Addendum No. 2

BID # CIP-24-25-P3034A
The Rink Sports Pavilion, Phase II - Construction
City of Santa Clarita, California

This addendum must be acknowledged via BidNet and should be included with the bid response.

The purpose of this addendum is to address the following for this bid.

I. UPDATE TO SECTION 27 41 16 - INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT
Please see attached update to SECTION 27 41 16 - INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT.

Approved:

Signed by:
12A01C67890D43C...
Damon Letz
City Engineer

Initial AV Initial JL Initial SP

END OF ADDENDUM

This addendum must be acknowledged via BidNet and should be included with the response.

_____ _____
Contractor's Representative *Date*

_____
Company Name

SECTION 27 41 16

INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 1 apply to this section.

B. Section Includes:

1. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, set up, and testing of the Audio and Control Systems work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, working systems. General design intent for this project is shown on the drawings and described in the specification.
2. All equipment requiring coordination with other trades must be tested and verified for proper operation. Contractor is fully responsible for the coordination and must resolve all conflicts with AV equipment that connect or interact with other systems.
3. If an operational function is specified that requires hardware or software to complete that specific function, then consider that software or hardware part of this specification. The cost of any omissions of software or hardware necessary to complete all operational functions outlined in this specification shall be borne by the contractor providing this system.
4. Design, engineer and provide complete means of support, suspension, attachment, fastening, bracing, and seismic restraints (hereinafter "support") of the Work of this Section, including future installed equipment, in accordance with local building codes and regulations. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction. Contractor shall obtain the services of an engineer licensed to perform this work within the state or jurisdiction it is to be performed.
5. The Contractor shall include all costs associated with structural engineering required by code for work in this section.
6. Use skilled mechanics that can return surfaces to the appearance of new work when modifying millwork.
7. Conduit and common back boxes including four square, pull boxes, junction boxes, etc. are supplied and installed by Division 26 Electrical Contractor. Connection panels that install in these boxes are supplied by AV Contractor.
8. Provide Power Over Ethernet switches and injectors where required.
9. Provide all cable and wire associated with this specification section and related documents.
10. All systems shall be completely installed with all the necessary interconnection, power supplies, patch cords, snakes, portable equipment cables and wiring to provide a fully functioning system.
11. The governing overall requirement for this project is a complete and functional system.
12. Include work not usually shown or specified, but necessary for proper installation and operation of the system or piece of equipment.

C. Products Supplied But Not Installed Under This Section

1. Loose equipment or products supplied but not installed shall be turned-over to the Owner immediately upon delivery. Contractor is to supply a signed statement of transfer of this equipment to the consultant for record. Client must sign this statement acknowledging receipt of this equipment.
2. Specialty floor boxes, back boxes including but not limited to Crestron, AMX, Extron, FSR, Steel City and speaker back boxes shall be provided to the General Contractor for installation.

D. Related Sections

1. Division 1.
2. Division 9.
3. Division 10.
4. Division 11.
5. Division 26.

E. Allowances

1. Refer to section 2.1.E for related requirements.

F. Measurement Procedures

1. Product quantity is as required. If a quantity is given, the Contractor will provide at least the given amount. Some products listed under this section may not be required to fulfill the obligations of the work.

1.02 REFERENCES

A. Comply with all applicable governing codes.

B. Comply with the following applicable organizations and standards:

1. AES Audio Engineering Society
2. ANSI American National Standards Institute
3. ASTM American Society for Testing and Materials
4. ATSC Advance Television System Committee
5. BICSI Building Industry Consulting Service International, Inc.
6. BTSC Broadcast Television Stereo Committee
7. CBC California Building Code
8. CEDIA Custom Electronic Design and Installation Association
9. EIA Electronic Industries Alliance
    a. RS-310-C: (ANSI C83.9) Racks, Panels, and Associated Equipment
    b. RS-453: Dimensional, Mechanical, and Electrical Characteristics Defining Phone Plugs and Jacks
10. ETL Electrical Testing Laboratories, Inc.
11. FCC Federal Communications Commission
12. ICIA International Communications Industries Association
13. IEC International Electrotechnical Commission
14. IEEE Institute of Electrical and Electronic Engineers
15. INCITS International Committee for Information Technology Standards
16. ISO International Organization for Standardization
17. ITU International Telecommunications Union
18. NAB National Association of Broadcasters

19. NCTA National Cable and Telecommunications Association
20. NEC National Electrical Code
21. NEMA National Electrical Manufacturers Association
22. NFPA National Fire Protection Association
23. NSCA National Systems Contractors Association
24. OSHA Occupational Safety and Health Administration
25. SMPTE Society of Motion Picture and Television Engineers
26. TASO Television Allocation Study Organization
27. TIA Telecommunications Industry Association
28. UL Underwriters Laboratories Inc.

