

## SECTION 274100 - AUDIO VIDEO SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings:
  - 1. Audio Video (AV) Drawings
  - 2. Theatrical Drawings
  - 3. Electrical Drawings
  - 4. Architectural Drawings
  - 5. Theatrical Rigging Drawings
- C. Coordinate work with other trades to properly execute the work within this specification.
- D. System features mentioned in this specification, or shown on the AV drawings, are required, whether they are listed in both places. Where there is conflict between this specification or the AV drawings, the more stringent requirement shall apply.

#### 1.2 BIDDER RESPONSIBILITY

- A. This specification and the AV drawings are detailed only to the extent necessary to show design intent and signal flow. The bidder shall examine and be thoroughly familiar with all contract drawings, design intent, systems specified, their installation, configuration, and industry best practices. The contractor is responsible for all devices and configuration required to produce a fully functional system, including devices that may not be documented on either this specification or the AV drawings. Equipment required to meet this stipulation shall be provided without claim for additional payment. Specific products to meet the required functionality are listed within this specification and notated within the AV drawing package.

#### 1.3 AV SYSTEM NARRATIVE

- A. Auditorium
  - 1. Audio: The audio system is designed to fill dual requirements – subtle, even voice lift for lectures and theater/music performances as well as support for video content played on the projection screen.
  - 2. Left/Right main and center array loudspeakers shall be installed around the proscenium arch to anchor the sound to the location of the performers on stage. Each loudspeaker location is a medium-format cabinet or small array, and all cabinets are of the same type from the same manufacturer to facilitate creating a balanced sonic image.
  - 3. A subwoofer shall be installed to extend low-frequency content to provide warmth and power to complement the LCR speakers.
  - 4. House Fills shall be installed in the auditorium. These will maintain intelligibility at the middle and rear sections of seats, keep a consistent volume throughout the auditorium, and

improve gain before feedback by reducing the need for the main LCR arrays to cover these seats.

5. Stag monitor speakers shall be installed.
6. Connections for microphones, laptops, and other input devices shall be provided around the stage.
7. In addition to the primary/auxiliary loudspeaker coverage of the room, ADA- compliant hearing enhancement is provided. Receivers connect to personal headsets or T-coil transmitters that allow the sound to be heard over this style hearing aid.
8. A complement of wired and wireless microphones shall be provided appropriate to program needs.
9. The House Mix Position houses live mixing and playback equipment, including:
  - a. A digital console for primary mixing of house and stage monitor audio feeds.
- B. The AV Rack shall be installed on stage. This rack will house system patching/processing as well as amplifiers and other heat-generating equipment, including:
  1. The main patch-bays used to interconnect the various input and output locations.
  2. The digital signal processors (“DSP”) used to time align, “tune” and control the main loudspeaker systems.
  3. The amplifiers and patching for the passive loudspeakers in the main audio systems.
  4. Control and processing for the auxiliary systems, which includes the ADA- system (described above), production intercom, and backstage program and paging systems (see also below) using DSP processing as mentioned above.
- C. Video: Video functions include lecture projection use for lecture-type use (typically PowerPoint) as well as playback of other media that are required for performance- specific use. The equipment can also be used as a cinema projection system for movie screenings..
  1. A motorized projection screen will be required on stage.. It will be located downstage of the main curtain, and recessed within the forestage acoustic reflector.
  2. A large format projector will be provided for projection. Based on the screen size, it is sized to provide sufficient image brightness during lecture presentations or other events requiring projection while the houselights are on.
  3. A digital video distribution and control system is housed in the Amplifier Room. This system will take input from laptops, computers, and other analog/digital video sources and display them on the projection screen. Inputs are provided in the Amplifier Room, at the house mix position, and on stage.
- D. Backstage
  1. Backstage devices provide auditorium program audio and stage manager paging, divided by zone.

2. Distributed audio is provided for uniform coverage of all backstage spaces used actively by performers and crew. The stage manager(s) or their designee can also page to these areas. This also applies to arts classrooms used as backstage spaces.

E. Configuration

1. The DSP / Control / Processing system shall be configured for two purposes:
  - a. Basic / Keynote speaker system with the following controls:
    - 1) Projector On/Off
    - 2) Screen Up / Down
    - 3) Auto-Mix of XLR input panels and QTY (4) wireless microphone channels
    - 4) Program Volume up/down
    - 5) HDMI input selection
  - b. Performance System:
    - 1) Routing of all wireless microphone channels and stagebox I/O panels to front of house mix position via DANTE Network
    - 2) Control and processing of individual speaker channels

1.4 PROJECT REQUIREMENTS

- A. Furnish any engineering services to provide a complete and professionally installed systems.
- B. All areas shall receive new cabling as specified.
- C. This work includes, but is not limited to the following:
  1. Furnish all back boxes and enclosures.
  2. Deliver to the job site all back boxes which are to be installed by others.
  3. Furnish and install all wire and cable.
  4. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment. Such items may include hardware, transformers, line/distribution amplifiers, and other devices for proper installation, interface, isolation or gain structure.
  5. Programming and documenting of all software-controlled devices. Provide DSP and control system programming prior to final testing, if requested by the Consultant.
  6. Refer to Submittals section of this specification for all submittal requirements.
  7. Provide frequency scanning and coordination for all AV system wireless transmitters and receivers. Account for local frequencies used by others within the surrounding area.
  8. Setup and adjustment of signal processing, system tests and adjustments, written report, demonstration for approval, participation in acceptance tests and final adjustments where required.
  9. Submission of shop drawings prior to fabrication.
  10. Verification of dimensions and conditions at the job site.
  11. Installation in accordance with these specifications, manufacturer's recommendations, and all applicable code requirements.
  12. Setup and adjustment of signal processing, system tests and adjustments, written report, demonstration for approval, participation in acceptance tests, and final adjustments.
  13. Coordination with the Electrical Contractor is required to assure correct Systems conduit routing, Systems backbox locations, and clean power circuit locations as specified in Division 26 – Electrical.
  14. Coordination with the Lighting Contractor
  15. Coordination with the Fire Alarm Systems Contractor
  16. Coordination with the Tel/Data Contractor and other Low Voltage Contractors

17. Coordination with the Owner's IT department and installers
18. Performance standards, without claim for additional payment
19. System Documentation
20. Instruction of owner's operating personnel
21. Maintenance and services for one year
22. Guarantee all equipment and components for the specified period from the date of acceptance.

- D. All work described within this section must be coordinated with other trades to ensure a successful installation.

#### 1.5 LEED V4 GENERAL REQUIREMENTS

- A. The work of this Section is required to comply with general requirements and procedures for compliance with prerequisites and certain credits required for the Project to obtain a Certified rating based on USGBC's LEED v4 Reference Guide for Building Design and Construction and as outlined in Division 01 Section "Sustainable Design Requirements – LEED v4 BD+C: Schools" (LEED v4).

1. The Construction Manager is responsible to coordinate with the work of other Sections and comply with all LEED v4 requirements in accordance with the Contract Documents such that the work carried out by this Section does not compromise the achievement of any other LEED v4 prerequisites and credits applicable to the entire Project.

- B. Related Sections for Sustainable Design Requirements:

1. Division 01 Section "Submittal Procedures" for LEED v4 submittal requirements.
2. Division 01 Section "Temporary Facilities and Controls" for requirements for temporary facilities.
3. Division 01 Section "Product Requirements" for product substitutions and additional LEED v4 submittal requirements.
4. Division 01 Section "Construction Waste Management and Disposal" for waste management, recycling and disposal.
5. Division 01 Section "Sustainable Design Requirements – LEED v4 BD+C: Schools" for general procedures for compliance with LEED v4 prerequisites and credits.
6. Division 01 Section "Indoor Air Quality Requirements" for material and procedure requirements.

#### 1.6 BIDDER QUALIFICATIONS

- A. Contractor Qualifications: To be considered qualified for this work, the contracting firm must be experienced in the provision of Audiovisual systems similar in complexity to those required of this project, and meet the following:

1. The Bidder's primary business is the provision, fabrication, and installation of professional audiovisual and related systems.
2. The Bidder has been regularly engaged in the installation and service of professional audiovisual presentation systems for a period of at least five years.
3. The Bidder is an authorized dealer for the specified Audiovisual Control System.
4. The Bidder employes a Certified programmer for programming the Audiovisual

- Control System, as required.
5. The Bidder is, at a minimum, an AVIXA certified solution provider, with at least (1) CTS-I and (1) CTS-D certified employee on-site for the duration of the installation.
  6. The Bidder has certified installers for the equipment specified.
  7. Bidder, when required by project designs, holds current manufacturer certifications from the Wireless AV presentation gateway.
  8. At the request of the Architect, demonstrate the following capabilities:
    - a. Adequate plans and equipment to complete the work.
    - b. Sufficient staff with appropriate technical experience to oversee and execute the work.
  9. The Bidder employs certified network engineers, certified with CISCO, COMPTIA, or AVIXA specifically for network engineering.
  10. Include certification of ownership and full familiarity with the operation of the following minimum test equipment. Provide a list of the manufacturer, model, and serial number for each item of test equipment required.
    - c. Audio Tester Equipment:
      - 1) SMAART, EASERA or similar measurement platform that includes a laptop computer, audio preamp, Type 1 measurement microphone, cables, and stands to complete the system test.
      - 2) AC impedance bridge.
      - 3) Sound level meter and octave band filter set.
      - 4) Digital Multimeter.
      - 5) Calibrator with appropriate microphone adapter.
      - 6) Random or pseudo-random Pink noise generator.
      - 7) Plug and cable tester
      - 8) Loudspeaker polarity indicator
    - d. Video Test Equipment:
      - 1) Photometer with luminance and illuminance probes.
      - 2) TriStimulus Color Analyzer with Laptop Computer
      - 3) HDMI 2.0 and HDCP 2.2 18GPS video generator.
      - 4) HDMI cable test instrument.
      - 5) Coaxial cable test kit.
    - e. RF Test Equipment:
      - 1) Signal Level Meter with appropriate software
      - 2) Leakage Detector
    - f. Fiber Optic Test Equipment:
      - 1) Optical Loss Test Set (Fluke Networks Certifiber Pro Optical Loss Test Set).
      - 2) ODTR (Fluke Optifiber Pro ODTR or equal).
    - g. LAN Test Equipment:
      - 1) CAT cable and POE++ tester (Fluke DSX or equal)
      - 2) Wi-Fi Network tester (Fluke AirCheck or equal)
      - 3) Wi-Fi Analyzer (Fluke AirMagnet or equal)
      - 4) Testers shall have been calibrated within the last 12 months of required use.

