

**SECTION 274100**  
**AUDIO VIDEO SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. These specifications and the associated TA-series drawings describe the sound and audio-visual (AV) system (hereafter referred to as the "Technical System") to be furnished.
- B. Project includes improvements of systems in the following fashion:
  - 1. Upgrades to wireless microphone system.
  - 2. Re-installation of existing wireless microphone system into existing portable equipment rack.
  - 3. Upgrade to digital mixing console.
- C. Work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; and Addenda.
- D. Work under this section of the specifications includes all labor, equipment, and installation as required to provide a complete technical system in compliance with the contract documents.
- E. Employ the services of a qualified structural engineer to review all overhead mounting, suspension, and rigging details of the technical system equipment. All mounting and rigging schemes indicated on the drawings are shown for concept only. Submit shop drawings stamped by a structural engineer of all details and weights for review by the project's Owner's Representative and Design Consultant.
- F. The work in this section shall be coordinated with other work to determine installation scope for conduit, outlet boxes, junction boxes, pull boxes, terminal cabinets, 120-volt AC power circuits, and insulated ground cables required for the technical system.
  - 1. Discuss any additional power requirements or existing grounding with the District Owner's Representative.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section, as do the following:
  - 1. Division 27 Section "General Communications Requirements".
  - 2. Division 27 Section "Common Work Results for Communications".
- B. All Category 5e/6 and fiber optic cabling and terminations shall adhere to the Division 27 Section "Telecommunications Requirements for Audio Video Systems".
- C. This section is a parent section to all sections numbered 274101 thru 274199. Requirements found in this section shall apply to all child sections unless otherwise noted.

**1.3 EXAMINATION OF SITE**

- A. This project is an existing facility undergoing system replacement.
- B. Prior to submitting a bid personally examine the site of the proposed work and verify the conditions which involve his work.
- C. By the act of submitting a bid, the contractor will be deemed to have made reasonable allowances for site examinations, site conditions, and included all costs in his proposal. Failure to verify these conditions will not be considered a basis for the granting of additional compensation.

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1.4 MATERIAL AND WORKMANSHIP

- A. All equipment shall be new and in proper operating condition. All workmanship shall be of the finest quality by experienced installation technicians.
- B. Contact the District, in writing, regarding the selection of colors for all exposed equipment.
- C. In addition to a complete set of the system project drawings and specifications, maintain at the job site a complete set of manufacturer's original operation, instruction, installation, and service manuals for each equipment item, for reference.

1.5 ORDINANCE AND CODES

- A. Comply with all applicable national and local codes and ordinances, and obtain all required permits. Assume responsibility for any violations of the law within the scope of his work.

1.6 DEFINITIONS

- A. No additional.

1.7 QUALITY ASSURANCE

A. Contractor General Qualifications:

- 1. Compliance with the requirements of Division 1.
- 2. Licensed to perform work of this type in the project jurisdiction.
- 3. At least five (5) years of verifiable direct experience with the devices, equipment and systems of the type and scope specified herein.
- 4. Prior successful experience of projects of similar size, scope and type as outlined in the Construction Documents.
- 5. Active membership in the National Systems Contractors Association (NSCA).
- 6. Active membership in Avixa.
- 7. Fully staffed and equipped maintenance and repair facility.
- 8. Factory-authorized dealer for the major components specified.
- 9. Manufacturer trained instructor for mixing console and wireless microphone systems.
  - a. Provide documentation from manufacturer certifying the Bidder's trainer meets the capability and level of experience to fully train the Owner's representative per the requirements listed in Part 3 of this section.
  - b. If not compliant, provide certified training services by manufacturer(s) (not manufacturer's sales representative).

B. Contractor Personnel Qualifications:

- 1. Skilled workers thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and the methods needed for proper performance of the work in this section. The workers shall have at least three (3) years direct experience in similar work, evidence of which shall be verified in writing with appropriate references.
- 2. Supervisor with at least five (5) years direct experience in similar work. The supervisor shall be present for and in responsible charge of all work in the fabrication shop and on the project site during all phases of the installation and testing of the system(s). To assure continuity, this supervisor shall be the same individual throughout the execution of the work unless illness, loss of personnel, or other reasonable circumstances intervene. This personal shall act as the Technical System Project manager, and shall attend all scheduled project meetings.

- C. Provide additional information as required for review by the Owner's Representative and Design Consultant to aid in proving acceptability.

1.8 SUBSTITUTIONS

- A. Substitutions of equipment/materials will be considered for approval. The contractor shall bear the "burden of proof" for demonstrating substitute equipment/materials' equivalency and suitability.

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- B. Requests for substitution of equipment/materials shall comply with Division 01 regarding the proposed substitute item(s), specifications, and front/rear views (if applicable).
- C. In the absence of Division 01 specifications on substitutions, information regarding substitution of equipment/materials shall be presented in writing to the Owner's Representative and Design Consultant for review. This written request shall contain copies of complete manufacturer's literature regarding the proposed substitute item(s), specifications, and front/rear views (if applicable).
- D. Submission of substitute equipment/materials (including any associated software) may be required for evaluation by the Design Consultant, at his discretion, prior to acceptance, and subject to evaluation fees. Contractor shall be responsible for the substituted equipment/materials and for all related shipping costs and evaluation fees.
- E. Replace any and all approved, installed substitute equipment/materials if an unforeseen defect appears, or if operational characteristics do not fulfill the design intent of the system.

**1.9 SUBMITTALS**

- A. Refer to requirements in Division 27 Section "General Communications Requirements".
- B. Include the following items:
  - 1. Bid
    - a. Contractor Qualifications
    - b. Personnel Qualifications
  - 2. Pre-Construction
    - a. Equipment List
    - b. Product substitutions, in accordance with Division 1
    - c. Manufacturers' Cut-sheets
      - 1) Minor pieces of equipment that are not visible and inconsequential to system operation may be included on Equipment List and no cut-sheet is required.
    - d. Schedule
      - 1) Include quiet time on-site for system Commissioning.
    - e. AV Pathways and Cabling – Follow requirements of Division 27 Section "Common Work Results for Communications".
    - f. Structural Details – For hung equipment, provide details showing mounting, suspension, and rigging, including weights of supported equipment and mounting/suspension materials, approved and stamped by a licensed structural engineer.
    - g. Equipment Rack Shop Drawings - Equipment rack front elevation showing equipment and panel layout.
    - h. Panel, Patch Panel, and Plate Shop Drawings - All panel, patch panel, and plate layouts indicating locations of connectors, engraving, nomenclature, panel material, and finish. Include Structured Cabling Work required by the technical system.
    - i. Refer to child sections for additional requirements.
  - 3. Project Completion
    - a. Refer to Division 27 Section "General Communications Requirements" and the Record Drawings and Operation and Maintenance Data sub-sections in Part 3 of this section for requirements.
    - b. Preliminary Testing Documentation Package – Provide preliminary results of system testing as described in Part 3 of this section for review prior to Commissioning. Include final results with Closeout Documentation.
    - c. Refer to child sections for additional requirements.

