control up to four emergency zones.
5. The Fire Alarm Override Interface shall be UL 864 listed. UL listing shall include the "Signaling" label.
6. The Fire Alarm Override Interface shall be a Biamp Vocia LSI-16, or approved equal.
7. Furnish, install and configure Fire Alarm Interfaces Devices in the quantities and at locations shown on the Contract Drawings.

G. Loudspeakers

1. In-ceiling Loudspeakers
 - a. Loudspeakers shall be 16 Watt, ported, utilizing one 2.25" full-range driver. Loudspeaker shall be designed for flush mounting in ceilings. Loudspeakers shall come in a complete assembly, mounted in an enclosure, ready for installation without additional field assembly. Speaker enclosure shall be White Polycarbonate - Acrylonitrile butadiene styrene (PC-ABS) with color matched powder coated steel grill.
 - b. Loudspeaker shall have the following characteristics
 - 1) Power Handling: 16 Watts
 - 2) Nominal Impedance: 8 Ohms
 - 3) Sensitivity (1W @ 1m): 84dB-Sound Pressure Level (SPL)
 - 4) Maximum SPL (pink noise at 1m @ rated power): 96dB SPL 102dB- SPL (peak)
 - 5) Frequency Range (-3dB): 90 Hz – 16 KHz
 - 6) Beamwidth (-6db point, avg. 1 – 4 KHz): 140 Degrees Conical
 - c. Speaker shall have an integrated multi-tap transformer with the following available taps:

- 1) 70V: 1W, 2W, 4W, 8W, 16W
 - 2) 100V: 2W, 4W, 8W, 16W
 - d. Speaker wiring connections shall be a three terminal barrier type strip.
 - e. Loudspeakers shall be UL 1480 listed.
 - f. Furnish and install speakers at in quantities and at locations shown on the Contract Drawings.
 - g. Loudspeakers shall be Bose Freespace Model DS-16F or TOA Electronic TOA H-1/H-2 series or approved equal.
2. Wall/Ceiling Mounted Linear Array Loudspeakers
- a. Loudspeakers shall be 1506 Watt, 50 cm straight line array with 8 x 2" drivers plus Constant Beamwidth Technology™ circuitry. Loudspeaker shall be designed for mounting on walls and suitable for installation and use in outdoor and wet locations. Loudspeakers shall come in a complete assembly, mounted in an enclosure, ready for installation without additional field assembly. Speaker enclosure shall be Black Polypropylene with color matched powder coated steel grill.
 - b. Loudspeaker shall have the following characteristics
 - 1) Power Handling: 150 Watts
 - 2) Nominal Impedance: 8 Ohms
 - 3) Sensitivity (SPL @ 1m, 3.3 ft): 93dB
 - 4) Max SPL 1: 115 dB (121 dB peak)
 - 5) Frequency Range (-10dB): 90 Hz – 206 KHz
 - 6) Vertical Coverage: 20°
 - c. Speaker shall have an integrated 60W multi-tap transformer with the following available taps:
 - 1) 70V: 7.5W, 15W, 30W, 60W
 - 2) 100V: 15W, 30W, 60
 - d. Speaker wiring connections shall be a three terminal barrier type strip.
 - e. Loudspeakers shall be UL 1480 listed.
 - f. Furnish and install speakers at in quantities and at locations shown on the Contract Drawings
 - g. Loudspeakers shall be JBL CBT 50LA or approved equal

H. Equipment Racks

1. Mount equipment in 19-inch racks as indicated on the Contract Drawings. Make all power supply connections AC and data with approved plugs and connectors. Arrange all inputs, outputs, interconnections and test points so they are accessible at the rear of the rack for maintenance and testing, with each item removable from the rack without disturbing other items or connections. Cover empty space in equipment racks with blank panels so that the entire front of the rack is occupied by panels.
2. Multiple racks shall be connected together with side panels removed for routing of cables between racks, provide ganging kits as required.
3. Racks shall be fabricated in accordance with Section 271116.