1.03 DEFINITIONS

A. Definitions of Terms: The following definitions and conditions apply to each of the respective parameters and the measurements of those parameters, unless specifically stated otherwise:

1. Frequency Response: The minimum acceptable frequency band over which the amplitude response is within 3 dB (or any specified range), or the specified limits of the response relative to the reference frequency (1 kHz for audio, 1.0 MHz for video) under design load conditions, at any operating level up to and including the specified maximum output while fully in compliance with all other performance specifications.
2. Maximum Output Level: The minimum acceptable maximum signal output level (voltage, current or power) attained under design load conditions attained while fully in compliance with all other performance specifications.
3. Harmonic Distortion: The maximum acceptable harmonic distortion measured at any operating level, up to and including the specified maximum output, with an applied sine wave signal of any frequency in the range of the specified frequency response.
4. Audio Intermodulation Distortion: The maximum acceptable intermodulation distortion resulting from the introduction of 60 Hz and 7 kHz signals in a ratio of 4:1 under design load conditions at any operating level up to and including the specified maximum output level.
5. Signal to Noise Ratio: The minimum acceptable ratio of signal to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.
6. Clipping Level: The minimum acceptable maximum level of signal applied to the device under design load conditions while fully in compliance with all other performance specifications.
7. Sensitivity: The maximum acceptable level of input signal applied to the device that is necessary to provide the maximum output under design load conditions.
8. Design Load: The load (in ohms) specified by usage of the particular device input or output.

B. Signal Levels: The following voltage levels shall be considered the standard operating levels for the particular circuitry, unless specifically noted otherwise (0.775 Volt = O dBu = O dBm for a 600 ohms terminated circuit):

1. Microphone Circuits: -30 dBu or less.
2. Audio Line Level Circuits: -30 dBu to +24 dBu; equivalent to -30 dBm to +24 dBm for a 600 ohms terminated circuit.
3. Loudspeaker Level Circuits: More than +24 dBu.

C. Characteristic Impedances: The following operating impedances shall be considered to be the standard operating impedances for the particular circuitry, unless specifically noted otherwise:

1. Microphone Circuits: 50-250 ohms source, 150-1500 ohms terminating, electrostatically and electromagnetically balanced to ground.
2. Audio Line Level Circuits: 600 ohms maximum source, 600 ohms minimum. terminating, line to line, electrostatically and electromagnetically balanced to ground.

1.04 SYSTEM DESCRIPTION

A. Design Requirements

1. General
    a. All audio processing functions for the system shall be implemented with Digital Signal Processing equipment (DSP). The system shall connect to the Local Area Network for monitoring. Functions provided by this system include but are not limited mixing, level control, automatic mixing, equalization, adaptive equalization, delay, routing, dynamics, filters, processors, presets, etc.
    b. The audio system shall include a DTMF module that will act as an interface between the paging system and the telephone system. Dialing a pre-defined sequence of numbers into the telephone will allow a zone or an all page to occur. The system will suppress background music during paging.
    c. Fire Alarm Interface: Sound System shall mute under zone control from the Project Fire Alarm System. Provide connection between fire alarm panel and audio system for automatic muting of signal upon trigger of alarm. Coordinate with work of Fire Alarm section.
    d. Infrastructure shall be provided for the installation of AV equipment that will be installed at a future date. This infrastructure shall be labeled to allow easy identification of these devices. Back boxes shall be labeled with Device ID. Conduit shall be labeled as follows: AV-CTRL = Control, AV-SPK = Speaker, AV-AUD = Audio, AV-VID = Video, AV = Both Audio & Video.
    e. An integrated web-enabled central control system shall be used to control all aspects of the audio and video system’s functions, signal routing, lighting, shades and audio levels.

B. Seating Area

1. General
    a. The system shall provide audio reinforcement for announcements and sporting events.
    b. The system shall allow for local control of functions, including but not limited to volume adjustment and source selection.
    c. A user interface located in the DJ booth shall be provided to control volume, source selection and system presets.
2. Sound Reinforcement System

a. The sound system shall utilize a distributed overhead mounted to structure loudspeakers and subwoofers to extend the low frequency coverage.
b. Four handheld wireless microphones shall be provided for voice reinforcement.
c. Audio Input Panels shall be located as shown on the plans. Coordinate with the client or representatives what zones should these panels be associated with.

3. Assistive Listening
   a. An assistive listening system shall be provided per ADA requirements. The system will consist of an RF transmitter, remote antennas, and headsets to allow personal monitoring of the audio program.
4. Public Address
   a. Paging can be initiated from the paging microphones located on the plans.
   b. Concessions shall have a local user interface control to select from all-page, indoor or outdoor paging presets. In addition, volume control for the outdoor zone only.

C. Software Programming

1. General
   a. Except when otherwise agreed in writing the client shall retain legal and beneficial ownership of all Intellectual Property, including source code, created by the Contractor, their employees and sub-contractors.
   b. The Contractor must allow sufficient time for the programming of all software configurable audio and control systems. Contractors must evaluate the systems functional requirements and user interface and then allow time in their bid accordingly. The system description as well as the end user interview will provide the Contractor with the necessary information needed to proceed with the programming. Any questions as to the systems functional requirements must be sent in written RFI form to the Consultant. All programming schemes must be submitted to the Consultant for approval before programming starts. This includes the appearance of all user interfaces, touch panel layouts, preset and sub-preset information (acquired through client interviews), and speaker control schemes. The Contractor will also submit a narrative for the control system concept to the Consultant for approval. The Contractor is to interview the Owner and their representatives to acquire the necessary information needed to allow for the proper programming of this system. The Contractor, after interviewing the Owner, will then submit a written report stating his interpretation of the client's requirements for approval by Consultant. Only after the Client and Consultant have approved the programming report may the Contractor proceed with the programming of this system.
   c. All equipment that is connected to the Client's local area network and is configurable via the local area network must have its equipment software installed onto dedicated computers provided by the Client. The

Contractor is to allot time to install and test equipment software onto a minimum of two of the Client's computers which are to be identified by the Client and/or Consultant. The computers shall be programmed to emulate user interfaces throughout the facility. The Contractor shall coordinate all software deployment over IP with the Client's Information technology department.