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1.10 ELECTRONIC FILE SHARING

- A. Refer to Division 27 Section "General Communications Requirements" for information on obtaining electronic versions of the construction drawings.

1.11 BASE BID AND ALTERNATES

- A. In addition to the Base Bid, provide prices for designated Alternates, as defined below and as further described in the specifications and on the drawings. Alternates shall be Add (additive) Alternates as described herein and on the drawings. Any work not designated as an Alternate shall be provided in the Base Bid.
- B. Any and all Alternates that are not accepted (i.e., not installed) shall include provisions for future installation of these Alternates. Typical provisions include engraving and installation for all panel-mounted receptacles reflecting the complete system, all wiring installed in conduit (except where conduit remains empty) with suitable identification (noted on the working drawings for inclusion with the record drawings), patch panel wiring and labeling, and appropriate rack space (including blank panels for Alternate equipment not installed).
- C. The Owner's Representative reserves the right to: reject all bids; reject all Alternates; accept any Alternates in any order or combination; and determine the low Bidder on the basis of the sum of the Base Bid and accepted Alternates.
- D. ADD Alternate LSW No. 1: Provide additional components for wireless microphone systems as indicated on signal flows and specifications.
- E. ADD Alternate BCMS No. 1: Provide additional components for wireless microphone systems as indicated on signal flows and specifications.

1.12 PROTECTION OF WORK

- A. Protect all work, materials and equipment from damage due to any cause. Provide for the safety and new condition of the equipment and materials until final acceptance by the Owner's Representative. Replace all damaged or defective materials and/or equipment as directed by the Design Consultant.
- B. Equipment racks, cabling racks, junction boxes, termination boxes, and other exposed equipment shall be kept covered and protected from airborne contaminants. Clean all debris from the equipment room(s)/location(s) and control areas, and clean all equipment and the interior rack floor, prior to system commissioning activities.

1.13 EXISTING AND/ OR OWNER FURNISHED EQUIPMENT

- A. Certain existing technical system equipment is to be re-used with the new technical system as indicated on the drawings and in these specifications. Any equipment not specifically noted as "existing" shall be new, and shall be provided.
- B. Verify all model numbers, quantities, sizes, and connector types as necessary to coordinate with system requirements.
- C. Examine the equipment and perform normal operational checks to verify that the equipment is in good condition and is operating normally. Should any equipment defects be found (physical, electrical, or otherwise), identify, in writing to the Owner's Representative: a) defects found; and b) the estimated cost of any proposed repairs versus cost of replacement.
- D. Where required for rack-mounting, furnish rack-mounting hardware or shelf for equipment not already having rack-mounting flanges. Also furnish security covers for existing equipment where such covers are required per the specifications.
- E. Proper operation and maintenance of such existing equipment remains the responsibility of the Owner's Representative.
- F. Owner's existing portable equipment (or other Owner-furnished equipment), may be used by the Owner's Representative with the new technical systems. Proper operation and maintenance of such existing equipment remains the responsibility of the Owner's Representative.

1.14 EXISTING WIRING

- A. Comply with NEC (National Electrical Code) requirements regarding removal of all existing wiring that is not re-used with the system(s) defined herein.

1.15 TEMPORARY TECHNICAL SYSTEM

- A. Provide and operate a temporary technical system of reasonably equivalent function as determined by the Design Consultant if the work in this section, as a failure of the contractor, is incomplete or found not in conformance with the contract documents. The temporary system shall remain in use until acceptance of the permanent system.

1.16 WARRANTY

- A. Warrant all work executed under this contract, including all in-shop and onsite material, parts and labor, for a period of twelve months after the date of final acceptance.
  - 1. Existing or any other Owner-furnished equipment shall not be included in this warranty.
  - 2. For equipment that has an advertised manufacturer's warranty longer than 12 months, include end date of warranty period.
- B. The warranty services are limited to normal business hours, unless additional agreements are made between the Owner's Representative and the contractor.
- C. Warranty work relating to technically complex equipment and/or programming such as for codecs, digital signal processing, control systems, and video projectors shall be performed by a factory authorized technician.
- D. Damage to the system resultant from improper use or adjustment by others, negligence, acts of nature, or other causes which are beyond the contractor's control shall be excluded from the warranty.
- E. Refer to General Conditions for additional requirements.

**PART 2 - PRODUCTS**

2.1 GENERAL

- A. Unless otherwise designated, provide all of one type of equipment from one manufacturer; for example, microphones of one type by one manufacturer, data switches of one type by one manufacturer, cabling of one type by one manufacturer, or loudspeakers of one type by one manufacturer.
- B. Equipment and wiring shown on the drawings represents the basis of design. Ensure similar or better performance is achieved by the use of equipment other than that shown.
- C. All major components of technical system equipment shall be provided and installed by a qualified contractor as outlined in Part 1 of this section.
- D. All equipment shall be new and of professional quality.
- E. Some items listed in these specifications are custom-made products. Ensure when pricing and ordering equipment that the exact part number called out is used. If there is a discrepancy, contact the Design Consultant for clarification.
- F. Each software programmable device furnished (i.e. Digital Signal Processor, control system, etc.) shall include most recent software and appropriate computer interface cable - minimum 25' (device to PC). Cable, software, source (uncompiled) code and all related aspects of all software-controlled equipment shall become the property of the Owner and will be furnished as a portion of the Operation & Maintenance (O&M) manuals (see Operation & Maintenance Manuals near the end of Part 3).
- G. The quantities of each item of portable or mobile equipment (and other portable or loose accessories), as well as those items associated with Alternates, are indicated in parenthesis. Such equipment is intended to be shared between rooms having technical systems, except where noted for use in one specific room.