2.03 SECURITY ADMINISTRATION

- A. The Contractor's shall 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. A list of personnel who are designated to grant access to the Public Address System and its equipment must be kept up-to-date. The Contractor shall periodically review this list with the Engineer. All personnel who have been terminated or are no longer involved with the Work of this Contract must immediately be removed as users from all systems.
- C. Depending on the application, security may be administered at the application, database, module, screen, data field, and/or transaction level. Prior to system implementation, the Contractor shall 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 be responsible for maintaining the selected security profiles.
- D. The System Administrator shall be responsible for creating and maintaining accounts for all users authorized to access the Public Address System. Access privileges granted to all users shall be regularly re-evaluated to ensure only current authorized users have access.
- E. All users and their access privileges shall be re-evaluated at six-month intervals, or at whatever period is appropriate for the level of security and sensitivity of information stored on that system. The Contractor shall provide the Engineer with a report of this information regularly for review. The report must indicate the applications that each user is authorized to use. It is important to keep these lists up-to-date as users are added and as others are removed and are no longer authorized, particularly during system installation, startup, testing, training, acceptance and turnover.
- F. The Contractor shall be responsible for logically securing 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 should 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. Backup media should be stored 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. The Notification Packages value in the registry should be modified to require that all passwords are at least 6 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. The Administrator account should be configured to lockout after repeated failed access attempts over the network. The account should still be accessible from the system console. In addition, the Administrator account should be renamed so it is not as easily accessible to unauthorized individuals.
11. Establish separate accounts for System Administrators. Administrators should only use privileged accounts when necessary for system administration. All other times they should use individual user accounts, which limits the possibility that unauthorized individuals can access administrator accounts.
12. Default Guest Account should be renamed and disabled. In addition, a strong account password should be in place and all rights should be removed from the account.
13. Null session should be disabled if not required by the system.
14. Secure and manage event logs. NTFS permissions should be set on the event log files to allow only Administrators and System access. In addition, auditing should 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. The appropriate registry entry should be modified 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.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Configure and program all equipment supplied for the Public Address System in accordance with the manufacturer's recommendations and the Authority's requirements. This includes speaker and announcement zones, nominal speaker outputs, user access

rights and privileges, initial library of messages, and any other required customizations to the COTS software product.

1. Prior to configuration, submit documentation that describes the configuration in full detail for approval by the Engineer.
- B. The configuration shall reflect the requirements described in this Section and the Contract Drawings.
- C. 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 speakers, microphones, back boxes, 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 Public Address System equipment installation.
 4. Coordinate all speakers, microphones, raceways and cabling installed in architecturally finished public areas with the Engineer. Coordinate colors and finishes with the Engineer to minimize the visual impact against the surrounding architectural finish.
 5. Coordinate all data networking requirements with the Engineer . 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 recover 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 Engineer . 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.
 7. Coordinate any interface with the Fire Alarm System with the work of Section 283100. Coordinate interface with the layout and installation of the Fire Alarm System. Ensure that all Fire Alarm Third Party Device Interfaces (TDI's) or Third Party Relay Interfaces (TRI's) required for override of the Public Address System voice announcements have been furnished and installed as part of the Fire Alarm System installation. Ensure that all wiring between Fire Alarm TRI's/TDI's and the Public Address System is furnished and installed as 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 Public Address System 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 263353. Ensure that UPS are properly sized to support the equipment loads for the specified backup time(s).
- D. Coordinate all device and equipment installation and power requirements with the equipment installer.
 - E. 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
 - F. The Contractor shall 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 Public Address System.
 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 Public Address System to a fully operational state. Elements of the plan shall include but are not limited to:
 - a. Installation plan drawings.
 - b. Product installation guides and literature.
 - c. 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.
 - d. 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 in Section 260526.
- B. All conduit and raceways shall be in accordance with the requirements of Section 260533.
- C. All 120VAC power wiring shall be in accordance with Section 260519.
- D. 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.
- E. Test and certify all cables in accordance with the requirements of Sections 271323 and 282310 and submit test reports to the Engineer for approval.