2. Control system minimum programming outlined below:
    a. The Contractor shall allot 4 hours for on-site control system programming with the Client's representative.
    b. The Control System in this project shall connect to the Client's Local Area Network (LAN). This connection will provide desktop computers control of the audio-visual system as well as make available remote troubleshooting via the internet. The Contractor shall provide time to install control system interface software on at least one desktop computers. Coordinate work with Client's Information Services personnel.
    c. Provide password protection to each control surface in this facility. Pushbutton panels shall be activated by holding the lower two buttons down for 5 seconds. Deactivation will automatically take place 120 seconds after control panel was last gestured. Touch panels shall be activated and deactivated by password. Upon start up a password dialog box shall be presented to the user to enter his/her password. Only after entering a password will the user have access to the system. The system shall be programmed to shut down automatically after being idle for a time to be specified by the user.
    d. All control panels shall be programmed with a technical user mode that allows technical personnel to access a second level of control. A push button volume adjust/source select control interface usually includes various sources that may be played into the zone under control. These sources enter a mixer in the DSP allowing control of both input and output of this mixer. Normal, user level, operation of volume control at a user interface shall permit only the output of the mixer to be controlled. This allows a user the ability to control the output of the mixer to raise and lower the volume of all source devices simultaneously. Pressing any of the source select buttons shall bring up a dialog box that will allow a technician to enter a password and allow technical personnel access to a second level of control functionality. This will permit a technician to balance levels at the inputs of the mixer when required. After sixty seconds of inactivity the panel will automatically default back to user level control.
    e. Touch panel layout design will conform to the InfoComm International "Dashboard for Controls" guidelines. Touch panel designs are to be custom to this project. Re-purposed touch panel designs are not acceptable.
    f. Technical users shall have the ability to access individual speaker zone controls via the touch panel interface.

g. The contractor shall provide a default audio level preset button, in the control system user interface, to allow a user or technician to recall all gain levels that were set when the system was commissioned.

h. Control Help File: Each touch panel will include a help file that will explain each layer of the touch-panel control scheme.

i. Control system shall utilize help desk software to provide:
   1) Real-time monitoring of:
      (a) Control system.
      (b) Device monitoring.
      (c) System online status.
   2) Remote system diagnostics via Contractors help desk.
   3) Remote system control.
   4) Fault reporting via email alert.
   5) Logging of help request.
   6) User access control via password protection.
   7) Event logging, report and chart generation.

j. The help desk software shall be placed on the desktop computers of each audio-visual maintenance person as well as key personnel of the Client. The Contractor shall train maintenance and operations persons to use this software feature.

k. All serial controlled devices must have bi-directional communication with the control system. All control functions locally available on each device must be accessible via the remote control system. All locally gestured control functions must mirror on the control system user interface. In other words, if a volume control is adjusted on a DSP interface that adjustment must register on the control interface.

l. Control system shall be used to power up and down connected equipment at control system start up and shut down.

m. Control system shall control both lighting and motorized window shades in each room. Provide adequate presets to allow training and video conferences as explained in room descriptions above.

n. The control system shall monitor the connected power amplifiers and report overheating that may occur.

3. Digital Signal Processor (DSP) minimum programming outlined below:

a. A user-friendly graphical interface programmed by the Contractor will allow for easy operation of the system. This interface shall allow novice users the control of main system components without having to access the digital schematic diagram. These main system components will include master volume control, zone volume control, room combining, routing, switching, source-equipment level control and any other control necessary for the system to function properly from a user standpoint.

b. When applicable contractor shall configure IGMP Snooping with a querier to mitigate Multicast issues.

c. The main digital processor shall be programmed to act as the clock master for the system.

d. All audio processing functions for the system shall be implemented with Digital Signal Processing equipment (DSP). The system shall connect

to the Local Area Network for monitoring. Functions provided by this system include but are not limited to mixing, level control, automatic mixing, equalization, adaptive equalization, delay, routing, dynamics, filters, processors, presets, etc.

e. Volume control must be applied to device inputs as well as mixer outputs. Each piece of source equipment shall have a volume control to allow input level balancing. A main volume control and mute button will allow for overall adjustment of the composite mix.

f. Provide automatic level control at the input of all line level source equipment.

g. Signal present indicators shall be placed on the graphical user interface to allow monitoring of all inputs and outputs to the audio system.

h. Meters shall be placed along strategic points in the signal chain to allow for monitoring signal level.

i. Schematic diagram shall be arranged so wire paths are easily traced. All inputs and output shall be clearly labeled.

j. The DSP system shall connect to the Local Area Network for control and programming.

k. The DSP system shall include levels of security for system operation and maintenance privileges.

1) A first level of security shall be available to a user that has privileges which requires no password, limited to source select and volume control.