#### 1.7 SUBMITTALS

- A. References Div 01 Section Product Requirements for each product
- B. Provide Submittals in accordance with requirements of Division 01 – General Requirements and as described within this specification.
- C. Bidder Qualifications (Pre-Bid Submittal):
  1. Perspective bidders must be thoroughly experienced in installing, engineering,

configuring and testing systems of the scope and size specified. Bidders must be a system integrator, normally engaged in the business of audiovisual and sound reinforcement system installation. Bidder shall provide a list of systems their company has furnished and installed of similar size and scope within the last (5) years. Indicate project name, address, and reference.

2. Bidder shall have qualified CTS, CTS-D, and CTS-I engineers, technicians, and project managers who will be assigned to this project. A CTS-D and CTS-I shall be employed on this project for the entirety of the installation and close-out.
  3. The bidder shall have a qualified and certified system programmer who will program the system. Submit any and all manufacturer certifications related to system programming, DSP programming, and control programming.
- D. Bid Submittals:
1. In conjunction with the bidding requirements set forth in the Division 01 documents, the bidder shall submit itemized unit prices for all devices, listed within this specification or documented on the AV drawings.
  2. The bid price shall include any Add-Alternates described.
- E. Product Data: Submit manufacturer's technical data, product specifications, installation instructions, and other pertinent information as applicable for each product or material specified or required. Do not procure material or begin work until product data and shop drawing submittals have been approved. All product data shall be submitted in one submission, in PDF format, with manufacturer provided specifications and cutsheets.
- F. Shop Drawings: Shop drawings shall be created in ACAD or equivalent and submitted electronically in DWG and PDF.
1. Include plan view locations, elevations, installation details, and accessories.
  2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes. Show all transformers, switches, relays, and control circuits.
  3. Drawings of loudspeaker mounting arrangements, equipment rack layouts, and receptacle and control plates and boxes.
  4. Plate and panel schedule listing all plates individually with size, mounting condition, backbox size, and plate finish color.
  5. Drawings of projector mounting arrangement and line of sight studies showing proper alignment and dimensions with the projection screen and projection equipment.
  6. Complete list of wire run numbers and termination locations of each end.
  7. Schematic diagrams of patch bays.
  8. Drawings of final assemblies of loudspeaker, screen, and projector suspension equipment stamped by a certified structural engineer. Each system solution must be separately engineered, verified, and stamped.
  9. Provide IP address table and addressing protocol in coordination with Owner's IT department.
  10. Provide mockup of all system graphical user interface screens. Supply narrative and demonstration of all touch panel programming. Supply panel layouts and button functions listed.
  11. Submit equipment rack layouts.
  12. Submit samples of lettering/label size and typeface for custom plates, panels, or other equipment where required.
  13. Provide EDID and HDCP management plan for all video signals.
  14. Consultant and Architect shall approve all panel and furniture finishes. The Consultant and Architect may request samples of finishes which the

- Contractor shall provide at no additional cost to the project.
15. Provide conduit riser documented in plan and elevation view.

G. Closeout Submittals:

1. Create user manuals for all devices within the system, including instructions for how to use the device.
2. Create and mount a simplified line diagram protected in a plastic sheath and mount behind each AV cabinet.
3. Create floor plans showing locations of all faceplates, interconnections, speakers, projectors, and their cable paths, including cable identification on 11x17 drawings. Deliver to owner upon completion of the installation.
4. Create record drawings on 30x42 drawings of as-built conditions in ACAD or equivalent and deliver electronically and in PDF format.
5. Operating and Maintenance instructions for each product. O&Ms shall be complete for each device.
6. Contractor's written warranty for all parts and labor for a period of one year from project acceptance.
7. Manufacturer's standard product warranty. Extend all special warranties to project where available.
8. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation.
9. List of spare and replacement parts recommended to be stored at the site for ready access.

1.8 QUALITY ASSURANCE

- A. The contractor awarded this project shall reference Div. 00 Instruction to bidders, for permits, licenses, and inspections required.
- B. Single Source Responsibility: Obtain all materials from one source from a single approved manufacturer for each different product required.
- C. All materials shall be new and shall conform to applicable provisions of Underwriters Laboratories and the American Standards Association.
- D. The contractor awarded this project shall reference Div. 00 Instruction to bidders, for permits, licenses, and inspections required.
- E. Follow latest federal, state, and local electrical and safety codes. Where conflicts exist, apply the most stringent requirement.
- F. Certification: CE, FCC Class A
- G. Contributing Organizations – The Organizations listed below have published standards used to establish the technical references to be followed under this scope of work.
  1. Acoustical Society of America (ASA) (ASC S1)
  2. Alliance for Telecommunications Industry (ATIS) (ASC T1)
  3. American Society of Safety Engineers (ASSE) (ASC A1264)
  4. Audio Engineering Society (AES) (ASC S4)
  5. Electronics Industry Alliance (EIA) (CEMA)
  6. Entertainment Services and Technology Association (ESTA) (ASC E1)
  7. Institute of Electrical and Electronics Engineers (IEEE) (ASC C136) (802.1)
  8. International Cable Engineers Association (ICEA) Formerly IPCEA

9. International Standards Organization (ISO)
  10. National Electrical Manufacturer's Association (NEMA) (ASC C119)
  11. National Fire Protection Associations (NFPA)
  12. National Safety Council (NSC) (ASC A10)
  13. Photographic and Imaging Manufacturer's Association (PIMA)
  14. Society of Motion Picture and Television Engineers (SMPTE)
  15. Telecommunications Industry Association (TIA)
  16. Underwriters Laboratories (UL) (ASC C101) (CE)
  17. NTSC
  18. National Association of Broadcasters (NAB) – System technical standards for video and RF compliance are listed in the most recent edition of the NAB Handbook
- H. Applicable Performance Standards – Execute all Division work in accordance with the following standards:
1. ANSI S4.48-1992 (R1998): Recommended Practice for the Application of Connectors, Part 1, XLR-Type polarity, and gender
  2. ANSI S4.55-1997: Recommended Practice for conservation of the Polarity of Audio Signals
  3. ANSI S4.56-1997: Recommended Practice for the subjective evaluation of Loudspeakers
  4. ANSI S12.2-1995 (R1999): Criteria for Evaluating Room Noise
  5. ANSI T1.217-1991 (R1998): Integrated Services Digital Network (ISDN) Management –Primary Rate Physical Layer
  6. ANSI T1.522-2000: Quality of Service (QOS) for Business Multimedia Conferencing. Specifies classes of Service for conferencing on IP Networks
  7. AES15: ANSI S4.49: AES Recommended practice for Sound Reinforcement Systems –Communications Interface PA-422.
  8. AES-R1-1997 AES project report for professional audio: Specifications for audio on high capacity media
  9. AES14-1992 (r1998) AES standard for professional audio equipment -- Application of connectors, part 1, XLR-type polarity and gender
  10. AES24-1-1999, (Revision of AES24-1-1995) AES standard for sound system control - Application protocol for controlling and monitoring audio devices via digital data networks
  11. AES26-2001 (Revision of AES26-1995) AES recommended practice for professional audio -- Conservation of the polarity of audio signals
  12. ANSI/TIA/EIA 606-1993: Standard for the Telecommunications Infrastructure of Commercial Buildings
  13. ANSI/TIA/EIA 607-1994: Commercial Building Grounding and Bonding Requirements for Telecommunications
  14. IEEE 149-1979 (R1990): Test Procedure for Antennas
  15. IEEE 1100-1999: Powering and Grounding Sensitive Electronic Equipment
  16. NEMA 250-2001: Enclosures for Electrical Equipment
  17. SMPTE 292M: SMPTE 292M defines the base 1.485Gbps HD-SDI. Note: This standard can handle all HD formats except 1920\*1080 @ 50P and 60P.
  18. SMPTE 372M: Uncompressed Dual-Link HD-SDI for 50P & 60P
  19. SMPTE 424M: 2.97 Gbps HD-SDI for 50P & 60P
  20. TIA/EIA-568-B: Digital audio over Cat5 audio cable
  21. UL 1047-1999: Isolated Power Systems Equipment
  22. UL 1581-1998: Reference Standard for Electrical Wires, Cables, and Flexible Cords
  23. UL 1682-1998: Standard for Safety for Plugs, Receptacles, and Cable Connectors, of the Pin and Sleeve Type up to 800 Amperes and up to 600 volts ac or dc.

24. UL 467-1998: Grounding and Bonding Equipment
25. UL 813-1999: Commercial Audio Equipment and accessories for use in commercial enterprises... this standard was originally listed for public review in the October 13, 1995 issue of Standards Action. It is being resubmitted owing to substantive changes in the text.
26. ANSI/TIA/EIA-568-A: Commercial Building Telecommunications Cabling
27. ANSI/TIA/EIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces
28. ANSI/TIA/EIA-607: Commercial Building Grounding and Bonding Requirements for Telecommunications
29. ANSI/TIA/EIA TSB-72: Centralized Optical Fiber Cabling Guidelines
30. ANSI/TIA/EIA-526-14A: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
31. ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Single mode Fiber Cable Plant
32. ANSI/IEEE C-2 National Electrical Safety Code how to install cabling in accordance with the most recent edition of BICSI® publications:
33. BICSI Telecommunications Distribution Methods Manual
34. BICSI Cabling Installation Manual

#### 1.9 DELIVERY, STORAGE AND HANDLING

- A. Take care in handling products in accordance with manufacturer's instructions.
- B. Store indoors in original undamaged packaging, in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Store products upright in secure, protected area. Do not stack! Verify with manufacturer that site conditions are acceptable before receiving material.
- C. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  1. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity.
  2. Drop shipping of equipment to the Owner's site is not allowed.

#### 1.10 WARRANTY AND GUARANTEE

- A. All systems and components shall be guaranteed free of defects in materials and workmanship for a period of one (1) year (or to the length of the Manufacturer's warranty if longer) from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.
- B. The Contractor shall be available on call and on eight (8) hour notice during the first month following acceptance of the system, to assist the Owner's representatives in any problems which may arise during the initial period of operation. If corrective measures on-site are required, they will be performed within 12 hours of the determination of a need for a site visit.
- C. If, during the Guarantee period, any component is out of service for more than seven (7) days due to unavailability of parts or service, Contractor shall supply and install an identical new component. If an identical component is not available, Contractor will substitute equipment, with the approval of the Owner.