- F. 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 Section 260526.
- 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. Install all wiring in accordance with Section 262716. 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 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 at no 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) shall not be 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, Thomas & Betts STA-KON fork tongue locking type or approved equal, 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 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.
- S. The Contractor 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. 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.
- T. Paralleling of multi-conductor cables to "create" a cable of larger wire gauge shall be prohibited.
- U. 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.
- 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 florescent 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 Public Address 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 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 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. 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 VoIP System and final connections.
 6. 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 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. Coordinate all work of this section with the work of all other trades.
 7. 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.
 8. See Contract Drawings for overall scope and configuration of Public Address System cable, control, and monitoring requirements.
 9. Coordinate all cable, conduit and device identifiers with the Engineer. Ensure uniformity and inter-relation of identifiers. Avoid duplication of identification.
- B. Connect and make operable all required system interfaces to third party systems.
- C. Ground equipment following the requirements of UL Standard 486A and in accordance with Section 260526.

3.04 PROGRAMMING

- A. The Contractor shall ensure that the Public Address System is properly configured and programmed to provide complete operation as specified herein and/or as indicated on the Contract Drawings.
- B. Provide an initial programming setup in accordance with the requirements of this Section and after installation a second re-programming session to fine tune the system to the Engineer's requirements after an initial use period of three months. The Engineer shall furnish to the Contractor a written list with the desired system and subsystem

programming modifications, additions, deletions, etc. The Contractor shall include a minimum of 25 percent of the system programming to be included in re-programming.

- C. Provide the complete set of database loading forms and informational requirements, a database loading/ creation manual, and five 4-hour sessions to work with the Engineer in database information development and use of manuals and forms. This is in addition to the training requirements specified in this Section.
- D. Initial message priority levels shall be configured as follows:

<u>Priority Level</u>	<u>Description</u>
0	Emergency
1	Non-Emergency Police Announcement
2	Major Service Change
3	Operational Announcement
4	Patron Page
5	Reserved
6	Maintenance
7	Reserved
8	Scheduled Announcements

3.05 TESTING

- A. Test Equipment
 - 1. Provide all required test equipment on site during construction and available to the Engineer during final adjustment and acceptance testing. Include:
 - a. Dual-trace Oscilloscope. 100 MHz bandwidth, 1 mV/cm sensitivity, TV sync separator and delayed trigger circuit. Tektronix 2247A or approved equal.
 - b. Multi-meter. Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 mA to 10A. Fluke 75 or approved equal.
- B. Testing shall be broken into three distinct phases:
 - 1. Factory Acceptance Testing
 - 2. Field Testing
 - 3. 30 Day Operational Acceptance Testing.
- C. Factory Acceptance Test (FAT)
 - 1. The Factory Acceptance Test shall demonstrate that the equipment to be supplied 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 Public Address System components and associated hardware, control equipment, and electronics to be furnished is complete, the Contractor shall notify the Engineer, and request a Factory Inspection and Test 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 Public Address System and all 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. In the event of a test failure, the Contractor shall make all repairs or modifications required for passing the test. The failed test shall be repeated 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.
5. 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 Public Address System components, even if it was originally planned to test only a sample of the units. These additional tests shall be made at no additional cost to the Authority.
6. 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 Tests at a later date.
7. Shipment of Public Address System Components and associated hardware, control equipment, and electronics shall start only after such inspection and testing have been satisfactorily completed and 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 the responsibility of furnishing 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 Public Address System components and associated hardware, control equipment, and electronics shall not be deemed as acceptance of the system and associated hardware, control equipment, and electronics.
8. These tests will include, but not be limited to the following:
 - a. A system set-up that demonstrates the use of each required component.
 - b. Environmental tests to ensure proper operation at the most extreme environments in which the equipment will be installed.
9. At a minimum, the FAT shall include the following specific system and operational tests:
 - a. Operational Test: Perform an operational system test to verify conformance of system to these specifications. Perform tests that include originating program material distribution, page material distribution, message distribution coordination, zone distribution selection, message assembly, system supervisory, alarm and monitoring functions, and paging operator workstation features. Observe sound reproduction for proper volume levels and freedom from noise.
 - b. Voice EVAC Override: Verify that an alarm input from the Fire Alarm Voice EVAC system overrides public address announcements in the test setup.