## 2.2 ETHERNET SWITCHES & ACCESSORIES

- A. Ethernet switches shall be as recommended by the manufacturer(s) of the connected technical system equipment. These devices shall also be coordinated with the Owner's Representatives IT department to maintain common products. Each shall be labeled as shown on the technical system drawings and as required to match the Owner's Representatives IT labeling standard. Products listed in this portion of the specifications are representative – furnish the most recent product. Confirm operation compatibility with connected devices.
- B. Ethernet switches shall have IPv4 and IPv6 routing, multicast routing, advanced quality of service (QoS), and security features in hardware. Disabling of power saving features and other blocking features shall be available for proper signal traffic.
- C. Ethernet switches shall be provided with all licensing requirements, product activation requirements, etc. for proper operation.
- D. Ethernet switches shall be configured for proper operation of the system. Configuration shall comply with Owner's network standards.
- E. Ethernet Switch – (##)(M)(P)(G)(R)(-L3)(-AVB): Ethernet switch with SFP uplink capabilities and the following characteristics required as shown on the signal flows:
  - 1. Cisco 2960 Series; or HP 2530 Series; or Extreme Networks Summit Series; or approved equal.
    - a. ##, minimum number of ports
    - b. M, managed (minimum unmanaged if not included)
    - c. P, PoE (non-PoE if not included)
    - d. G, gigabit 10/100/1000baseT (minimum 10/100baseT if not included)
    - e. R, rack mount (rack mounting optional if not included)
    - f.
  - 2. Cisco 3560 Series; or HP 5120 Series; or Extreme Networks Summit Series; or approved equal.
    - a. ##, minimum number of ports
    - b. M, managed (minimum unmanaged if not included)
    - c. P, PoE (non-PoE if not included)
    - d. G, gigabit 10/100/1000baseT (minimum 10/100baseT if not included)
    - e. R, rack mount (rack mounting optional if not included)
    - f. -L3, layer 3 required (minimum layer 2 if not included)
  - 3. Extreme Networks Summit X430 or X440 Series (AVB requires AVB feature pack).
    - a. ##, minimum number of ports
    - b. M, managed (minimum unmanaged if not included)
    - c. P, PoE (non-PoE if not included)
    - d. G, gigabit 10/100/1000baseT (minimum 10/100baseT if not included)
    - e. R, rack mount (rack mounting optional if not included)
    - f. -L3, layer 3 required (minimum layer 2 if not included)
    - g. -AVB, AVB capable switch (no AVB capabilities required if not included)

## 2.3 CABLE - BULK

- A. The products in this section have been approved for use in the project as necessary to facilitate a complete and working system. Inclusion in this section does not indicate a requirement for use.
- B. Product must be procured from the original cable manufacturer.

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- C. AWG wire sizes indicated herein or on the drawings are the minimum size conductors required. Larger size conductors (i.e., smaller AWG number) are permitted assuming no impact on the project will occur (such as the resulting need for larger or additional conduit, cable trays, chases, etc.) to accommodate such cable.
- D. Where cable is run exposed (such as in ceiling plenums, cable trays, chases, or below accessible floors):
  - 1. Verify which locations do and do not require plenum-rated cable.
  - 2. Furnish the appropriate cable type.
  - 3. Obtain written authorization from the District in this regard.
- E. Category cabling:
  - 1. No primary runs anticipated outside of booth area. Coordinate with District.
  - 2. Horizontal cables for dry environments - shielded
    - a. Requirements
      - 1) Minimum performance specifications: Cable shall meet requirements for Category 6 of TIA-568-C.
      - 2) Aluminum Foil Tape Shield (F/UTP)
      - 3) Four pairs of 23 AWG copper conductors with drain wire
      - 4) Cable jacket color(s) shall be
        - a) As selected by District to match District Standards
      - 5) Cable jacket marking: Shall be legible and shall contain the following information:
        - a) Manufacturer's name
        - b) Copper Conductor Gauge
        - c) Pair Count
        - d) UL and CSA listing
        - e) Manufacturer's trade mark
        - f) Category rating
        - g) Sequential distance markings, in one foot increments
      - 6) Individually insulated conductors under a common sheath
      - 7) Where all cables are to be installed in conduit from outlet box to AV Equipment Rack, cable shall be riser (CMR or MPR) rated. Where any portion of any cable is routed in an air plenum space, cable shall be plenum (CMP) rated.
    - b. Manufacturer shall be:
      - 1) From the following list, subject to District requirements:
        - a) Superior Essex CAT 6+ ScTP
        - b) Belden DataTwist 2400
        - c) Berk-Tek LANMARK-6 FTP
        - d) Hitachi Shielded Category 6 Cable
        - e) Hubbell Speedchannel FTP Cable, Category 6
        - f) Mohawk Category 6 F/UTP
        - g) Panduit TX6000 Shielded Copper Cable
  - 3. Horizontal cables for dry environments - unshielded
    - a. Requirements
      - 1) Minimum performance specifications: Cable shall meet requirements for Category 6 of TIA-568-C.