2) A second level of security shall grant an operator privileges that include System shut down, run hardware diagnostics, access on line help and adjust settings. This is reserved for maintenance personnel.

3) A third level of security shall grant supervisor privileges and allow all that is outlined above plus the ability to change system options and edit user list.

4) A fourth level of security shall grant designer privileges and allow all that is outlined above plus the ability to modify the base file. This should be reserved to the AV contractor only.

l. The Contractor is to allow programming time for at least 5 different presets as directed by the Owner and their representative.

m. The Contractor shall allot 4 hours for on-site digital signal processor programming with the client's representative.

4. Complexity of Programming:

a. It is required that the Contractor be experienced in programming systems this complicated. Contractors shall allow enough time in their bid to permit extensive programming of all software configurable audio and control systems to the requirements of the client and consultant. Contractor shall break out cost associated with programming of these systems for review by the Consultant. By submitting this bid, the Contractor agrees that they understand systems of this type and that all programming services are included to the satisfaction of the Client and Consultant. The Contractor further agrees that they will not make any

claim for additional monies because of misinterpretation of programming requirements.

D. System Performance Standards and Requirements (meet or exceed)

1. Audio Systems:
    a. Electrical Performance; Source Input to Power Amplifier Output:
        1) Frequency Response (Equalizer flat): +/- 0.2 dB 20 Hz to 20 kHz.
        2) Total Harmonic Distortion (THD): Less than 0.05%, 20 Hz to 20 kHz, 4 ohms.
        3) Noise: At least -105 dB, 20 Hz to 20 kHz, referenced to input of +4 dBm.
        4) Crosstalk: At least -60 dB, 20 Hz to 20 kHz.
        5) Damping Factor: Greater than 500 (below 1 kHz)
    b. Electro/Acoustic Performance; Distributed Systems: 103 dB Consistent with devices specified herein.
        1) Equipment: Specified individually.
        2) Audio signal paths: Shall not degrade performance of connected equipment.
    c. NEC - Article 640: Audio Signal Processing, Amplification and Reproduction Equipment.
2. Data and Communications Systems:
    a. TIA/EIA 568-C series: Commercial Building Telecommunications Cabling Standard.
    b. ANSI J-STD-607-A: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
    c. Comply with ITU-T (International Telecommunications Union – Telecom) for video conferencing systems.
3. Control Systems:
    a. RS485 (TIA-485): Electrical characteristics of generators and receivers for use in balanced digital multipoint systems.
    b. RS232 (TIA-232): Interface between data terminal equipment and data circuit-terminating equipment employing serial binary data interchange.
    c. RS 422 (TIA-422): Electrical characteristics of balanced voltage digital interface circuits.

1.05 SUBMITTALS

A. General

1. In addition to the requirements of Division 1, submit all materials for review arranged in the same order as the Specification, individually referenced to the Specification paragraph and Contract Drawing number. Submit 8 1/2" x 11" items bound in volumes and drawings in edge-bound sets. Submit all drawings on sheets of the same size.
2. The Contractor is to provide two copies of each hardcopy submittal and an electronic format copy (Shop drawings must be submitted as .DWF. All other submittals shall be provided as .PDF). All submittals must be original files or documents, scanned copies will not be accepted.

3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.
4. Should the Contractor proceed with the Work of this Section in the absence of submittals for such work submitted and returned with action "No Exception Taken" or "Make Corrections As Noted", the Contractor proceeds at the Contractor's sole risk.
5. If the Contractor deviates from the design shown on the Contract Documents when preparing their shop drawings, the Contractor shall indicate with architectural style clouding, those deviations. The Contractor shall also submit with the Shop Drawings, a list of those deviations and substitutions, including the following:
    a. The deviation item number which shall also correspond to a number designation applied to each cloud on the shop drawings.
    b. Section of the specification that applies to these changes.
    c. The applicable shop drawing sheet number for each item.
    d. The corresponding audio-visual Contract Document sheet number for each item.
    e. A clear description of the deviation.
    f. The Contractor’s rational for the deviation (i.e. what benefit the deviation provides, why it is required, any cost impact, etc.).

B. Infrastructure

1. Provide drawings indicating boxes conforming and non-conforming to Consultant’s AV drawings.

C. Product Data

1. Manufacturer’s Product Data
    a. Contractor is to submit submittal in electronic format (i.e. PDF)
    b. List of materials (i.e. Table of Contents) categorized by room type: For each item specified in PART 2, include:
        1) Drawing device ID code.
        2) Manufacturer.
        3) Model number.
        4) Listing: UL or other lab.
        5) Quantity.
    c. In sequence of List of Materials, provide a data sheet for each item, including all accessories marked for the proposed product.