- c. Signal-To-Noise Ratio Test: Measure the ratio of signal to noise of the complete system at normal gain settings using the following procedure.
- d. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50; 200; 400; 1,000; 3,000; 8,000 and 12,000 Hz into each pre-amp channel and measure the distortion in the power amplifier output. The maximum distortion at any frequency is three percent total harmonics.
- e. Power Output Test: Measure the electrical power output of each power amplifier at normal gain setting at 50; 1,000 and 12,000 Hz. The maximum variation in power output at these frequencies shall not exceed plus or minus 1 dB.

D. Field Quality Control Tests

- 1. Maintain a competent supervisor and supporting technical personnel, acceptable to the Engineer during the entire installation. Change of supervisor during the project shall not be 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 polarity of AC power. Verify, test and document correct and safe function of isolated ground power systems.
- 3. Upon completion of the system installation, it shall be the responsibility of the Contractor to perform the necessary adjustments and balancing of all signals and amplifier gain, and other level controls to ensure proper system operation. The system shall be physically inspected by the Engineer to assure that all equipment is installed in a neat and professional manner as called for by the plans and specifications.
- 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 document the setting of all controls, parameters of all corrective 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 final submittal.
- 6. Verify the performance parameters of the individual systems following established professional 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, being careful to include the following information:
 - a. Performance date of the given procedure.
 - b. Condition of performance of procedure.
 - c. Type of procedure, and description.
 - d. Parameters measured and their values, including values measured prior to calibration or correction, as applicable.
 - e. Parameters associated with calibration or corrective networks, components, or devices.

- f. The names of personnel conducting the procedure.
- g. The equipment used to conduct the procedure
8. Measure and record impedance curves of all loudspeaker lines at amplifier rack terminal barrier strips.
9. Apply a sine-wave sweep signal to each loudspeaker system, sweeping from 50 Hz to 5000 Hz at a sound pressure level which is 10 dB below the loudspeaker's rated electrical input power. Listen for rattles or objectionable noise and correct if apparent.
10. Using a plus 4 dBm sine-wave input, set controls of each component to produce a plus 4 dBm sine-wave output. Under these conditions (unity gain), the presence of any waveform, distortion, interference signals, or oscillations shall be unacceptable.
11. Check for proper polarity of ceiling mounted loudspeakers by applying music program or pink noise to each system and walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shifting of source from one loudspeaker to the next.
12. Drive each ceiling distributed loudspeaker system with one octave of pink noise centered at 1000 Hz at a sound pressure level which is at least 10 dB above the ambient noise. Adjust power amplifiers to provide uniform distribution of sound throughout the seating areas within a tolerance of plus or minus 3 dB. Use an ANSI Type 1 sound level meter set for slow response to take readings at standing ear height.
13. Individually drive each reinforcement loudspeaker with one octave of pink noise centered at 1000 Hz at a sound pressure level which is at least 10 dB above the ambient noise. Adjust power amplifiers to provide an equal sound pressure level from each loudspeaker on its aiming axis in the seating area. Use an ANSI Type 1 sound level meter set for slow response to take readings at standing ear height.
14. 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 final equalization and acceptance testing.

E. Field Installation Acceptance Test

1. The Field Installation Acceptance Test shall be performed for all installed components. Because the installation may be staged, a staged field installation acceptance test is satisfactory.
2. The Contractor shall test, at a minimum, the following for the Field Installation Acceptance Test:
 - a. The Field Installation Acceptance Test shall test all cables, wires, components and software installed in the field.
 - b. The Field Installation Acceptance Test shall ensure the proper operation of all installed components, including but not limited to:
 - 1) Audio announcement sound pressure levels and intelligibility measures to test the speakers and connections to the amplifiers.