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- 2) Four pairs of 23 AWG copper conductors
  - 3) Cable jacket color(s) shall be
    - a) As selected by District to match District Standards
  - 4) Cable jacket marking: Shall be legible and shall contain the following information:
    - a) Manufacturer's name
    - b) Copper Conductor Gauge
    - c) Pair Count
    - d) UL and CSA listing
    - e) Manufacturer's trade mark
    - f) Category rating
    - g) Sequential distance markings, in one foot increments
  - 5) Individually insulated conductors under a common sheath
  - 6) Where all cables are to be installed in conduit from outlet box to AV Equipment Rack, cable shall be riser (CMR or MPR) rated. Where any portion of any cable is routed in an air plenum space, cable shall be plenum (CMP) rated.
- b. Manufacturer shall be:
- 1) From the following list, subject to District requirements:
    - a) Superior Essex CAT 6+
    - b) Belden DataTwist 2400
    - c) Berk-Tek LANMARK-6
    - d) Hitachi Category 6 Cable
    - e) Hubbell Speedchannel Cable, Category 6
    - f) Mohawk Category 6
    - g) Panduit TX6000 Copper Cable
- F. Fiber Optic cabling:
1. None anticipated. Coordinate with District.
- G. 22 AWG/NP, microphone, intercom, or line-level circuits installed in conduit or equipment racks, 22 AWG, 2-conductor shielded, PVC jacket – not plenum rated:
1. Belden 8451 or Gepco SAHS122R; or
  2. Belden 9451 or Gepco 61801EZ; or
  3. Belden 5500FE or Gepco SSS222R; or
  4. Belden 9451D (dual) or Gepco D61801EZGF (dual); or
  5. Belden 8422 or 8412 (20AWG); or
  6. West Penn 291 or Gepco SSS222R; or
  7. West Penn 452; or
  8. West Penn 454 or Gepco SAPS122R.
- H. 22 AWG/P, microphone, intercom, or line-level circuits installed in a return-air plenum without conduit, 22 AWG, 2-conductor shielded, plenum rated:
1. Belden 9451P or Gepco 61801HS; or
  2. Belden 6500FC; or
  3. Belden 9451DP (dual); or
  4. West Penn 25291B or Gepco SSS222P.
  - 5.



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- I. RG-58/NP, single 50-ohm coax, installed in conduit or other non-plenum interior locations, not plenum rated:
  - 1. Belden 7806R; or
  - 2. West Penn 812.
- J. RG-58/P, single 50-ohm coax, installed in return-air plenum, plenum rated:
  - 1. Belden 82240 or 88240; or
  - 2. West Penn 25812.
- K. RG-8X/NP, single 50-ohm coax, installed in conduit or other non-plenum interior locations, not plenum rated.
  - 1. Belden 7808R or 9258; or
  - 2. Gepco V5020; or
  - 3. West Penn 807.
- L. RG-8X/P, single 50-ohm coax, install in return-air plenum, plenum rated:
  - 1. West Penn 25810.
- M. RG-8/U/NP, single 50-ohm coax, installed in conduit or other non-plenum interior locations, not plenum rated:
  - 1. Belden 9913; or
  - 2. West Penn 810.
- N. RG-8/U/P, single 50-ohm coax, installed in return-air plenum, plenum rated:
  - 1. Belden 89913; or
  - 2. West Penn 25812.
- O. RG-213/NP, single 50-ohm coax, installed in conduit or other non-plenum interior locations, not plenum rated:
  - 1. Belden 8267.

#### 2.4 CONNECTORS

- A. The products in this section have been approved for use in the project as necessary to facilitate a complete and working system. Inclusion in this section does not indicate a requirement for use.
- B. All XLR receptacles located outdoors, in boxes that are located outdoors, in natatoriums, or in areas where moisture or other corrosive materials are present shall have gold plated contact pins.
- C. XLR Cable Connector, cable mounted connector for line-level, microphone level, and intercom circuits:
  - 1. Neutrik X-series; or
  - 2. Switchcraft E Series Q-G.
- D. XLR Panel Connector, panel mounted audio connector for line-level, microphone level, and intercom circuits, color shall match plate color where possible:
  - 1. Neutrik D-Series; or
  - 2. Switchcraft standard AAA Series Q-G with metal handle.
- E. XLR Combo Connector, female XLR and 1/4" TRS receptacle in one chassis-mount connector:
  - 1. Neutrik NCJ6FI-S.
- F. 1/4" TRS Cable Connector, three-conductor (Tip Ring Sleeve) connector with a metal barrel and solder lugs:
  - 1. Canare F-16; or
  - 2. Neutrik NP3C; or
  - 3. Switchcraft 267.

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- G. 1/4" TS Cable Connector, two-conductor (Tip Sleeve) connector with a metal barrel and solder lugs:
  - 1. Canare F-15 plug; or
  - 2. Neutrik NP2C plugs; or
  - 3. Switchcraft 250.
- H. 1/4" TRS Panel Connector, three-conductor (Tip Ring Sleeve) connector with the sleeve contact isolated from the panel or plate to which it is mounted:
  - 1. Neutrik NJ3FP6C; or
  - 2. Switchcraft E112BL.
- I. 1/8" TRS Cable Connector, 1/8" (3.5mm) three-conductor mini-plugs which have a metal barrel and solder lugs:
  - 1. Canare F-12; or
  - 2. Neutrik NTP3RC; or
  - 3. Switchcraft 35HDNN plug.
- J. RJ45 Panel (Faceplate) Connector-6, data connector rated for shielded Category 6 cable:
  - 1. Neutrik etherCON NE8FDY-C6\* with SCDX cover  
\*Division 27 "Telecommunications Requirements for Audio Video Systems" Contractor shall terminate horizontal cable onto etherCON connector installed in custom faceplate.
- K. BNC Cable Connector, 75-ohm BNC, compression fitting for coaxial cable furnished:
  - 1. Liberty CM-RG-BNC series; or
  - 2. West Penn CN-CS-BNC and CN-FS-BNC series.
- L. BNC Panel Connector, 75-ohm BNC, pass-through, D-style mounting:
  - 1. Neutrik NBB75DFI; or
  - 2. Approved Equal.
- M. Terminator, RF or SDI terminator plug:
  - 1. Extron T-BNC series; or
  - 2. Pomona 3840 series; or
  - 3. Trompeter TNA series.
- N. Captive Screw Terminal Block, modular terminal blocks for mounting on DIN rails:
  - 1. Entrelec Screw Clamp series; or
  - 2. Approved Equal.

## 2.5 EQUIPMENT RACKS

- A. Re-use existing equipment racks. Provide new enclosure for Digital Console Mix Engine.
- B. Furnish all necessary accessories including ganging hardware, blank plates (to fill all unoccupied space), vent panels (as applicable), shelves, security covers, mounting screws, trim kits, lacing bars, cable management, leveling feet, casters, etc. to provide a complete solution which complies with "best practice" guidelines.
  - 1. Full-solution accessories are not detailed in this specification. They shall be provided as needed and shall be approved by the manufacturer for use with the intended rack series (i.e. Middle Atlantic casters must be used with a Middle Atlantic rack).
- C. Furnish all required components for a complete thermal management solution.
  - 1. Rack fans shall achieve a quiet operating condition, such as the Middle Atlantic QFAN.
  - 2. Thermostatic fan control shall be utilized where appropriate.
- D. Furnish all required components for a complete rack ground isolation solution.
  - 1. Racks shall be isolated from the floor by the use of isolated leveling feet (such as Middle Atlantic LF-ISO) or an isolation pad/system (such as Middle Atlantic ISO-1).