- D. During the course of the Guarantee period, the Systems Contractor will provide the Owner with a 24 hour service phone number for emergency calls. A service engineer will respond to all emergency calls within one (1) hour. The personnel answering this call must be fully qualified to troubleshoot problems and propose solutions. A qualifying emergency event is defined as an event that may cause severe hardship or cause the systems to be inoperable or unusable for a scheduled class or event.
- E. During the course of the Guarantee period, the Contractor shall provide a minimum of three (3) service visits to the site for inspection and adjustment of equipment. Contractor shall submit proposed schedule for these visits and shall notify Owner and Systems Designer in writing at least one month in advance of each visit.
- F. During the course of the guarantee period, the Systems Contractor will supply the Owner with any published updates of manufacturer provided operating programs for any and all software-controlled equipment that are issued to correct “bugs”. During the Guarantee period, the Owner will rely on the Systems Contractor to determine when to update the software, unless it is needed to correct a situation that renders the systems unstable, non-functional, or otherwise affects operations.
- G. Repeated device failures, defined as the failure of a device or a single type of device three or more times over three contiguous months, will be considered as a failure of a manufactured system and all items of this type shall be replaced at no charge to the Owner.
- H. At least one representative of the Systems Contractor, well versed in the installation and the operation of the systems, shall be on site in support of the Owner for the first significant public event in each space (as determined by the Owner) where the system will be used. The Contractor representative(s) for this event shall also be competent in show operations.
- I. The contractor is to coordinate ongoing remote access to AV Systems Networks for support and troubleshooting. Owner to provide the access at their discretion.

#### 1.11 SERVICE LEVEL AGREEMENTS

- A. The contractor shall provide, as part of their bid, costs related to extended service level agreements in the following increments:
  - 1. Three Years
  - 2. Five Years
- B. These service level agreements shall be broken out from the lump sum bid and listed as alternates. Upon project completion, the Owner may decide to execute one of the Service Level Agreements.
- C. The Contractor shall hold the Service Level Agreement prices for the duration of the project.

### PART 2 - PRODUCTS

#### 2.1 SUBSTITUTIONS

- A. Refer to Div. 01 for substitution requirements.
- B. Certain items of equipment are specified by the manufacturer’s type numbers to indicate an acceptable standard of quality and performance. Substitutions of equal equipment beyond the

alternatives listed will be reviewed by the consultant and may be rejected if the equipment does not meet or exceed the manufacturer's written specifications for the basis of design product. Address request for listing substitutions to the Architect and follow all substitution request requirements, as specified in Division 01. With any request for substitution, include measured data proving the equivalence of the proposed substitute in quality and performance. The Consultant shall be the final judge of the validity of the data submitted.

- C. The substitution request shall include the following:
  - 1. List of advantages to the system
  - 2. Cost savings
  - 3. Printed Specifications
  - 4. Previous field experience using the substitution
- D. Acceptable alternate manufacturers are listed under major equipment. The chosen alternate device by the approved manufacturer must meet or exceed the manufacturer's written specifications of the basis of design product.

## 2.2 BASIS OF DESIGN GENERAL EQUIPMENT APPROVED ALTERNATE MANUFACTURERS

- A. Digital Signal Processing Basis of Design: QSYS Core
  - 1. Approved DSP Alternate Manufacturers:
    - a. Symetrix Server D100
    - b. Biamp Tesira Server-IO
- B. AVoIP Control Processor Basis of Design: QSYS Core
  - 1. Approved Alternate AVoIP Control Processing Manufacturers:
    - a. Crestron
    - b. Extron
- C. Loudspeaker Basis of Design: Fulcrum Acoustic
  - 1. Approved Alternate Loudspeaker Manufacturers:
    - a. Meyer Sound
    - b. D&B Audiotechnik
  - 2. If submitted an alternate speaker, contractor must submit Ease 4 or better modeling to consultant prior to approval.
- D. Wireless Microphone Basis of Design: Shure ULX-D
  - 1. Approved Alternate Wireless Microphone Manufacturer:
    - a. Sennheiser EW-DX
    - b. AKG DMS800
- E. Digital Mixing Console Basis of Design: Yamaha
  - 1. Approved Alternate Digital Mixing Console Manufacturers:
    - a. Allen & Heath
    - b. Midas
- F. AVoIP Basis of Design: QSYS

1. Approved Alternate AVoIP Manufacturers:
  - a. AV Pro Edge
  - b. Visionary Solutions
  
- G. AV Cabinets Basis of Design: Middle Atlantic
  1. Approved Alternate AV Cabinet Manufacturers:
    - a. Hubbell
    - b. Raxxess
  
- H. Assisted Listening System Basis of Design: Listen Technologies
  1. Approved ALS Alternate Manufacturers:
    - a. Williams AV
    - b. Telex
  
- I. Projector Basis of Design: Epson
  1. Approved Projector Alternate Manufacturers:
    - a. Barco
    - b. Christie
  
- J. Electric Screen Basis of Design: Draper
  1. Approved Electric Screen Alternate Manufacturer:
    - a. DA-Lite
    - b. Stewart
  
- K. Performance Intercom Basis of Design: ClearCom
  1. Approved Alternate Intercom Manufacturers:
    - a. RTS
    - b. Telex
  
- L. AV Network:
  1. General:
    - a. AV bidder shall provide quantity of switches as required to meet the connectivity requirements in the AV contract drawings.
    - b. AV bidder to tie multiple switches together with fiber/SFP ports, as required. Multiple switches are to be tied together use a minimum of 2 x SFP+ ports to facilitate a minimum of 20G uplink.
  
  2. AV Network Switch:
    - c. Features:
      - 1) Most suitable for fixed installations
      - 2) VLAN grouping segmentation
      - 3) MAC address table
      - 4) IGMP support
      - 5) IGMP snooping
      - 6) Port Sensing
      - 7) Auto Sensing
      - 8) POE budget suitable for intended equipment
      - 9) Auto-MDIX/MDI
      - 10) DoS

- 11) IPv4
- 12) IPv6
- d. Connectivity:
  - 1) Ethernet connectivity: minimally 24 RJ45 connectors
  - 2) Fiber connectivity: minimally 4 SFP+ connectors
  - 3) Ethernet port speed: 1Gbps
  - 4) Minimally supported protocols:
    - a) AVB/Milan
    - b) Dante
    - c) RAVENNA/AES67
    - d) Q-LAN
    - e) REAC
    - f) SACN
    - g) ARTNET
    - h) COS (class of service)
    - i) DiffServ (DSCP)
    - j) PoE+
    - k) IEEE1588 PTP V2
- e. Acceptable Products:
  - 1) Netgear (see major equipment list)
  - 2) Luminex
  - 3) Cisco

M. Amplifier basis of Design: QSYS CX-Q

- 1. Approved Alternate Amplifier Manufacturers:
  - a. APEX
  - b. Crown
- 2. Provide all required I/O to meet the functional requirements as shown in the contract drawings.

2.3 MAJOR EQUIPMENT

- A. Whenever any equipment is specified by the manufacturer and model number, it is for purposes of establishing a standard of quality, performance, construction and function.
- B. All materials and equipment shall be new and of the latest design or model offered for sale by the manufacturer.
- C. Equipment models provided shall operate at the required AC line voltage and frequency.
- D. Contractor shall provide quantities as indicated in the equipment list, detail drawings, location drawings, schedule of terminations for a complete installation.

**STAPLES HIGH SCHOOL MAJOR EQUIPMENT - SPECIALTY AV**

1. Contractor shall confirm all quantities against drawings and specifications.
2. Where discrepancies between drawings and specifications are present, the stronger and more stringent requirement shall be furnished.
3. This list shall not be considered a complete list of required material. Contractor shall furnish all required material for a fully functional system.
4. Finish color of all facilities panels and equipment in public view (touch panels, loudspeakers, custom panels, faceplates, etc. must be confirmed with the architect.

<b>BASE CONTRACT - PROVIDE LUMP SUM</b>			
<b>Device</b>	<b>Manufacturer</b>	<b>Model</b>	<b>QTY</b>
AVoIP Encoder	QSYS	NV-1-H-WE	3
Bluetooth	QSYS	unD6IO-BT	3
XLR	QSYS	D2i	5
10" Control Panel	QSYS	TSC-101-G3	3
Tabletop Mount	QSYS	TSC-710t-G3	1
PTZ Camera	QSYS	NC-12x80	1
Ceiling Mic	Shure	MX202BC	4
Electric Screen	Draper	114208	1
Wireless Present	Crestron	AM3200	1
AVoIP Encoder	QSYS	NV-32-H	1
7" Touch Screen	QSYS	TSC-70-G3	1
DSP	QSYS	CORE X10	1
Dante License	QSYS	SDLAN-128-P	1
Appliance Recorder	Tascam	SS-CDR250N	1
Audio Output	QSYS	QIO-L4o	1
Mic Input	QSYS	QIO-ML4i	1
GPIO	QSYS	QIO-GP8x8	1
Antenna Splitter	Shure	UA844+SWB	1
Cable	Shure	UA8100	A/R
Active Splitter	Shure	UA834WB	A/R
2" Antenna Cable	Shure	UA802 or equiv.	A/R
Mounting Flange	Shure	A13HDB	A/R
1/2-wave Antenna	Shure	UA860WB	2
Wireless Receiver	Shure	ULXD4Q	1
Body Pack XMTR	Shure	ULXD1	4
Lav Mic	Shure	WL185	4
Wireless Handheld	Shure	ULXD2/B87A	4
Rechargeable Battery	Shure	SB900B	4
Battery Charger	Shure	SBC800	1
AVoIP Decoder	QSYS	NV-21-HU	2
Projector	Epson	EB-PU2220B	1

Projector Mount	Custom	Custom	1
65" Display	Samsung	QM65	1
Display Mount	Chief	LTM1U	1
12" Subcardioid Coaxial Loudspeaker	Fulcrum Acoustic	CCX1295	7
8" Coaxial Loudspeaker	Fulcrum Acoustic	RX8	5
Dual 8" Coaxial Loudspeaker	Fulcrum Acoustic	DX896	2
5" Coaxial Loudspeaker	Fulcrum Acoustic	RX5	7
Subwoofer	Fulcrum Acoustic	CCS18	1
Center Array	Fulcrum Acoustic	CCS15	2
Center Array	Fulcrum Acoustic	CCS230	1
Array Frame	Fulcrum Acoustic	Specify	1
12" Loudspeaker Yoke	Fulcrum Acoustic	YK-CX12	7
8" Loudspeaker Yoke	Fulcrum Acoustic	YK-DX8	2
8" Loudspeaker Yoke	Fulcrum Acoustic	UB-RX8	5
5" Loudspeaker Yoke	Fulcrum Acoustic	UB-RX5	7
Custom Rigging / Signed Stamped	Custom	Custom	1
Factory Paint for All Speakers	Custom	Custom	A/R
Amplifier	QSYS	CX-Q 8K8	3
Network Switch	Netgear	M4300-52G-POE+	2
ALS Kit	ListenTech	LS-31-072	1
ALS Receiver	ListenTech	LA-3200-072	8
ALS Ear Speaker	ListenTech	LA-401	8
ALS Neckloop	ListenTech	LA-430	8
ALS Receiver Charger	ListenTech	LA-423-01	2
AV Cabinet	Middle Atlantic	SR-40-28	2
Cat6A Patch Panel	Belden	Specify	2
SDI Patch Panel	Canare	32MD-ST	1
UPS	Shure	UPX-200R-2	1
Power Strip	Middle Atlantic	PD-2420SC-NS	1
4RU Drawer	Middle Atlantic	D4	2
2RU Drawer	Middle Atlantic	D2	2
Digital Mixer	Yamaha	DM3-D	1
Gooseneck Mic	Clear-Com	110/340	4
Intercom User Station	Clear-Com	HXII-KB-X4	4
Intercom Ant.	Clear-Com	FSII-TCVR-IP-19	1
Central Station	Clear-Com	FSEBASE	1