- 2) Full diagnostic tests of the electronic signage.
3. Submit detailed test procedures for each component and subsystem.
 - a. 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 Installation Acceptance test.
 - a. The schedule shall describe when each component and subsystem will be installed and the schedule for field acceptance.
 - b. The schedule shall describe the complement of test procedures to be utilized for each test.
 - c. 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 Installation Acceptance Test.
6. All retesting required due to Field Acceptance failures or results unsatisfactory to the Engineer shall be performed at no additional cost to the Authority.
7. Submit each test result record after completion.

F. System Functionality Test

1. The System Integration Test shall ensure that the entire system works properly together. The System Integration Test shall test functionality from end-to-end.
2. The System Integration Test shall be performed after the full required installation of the Public Address System for each construction phase.
3. At a minimum, the System Integration Test shall verify the following:
 - a. Message creation, editing, and storage of audio messages.
 - b. Message prioritization for audio messages.
 - c. Message scheduling for audio messages.
 - d. Message library functionality for audio messages.
 - e. Zone configurations.
 - f. Message transmission, from microphone stations.
 - g. Public Address System override upon activation of Fire Alarm Voice EVAC.
4. Each System Integration Test shall include procedures to verify the operation and performance of all equipment and software installed in previous phases is unaffected by the work of the current phase.
5. Submit the test procedures that will be used to perform the System Integration Test.
6. Submit a list of equipment that will be used to perform the System Integration Test.
7. All retesting required due to test failures or results unsatisfactory to the Engineer shall be performed at no additional cost to the Authority.
8. Submit all test records.

G. Final Adjustment and Equalization

1. Schedule a time to perform the Final Adjustment and Equalization. Notify the Engineer at least 10 days in advance.
2. Furnish a technician who is familiar with the system to assist the Engineer during the Final Adjustment and Equalization.
3. System acceptance tests shall employ an approved sound level meter, and spectrum analyzer to be provided by the contractor. Measurements shall be made at the combined output of the amplifiers and at selected locations throughout the facility.
4. Record final settings on all equipment and submit to the Engineer.

H. 30 Day Operational Acceptance Test

1. Following the satisfactory completion of Field Testing, a 30 Day Operational Test shall be performed. Due to the necessity of staged construction activities, multiple 30 Day Operational Tests may be required one for each construction phase. At the end of the last installation phase, the final 30 Day Operational Test shall be on the completed fully installed system.
2. At the satisfactory conclusion of each 30 Day Operational Test, a Certificate of Partial Completion will be provided, and the warranty/maintenance period shall begin for the installed equipment.
3. During each 30 Day test period, the Engineer 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. All malfunctions encountered during Operational Acceptance Testing shall be corrected by the Contractor at no additional cost to the Authority. Said malfunctions include, but are not limited to, equipment failure or failure of the Public Address System 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, or both, with the exception of those items not furnished as Work of this Contract, that prevents the Authority from performing meaningful work using the Public Address System based upon the Authority's business needs.
4. The Contractor shall 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 Public Address System performance as described herein.
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 Public Address System has met the Standard of Performance for the consecutive days required by operating in

conformity with the technical specifications set forth in this agreement at the required Public Address System Availability Level stated in the specifications.

- I. Failure to Complete Acceptance Testing Successfully
 1. In the event the Public Address 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. The Contractor shall refer Substitution clause in Division 1 specifications for current requirement.
 - b. The Authority may permit the Contractor to continue to attempt to cause the Public Address System 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 there under or available at law or in equity or seek to enforce any damages.
- J. During the Field and 30 Day Operational Testing, the Contractor shall perform any re-calibration, re-configuration or re-programming of the Public Address 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 30 Day Operational Testing shall be fully documented by the Contractor and shall not be implemented without prior approval by the Engineer.
 1. Prior to the commencement of Operational Acceptance Testing, the Contractor shall have on site, one complete set of "working" shop drawings and wiring diagrams for use by the Engineer and the Contractor's field technicians during the test process.
- K. Following satisfactory completion of the final 30 Day Operational Test, a Certificate of Final Completion will be issued, and the final warranty period shall begin.