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- E. Equipment racks and all associated blank panels located in equipment rooms shall be factory finished semi-gloss black. Equipment racks and associated blank panels located in control booths or other visible locations shall be factory-finished color as selected by the District.
- F. Furnish locking storage drawers, hinged security covers, and racks with locking doors all keyed alike. Furnish four keys total.
- G. Equipment rack specification indicates the system basis of design. Verify equipment layout, rack size, and number of equipment racks required for equipment furnished.
- H. Desktop Rack – SA, stand-alone rack for locating on top of or beneath a desk or counter, laminate surface, minimum depth 18":
  - 1. Middle Atlantic Products BRKxx series; or
  - 2. Chief ER-xx-18 series.

**2.6 EQUIPMENT RACK ACCESSORIES**

- A. The following equipment rack accessories shall be provided as indicated on the rack elevations or within this section.
- B. Logo rack panel, single vertical rack space, labeled with contact information for the contractor and Design Consultant. Panel specified is custom and already has the information for the Design Consultant; the contractor shall coordinate their logo/information with the panel manufacturer (shop drawing required). One required to be installed at the top of each bank of equipment racks:
  - 1. Liberty Wire and Cable model HEI-RHIM-TEMPLATE.
- C. Storage Drawer – 2, rack drawer, 3.5" high (2RU), approximately 16" deep, color to match adjacent rack-mounting panels (one required):
  - 1. Atlas Sound SD2-14; or
  - 2. Middle Atlantic D2; or
  - 3. Chief SDR-2.

**2.7 STANDBY EQUIPMENT**

- A. The following equipment shall be on-hand at the time of system commissioning and system first-use for possible replacement of defective equipment or for field conditions noted. Maintain ownership of this standby equipment. However, if any item of this standby equipment is used to replace defective equipment, the installed item of standby equipment becomes Owner's property. Assume ownership of the defective equipment:
  - 1. Backup software for programmable devices.
  - 2. Laptop computer for all programmable devices.
- B. Allowances for overnight shipping of critical components should be included and utilized if component failure is essential to Owner's initial operation or first-use requirements.

**2.8 AC POWER**

- A. Furnish a multi-receptacle power strip for each AC circuit within the equipment rack(s). Furnish a minimum of 2 spare receptacles (beyond that required for connected equipment, rack fan, etc.) within each equipment rack. All power strips shall maintain integrity of technical system grounding requirements. All power strips shall comply with power sequencing requirements as described elsewhere.
- B. All equipment shall be connected so that maximum rated performance can be obtained without exceeding the AC circuit capability.
- C. UPS – 1RU: uninterruptable power supply, single rack space, 750 VA power rating, 15A input, minimum of four output receptacles (one required for Digital Console Surface and Mix Engine):
  - 1. APC Smart-UPS 750VA part number SUA750RM1U; or
  - 2. Eaton (Powerware) 5115 RM part number 103003269-6591; or
  - 3. Middle Atlantic UPS-1000R; or

4. TrippLite SmartPro part number SMART750RM1U.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Coordinate locations and sizes of junction boxes, outlets, and conduit with the work of other trades. Field verify compliance with the construction documents.
- B. Carefully inspect areas where equipment will be installed. Notify the District of any conditions that would adversely affect the installation and subsequent operation of the system.
  1. Repeat inspection on a regular basis to ensure ongoing work by other trades does not pose a conflict to Contractor's pending work.

#### **3.2 INSTALLATION**

- A. General
  1. Contractor shall demonstrate a reasonable standard of care. Installation shall be rendered in a workmanlike manner observing direction set forth herein as well as industry standard best practices.
  2. In addition to any spare cabling shown on drawings, utilize industry best practice to pull additional spare cabling in conduit where logical. Neatly bundle a usable length of cable at each end of each spare circuit. All spare circuits shall be labeled and noted on the field drawings for inclusion into the record drawings.
  3. Install any floor-mounted receptacles so that release buttons (for both receptacles and cable connectors) are easily accessible when cable connectors are installed.
  4. Blank panels and/or vent panels shall be installed in unused rack spaces. Ensure that air flow within the rack is maintained (i.e. cool air can enter the rack and hot air can exit the rack).
  5. Equipment racks and other exposed equipment shall be kept covered and protected from airborne contaminants. Clean all equipment racks and the interior rack floor, prior to system commissioning activities.
  6. For racks installed in credenzas, fasten carpet tiles or low friction sliders to the bottom of the rack to protect the finish of the furniture.
  7. Where the design location requires products, materials, or equipment to be visible to the public, manufacturers logos shall be removed if possible. Unless otherwise directed, neatly remove or logos.
  8. AC power switches located on the front panel of equipment mounted in racks shall be covered by a security cover or utilize front panel lockout features. Exclusions from this list are items requiring user interface such as compact disc players, Blu-ray players, tuners, and wireless microphone receivers.
  9. Furnish all equipment with factory finish where possible using the standard available factory color(s) as selected by the District. Notify the District regarding color options of relevant equipment prior to ordering equipment from each manufacturer.
- B. Grounding
  1. Each equipment rack within a row of racks and each row of racks within a room shall be electrically bonded to each other. Bonding shall be via copper ground bus. Any bolts shall fasten to unpainted sheet metal.