Wireless Intercom Belt	Clear-Com	FSII-BP19	5
Intercom Charger	Clear-Com	AC60	1
Intercom Headset	Clear-Com	CC-300-X4	5
Terminations, faceplates, cabling, backboxes, & conduit	By Contractor	By Contractor	A/R
Installation, mounting of all equipment, commissioning, configuration	By Contractor	By Contractor	A/R
All Software Licenses for a Fully Functional System	By Contractor	By Contractor	A/R
<b>ADD ALTERNATE #1 - SUPPORTING SPACES</b>			
<b>Device</b>	<b>Manufacturer</b>	<b>Model</b>	<b>QTY</b>
Intercom Ant.	Clear-Com	FSII-TCVR-IP-19	1
Amplifier	QSYS	CX-Q 8K8	1
10" Control Panel	QSYS	TSC-101-G3	1
Confidence Monitor Stand	Middle Atlantic	MFQUB	1
55" Confidence Monitor	Samsung	QM55	1
AV Cabinet	Middle Atlantic	EWR-8-22SD	1
AVoIP Decoder	QSYS	NV-21-HU	2
Terminations, faceplates, cabling, backboxes, & conduit	By Contractor	By Contractor	A/R
Installation, mounting of all equipment, commissioning, configuration	By Contractor	By Contractor	A/R
All Software Licenses for a Fully Functional System	By Contractor	By Contractor	A/R
<b>ADD ALTERNATE #2 - MIX &amp; STAGE BOXES</b>			
<b>Device</b>	<b>Manufacturer</b>	<b>Model</b>	<b>QTY</b>
120-Channel Digital Mixer	Yamaha	DM7	1
Dante Card	Yamaha	PY64-D	1
Stage Box	Yamaha	RIO3224-D3	2
Audio Rack w/ Casters	Gator	GRC-BASE-10	2
Terminations, faceplates, cabling, backboxes, & conduit	By Contractor	By Contractor	A/R
Installation, mounting of all equipment, commissioning, configuration	By Contractor	By Contractor	A/R
All Software Licenses for a Fully Functional System	By Contractor	By Contractor	A/R
<b>ADD ALTERNATE #3 - WIRELESS MICROPHONES &amp; LOOSE EQUIPMENT</b>			
<b>Device</b>	<b>Manufacturer</b>	<b>Model</b>	<b>QTY</b>
Wireless Receiver	Shure	ULXD4Q	5
Body Pack XMTR	Shure	ULXD1	20

Lav Mic	Shure	WL185	4
Wireless Handheld	Shure	ULXD2/B87A	4
Rechargeable Battery	Shure	SB900B	20
Battery Charger	Shure	SBC800	3
Earset Headworn Microphone	Shure	MX153	24
Headphones	Sony	MDR-7506	5
Dynamic Cardioid Microphone	Shure	SM57-LC	12
Dynamic Cardioid Vocal Microphone	Shure	SM58-LC	12
Condenser Cardioid Microphone	Shure	SM81-LC	4
Microphone Road Case	Gator	G-TOUR M15	4
Choir Microphone Boom Stand	K&M	KM21021	4
Round Base Microphone Stand	K&M	KM26010	4
Tabletop Microphone Stand	K&M	KM23325	4
Supercardioid Microphone	AKG	D112	1
Dynamic Cardioid Microphone	Sennheiser	e604	5
Condenser Shotgun Microphone	Sennheiser	MKH8060	2
Active Instrument DI Box	Radial Labs	J48	4
Microphone Cable - 20'	Whirlwind	MK420	20
Microphone Cable - 50'	Whirlwind	MK450	20
Drum Microphone Clip	Shure	A75M	5
Terminations, faceplates, cabling, backboxes, & conduit	By Contractor	By Contractor	A/R
Installation, mounting of all equipment, commissioning, configuration	By Contractor	By Contractor	A/R
All Software Licenses for a Fully Functional System	By Contractor	By Contractor	A/R

## 2.4 AUDIO & VIDEO WIRE AND CABLE

- A. All wire numbers listed in the drawings are Belden unless otherwise noted.
- B. THHN wire is not an allowable substitute for twisted pair stranded loudspeaker wiring.
- C. Approved manufacturers: Belden, Canare, Gepco, West Penn, Whirlwind
- D. Where conflict exists with any codes or ordinances, such codes and ordinances shall take precedence.
- E. Where conflict exists with electrical specifications, the higher standard or more stringent requirement shall apply.

2.5 SPECIFICATIONS – RACK MOUNT PANELS

- A. Material: 11 gauge steel or 1/8" Aluminum, minimum thickness Finish: Black or to match adjacent equipment
- B. Size: 19" wide, standard EIA mounting hole spacing, height as specified

2.6 SPECIFICATIONS – BACK BOX ENCLOSURES

- A. Material: Code grade steel
- B. Finish: Black or galvanized Size: As specified

2.7 SPECIFICATIONS – PLUG BOX AND TERMINATION PANELS

- A. Material: 11 gauge steel or 1/8" Aluminum, minimum thickness Finish: Black (unless instructed otherwise by Architect)
- B. Size: As specified
- C. Approved Manufacturers: Steel City, Raco, Hoffman, Whirlwind, Pro Co, Wireworks

2.8 AUDIO TRANSFORMERS

- A. All transformers shall be selected for proper interface and loading in the circuits by as-built conditions and per manufacturer's recommendations.

2.9 LOUDSPEAKER RIGGING EQUIPMENT:

- A. Provide rigging for loudspeakers and suspended loudspeakers. Provide with sufficient number of suspension points for field adjustment of loudspeaker aiming. Color to determine color. Verify that adequate clearance from all other hanging components and adequate clearance from structural steel is provided. Provide all required hardware necessary for the safe and proper installation of loudspeakers.
- B. Available manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work, include but are not limited to:
  - 1. APE Rigging
  - 2. Polar Focus

C. MAJOR EQUIPMENT

- D. Equipment provided shall be as specified herein or an approved substitute.
- E. Detailed performance specifications shall be those published by the manufacturer effective on the date of this document for all equipment listed.

2.10 DETAIL DRAWINGS

- A. Furnish all materials and labor to provide complete and finished work even though not specifically shown on the drawings.
- B. Detail drawings are located in large format AV drawings.

### PART 3 - EXECUTION

#### 3.1 AUDIO SYSTEM REQUIREMENTS

- A. Requirements herein refer to materials and work which are related to or part of the Systems. Where conflict exists with other specifications concerning such work or materials, this specification takes precedence unless otherwise approved in writing by the Owner.

#### 3.2 DANTE NETWORK REQUIREMENTS

- A. All Dante endpoints shall be within (3) switch hops from transmitter to receiver.
- B. One DSP shall act as PTP clock for all peripherals.
- C. The integrator shall configure the chosen core to be PTP V1 and PTP v2 clock masters.
- D. The integrator shall provide proof with PTP Trackhound or equivalent screenshot.
- E. The integrator shall configure the DSP to route DANTE streams, per the drawings, via scenes controlled and processed by Dante Controller within the DSP or via QSYS.
- F. The core switch shall act as IGMP querier to handle all multicast traffic on the network for added network stability.
- G. The integrator shall be fully knowledgeable in all Dante and QSYS networking requirements, network white papers, and best practices. The integrator shall implement all best practices, network recommendations, and manufacturer recommendations as required for a stable network.

#### 3.3 VIDEO NETWORK REQUIREMENTS

- A. In general, encoders and decoders servicing a space shall be patched into the same network switch. Minimize all cross switch hopping for video.
- B. The integrator shall create video bandwidth estimates and advise where backbone connectivity is insufficient for video distribution across the network. This shall take place during submittals and prior to rough-in.

#### 3.4 GENERAL

- A. Equipment will be installed by competent workers at locations shown on the drawings in strict accordance with approved shop drawings and manufacturer's instructions.
- B. Equipment is to be firmly held in place, with the exception of portable equipment. This shall include loudspeakers, enclosures, amplifiers, cables, etc. Fastenings and supports adequate to support their loads with a safety factor of five, unless otherwise stated.
- C. Take such precautions as necessary to prevent and guard against electro-magnetic and electro-static hum and to install the equipment so as to provide safety for the operator.
- D. Project equipment, including patch panels, connectors, receptacles, racks, consoles, and video projectors, from construction dust and debris until final acceptance of the system.

### 3.5 SYSTEM DEMONSTRATION AND CHECKOUT (COMMISSIONING)

- A. System installation will be certified complete and in working order by contractor. During commissioning the contractor commissioning technician will follow the procedures outlined in the AVIXA AV Systems Performance Verification Guide (See Appendix A).
- B. Fill in and submit the Digital AVIXA Audiovisual Systems Performance Verification Checklist form prior to scheduling formal commissioning. Submit scanned copy or printed file using iAuditor APP.
- C. Confirm test results and data obtained and submitted for review during final commissioning, as requested.
- D. Provide as-built drawings, manuals, and configuration software available to consultant during the final testing and commissioning. System Demonstration and Testing does not define the entire scope of proof of performance of the AV systems. Detailed performance requirements are listed in paragraph 3.13 below.

### 3.6 ROOM NUMBERING REQUIREMENTS

- A. All system programming and labeling utilizing room numbers shall follow the room numbering plans provided by the Architect for all submittals and final installations. Room numbers shown on contract documents for individual trades are not to be considered final numbers and shall not be utilized.

### 3.7 LABELS

- A. Except where otherwise specified, label as shown on drawings and as specified each item of rack-mounted equipment, switches, controls, and receptacles. Conform to AVIXA Cable Labeling Standard F501.01:2015
  - 1. Connector and Rack Panels: Constructed of engraved and filled anodized aluminum plates. Minimum 1/8" plate thickness. Dry transfer or other types of adhesive labels not acceptable.
  - 2. Rack-Mounted Equipment: Labels constructed of engraved and filled plastic laminate engraving stock. Designate function and input and output line(s) of all signals served by labeled equipment. Key designations to system functional and patch panel diagrams.  
  