D. Shop Drawings

1. Field (Installation) Drawings: Collate in sequence:
    a. Contractor is to submit shop drawings in .DWF format.
    b. Drawing index/symbol sheet.
    c. Floor plans. At scale of Contract Documents. Show:
        1) Device rough-in boxes with ID number.
        2) Mounting height.
        3) Conduit size.
        4) Wire type.
        5) Wire fill.

d. Sections/Elevations. At scale of Contract Documents:
   1) Mounting location reference to nearest gridline.
      (a) Provide sections for each room containing AV equipment.
      (b) Provide elevations for each wall in rooms containing AV equipment.
      (c) Show all equipment, including speakers, monitors, projectors, podium, floor boxes, facility boxes, etc.
      (d) Provide vertical dimensions referenced above finished floor to each piece of equipment.
      (e) Provide horizontal dimensions reference to gridlines.

e. Enlarged Plans. At scale of Contract Documents or larger as required for trade coordination. Show:
   1) Items indicated in "floor plans" above.
   2) Architectural features.
   3) Rack cabinets.
      (a) Ventilation details.
      (b) Power distribution detail.
   4) System furniture.
   5) Clearances required by applicable Code.

f. System Conduit Riser Drawing, Show:
   1) Terminal cabinets.
   2) Coordination with floor plans.
   3) Wire runs not shown on floor plans.
   4) Wire type.
   5) Wire fill.

g. Mounting details:
   1) Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type, where required by code.
   2) Show loads, type and strength of connections, sizes, dimensions, materials, etc.
   3) Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.
   4) Provide details for:
      (a) Equipment rack anchorage.
      (b) Loudspeaker mounts.
      (c) Attachment to building structure.

h. Installation details as required:
   1) Terminal cabinets: Terminations.
   2) Audio-Visual panel details.

i. Wire run sheets. Show:
   1) Wire number.
   2) Source.
   3) Designation.
   4) Signal type.
   5) Wire type.
   6) Operating level or voltage.

7) Timing reference, where applicable.
8) Physical length.

2. Shop (Fabrication) Drawings: Collate in sequence:
   a. Contractor is to submit shop drawings in .DWF format.
   b. Drawing index/symbol sheet (if separate set from Field Drawings).
   c. System functional drawings. Submit separate drawings for each system/subsystem. Show at least:
      1) Equipment:
         (a) Function, make, model.
         (b) Rack number, module frame and slot number.
      2) Field device information
         (a) Terminal cabinets.
         (b) Pull boxes.
         (c) Audio-visual panel connector designations.
      3) Wiring
         (a) Wire number.
         (b) Wire type.
      4) Shield condition at both ends (float, ground, location of ground).
      5) Connector wiring details, each type.
      6) Audio: Nominal operating level, Polarity. Note deliberate polarity inversions where required to maintain absolute polarity.
      7) Twisted pair, transmit and received devices: Transmission range at 60 Hz., cable length and signal quality.
   d. Provide drawings for the following systems, if applicable:
      1) Audio.
      2) Control.
      3) Data transmission.
      4) Coordinated grounding scheme.
   e. Equipment rack elevations: Show:
      1) All racks scaled at 1 1/2" equals 1 foot, or larger.
      2) Rack: Make, model.
      3) Equipment: Function, make, model.
   f. Rack wiring drawings: For each rack, show:
      1) Power strip: Receptacles, circuiting.
      2) Sequencing power and surge suppression systems.
      3) Equipment.
      4) Grounding.
      5) Wiring, all systems.
      6) Wiring harness scheme.
      7) Ventilation detail.
   g. Fabrication details: Submit for:
      1) Receptacles.
      2) Panels.
      3) Special mounting provisions.
   h. Legends/engraving details. Half or full size:
      1) Receptacles.

2) Audio-visual panels.
3) Equipment designations.

i. Patchbay elevations: Show:
1) Patchbay elevations to be half-size scale.
2) Equipment: Function, make, model.
3) Patchbay type.
4) Patchbay number.
5) Connector configuration.
6) Connector type.

E. Samples

1. Of all finishes/materials that will be visible to the public, including but not limited to:
a. Receptacles and controls with associated trim plate.
b. Each type of loudspeaker baffle and/or grille.
c. All audio-visual panels.
d. Audio-visual devices in public areas.

F. Programming

1. Control Programming Scheme Submittal
a. Contractor is to provide submittal in electronic format (i.e. PDF)
b. Provide a password-protected link to a folder on the Contractor's network to remotely access the touch panel from the Consultant's computer. Contractor is to have a dedicated control processor utilized on their network or provide an emulation file of each control system interface that will allow reviewer to operate the interface as if operating the actual device.
c. Provide a graphic layout of each user control interface (touch panels, push buttons, etc.).
d. Provide a list of devices that are controlled by each control user interface, including:
1) Device.
2) Brand.
3) Model Number.
4) Control Method.
e. Provide a logic tree for each page for each control interface.
f. Provide a system routing sheet for each control user interface, including:
1) Source.
2) Switcher / device input.
3) Switcher / device output.
4) Final destination.
g. Provide help file content on each user interface.

G. Shop and Project Site Test Reports

1. Contractor is to provide submittal in electronic format (i.e. PDF)
2. Schedule: Submit test reports in a timely manner relative to the Project schedule such that the representative of the Owner may conduct Verification of Submitted Test Data without delay of progress.

a. Shop test report: Submit prior to shipping completed equipment racks to Project Site.
b. Project Site test report: Submit project site test report for this section after system completion and prior to Acceptance Review and Testing.

3. Content: Include at least:
   a. Time and date of start of burn-in.
   b. Time and date of test.
   c. Personnel conducting test.
   d. Test equipment, including serial and date of calibration.
   e. Procedures used.
   f. Results of test - numerical or graphical presentation.