3.06 POST-INSTALLATION SERVICES

A. Warranty

1. Notwithstanding the Contract Documents, any inspection or approval by the Engineer 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 the Public Address System shall be to repair or replace and make operational all Public Address System components within 24 hours of being notified of the condition at no additional 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
 - a. 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
 - a. When requested by the Engineer within one year of date of Final Completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps and adjusting controls to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

B. Guarantee

1. Any inspection or approval of the Work by the Engineer, 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 Services During Construction

1. The maintenance services during construction shall include as a minimum the following:
 - a. Correction and repair of all errors and malfunctions.
 - b. Repair of failed hardware and components furnished as Work of this Contract.
 - c. Procurement and installation of all recommended and required software upgrades and patches required to operate the system during construction.
 - d. 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.
 - e. System administration and configuration
 - f. On-site assistance in adjusting sound levels, resetting matching transformer taps and adjusting controls to suit actual occupied conditions during the construction period.

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 1.07 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 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.

3.07 MAINTENANCE MANUALS

- A. The maintenance manuals shall provide complete documentation of the Voice Paging System for the purpose of system maintenance and operation. 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. Provide one set of all drawings as reproducible and one set of electronic files in AutoCAD format. Provide 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. Provide one set of all manuals in PDF format.
- C. Include all original manufacturer manuals and literature.
 - 1. Provide 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
 - a. Product Data
 - b. Shop Drawings
 - c. Test Documentation, including list of equipment and result records
 - d. Spare Parts List
 - e. Tools List

3.08 OPERATIONAL MANUALS

- A. The Operational Manuals shall be provided as a guide to users of the Public Address System. The manuals shall enable a novice user to login and utilize the system. Separate

operational manuals shall be provided for system administrators, maintainer, and dedicated announcers.

- B. At a minimum, each 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 Public Address System and implemented through the user interface.
 3. Start-up and shutdown procedures including log-in.
 4. Navigating the application.
 5. Making an announcement. This includes each type of announcement, such as text-to-speech, live audio or library message.
 6. Using the library of messages. The extent of these instructions may vary on type of operational manual.
 7. Invocation and explanation of System reports.
- C. At a minimum, the System Administrator Manual shall also include 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. Configuring announcement zones.
 4. Using the diagnostic and troubleshooting tools.
 5. Conducting backup and restoration of databases, configuration, libraries, schedules, etc.
- D. At a minimum, the Maintenance Manual shall also include detailed descriptions of the following:
1. An Introduction that includes a theory of operations and a bill of materials.
 2. List of all components, identifying manufacturer, model number and configuration.
 3. System block diagram.
 4. Each manufacturer's product data sheet annotated to clearly identify the system components.
 5. Each manufacturer's operating and maintenance instructions.
 6. General description of normal maintenance procedures.
 7. Using the diagnostic and troubleshooting tools.
 8. Navigating and using the system fault logs.

E. Dedicated Announcer Manual

1. The Dedicated Announcer 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.

3.09 TRAINING

A. The Contractor shall provide training courses to familiarize users with the Public Address System.

1. Three courses shall be provided:
 - a. Operator
 - b. System Administrator and
 - c. Maintenance and Supervisor Training Courses

B. Provide 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. The Contractor shall 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 required by the Engineer. Class sizes shall contain no more than 15 students and classes shall include hands on training to 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).

<u>Staff Category</u>	<u>Number of Staff</u>	<u>Minimum Class Time</u>
Operations	30	12 hours
Supervisory/ Administrator	15	20 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.

3.10 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 Engineer and the Authority.
 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. 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.
 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, configured and 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:
 - 1. Submit 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. Rescue disks.
 - 4. Complete drive backup.