Where possible, mount labels on blank panel directly above corresponding connection. For modular equipment, provide label on inside of mainframe door identifying type of module for each slot (unless there is only one type) and gain setting as established at final checkout.
  - 3. For centralized rack(s) that support multiple systems, clearly label and identify equipment and which systems that they support.
  - 4. Receptacles: Engrave and fill receptacle label directly on mounting plate as indicated on Contract Drawings.
- B. Identify wires and cables at every termination and connection point with the specified cable markers. The contractor is strongly encouraged to use a numbering scheme that identifies cables terminating at patch panel jacks with the patch bay row and jack designation; use A, B, and C suffixes to distinguish multiple cables terminating at the same jack.
- C. Identify switches, relays, terminal blocks, etc., with reference numbers keyed to the as-built wiring diagrams.

- D. Room numbers appear on the contract documents for reference only. Labels shall reflect the Owner's final room designations.
- E. Labels and legends shall be as approved on shop drawings.
- F. Cable Markers:
  - 1. High-grade PVC clip-on or permanent-type cable markers with permanent markings, or printed vinyl tape protected by clear shrink tubing or adhesive wrap.
  - 2. Acceptable Products:
    - a. Wieland Electrovert Type C or Z.
    - b. Brady B-702 with Alpha FIT-221 series clear tubing.
    - c. Brady BMP21-PLUS.
    - d. Dymo RHINO 6000

### 3.8 AMPLIFIERS AND DIGITAL AUDIO SIGNAL PROCESORS

- A. Gain Control Security:
  - 1. Amplifiers and Signal Processing Equipment: Power amplifiers and signal processing equipment with front panel controls or power switches which are to be permanently adjusted (not normally adjusted by the operator), such as equalizers, distribution amplifiers, limiters, and audio delays, shall be furnished with lockout of front-panel controls, security panels, or be mounted on subpanel behind blank panels. Provide transparent plastic panels for viewing of indicators such as meters or LED indicators.
- B. Audio Digital Signal Processing (DSP) and Surround Processing:
  - 1. Install all equipment to manufacture specifications and industry standards.
  - 2. Adjust the system gain and equalization to meet specifications. Adjust equalization curves as required for speech and program audio playback.
  - 3. Record and store all DSP configuration files.
  - 4. Test all functions of each piece of audio DSP equipment, including front panel and remote controlled functions.

### 3.9 LOUDSPEAKER EQUIPMENT

- A. Loudspeaker Arrays:
  - 1. Carefully inspect the site to verify that no obstructions, such as beams, panels, large framing members, etc. existing between high-frequency horns and any seating area covered by the horns. Immediately notify Architect of any such obstructions.
  - 2. Provide and install all safety cable to secure loudspeaker components and mounting.
  - 3. Provide all structure and framework as required to properly support the loudspeakers in the indicated location. Provide shop drawings of proposed structure for review prior to fabrication. Obtain the stamp of a structural engineer registered in the same state as the construction site on shop drawing which depict loudspeaker cluster structure, framework, and support systems.
  - 4. Paint all components and provide cloth grills for loudspeaker enclosures as

required by Architect.

B. Ceiling-Mounted Loudspeaker Enclosures and Grilles:

1. Ceiling Enclosures: Enclosures supported directly from ceiling structure in an approved manor. Support directly by acoustical ceiling tile IS NOT ACCEPTABLE.
2. Flush and surface-mounted ceiling enclosures: Provide enclosures where indicated on drawings.

3.10 VIDEO EQUIPMENT

A. Projectors:

1. Verify lens selection, locations, and elevations shown on drawings using the manufacturer's throw distance and elevation formulas for the specified projector model.
2. Provide plan and section drawings verifying the image size and format, lens-to-screen distances, and mounting methods.
  - a. For video projectors that meet the criteria for FDA-designated risk group for Laser Illuminated Projectors, contractor to submit the video projector Risk Class Category, and verify that installation will meet the video projector manufacturer installation requirements by indicating the resultant hazard distance and restriction zones in the submitted plan and section drawings.
3. Provide detailed drawings of custom-fabricated or stock mounts and hardware.
4. Provide detailed drawings of millwork or finish items required for specified screen dimensions.
5. Where projector mounts or motorized lifts are installed by others, provide drawings to guide installer indicating installation positions allowing optimal projector performance.

B. Mounting:

1. Install projector mount and suspend projector at location and elevation indicated on approved shop drawings.
2. Projector mounts and motorized lifts must meet all applicable safety and code requirements for ceiling mounted equipment.
3. Fixed projector mounts must be rigid and completely free of sway or rotation deviation.
4. Projector support pipes shall be only fixed-length pipes as required—do not use adjustable-length pipes.
5. For ceiling-mounted installations where screen surfaces are vertical, level projector at 0° front-to-back and side-to-side.
6. Position projector with lens centered on screen centerline in plan unless projector is provided with horizontal lens shift capability. Do not employ vertical or horizontal electronic keystone correction unless specifically authorized to do so.
7. Wherever possible, minimize hardware and cables visible from audience seating and presenter area viewpoints.
8. Paint exposed mounting hardware to match room interior or as instructed by Architect.
9. Where structural mounts or millwork openings are provided by others, verify correct positioning and dimensions before mounting projector. Provide written notification to the Owner or Architect of any discrepancies in mount positioning

- or stability deficiencies before projector installation.
10. Provide all necessary projector brackets, fittings, pipes, miscellaneous hardware and wireways.
  11. Run cabling from video projector box to projector within projector support pipe.
  12. Provide approved security cable for video projectors to accept padlock provided by owner.
  13. Confirm that the lift and or projector is isolated from building or external vibrations.
  14. When using an external box for projector components make sure the box is adequately ventilated and has enough AC power receptacles.
  15. Confirm that the projector fan noise is within the manufacturer's specification. Submit measurement with AV checklist.

### 3.11 VIDEO DISPLAY WALLS

#### A. Submittals:

1. Provide elevation drawings showing location of video displays for approval. Where display is part of a larger graphic display, verify exact location of display with Architect.

#### B. Mounting:

1. Install display mount and display at location and elevation indicated on approved shop drawings.
2. For wall-mounted displays, provide mount to support display from blocking, if provided, or from wall studs. If a recessed box is provided behind display for power outlets and electronic accessories, provide mount that does not obstruct access to box.
3. Wherever possible, minimize hardware and cables visible from audience seating and presenter area viewpoints.
4. Where display is mounted in an architectural recess, verify that sufficient clearance (4" minimum, or as required by the video display panel manufacturer) is provided for ventilation airflow.
5. Provide display mounts with security provisions to accept owner-provided locking devices.
6. Confirm that all displays meet proper profile depth per ADA regulations.

### 3.12 DIGITAL MEDIA TRANSMISSION AND SWITCHING SYSTEMS:

#### A. Extended Display Identification Data (EDID):

1. Do not operate digital media transmission/switching equipment in "automatic EDID" mode, unless equipment provided has no other option.
2. Do not include resolutions in the EDID table that cannot be handled by display(s).
3. For systems where laptop computers will be used in "mirroring" mode, ensure that as many possible common resolutions are included in the EDID table without violating provision of preceding paragraph.
4. For inputs where the source is a fixed device (i.e. a fixed part of the system) create the EDID table with a single entry, again without violating provision of preceding paragraph but one.

#### B. HDCP Implementation:

1. For systems containing a non-HDCP-compliant display device, such as a class capture appliance or videoconference CODEC, and where switching equipment supports the capability, dynamically configure input devices for portable equipment such as laptops to report to the equipment as non-HDCP devices when the non-compliant device is in use.

### 3.13 CONTROL EQUIPMENT

#### A. Ethernet/IP/Local Area Network Accessibility and Control:

1. Coordinate Ethernet connectivity and IP addressing of control devices with Electrical Contractor and the Communications/Technology management of the facility. Owner will provide all required IP addresses to AV contractor.
2. Provide owner with remote control and management software interfacing via Local Area Network access from PC to any IP addressed control devices.
3. Coordinate with end-user and Communication/Technology management of the facility, on POP-3 email notification of system service issues where desired and /or where possible. Co-ordinate with Owner and Communications/Technology management of the facility on POP-3 email of service or security issues in case of failure or disconnection of any bi-directional (e.g. RS-232 or Cresnet/AXLINK) device.
4. Verify requirements of system control via IP with or Owner and Consultant.

#### B. Audio Visual Control System Programming

1. All programming to be performed by programmer certified by the manufacturer of the AV control system equipment provided.
2. Program system or instruct AV Control System Manufacturer to program system as instructed by the AV Consultant and the Owner, and as indicated on the drawings so that all devices are controlled in a logical manner, and to take full benefit of the capabilities of the Control System.
3. Submit for approval changes to programming or control panels required by actual conditions (e.g. number of dimming system presets).
4. Refine and adjust, as required, programming to operate in a logical and consistent fashion. Make revisions to program as directed by the AV Consultant at checkout to correct operational inconsistencies or to properly control devices.
5. Ascertain that the system is optimally programmed for smooth transitions between media uses and for minimal wear-and-tear on equipment and audiovisual media.
6. Verify that video playback device transports, etc., are stopped when another input source is selected, unless playback device is routed to a different destination from the selected source.
7. Wherever possible, utilize status feedback of source equipment, dimming systems, etc., to indicate to the control system and user the actual operating mode of the equipment. When feedback is not available (e.g. consumer playback equipment) program control system to issue commands as required to minimize status reporting errors.
8. Provide color electronic drawing files of screen layouts of touchscreen control panels for approval prior to system programming.
9. Distinguish between primary and secondary control buttons by intensity or color. If available, use “3D” buttons to indicate button activation as visually “depressed”. Avoid excessive use of primary or other bold colors.

#### C. Color Video Touch-Screen Control Panels:

1. Submit panel graphics (including text, buttons, colors, images, backgrounds etc.), as well as panel flips, sub-panels and overall screen logic flow to the Owner and Consultant for review and approval.
2. Use control system supported software for panel logic programming and design; make software files available directly to the end user upon request, free of charge.
3. Join numbers (other than those reserved for panel logic), hardware programming and all other installation requirements including programming software and computers are the responsibility of the installing contractor.
4. Any adjustments, revisions, modifications, etc. to the panel graphics and control system required for complete operation are the responsibility of the installing contractor.