H. Close Out Submittal

1. Contractor is to provide submittals in electronic format (i.e. PDF)
2. Operation and Maintenance Manuals
   a. Index.
   b. Systems operating instructions.
   c. Reduced set of system Record Drawings.
   d. Key schedule.
   e. Maintenance and spare parts schedules.
   f. Shop and Field Test Reports.
   g. Equipment manuals. Collate alphabetically by manufacturer. Provide manufacturer's original operation, instruction and service manuals in color for each equipment item. Provide tabbed dividers between each product. Manuals provided by the Manufacturer in an individual binder may be submitted in that form.
3. Framed Operating and Maintenance Instructions: Provide adjacent to each ensemble of equipment racks. Provide sturdy frame with clear glass or non-scratching plastic cover. Provide permanent, non-fading media. Blueprints shall not be acceptable. Include:
   a. Sequence for system start-up and shutdown.
   b. System Functional Diagrams.
   c. Signal levels and impedance at accessible system signal and test ports, where applicable.
4. Record Drawings
   a. As work progresses, maintain records of "as installed" conditions. Update the set at least weekly. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to final Record Document drawings, as specified in Division 1.
   b. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
5. Provide four copies on SD card containing the “as built” drawings, all manuals, training manual and programming code.
   a. Submit un-compiled programming code.
6. Training Submittal

a. Provide all training materials for review prior to scheduling training sessions.
   1) Training manual.
   2) Agenda for the training session.
   3) The final punch list, indicating that all equipment is fully functional.
b. See the section under Owner's Instructions for training manual requirements.
c. No training session will be scheduled until final punch list is completed and submitted.

7. Warranty Certificates
   a. Comply with Division 1.

1.06 QUALITY ASSURANCE

A. Qualifications

1. The bidder shall, prior to the bid, in accordance with the Instruction to Bidders, submit at least the following information to verify that the bidder has the necessary experience and qualifications to perform the specified work:
   a. A detailed brochure describing the bidder's capabilities in terms of facilities, personnel (include a personnel organization chart followed by resumes), experience, background, examples of similar installations (at least two projects within the past two years), distribution arrangements with manufacturers and financial capability, including certificates of insurance and satisfaction of the project bonding requirements.
   b. Contractor must, at the time of this bid submittal, have distribution or a dealership agreement with all manufactures whose products are specified in the bid documents. Contractor must also have completed manufactures training and certification before bids are submitted.
   c. AIA Document A305 "Contractor's Qualification Statement".
   d. Information identifying any and all local agents and/or subcontractors that will assist in the work and their role in the project.
   e. Identification of sources of labor for all fabrication and installation throughout the duration of the project.
   f. Evidence that he has acquired all necessary licenses, certificates and approvals to perform the specified work within the state or jurisdiction the work is to be performed.
2. Projects that include Digital Signal Processing (DSP) equipment will require the Contractor to submit evidence of qualification from the manufacturer of said equipment. This would include completion of manufacturer's training courses, the name of the person or persons who completed said training and prior projects completed using DSP technology. If the Contractor is not approved for the DSP programming, they may hire a qualified programmer approved by the consultant.
3. Projects that include networked audio or video systems will require the Contractor to submit the name of the person, in their employment, qualified to perform this work. This person shall have certification in computer network technology and hold one of the following certifications:
   a. CNP – Certified Network Professional Program.

b. Computing Technology Industry Association - Network+ certification.
c. MCSE – Microsoft Certified Systems Engineer.
d. CNE – Certified Systems Engineer.
e. CCNA – Cisco Certified Network Associate.

4. Projects that include software configurable, integrated central control systems must include a factory authorized programmer who is fully engaged in the work of system programming 8 hours a day 5 days a week. This person shall hold the highest level of certification from the manufacture of the equipment being programmed.
5. It the contractor does not employ a programmer that meets the above requirement, the Contractor is to enter an agreement utilizing the authorized independent programmer as a sub-contractor. Under this agreement, the Contractor will retain all the responsibility for a complete and working system. The Contractor must include in their bid time to work out any programming bugs that may occur in the initial programming stage. These items include working through the initial and final programming stage with the authorized independent programmer to provide a functional system, testing the programmer's graphical user interface for intended functionality and provide onsite support for the programmer in the uploading and testing of programming revisions.
6. The control systems programmer shall be present either by web meeting or in person at the end user interviews to acquire information firsthand. The control systems programmer shall submit a report outlining the meeting results to Contractor for approval. Only when the Contractor approves this report shall it be submitted to the consultant for review.
7. The Contractor shall provide information on how and by whom the requirements of the warranty period will be fulfilled.
8. The submittal must justify, in the judgment of the Consultant, the Architect, and the Owner, that the Contractor has the capability to manage and install a project of this size and scope and that he is capable of the necessary business and technical arrangements for this installation and the pursuant warranty service. Contractor may be disqualified as a bidder if all of the submittal does not meet the approval of the Owner and his/her representative.
9. Company: Work of this Section shall be performed by a Sound or Audio-Visual Systems Contractor who has at least five years direct experience with the devices, equipment and systems of the type and scope specified herein, and who has a fully staffed and equipped maintenance and repair facility, and who is licensed to perform work of this type in the Project jurisdiction.
10. Personnel: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section. Supervisors shall have at least five years direct experience in similar work. Installation and maintenance personnel shall have at least three years direct experience in similar work.
11. Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual throughout the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.