END OF SECTION

SECTION 275116

PUBLIC ADDRESS SYSTEM

APPENDIX "A"

SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of Division 01 - GENERAL PROVISIONS:

Shop Drawings

- 275116A01
1. Functional Block Diagram: The Functional Block Diagrams shall describe, at a minimum, the following information
 - a. Executive Summary, a summary of the documentation material provided in the deliverable, an overview of the Public Address System.
 - b. Functional Description, a description of the overall system that provides a functional description of the major components and describes their operation.
 - c. System Architecture, a graphic representation of hardware components and their interconnections. This shall include identification of the interfaces between each device and each computer and the interfaces to all other systems.
 - d. Security Features.
 - e. System Performance Analysis
 2. Installation Plans: Provide floor plans indicating raceway and wiring and other system components to be used in the installation of all Public Address System equipment. Any deviation from the Contract Drawings requires prior written approval from the Engineer
 3. Wiring Diagrams: Provide 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: Submit 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.
- 275116A02
1. Submit diagrams and documentation indicating the system configuration and default settings for the Voice Paging System.

Samples

- 275116C01
1. Provide one each of fully working and completely assembled loudspeaker for approval by the Engineer.
 2. Provide one each of fully working microphone station, for approval by the Engineer.

Product Data

275116D01

1. Upon approval of the Qualifications submit manufacturer's data on the Public Address System components, including, but not limited to electrical specifications, mechanical specifications, rough-in diagrams and instructions for installation, operation and maintenance, suitable for inclusion in maintenance manuals
2. Catalog cuts for all equipment showing compliance with 2.02 of this Section.
3. Submit a complete schedule and bill of materials for the equipment to be furnished and or installed under this Section.
4. Submit complete installation instructions and recommendations for all components of the Public Address System.

Manufacturer Test Reports

275116F01

I. Factory Acceptance Test Plan:

1. Submit to the Engineer for approval a Factory Acceptance test plan which includes the following details:
 - a. A summary statement of the purpose and goal of each portion of the test plan
 - b. The method of testing
 - c. A description of the overall test environment including diagrams showing the total test environment, relevant equipment interconnection and test equipment hook up.
 - d. 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.
 - e. 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) Identifies the:
 - a) Steps for each test to be performed
 - b) Test purpose
 - c) Conditions which exist at the start of each test procedure
 - d) Conditions/results expected at the conclusion of each test procedure
 - e) The specification requirement which will be demonstrated by the test procedure
 - 3) Includes 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) Describes the documents to be provided to the Engineer to validate the test results (reports, database listings, statistical analyses, etc.).
2. Submit to the Engineer for approval, a request to conduct the Factory Inspection and Testing. The request shall include the estimated length of time required to complete the inspection and testing and shall include an agenda that identifies when each of the tests are scheduled to be conducted
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 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 Factory Inspection and Test document.
 - a. In the event of any device or component fails a test, the test shall be halted and the system manufacturer shall make the necessary repairs or adjustments. The test shall then be repeated.
 - b. Unless permitted by the Engineer, subsequent test steps shall not begin until the test failure is satisfactorily corrected.

- c. 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 request that previous test be fully or partially repeated.
- d. The Engineer may, in his sole judgment, authorize testing to begin on a different unit while repairs or modifications are made to correct a failure.
- e. If, in the judgment of the Engineer, there are an excessive number of test failures, the Factory Inspection and Test shall be terminated. The Contractor shall reschedule the Factory Inspection and Test for a later date.
- f. If the test is terminated, before commencing of the re-test (schedule at a later date), the system manufacturer shall 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.

J. Field Test Plan:

- 1. Submit to the Engineer for approval a field acceptance test plan which follows the same format and requirements of the Field Test plan described in 3.05E of this Section. The test plan shall include, at a minimum, all tests and procedures incorporated in the Factory Inspection and Test that was approved by the Engineer and any additional tests to demonstrate that the installed equipment operates as specified.
- 2. Upon completion of the Field Test, 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 Test Results

- 1. Upon completion of the 30 Day Operational Test submit the written report documenting the results of the test. Identify all equipment, software and components adjusted, repaired or replaced during the 30 day test

Construction and Installation Procedures

275116G01

D. Installation Staging

- 1. Submit an installation staging plan detailing the installation of equipment in each construction phase in accordance with 3.01 F of this Section.