D. Control System Functions:

1. Following are general descriptions and guidelines for control system panel functions and layouts:
  - a. Turn system power on/off.
  - b. Input Source selection.
  - c. Separate speech and program audio volume controls. Preset microphone and audio playback levels on startup.
  - d. Control system shall provide the user with the ability to select between either a stereo sub-mix of all audio fed through the sound reinforcement system, or the stereo microphone for audio and video recording devices. Do not allow both the stereo sub- mix and stereo microphone to feed the audio recording devices simultaneously.
  - e. Recovery from power outage.
  - f. Control digital signal processors to provide system presets indicated in this specification or on the AV drawings or others as required.
  - g. AC power failure and switchover to UPS.
  - h. Others as identified elsewhere in the Contract Documents or required.
  - i. After system shut-down, system will restart with default settings restored.
2. Following are specific descriptions and guidelines for control system panel functions and layouts:
  - j. Volume Control (provide separate microphone and program audio volume controls where applicable).
  - k. Projection screen up/down.
  - l. Transport controls for all applicable AV sources.
  - m. Select which video input is actively displaying and playing audio through the AV system.
  - n. Others as identified elsewhere in the Contract Documents or required.
3. Where applicable, configure the audiovisual control system(s) with the following operation(s):
  - o. Control system shall communicate with video display devices (particularly video projectors) during start-up and shut-down. Feedback shall be provided on the control panel indicating when the projector is cooling down, and inform the user that the projector cannot be restarted until cool-down is complete.
  - p. Control system, audio signal processors, and digital video switch equipment will connect to the UPS where these devices are specified. Control system shall communicate with UPS device. In the event of a power outage, after one minute has passed, control system shall instruct the other UPS-connected devices to shut-down properly in order to protect their programming. After power is restored, user will be required to restart system from control panel.

4. Interface with Fire Alarm System: The audiovisual system shall connect to the FAS as identified on the drawings. Systems shall be muted when triggered by the FAS.

### 3.14 AV NETWORK SECURITY

- A. All equipment to be configured to prevent unauthorized users from access to the systems and network and prevent disclosure of confidential information.
- B. Utilize all appropriate security features available for connected products, including but not limited to:
  1. AES encryption
  2. 802.1x authentication
  3. SSH, SFTP or other secure protocols
- C. Whenever possible, all AV devices should be separated into their own respective VLAN's to isolate them as necessary.
- D. All equipment to be configured to prevent unauthorized users from access to the systems and network and prevent disclosure of confidential information.
- E. Default passwords of internet connected audiovisual equipment are readily known and can be used as a means to access network equipment by unauthorized users. AV networked devices may include any device with a wireless or wired Ethernet port.
  1. Assign role based access control with different levels of access and permissions for each user type:
    - a. Admin – Ability to make changes to network, security configurations, and user accounts.
    - b. AV Configuration – Ability to make changes to AV Parameters.
    - c. System User – System operation only.
    - d. Others as required by the Owner.
  2. Change all passwords from default values to project specific passwords. Follow industry recommended password strength standards when choosing new passwords.
  3. Provide new passwords to the Owner.
  4. Provide instructions to change passwords.
- F. AV Network Switches:
  1. Do not connect unauthorized AV network switches to the Owner's LAN.
  2. Provide logical separation of AV and IT networks through hardware and VLAN's.
  3. Disable unoccupied ports and services on managed switches.
- G. Follow all applicable Audiovisual Network Deployment standards of Owner.
  1. Coordinate all IP addressing with Owner, follow the standards and populate the Owner's standard "AV Equipment" schedule as required.
- H. Populate an "AV Equipment" schedule as required by Owner, indicating the following:
  1. Room/System

2. Manufacturer
3. Model number
4. Product serial number
5. Device Name
6. MAC address
7. IP address
8. Others as required by the Owner

- I. Coordinate use of Owner's network time server with AV devices as required.
- J. Follow AV network cable color standards.
- K. Others as required by Owner IT department.

### 3.15 INSTALLATION OF SYSTEMS

- A. Locate all apparatus requiring adjustments, cleaning or similar attention so that it will be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.
- B. Furnish and install brackets, braces and supports. All mounting hardware shall be included.
- C. All bolts and fasteners must be Grade 5 or better.
- D. All bolted attachments to have lock washers or other self-locking fasteners.
- E. Provide all required mounting brackets and framing, hardware and components, safety systems and rigging systems using the following minimum design factors (given as ratio of working load limit (WWL) : rated breaking load):
  1. 5:1 – Minimum design factor for all mounting components regardless of mounting condition.
  2. 5:1-8:1 – Minimum design factor for manufacturer provided mounts & assemblies where engineered stamped documentation and destructive testing data is provided by manufacturer.
  3. 10:1 – For all hardware and connecting assemblies between manufacturer rated assemblies when equipment is hung above the general public. This includes but is not limited to wire rope, bolts, shackles, turnbuckles, beam clamps, supplemental steel provided by Systems contractor and other connecting hardware.
  4. Design factor calculations to be provided with all equipment mounting details.
  5. Systems Contractor shall coordinate required additional blocking, supplemental steel or channel strut supports with Main Contractor & specific trade contractors.
  6. All mounting systems not provided as a complete package from a single manufacturer must be engineered, approved, and have drawings stamped by a professional rigging engineer or licensed structural engineer, as approved by the Main Contractor. The engineer shall verify that the design meets or exceeds design criteria for this particular use case. Each mounting system solution must be separately engineered, verified, and stamped.
- F. All supporting structures and enclosures supplied by the Contractor not having a standard factory paint finish shall be painted. Paint specifications will be supplied by the Architect or indicated herein.

- G. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Architect. This does not exclude equipment or materials where standard colors and finishes may be specified herein.
- H. Finish of blank panels and custom assembly panels shall match adjacent equipment panels. Verify all panel colors with Architect. All color choices should be clearly indicated on panel drawing submittals, and on the panel schedule.
- I. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched or screened. Markings for these items are detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Systems Designer prior to marking.
- J. Protect equipment and related wiring where construction conditions may cause damage or environmental conditions exceed manufacturer's specifications.
- K. The standard reference for the layout and construction of the system shall be:
  - 1. Giddings, Philip. Audio Systems Design and Installation.
- L. All cables, connectors and peripheral equipment's required to attain a fully functional system shall be furnished, installed and performed by the contractor awarded this project.
- M. Locate all apparatus requiring adjustments, cleaning or similar attention so that it will be accessible for such attention.
- N. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Architect. This does not exclude equipment or materials where standard colors and finishes may be specified herein.
- O. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched or screened. Markings for these items are detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Systems Designer prior to marking.
- P. The equipment specified herein is designed to operate in environments of normal humidity, dust and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.
- Q. Secure equipment firmly in place, including control panels, loudspeakers, conduit, amplifiers, racks, and cables. Make fasteners and supports to support their loads with a safety factor of at least three.
- R. Take precautions to prevent electromagnetic and electrostatic hum. Install equipment to provide safe operation.
- S. Clearly, consistently, logically, and permanently mark connectors, jacks, relays, receptacles, cables, and cable terminations.

- T. All wall mounted devices shall be mounted, secured and installed in accordance with SEI/ASCE 7 and shall additionally withstand the effects of any motions within the building as determined by SEI/ASCE 7.
- U. The term “WITHSTAND” means “THE UNITS WILL REMAIN IN PLACE WITHOUT SEPARATION OF ANY PARTS FROM THE DEVICE WHEN SUBJECTED TO THE SEISMIC FORCES SPECIFIED AND THE UNIT WILL BE FULLY OPERATIONAL AFTER THE SEISMIC EVENT.”
- V. SECURE ATTACHMENT OF AUDIO VISUAL ITEMS
  - 1. To ensure proper attachment of Fixtures, Furnishings & Equipment items, including and Technology items, where “items” are attached to wall, ceiling, overhead structure, and/or floor, Contractor shall provide information adequate for architect to verify items, attached to wall, ceiling, and/or floor are attached securely and per manufacturer’s recommendations. Architect’s review may be implemented during submittal process.
  - 2. The contractor shall provide struts, hangers, fasteners, safety harnesses, channels, bolts, screws, rods, etc. to securely attach items to existing structure to meet field conditions and meet applicable codes.

W. CONDUIT

- 1. Review and coordinate Systems conduit installation with the electrical contractor to ensure proper operation of the Systems.
- 2. All wiring shall be in conduit unless authorized by the Architect, approved by the Systems Designer, and permitted by code. Exceptions are short runs at rack terminations where there is no means of connecting conduit to the equipment.
- 3. Where installed exposed, conduits shall be parallel with or at right angles to walls or ceilings and shall be supported from walls or ceilings by means of approved galvanized iron clamps or hangers. Conduit connections to equipment racks shall be insulated.
- 4. Minimum size conduit shall be 3/4 inch. All conduit shall be sized for maximum 40% fill or less if required by code.
- 5. No conduit run between pull boxes/termination boxes may exceed 100 feet in length.
- 6. No conduit run shall have more than 180 degrees of combined turns between pull boxes/termination boxes, and no single turn may exceed 90 degrees.
- 7. Conduit containing STP, UTP, and COAX wire types must be installed so that the final length of the cable runs does not exceed maximum allowable cable lengths.

3.16 CONDUIT SEPARATION

- A. Systems wiring is divided into wiring groups according to their nominal voltage levels (refer to Schedule of Terminations):

	Wiring Type
Group A	Microphones and other sensitive wiring (0 mV to 100 mV)
Group B	Line level wiring (100 mV to 10 V)
Group C	Loudspeaker and control wiring (10 V to 70 V)
Group D	Telephone, video, control and digital circuits
Group E	Fiber optic cable
Group F	Spare Conduit

1. Note: These wiring groups must never be intermixed within a given conduit run or junction box.

B. Minimum conduit separation between conduits carrying wiring of different groups is:

	Group A	Group B	Group C	Group D	Group E
Group A	adjacent	6"	12"	12"	adjacent
Group B	-	adjacent	12"	6"	adjacent
Group C	-	-	adjacent	6"	adjacent
Group D	-	-	-	adjacent	adjacent
Group E	-	-	-	-	adjacent
Group F	12"	12"	12"	12"	adjacent

1. Note: Ninety degree crossings in close proximity are acceptable. Separations must be maintained until within six feet of box or gutter entry.

C. Minimum conduit separation between conduits carrying Systems wiring and other electrical service conduit is:

	Group A	Group B	Group C	Group D	Group E	Group F
Dimmer controlled lighting	24"	12"	6"	12"	adjacent	24"
SCR controlled services	24"	12"	6"	12"	adjacent	24"
220/440V circuits	6"	6"	adjacent	adjacent	adjacent	24"
All other services	6"	6"	adjacent	adjacent	adjacent	24"

1. Note: Heavy current demands in or long parallel runs with the above services may dictate greater separations to avoid interference in the Systems. Separations must be maintained until within six feet of box or gutter entry.

D. Contractor must have written authorization from the Systems Designer for any conduit installation which does not conform to these requirements. The conduit separations above are based on the use of EMT conduit for all AV and other signals. Separations where Rigid conduit is utilized for AV systems and/or other adjacent systems may be halved. Separations where PVC conduit is utilized for AV systems and/or other adjacent systems must be doubled. The Contractor must request information on separation adjustments for each instance where a different type of conduit than what is listed above is used.

3.17 ELECTRICAL POWER

- E. Review and coordinate electrical power system installation including grounding with the electrical contractor to ensure proper operation of the Systems.
- F. Verify that all AC power circuits designated for Systems equipment are wired with correct polarity and isolated ground. Report in writing any discrepancies found to the Architect for corrective action.
- G. Provide distribution of electrical power within the equipment racks with a minimum of one spare AC receptacle for each four in use per branch circuit.