#### **3.3 CABLE MANAGEMENT AND TERMINATION**

- A. Employ cable management and installation techniques to fulfill ANSI/INFOCOMM 10:2013, 9.4 (ANS2013-12-20) "Cable Management, Termination, and Labelling Reference Verification Items" as a minimum standard with the additional requirements as described in this paragraph.
- B. General

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1. Do not violate the minimum cable bend radius as specified by the cable manufacturer.
  2. Dress cables so terminations are free from stress due to gravity acting on the cabling. Use cable supports as required depending on the size and stiffness of the cable.
  3. Terminate cables with sufficient service loop to allow at least one re-termination without having to open a cable bundle or pathway.
  4. All circuits, including various audio signal levels, shall be separated according to function. Where audio and video circuits are installed in conduit or other raceway, separate conduits are required for the various circuit functions.
  5. Where circuits are exposed in the equipment racks or large junction or pull boxes, circuits shall be bundled according to function. Refer to "Conduit/Circuit Group Divisions" and "Conduit Routing and Separation" schedules for additional information.
  6. All solder connections shall be made with soldering iron and rosin core solder. All solder connections shall be checked for "cold" solder joints.
  7. If equipment is removed or replaced for service, ensure the proper cable termination points are apparent when the equipment is re-installed.
- C. Equipment Racks
1. Use Velcro tie wraps for dressing cables within the rack(s), hand tightened and spaced at various inconsistent distance intervals.
  2. Do not use zip ties for UTP cables or any in-rack cables.
  3. When dressing cables within the rack, do not tighten tie wraps so the cable is deformed.
  4. Install rack-mounted equipment manufactured without IEC removable power cords so the power cords are dressed using removable fasteners such as Velcro and there are no obstructions to the item being pulled out from the front of the rack. Avoid coiled or bundled cable loops.
  5. For rack-mounted equipment manufactured with IEC removable power cords, provide power cord assemblies of the minimum length needed to accomplish connection to the PDU. Avoid excess power cabling including coiled or bundled cable.
  6. Factory terminated cable assemblies are only permitted for use within racks, between devices external to racks, as portable equipment, or for use in conduit unless specifically noted as follows: Permitted for rack inter-connect when racks are in close proximity (same room) and may pass thru conduit if necessary in this situation. Required for rack intra-connect where applicable. Cable assemblies shall be the minimum length needed to accomplish the connection.
  7. Install rack equipment to enable repair or replacement without hindrance. If there are obstructions prohibiting the disconnection of terminations on the back side of the technical equipment, there must be sufficient cabling to permit the equipment to be pulled from the front allowing for easy disconnection.
- D. Splicing, Paralleling, and Extension
1. Circuits shall not be spliced.
  2. Circuits requiring parallel connection as indicated on signal flows shall be extended via approved termination in an appropriately sized junction box and shall conform to the following guidelines:
    - a. Approved connections include DIN mounted terminal blocks as specified in Part 2.
    - b. Field splicing techniques such as wire nuts, "twist and solder", etc. are not allowed.
    - c. Any circuit requiring parallel connection shall be permanently labelled on every cable as defined herein.
    - d. Care must be taken to maintain appropriate protection and shielding of circuits in order to maintain a fully functional system.

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3. Circuits requiring extension (non-data) due to field conditions such as excessive conduit bends, etc., shall be extended via approved termination in an appropriately sized junction box and shall conform to the following guidelines:
  - a. Extension of circuits is to be avoided if at all possible.
  - b. Contact the Design Consultant via documented project communication. Inform the Design Consultant of the circumstances regarding the desired extension. Contractor and Design Consultant will coordinate to determine the most appropriate course of action.
  - c. Approved connections include DIN mounted terminal blocks as specified in Part 2.
  - d. Field splicing techniques such as wire nuts, "twist and solder", etc. are not allowed.
  - e. Any circuit requiring extension shall be permanently labelled on every cable as defined herein.
  - f. Care must be taken to maintain appropriate protection and shielding of circuits in order to maintain a fully functional system.

**E. Telecommunications Cabling**

1. Refer to Division 27 Section "Telecommunications Requirements for Audio Video Systems" for all work associated with data-related cabling such as CAT5e, CAT6, and/or fiber.
2. All data-related cabling entering a rack shall be terminated to a Data Patch Panel. Rack inter- and intra-connect cabling utilizing factory-terminated cable assemblies are not required to pass thru a Data Patch Panel.

**F. Microphone/Line Level Audio**

1. Audio circuit termination shall observe the methods set forth in "Sound System Interconnection" RaneNote 110, © 2011 by Rane Corporation. This reference document may be obtained at:  
[http://www.rane.com/pdf/ranenotes/Sound\\_System\\_Interconnection.pdf](http://www.rane.com/pdf/ranenotes/Sound_System_Interconnection.pdf)
2. Key methods include, but are not limited to the following:
  - a. All audio circuits shall be balanced two-wire circuits, with a separate grounding shield conductor, unless noted otherwise. All circuits shall have either the red or white wires as the "high" or "+" side of the line and connect to pin 2 of microphone-type XLR audio connectors and the tip of 3-conductor phone connectors. The black wire of the two-wire circuit shall be the "low" or "-" side of the line and connect to pin 3 of microphone connectors and the ring of 3-conductor phone connectors. The shield conductor shall connect to pin 1 of microphone connectors or to the sleeve of phone connectors.
  - b. Shield conductors shall be connected at each end of each wire to the pin 1 of each XLR, shield connection for each electronic device, etc. No shield wires shall be left unconnected except where noted on the drawings, nor shall any shield come in contact with conduit, pull boxes, or other building steel. Audio line-level circuit shield wires shall be grounded to rack sheet metal only via rack-mounted equipment. Shields shall be electrically isolated in multi-conductor cables. Shields for audio line-level circuits connected to audio transformers shall be connected to transformer electro-static shields and case ground.
  - c. In the case of an unbalanced source feeding into a balanced input and the cable run is short (i.e. less than fifteen feet), connect the signal connection of the unbalanced connector to the "high" side of the balanced input. Connect the "ground" connection of the unbalanced line to the "low" side of the balanced connector. Connect the cable shield to the shield connection of the balanced input but do not connect it to the unbalanced connector. If the cable run is longer than fifteen feet, balance the line at the unbalanced source using specified balancing devices.
  - d. In the case of a balanced source feeding into an unbalanced input and the cable run is short (i.e. less than fifteen feet), connect the "high" side of the balanced output to

the signal input of the unbalanced connection. Connect the "shield" of the balanced connection to the "ground" of the unbalanced connection. Leave the "low" side of the balanced output floating.