Manuals, Warrantees/Guarantees

275116I01

- 1. Prepare and submit, consolidated comprehensive, separate, Users Manuals, Maintenance Manuals, System Administration Manuals and Communications Protocol Manuals for the Public Address System, and all associated equipment, hardware, and software. The Contractor shall provide information for products furnished under this Section and prepared in the form of an instruction manual, which shall be used as the basis for the Users, Supervisor and Maintenance training courses, to be conducted by the Contractor. Operations, System Administration and Maintenance manuals shall be specifically written for this installation. Pages from the original equipment manufacturer's standard operations and maintenance manuals can be referenced in the manuals written for this Contract, provided all of the referenced items are included in the manuals.
- 2. 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 the following items:

- a. An Introduction that includes a theory of operations and bill of materials.
 - b. General description of normal maintenance procedures.
 - c. Detailed description of Public Address System including all of the functional capabilities.
 - d. Detailed description of procedures for modifying the Public Address System software configuration settings.
 - e. 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.
 - f. Backup and restore message libraries and schedules, , error and event logs.
 - g. Detailed description of procedures to back up and restore the Public Address System configuration including all parameters, thresholds, libraries and tables.
 - h. As installed color coded interconnection wiring diagrams, both "factory" and "field".
 - i. 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.
 - j. 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.
 - k. Each manufacturer's product data sheet annotated to clearly identify product or part.
 - l. Each manufacturer's printed operating and maintenance instructions.
 - m. List of recommended cleaning agents, maintenance procedures and schedules.
 - n. List of recommended test equipment including manufacturer's name, address, and model number
3. Bind all 8.5inches by 11inches 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 which exceeds 8.5inches by 11inches shall be 11inches by 17inches in size and fan-folded to 8.5inches by 11inches size. No documentation shall be smaller than 8.5inches by 11inches. Document pages shall be numbered sequentially.
4. In addition, submit documentation in Adobe PDF format, on approved electronic media.

Qualifications

- 275116K01 1. Submit name and address of the Voice Paging System Manufacturer, System Integrator and Installer and proof of compliance with 1.06 of this Section.

Record Documents

- 275116M01 M. As-Built Drawings: 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.

Spare Parts List

- 275116N01 N. 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. Spare parts shall be furnished to the Authority prior to the start of the first 30-Day Operational Acceptance Test.

Inspection Reports

- 275116O01
1. Submit to the Engineer for approval a field acceptance test plan which follows the same format and requirements of the Field Test plan described in 3.05E of this Section. The test plan shall include, at a minimum, all tests and procedures incorporated in the Factory Inspection and Test that was approved by the Engineer and any additional tests to demonstrate that the installed equipment operates as specified.
 2. Upon completion of the Field Test, 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.
- 275116O02
1. Upon completion of the 30 Day Operational Test submit the written report documenting the results of the test. Identify all equipment, software and components adjusted, repaired or replaced during the 30 day test

Training

- 275116Q01
1. Submit to the Engineer, for approval, copies of the Training Plan which includes, but is not limited to the following for each training class:
 - a. Detailed description of the proposed course curriculum;
 - b. Draft copies of the course material including but not limited to manuals, study guides, workbooks, technical reference material, etc.;
 - c. Comprehensive schedule for the delivery of all training classes;
 - d. 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 are to be used by the Authority personnel during the training courses.
 3. After completion of all Operations, Maintenance and Supervisor Training Courses, submit the following:
 - a. 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 2007 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.
 - b. Video recordings of each instructional class on DVD for the Authority's future use.

Video instructions for operation of each item of equipment supplied also shall be provided. 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.

Information

275116S01

E. Requirements Matrix

1. The requirements matrix shall contain each and every design requirement, listing Contract specification reference number and identify the logical processes and physical system or subsystem components that will satisfy the requirement.
2. 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, the Contractor shall submit an updated requirements matrix.

F. System Configuration

1. Submit diagrams and documentation indicating the system configuration and default settings for the Public Address System.

END OF APPENDIX "A"