3.18 STEEL SUPPORTS

- A. Fabricate and install any supports so that the installation does not weaken or overload the building structure. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems. No drilling or cutting of concrete beams, joists, or structural steel, nor welding to structural steel, will be permitted except as authorized, in writing, by the Architect.

3.19 BOXES

- A. With the exception of portable equipment, all boxes, conduits, cabinets, equipment and related wiring shall be held in place and the mounting shall be plumb and square.
- B. All boxes shall be securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.
- C. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes are not permitted except as authorized, in writing, by the Systems Designer.
- D. Clean all box interiors before installing plates, panels or covers.
- E. Using permanent marker on the box or on wire tags, indicate the lengths of installed cable for all COAX and Category wiring inside the box.
- F. Using permanent marker, inside the box, indicate the box name, for example "AA".

3.20 WIRING METHODS AND PRACTICES

- A. Provide installation of all Systems wire and cable, ensuring proper:
  - B. Pulling Tensions
  - C. Quantities
  - D. Types
  - E. Lengths
    - 1. Routing
- F. Wire Group Separation
  - 1. Identification
- G. The interconnection of equipment in a rack shall use the same wire by type as specified for runs external to racks unless otherwise indicated on AV single line drawings. All wiring within racks shall be direct between devices without splices.
- H. Connector polarity shall be maintained except for terminations at equipment manufactured to other standards. In the event that manufactured equipment can be ordered with, or internally set to, various standards, the equipment shall be configured as follows:
  - 1. Polarity for XLR style connector shall be: pin 2-high, pin 3-low, and pin 1-shield.

- I. Polarity for TRS style connector shall be: tip-high, ring-low, and sleeve-shield.
- J. Spare wire runs of each group and type shall be pulled to each termination location. The number of spares shall be ten percent of those in actual use or one, whichever is greater.
- K. Splicing of cables is not permitted between terminations of specified equipment.
- L. Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs without written approval from the Systems Designer; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, and rollers to protect cables from excess tension, abrasion or damaging bending during installation.
- M. Provide wire pulling lubricants and pulling tensions in accordance with the wire and cable manufacturer's recommendations.
- N. All wires shall be permanently identified at each wire end by marking with self-laminating adhesive labels fully covered with clear heat shrink tubing, and a chart kept of each wire's function. This applies to wire within a rack assembly as well as wire running in conduit.
- O. Wire ends should be wrapped with heat shrink tubing. Each shield or drain wire should be covered with heat shrink to avoid unintentional connections.
- P. Use Wago or Entrelec DIN rail mounted terminal blocks for all terminal block wiring connections. Do not exceed one wire per terminal connection point. Do not cut strands from conductors to fit lugs or terminals. Spare terminal blocks, equivalent to 10% of those in actual use, shall be provided.
- Q. Form, in an orderly manner, all conductors in enclosures and boxes, wire ways and wiring troughs, providing circuit and conductor identification. Tie using wraps of appropriate size and type. Limit spacing between ties to six (6) inches and provide circuit and conductor identification at least once in each enclosure.
- R. Provide service loops, minimum 6', at each termination so that plates, panels, patch bays, and equipment can be dismounted and placed on an adjacent horizontal work surface allowing for safe service and inspection without disconnection.
- S. Maximum installed length of Category cables is 200'
- T. Maximum installed length of Coaxial cable for HD-SDI, 3G-SDI, 6G-SDI, and 12G-SDI is 200'
- U. Provide lengths of installed cables marked inside each termination back box using legible and permanent markings.

### 3.21 GROUNDING

- A. Audio system wiring shall conform to the following procedures:
  - 1. Audio equipment AC ground pins shall connect to AC isolated ground.
  - 2. Audio equipment chassis shall connect to AC isolated ground or rack frames.
  - 3. Audio rack frames shall connect to AC isolated ground bus in panelboard by means of #2 gauge (minimum) conductor.
  - 4. Audio shields between AC powered pieces of equipment, where signal shield is tied to chassis ground, shall be directly connected to ground at the initiating end only. Capacitively terminate the receiving end with a 0.1 $\mu$ F capacitor.
  - 5. Audio signal paths between AC powered pieces of equipment shall be

- connected using balanced lines and/or transformer isolation. No unbalanced signal paths may be connected to the patch bay.
6. Isolate all Systems wiring from racks, back boxes and conduit.
  7. Isolate all Systems racks from conduit and other conductive surfaces. Use insulated bushings for conduit connections and a dielectric plinth between racks and conductive flooring materials.
  8. AC isolated ground system shall be isolated from all other facility grounds except at the single point of connection at the AV isolation Transformer.
  9. All metallic conduit, boxes and enclosures shall be grounded in accordance with the current National Electrical Code.
- B. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provision of grounding conductors separate from the AC ground.

### 3.22 EQUIPMENT RACKS

- A. The equipment racks shall be considered as custom assemblies and shall be assembled, wired and tested in the Contractor's shop. Assembly of racks on-site will not be permitted, without written approval from the Systems Designer (except for system wiring which must terminate directly to the patch bays via soldering, punch-down or other non-connectorized termination process).
- B. Placement of equipment in equipment racks, as shown in the drawings, is for maximum operator convenience. Verify any changes in placement of the equipment with the Systems Designer before assembly.
- C. Racks shall be installed plumb and square without twists in the frames or variations in level between adjacent racks.
- D. All wire, cable, terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system. Labeling on manufactured equipment shall be by engraved plastic laminate or by thermal printer on adhesive tape, with white lettering on black background or dark background that is similar to panel finish.
- E. Provide stiffeners to custom panels to prevent panel deformation during normal plugging or switching operations.
- F. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice.
- G. Harnessed cables shall be combed straight, wrapped every six (6) to ten (10) inches, and attached to the structure as necessary. Each cable that breaks out from a harness for termination shall be provided with an ample service loop so that panels, patch bays, and equipment can be dismounted and placed on an adjacent horizontal work surface allowing for safe service and inspection without disconnecting.
- H. Harnessed cables shall be formed in either a vertical or a horizontal relationship to equipment, controls, components or terminations.
- I. Cable shields shall be connected to the isolated ground system with due regard for ground loops. (See Giddings reference book, Chapter 10)

- J. All system components and related wiring shall be located with due regard for the minimization of induced electro-magnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience for the operator.
- K. All rack mounted equipment, with front panel controls, shall be provided with security covers to avoid tampering with preset levels. If specific security covers are not included in the equipment list, the Contractor will provide the manufacturer's security cover for each specified device or a suitable alternate.
- L. Every device shall be installed with regard for proper polarity. Absolute polarity shall be maintained through the entire Systems signal chain.
- M. Any permanently mounted electronic device must be balanced. Contractor will provide balancing transformers for unbalanced equipment connections where necessary.
- N. System Power Control
  - 1. Provide a relay-controlled power switching system with a master power switch and power-on indicator for the system. Connect the master power switch to control each receptacle in the rack except for one of the spare receptacles. Label unswitched receptacles "UNSWITCHED".
  - 2. Middle Atlantic USC-6R
  - 3. Atlas Sound SACR-191
  - 4. Juice Goose CQ1520
    - 1) Quantity: A/R
- O. Remote Power ON/OFF Switch:
- P. Provide a single-Rackspace mounted remote power key switch with LED status indicators.
  - a. Middle Atlantic K-DEC in rack panel
  - b. Juice Goose Equal
  - c. Equal
    - 1) Quantity: A/R

### 3.23 VERIFICATION TESTS

- A. Test each point to point wire segment individually, and test any linkage of multiple point to point cables that form an end to end link.
- B. Contractor must document all verification test requirements and results for submission (see 3.13.A below).
- C. Confirm that each individual wire and cable run (whether in a rack or in conduit) is identified with a unique number. These numbers are affixed to both ends of each cable and are clearly visible. Provide a complete list of these numbers along with the termination location of each end of the wire run.
- D. Verify all circuits and extensions for correct connection, continuity and polarity. Absolute polarity must be maintained between all points in the system.
- E. Identify installed length of all copper and fiber cabling.
- F. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. A wide band oscilloscope shall be used to verify this condition.

1. Confirm that the system is free of audible clicks, pops, and other noises when any operating control is activated, with or without input signal.
- G. For all microphone lines, tie lines, return lines and effect loudspeaker lines, confirm:
1. Proper circuits appearing at each termination location
  2. Proper circuits appearing at each jack bay position
  3. Continuity of all conductors
  4. Proper polarity is maintained
  5. Absence of shorts between conductors within each circuit
  6. Absence of shorts between circuit conductors and conduit
- H. Perform a sweep test to 0.5MHz
- I. For RF Coaxial cabling confirm:
1. Receptacles output does not exceed +15dBmv (50-400MHz - +6 dBmv minimum, above 400MHz - +3dBmv minimum)
  2. For each modulated video output, tap to meet +9dBmv (+/- 3dBmv)
  3. Verify that all TV channels are visible and free of any interference or signal distortion
  4. Frequency sweep test from 5MHz to 1000MHz.
- J. For all other Coaxial cabling confirm:
1. Verify that the installed cable meets, at a minimum, the requirements set forth in SMPTE ST 2081 for 6G-SDI single-link and 12G-SDI dual-link.
  2. Verify that TDR impedance is 75 +/-3 ohms
  3. Frequency sweep test from 5MHz to 6GHz.
- K. For Category Cabling:
1. Use Category 6A cable pair tester to verify compliance with TIA/EIA standards referenced above (including all current addendums)
  2. Test each cable using the permanent link procedure for opens, shorts, reversals, cross twists and mis-wiring. Check NEXT, ELFEXT, Delay Skew, Return Loss, and Alien Crosstalk.
- L. Report all mis-wiring or failures found and report retests as needed.
- M. If any conductors report open or short, replace the entire wire and re-test.
- N. For Fiber cabling:
1. Using appropriate test devices and proper factory terminated jumpers, measure all fiber optic line attenuations, end to end, required by TIA/EIA-526-14A.
  2. Optical budget may not exceed the cable performance by length plus splice and connector losses (0.03 dB for each fusion splice, 0.3dB for each mechanical splice, and/or 0.4 dB for each connector).
  3. Overall attenuation must meet TIA/EIA-568B standards. Perform attenuation tests at 850nm and 1300nm.