### 3.4 LABELING

- A. Adhere to INFOCOMM F501.01:2015 "Cable Labeling for Audiovisual Systems" as a minimum standard with additional requirements as described in this paragraph.
- B. Refer to Division 27 Section "Telecommunications Requirements for Audio Video Systems" for all labeling requirements associated with data-related cabling such as CAT6, and/or fiber.
- C. Develop and utilize a consistent numbering schema across the entire project. Utilize system names and building references where applicable, such as the rack number or rack room in a distributed system. All labels for input/output plates and control panels shall be consistent with the final room numbering for the facility.
- D. Adhere to the labeling standard across all platforms, including within the DSP programming.
- E. Refer to general notes, the signal flows, and panel and plate details for expected labeling scheme of system equipment and components. Comply with any specific color coding as described.
- F. All equipment in equipment racks shall be labeled front and rear for ease of identification. Labels shall be of a contrasting color with that of equipment color to promote visibility.
- G. Install permanent labeling on the front of each equipment rack in a row of racks identifying the rack designation (number).
- H. Within each rack and at other remote locations for technical system equipment, label all associated AC power receptacles reflecting the appropriate circuit breaker. Ensure that the circuit breakers are labeled as to the rack or remote equipment location.
- I. Document the labeling standard for inclusion in the Operation and Maintenance Data.
- J. Document all labels for the Record Drawings.
- K. Pre-approved labelling systems include:
  - 1. Brother P-touch EDGE with HGeS2\*\*\*PK labels; or
  - 2. Brady Equipment Identification Labels.

### 3.5 SYSTEM CONFIGURATION

- A. Coordination
  - 1. Coordinate and take responsibility for the approval of all system configuration components as described in this paragraph.
  - 2. Coordinate all aspects of the technical system network, including configuration and connection with to the Owner's LAN. Utilize Owner's designated configuration style, standards, and security requirements.
- B. Software
  - 1. Furnish, install, and configure the most recent approved, non-beta, software for each device or system.
  - 2. Provide software as identified in other areas of these specifications or on the drawings.
  - 3. Provide software not specifically identified but required to allow for system operation and/or to allow for more efficient system configuration, setup, and operation.
- C. Firmware
  - 1. Ensure the firmware for each device is the most recent manufacturer approved version and is installed and operational.
- D. Operating Systems
  - 1. Gain approval of the operating system version and type from the Owner's IT representative and associated equipment manufacturer(s).

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2. Ensure the operating system for each device is the most recent, installed, and fully operational.
3. Ensure the latest security patches are installed.

E. Network Configuration

1. All technical system devices with an Ethernet port shall be connected to the associated network.
2. Secure the entire network, documenting all passwords. Comply with the Owner's IT representative's requirements with respect to password selection and network security implementation.

F. Network Documentation

1. Document the IP and MAC addresses of all IP capable equipment for inclusion with the Operation & Maintenance Manuals.

3.6 CONTRACTOR'S TESTING AND ADJUSTMENT

- A. At the completion of the installation, perform the following tests on the system to ensure proper installation and operation. The technical system shall be fully tested with all equipment on site, installed, connected, and fully operational.

B. General

1. Utilize the technical support services offered by the manufacturers of the various technical system components to ensure optimum performance.
2. All test equipment used for these tests shall be on site during the system commissioning activities should verification of submitted measurements be required.
3. Ensure that all equipment is on the job-site and fully operational. This includes portable (not installed) items and other loose equipment. Remove all devices from shipping or packaging containers, ready for use, and place in equipment storage cabinet.
4. The functional tests shall include operational tests of all program source equipment (record and playback), wireless microphone system, mixing console, system inputs and outputs, all patch panel receptacles, intercom system, video routing, video distribution, operational controls, AC power sequencing, operation of software, and all system electronics. Functional tests include examination for hum, buzz, hiss, ghosts, hum bars, oscillation, thumps, unintended reception of other signals such as AM or FM radio, TV, CB, ham radio, cell phones, or any other unwanted signals through the system.
5. Ensure all inputs and outputs are wired to the appropriate devices per construction documents.
6. Verify system startup and shutdown operates in the proper sequence.
  - a. System head end components shall be energized at the beginning of the startup sequence in an appropriate order to guarantee proper communication will associated devices.
  - b. Loudspeaker power amplifiers shall be energized at the end of the sequence in order to eliminate unwanted transients being reproduced through system loudspeakers.
  - c. System shutdown sequence shall be in reverse order.
7. Where a system computer is furnished, load and configure all necessary control software. Examples include but are not limited to the following as applicable: wireless microphone management, amplification management, projector/display management, audio console configuration/control, DSP configuration/management, and active loudspeaker management.

C. Audio System

1. Electronics
  - a. Test all system audio electronic components for uniform frequency response from input to power amplifier output.



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- b. Setup and configure the assistive listening system. Verify proper input signal level. Walk the entire coverage area using speech as the program material to verify signal performance.
  2. Microphone/Line Level
    - a. Verify that all microphone and line level cabling and connectors are installed with Pins 1, 2, and 3 wired properly and there are no shorts to ground. Ensure proper polarity. Recommended test equipment includes:
      - 1) Alphonon ACT-100 Remote Tester
      - 2) NTI Minirator MR-PRO with Cable Test Adapter
      - 3) A microphone is NOT an acceptable measurement device for cable tests.
    - b. Verify that all microphone connectors, extension cables, and microphones are wired properly and in polarity.
  3. Wireless Microphones
    - a. Setup and configure each wireless microphone system using the software provided by the manufacturer of the wireless microphone system. The following tasks are required:
      - 1) Utilize wireless microphone management system if applicable, e.g., Shure Wireless Workbench, to perform an RF spectrum sweep.
      - 2) Perform frequency coordination with Owner. Take into account existing wireless microphone system(s).
      - 3) Perform frequency assignment of all transmitters/receivers per the results of the frequency coordination and RF spectrum sweep.
      - 4) Verify all receivers are set to maximum line level audio output.
      - 5) Set all handheld wireless transmitter microphone sensitivity settings to allow high level voice output without AF over modulation. All transmitters should be set the same.
      - 6) Set all body pack wireless transmitter microphone sensitivity settings to allow high level voice output without AF over modulation. All transmitters should be set the same.
      - 7) Using subjective listening, adjust the body pack settings to match the audio level of the handheld transmitters.
      - 8) Walk the entire performance coverage area using speech as the program material to verify signal performance. Utilize wireless microphone management system if applicable, e.g., Shure Wireless Workbench, to perform a QOS test.
- D. Adjustment
  1. Repair or replace any defects or malfunctions found prior to the commencement of commissioning activities by the Design Consultant.
- E. Testing Documentation
  1. Document the results of all tests and compile into a complete Testing Documentation package with the following items:
    - a. Results of the tests detailed herein; and
    - b. Documentation of any changes to the systems as a result of the Adjustment process; and
    - c. Digital photographs of primary systems, sub-systems and components; and
    - d. Written notice to the Design Consultant that the system(s) are ready for commissioning.
  2. Transmit the Testing Documentation package to the Design Consultant in a timely fashion to allow the Consultant appropriate time for review and comment prior to final

commissioning. The Consultant cannot visit the site or begin the commissioning phase until the package has been transmitted and reviewed.