12. Staff Engineer: The Contractor shall have on his full-time payroll at least one staff engineer having five years minimum experience as an electronics engineer covering systems and projects comparable in substance and complexity to the project described herein. The staff engineer shall have NICET certification in Electrical/Electronics Engineering Technology and Audio Systems or equivalent. The signature of that engineer shall appear on all shop drawings and submittals.
13. Coordination: Coordinate the Work of this Section with the Work of all other Separate Contracts. Comply with Division 1.
14. Help Desk: The Contractor must employ a fully staffed help desk department that shall provide knowledgeable responses to inquiries regarding system operation. This department must also have the ability to provide remote diagnostics to identify equipment faults for troubleshooting.

B. Cutting and Patching

1. Cut, patch and extend existing work using skilled mechanics that are capable of matching existing quality of workmanship.
2. Assign work of moving, removal, cutting and patching, to trades qualified to perform the work in a manner to cause least damage to each type of work, and provide means of returning surfaces to appearance of new work.
3. Perform cutting and removal work to remove minimum necessary, and in a manner to avoid damage to adjacent work. Cut finish surfaces such as masonry, tile, plaster or metals, by methods to terminate surfaces in a straight line at a natural point of division.
4. When new work abuts or finishes flush with existing work, make a smooth and workmanlike transition. Patched work shall match existing adjacent work in texture and appearance so that the patch or transition is invisible.
5. Protect existing finishes, equipment, and adjacent work that are scheduled to remain, from damage.
6. Promptly repair damages caused to adjacent facilities by demolition operations, at no change in Contract Amount.

C. Painting

1. Use skilled mechanics that are capable of painting audio-visual equipment and hardware to match architectural surroundings, where applicable.

D. Regulatory Requirements

1. Regulations Applicable: including but not limited to those defined in Division 1.
2. Comply with all applicable federal, state, and local labor regulations, and applicable local union and trade regulations.
3. Installation practices shall be in accordance to industry-accepted standards (ANSI, Cal-OSHA, IEC, IEEE, FCC, NEC, NFPA, ICIA, NSCA, CEDIA, BICSI) or local acts, codes and standards enforced at the place of work, whichever is most stringent.
4. Procure and pay for all necessary permits, licenses, inspections, and observe any requirements stipulated therein.
5. Provide UL/ULC fire rated enclosures around all audio-visual floor and back boxes where required by code.

E. Programming

1. User Group Interview:
    a. Conduct interviews with the end-users to acquire programming requirements. Submit written results of the interview and the requirements set forth by the user group. Associate the user group requirements into the programming of each sub system. Submit to the Consultant a report that outlines the interviews conducted.

F. Pre-installation Meetings

1. Attend a pre-installation meeting at the project site with the Owner and his representatives in order to coordinate related work and scheduling issues.

G. Verification

1. Verify dimensions and conditions at the Project Site. Submit any conflicts in timely manner for resolution.

H. Shop Fabrication and Testing

1. Assemble and fully wire equipment racks at a fabrication shop off the Project Site. Burn-in for not less than 120 hours. Following burn-in, perform specified adjustment procedures. Provide test equipment and test according to procedures specified herein. Submit verification of shop test in timely manner. Following verification of shop test and when installation locations are ready as specified herein, deliver equipment racks and equipment to the Project Site and install.

I. Project Site Installation and Testing

1. Install as specified herein.
    a. Perform specified adjustment procedures. Provide test equipment and test according to procedures specified herein. Request verification of Project Site test in timely manner.

J. Verification of Submitted Test Data

1. Re-test in presence of designated representative(s) of the Owner at reasonable mutual convenience. Provide services of the designated supervisor and an additional technician familiar with work of this Section. Provide all test equipment. Provide complete set of latest stamped submittals of record for reference. Provide complete set of Shop and Project Site Test Reports, as applies. Provide a complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

K. Reference/Project Record Documents

1. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete set of the latest stamped, action submittals of record for reference. Also maintain a separate, clean, undamaged set for preparation of Project Record Documents. Also maintain at the workplace a complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

1.07 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading

1. Deliver materials in manufacturer's original undamaged packages or in bulk packing which provides equivalent protection from rough handling, dust and dirt.
2. Deliver all assembled equipment racks in custom manufactured wood crates to avoid damage during shipping.
3. All packing, shipping, insurance, handling and storage costs of equipment and materials shall be the responsibility of the Contractor.
4. The Contractor shall be responsible for ensuring all equipment and installation materials stored in their shop facilities until it is delivered to the Project Site and a delivery acknowledgement is received from the Owner or its authorized representative.
5. Equipment unpacked for inspection but not ready for permanent installation must be returned into its protective packing.
6. The Contractor shall be responsible for furnishing a temporary substitute for equipment that could not be delivered in time for system operation. All costs associated for renting, shipping and handling temporary substitute equipment shall be the responsibility of the Contractor.
7. In the event the equipment or installation material delivery is delayed, the Contractor must employ the fastest means of delivery service available to deliver the equipment on time. All costs for expediting the delivery of equipment shall be the responsibility of the Contractor.
8. Store packaged materials off of the ground or slab in a manner to protect them from elements, especially moisture damage.
9. Deliver completed, wired, tested equipment racks to associated equipment rooms at the Project Site when major work of all other separate contracts is complete, equipment room ventilation is operating with clean filters in place, the area is clean and free from airborne contaminates, and continuing work of other trades will not produce airborne contaminates or permit transport of such airborne contaminates to the equipment rooms.