- O. Confirm that loudspeakers and mountings are free of buzzes and rattles when the loudspeaker is swept with sine wave tones over its rated bandwidth at one-half (1/2) its maximum rated power.
- P. For all permanently mounted loudspeaker terminations, provide impedance measurement of each pair of loudspeaker lines with all loudspeakers connected and all amplifiers disconnected. These measurements shall be documented as editable tabular data listing impedance for each 1/3 octave band from 20 Hz to 20 kHz and shall be accurate to the nearest tenth of an Ohm.
- Q. For all intercom terminations, confirm proper operation by initiating and receiving audio communication and call light. For single lines connected to a matrix, test each line with each channel in the matrix. Verify that all channels are quiet and without spurious noise.
- R. For all electronic devices mounted in racks and connected to patch bays, confirm:
  - 1. Every input and output is balanced.
  - 2. Proper polarity is maintained throughout the entire audio path.
  - 3. Tip connection of each TRS jack is connected to the positive terminal of each corresponding input or output.
- S. For all devices requiring IP addressing:
  - 1. IP addressing scheme must make use of subnets such that all devices, regardless on which network (Audio, Video, Control, or House) they reside, have a unique IP address to eliminate the possibility of duplicate IP addresses if networks are inadvertently cross-patched.
  - 2. All devices must have static IP addresses.
  - 3. Create a spreadsheet of all devices and their IP addresses, Subnet Masks, MAC Addresses, and other pertinent IP configuration information.
  - 4. Coordinate all IP addressing schemes with the Owner.
- T. If the Audio, Video, and Control network switches are dedicated to these systems and the systems do not rely on Owner furnished and configured network switches:
  - 1. Configure network switches to operate properly and provide the proper network configurations to support the network devices and protocols used by those devices.
  - 2. Configure, as needed, VLANs, IGMP, QOS, and other protocols requiring configuration to provide a fully functioning and robust network system.
  - 3. With all networks configured and operating, and all network devices configured and operating, confirm that the networks are behaving as expected.
- U. Electrical Contractor, coordinating with the Systems Contractor must confirm that there are no shorts between the Neutral and Isolated Ground conductors, and between the isolated ground conductor and building ground for each AV Technical Power circuit. Electrical Contractor, coordinating with the Systems Contractor must confirm there are no Bootleg Grounds or Neutral-Ground Reversals on each AV Technical Power circuit.
- V. The Contractor is responsible for the programming and configuration of all DSP systems and control systems necessary as specified in this project specification and AV large format drawings.
  - 1. Programming and configuration must be complete and ready prior to System Designer's arrival for verification of functionality and acceptance testing.
  - 2. Programming for the DSP systems must contain control pages to support

normal operations, and to support Acceptance Testing and System Tuning operations, as described in this specification and the large format AV drawings.

3. Programming for the Control Systems must include all master controller code and touch panel code and graphics, working together to provide the function as described in this specification and the large format AV drawings.

W. Test all Audio, Video, and Control system controls, including but not limited to mixing consoles, switchers, routers, touch panels, paging stations, volume controls, and source selectors for proper operation.

X. Test proper operation of any portable controls at each designated control location (Stage Manager's rack, for example).

### 3.24 INITIAL ADJUSTMENT

A. All initial adjustments must be documented and submitted as part of the Verification Test Reports (see 3.13).

B. Make all adjustments and modifications so that the system is operational and fully functional including but not limited to:

C. Update all device software and firmware to the latest manufacturer's recommended release that allows for proper operation with ALL OTHER DEVICES in the systems.

1. Make all adjustments and modifications for system gain structure per recommendations of major component manufacturers.
2. Properly configure all EDID and HDCP settings to allow for proper function of all video systems.
3. Install all programming for digital mixing consoles, DSP, Control and any other software based devices in the systems, and verify that audio and video signal passes as designed through these systems. Verify that control systems function as specified. Contractor to provide initial DSP and control system programming prior to acceptance testing, one full set of programming changes and adjustments, prior to handover to the Owner, and one additional set of changes and adjustments during the initial warranty period, as part of the base scope of work.
4. Properly balance all 70 Volt loudspeaker zones to be consistent from zone to zone using amplifier settings and loudspeaker taps to adjust for differing loudspeakers or installation height. All 70 Volt loudspeakers within a given zone must not have a broadband SPL variation of greater than +/- 2dB.
5. Properly adjust delay and equalization for all loudspeaker systems using SIM, SMAART or other similar dual FFT type measurement devices. All testing and adjustment shall be in accordance with all manufacturer recommendations and industry standard practice. Contact the Systems Designer for further system delay and equalization requirements.
6. Capture traces showing magnitude and phase response for each loudspeaker or loudspeaker cluster before and after equalization and delay adjustments.
7. Capture traces showing magnitude and phase response for the systems operating as a whole from 3 locations in each major seating area. One of these areas should be the House Mix Position, if applicable.
8. Equalization and timing of the loudspeaker systems shall be further adjusted by the Systems Designer and Owner during Acceptance Testing.

### 3.25 VERIFICATION TEST REPORT

- A. Submit written report detailing the results of Initial Adjustments and Verification Tests. Report to include, at minimum, the following:
  - 1. Copies of all relevant drawings, charts, test instrument data, and photographs.
    - a. PDF copies of all available manufacturers' operation and service literature for each major system component.
    - b. Copy of all programming files including, but not limited to, Audio DSP programming and Graphic User Interface (GUI) files, Control system Touch Panel GUI files and control system control programming files including un-compiled source codes.
    - c. All other documentation and results of testing and initial settings as referenced in 3.11, and 3.12 above.
    - d. Written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection, Acceptance Testing, and tuning.
  - 2. Prepare and submit an InfoComm standard Commissioning Checklist for each system in this specification.
  - 3. Prepare and submit a training syllabus for Owner training (see section 3.15).
- B. This report shall be completed and submitted to the Systems Designer for review a minimum of five (5) days prior to Acceptance Testing and final tuning.

### 3.26 ACCEPTANCE TESTING

- A. Acceptance Testing shall be performed by the Systems Designer and Contractor during a period designated by the Architect. Contractor shall furnish a minimum of two (2) technicians or one technician per Systems Designer commissioning team, for the acceptance testing period, and one or more engineers fully capable of programming DSP and Control systems and making any other engineering adjustments to equipment in the systems. Contact Systems Designer for number of commissioning teams that will be deployed. For Bid purposes assume there will be 1 commissioning team.
- B. The minimum time required for Acceptance Testing is 2 working days, including 1 days of dedicated quiet time. Coordinate this time so that free access, work lighting, and electrical power are available on the site.
- C. Ensure that Systems areas are in a clean and orderly condition ready for acceptance testing.
- D. Be prepared to verify the performance of any portion of the system by demonstration, listening tests and instrumented measurements.
- E. Be prepared to facilitate the visual inspection of system components and wiring, including removal of termination panels for inspection of wiring termination and wire management practices.
- F. Be prepared to demonstrate all software and control systems.
- G. Be prepared to go through the commissioning checklist and verify all items as complete.
- H. Make additional mechanical and electrical adjustments within the scope of the work and which are deemed necessary by the Systems Designer as a result of the Acceptance Tests. This may include realigning of loudspeaker systems, changes in system gain structures, grounding, filtering or interfaces.

- I. Final acceptance will be contingent upon issuance by the Systems Designer of a letter of acceptance stating that the work has been completed and is in accordance with the contract documents.
- J. Contractor will bear any costs incurred for additional Systems Designer's time and expenses due to failure to have the system functioning in accordance with specification requirements at the times scheduled for Systems Designer's Acceptance Testing.
- K. Confirm that each individual wire and cable run is identified with a unique number. These numbers are affixed to both ends of each cable and are clearly visible. Provide a complete list of these numbers along with the termination location of each end of the wire run.
- L. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. A wide band oscilloscope shall be used to verify this condition.
- M. Confirm that the system is free of audible clicks, pops, and other noises when any operating control is activated, with or without input signal.
- N. For all microphone lines, tie lines, return lines and effect loudspeaker lines, confirm:
  - 1. Proper circuits appearing at each termination location.
  - 2. Proper circuits appearing at each jack bay position.
  - 3. Continuity of all conductors.
  - 4. Proper polarity is maintained.
  - 5. Absence of shorts between conductors within each circuit.
  - 6. Absence of shorts between circuit conductors and conduit.
- O. Confirm that speakers and mountings are free of buzzes and rattles when the speaker is swept with sine wave tones over its rated bandwidth at one-half its maximum rated power.
- P. For each installed data network cable or fiber optic cable confirm conformance to the specified TIA/EIA performance standards

### 3.27 USER TRAINING

- A. Refer to Div. 01 for additional training requirements.
- B. The contractor will provide in-depth training in operation and regular maintenance of all systems and on all equipment included in the scope of work contained in this specification and the AV large format drawings.
- C. Training to include (but is not limited to):
  - 1. Detailed operation of mixing consoles, video switchers and routers, computer control systems and other essential system elements as relevant to their installation in this project.
  - 2. Maintenance and repair of system equipment, including replacement procedures for user- replaceable parts.
  - 3. Review of Operation and Maintenance Manual (See 3.16)
- D. The contractor will provide a minimum of (6) training sessions of four hours each (24 hours total) with times and dates to be approved by the Owner.
- E. The first session shall take place in the presence of the Systems Designer and shall occur directly after the completion of Acceptance Testing. If the Systems Designer, Owner, and/or

Architect judge any work to be deficient and/or not substantially complete at the time scheduled for training, the training will be postponed until the Systems Designer, Owner, and Architect judge the entire AV system conforms to this specification and the AV large format drawings.

- F. The contractor will bear any costs incurred for additional Systems Designer's time and expenses due to failure to have the system functioning in accordance with specification requirements at the times scheduled for User Training.

### 3.28 SYSTEM DOCUMENTATION

- A. Within thirty (30) days of the Acceptance Testing, prepare and submit a CD-ROM of the preliminary Operation and Maintenance manual for approval by the Systems Designer. Manual to include, at minimum, the following documents in PDF format:
  - 1. Table of contents
  - 2. Written Guarantee and service policy
  - 3. Basic power on/off and operational procedure
  - 4. Copies of all shop drawings which have been updated to include any changes made during the installation process
  - 5. All available manufacturers' operation and service literature for each major system component
  - 6. One line signal flow diagram with all cable runs and patch points identified by alpha- numeric character
  - 7. Copy of the Verification Test report
  - 8. Copy of conduit riser diagram
  - 9. Copy of the final tuning settings as provided by the Systems Designer
  - 10. Copy of the IP Addressing table
  - 11. Copy of all uncompiled source codes and configuration files which have been updated to include any changes made during the installation process.
- B. The Systems Designer will review the above system documentation. Upon approval, Contractor shall prepare and submit to the Owner:
  - 1. Five (5) copies of the final Operation and Maintenance manual on CD-ROM or DVD.
  - 2. Two (2) hard copies of the final Operation and Maintenance manual printed and neatly bound
- C. Provide framed or laminated copy of the as-built signal flow diagram for each theater to be mounted in each control room. This diagram shall have all cable runs and patch points identified by alpha-numeric characters.

**END OF SECTION 274100**