3. Include the Testing Documentation package in the Operation and Maintenance Data package.
  4. Modify the Record Drawings to include any changes as a result of the Adjustment process.
- F. Contact the Design Consultant should problems or concerns arise during the testing activities.
- G. Should the Design Consultant be required to invest time performing some or all of the tests, the Contractor will compensate the Design Consultant for all associated costs.

### 3.7 COMMISSIONING

- A. After completion of the system installation and after the preliminary tests and adjustments are complete, the contractor in conjunction with the Design Consultant shall perform on-site commissioning of the technical system. This process will include, but not be limited to the following, as applicable:
1. Random verification of contractor tests;
  2. System check-out;
  3. Tailoring of the technical system's audio frequency response to the facility's acoustical environment;
  4. Observation of video system to verify proper image display;
  5. Function and operability of the control system.
- B. Provide the services of the designated supervisor and any other technicians who are familiar with the system, for approximately one five-hour day. Additional time may be required due to Alternates accepted by the Owner's Representative, or due to Addenda or Change Orders (if any) which modify the scope of work. The supervisor shall provide personal assistance during these activities. This time period does not include time for correcting wiring errors, equipment malfunctions, or problems related to the installation of the technical system. This work could occur at any time day, night, weekends, or holidays without additional claims for expense.
- C. At the discretion of the Design Consultant, the Contractor shall participate in the control and adjustment of computer controlled systems including but not limited to the following systems: DSP, wireless microphone, etc.
- D. At the completion of the final commissioning period, the Contractor shall compile all system configuration settings (files) with copies as required for inclusion in the O&M Manuals described later in these specifications.
- E. In addition, provide the following: hand and power tools appropriate for the type of installation, ladders, lifts, and/or scaffolding as required to reach all high-mounted devices, spare wire and cable of the types used in the installation, selection of wiring fasteners used in the installation, complete set of the most recent reviewed shop drawings, complete set of all manufacturers' original installation/operation/maintenance manuals, and specific test equipment used during the preliminary testing activities.

### 3.8 TRAINING AND OPERATIONAL ASSISTANCE

- A. After the technical system is operational, the Contractor shall provide instruction to designated Owner's Representative as to proper methods of system operation.
- B. Instruction shall include (but not be limited to) the following:
1. Provide walking tour of the system. Describe various components and their associated purpose within the system.
  2. Describe the functionality of the system and general performance expectations.
  3. Describe and demonstrate basic console features, including:
    - a. Audio Processing
      - 1) HPF, LPF

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- 2) Equalization
- 3) Compressing, Limiting, libraries
- 4) Effects management, libraries
- b. Setting up Mixes
- c. Using DCAs
- d. Using Groups
- e. Buss configurations
- f. Routing
  - 1) DM64, Network Ports
- g. Network Port Set up
- h. Wireless communications
- i. Surface-less mixing
- j. Soft keys
- k. Scene recall
- l. User accounts
- m. User preference settings
- n. IP-1, IP-6 & IP-8 setup (if applicable)
- o. ME-1 setup (if applicable)
- p. dLive Director
- q. iPad applications
  - 1) OneMix
  - 2) dLive Mix
- 4. Create basic audio console configuration to best suit the needs of the Owner.
- 5. Create basic audio console start up scene.
- 6. Archive audio console show file to onboard storage and external storage media.
  - a. Direct Owner to save a copy of the archived show file/start-up scene for future use.
- 7. Describe and demonstrate wireless system features, including:
  - a. Receiver operation:
    - 1) Onboard menu system
    - 2) Network setup
    - 3) Receiver naming
    - 4) Channel naming
    - 5) RF scanning
    - 6) Group/Channel selection
    - 7) Direct frequency selection
  - b. Wireless Workbench operation:
    - 1) Network setup
    - 2) Receiver naming
    - 3) Channel naming
    - 4) Frequency management
    - 5) RF scanning
    - 6) Group/Channel selection
    - 7) Direct frequency selection

- 8) Grouping
  - 9) Transmitter Telemetry
    - a) AF
    - b) Signal Strength
    - c) Battery status
  - 10) Transmitter operation
    - a) Battery insert/removal
    - b) Battery charging (if applicable)
    - c) Receiver naming
    - d) Group/Channel selection
    - e) Direct frequency selection
    - f) Transmitter/Receiver IR Sync Operation
  - 11) Show/Scene setup and saving
8. Microphone technique for handheld, head worn, lapel, and costume-hidden (drama applications).
- C. Video record the instruction class and provide the recording in a usable digital format to the Owner's Representative.
  - D. Provide operational assistance for the first major use of the completed system as directed by the Owner's Representative, including being present for: one prior rehearsal associated with the event (if applicable); a technical-check immediately prior to the event; and the event itself.
- 3.9 OPERATION AND MAINTENANCE DATA
- A. At the completion of the project, compile thorough copies of the Operation and Maintenance Data per Division 27 Section "General Communications Requirements".
  - B. As applicable, save full digital version to the system computer.
- 3.10 WARRANTY CHECK
- A. Visit the job two weeks prior to the end of the warranty period to check all equipment for proper system operation. Any defective equipment found shall be replaced or repaired under the terms of the system warranty.
  - B. Refer to General Conditions for additional requirements.
  - C. Update Record Drawings and Operation and Maintenance Data to reflect work done during Warranty period.

**END OF SECTION 274100**