B. Acceptance at Site

1. All equipment and installation material delivered to the Owner shall be properly documented in the form of delivery receipts.
2. Equipment delivered to the Project Site must include a delivery acknowledgement receipt signed by the Owner or its representative. Issue a signed copy of the delivery receipt to the Owner and file the signed copy for future reference.
3. The Contractor shall be responsible for the insurance coverage and security of equipment delivered to the Project Site until it receives an acknowledgement of delivery from the Owner or its authorized representative.

C. Storage and Protection

1. The Contractor shall provide a safe and secure storage location for all equipment and installation materials until they are delivered to the Project Site and it receives an acknowledgement of delivery from the Owner or its authorized representative.
2. For equipment assembled and tested at the Contractor’s shop facility and delivered to the Project Site, ensure that the equipment is properly protected from improper handling, rain, water, humidity, moisture, heat, direct exposure to sunlight, dust and dirt during delivery and storage on or off the Project Site.
3. Do not remove protective packing from equipment until they are ready to be installed.

4. If, after equipment is installed, the Project Site cannot be cleaned or is still not clean because of on-going work by others, provide protective covering and protection to prevent airborne dust and dirt originating from damaging equipment.

1.08 PROJECT SITE CONDITIONS

A. Environment Requirements

1. The spaces where audio-visual system assemblies are installed shall meet the following requirements:
    a. Free from dust generated from construction.
    b. The room temperature shall be within the specified operating temperature recommended by the manufacturer.

1.09 SEQUENCING

A. Submit all testing documentation to the Owner's Representative for review prior to requesting the Fabrication Inspection and Substantial Completion inspections.

B. Allow adequate time for corrections to be made after inspections to maintain the Project Schedule.

1.10 SCHEDULING

A. Comply with the Project schedule.

B. Make all Submittals specified herein in a timely manner. Failure to make timely submittals complete as specified herein is considered to be lack of substantial progress of the Work of this Section. Contractor is to work around client schedule throughout the duration of the project.

C. Deliver all equipment, devices and materials required for the Work of this Section and install, test and ready all work for Acceptance Testing at least fourteen days prior to the completion date for the associated area of the Project, unless specifically instructed otherwise by the Owner.

D. It shall be a common understanding that there is a time constraint when executing this work. The Contractor shall use all means and resources to complete this project on or before the specified schedule at no additional cost to the Owner. This includes working beyond normal business hours and days, additional manpower, additional tools, etc.

1.11 WARRANTY SERVICE

A. Warrant all Work of this Section to be free from defects in materials and workmanship for a minimum of 1 year from the date of Owner acceptance of the Work of this Section.

B. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of system acceptance. In the case of Contractor modified equipment, the manufacturer's warranty may be voided. In such cases, provide a warranty equivalent to that of the original manufacturer.

C. All high-level software shall follow the warranty conditions specified by the manufacturer. Immediately update or upgrade the Owner's installed software as soon as new versions, updates or patches become available from the manufacturer at no additional cost to the Owner within this warranty period.

D. Response Time: Provide a qualified technician familiar with the work at the Project Site within 12 hours after receipt of a notice of malfunction. Provide the Owner with the telephone number attended 8 hours a day, 5 days a week, and an answering service or equivalent facility attended 24 hours a day, 7 days a week, to be called in the event of a malfunction. Provide repairs at no expense to the Owner and at the Owner's request, alternate facilities, services and systems for the duration of the repairs to any defective work of this Section. Provide a complete and operational System, within 48 hours after notification of a malfunction.

E. All work requested due to warranty issues shall be performed during regular working hours unless the Owner agrees to pay the difference in labor rates for overtime or nighttime work.

F. The Contractor shall use qualified service personnel to respond to all warranty issues or calls.

G. Off Site Service: Conduct all warranty repairs and services at the Project Site, unless in violation of manufacturer's standard product warranty. Provide substitute systems, equipment, and/or devices acceptable to the Owner for the duration of off-site repairs. Provide transportation for substitute and/or test systems, equipment, devices, materials, parts and personnel to and from the Project Site.

1.12 OWNER'S INSTRUCTIONS

A. General

1. Conduct training on the completed system at a reasonable convenience of the Owner during normal Owner business hours. Contractor is to assess the complexity of the system and shall fully train the operation and maintenance staff named by the Owner.
2. Do not start training until all systems have been commissioned, training manuals are approved and an agenda along with schedule of each departmental training session has been submitted to the owner.
3. Training shall be conducted in the actual room that is the topic of the training session.
4. The client asserts legal and beneficial ownership of all training materials which are specifically commissioned for this project.

B. Operator Training – Do not start training before system is in full operation and all components have been signed off by owner's representative. Use the items covered in the commissioning portion of this specification as a basis for the training curriculum.

1. At least two 2-hour sessions of instruction will be given in order to familiarize the Owner with the operation of the system.

C. Maintenance Training

1. At least two 2-hour sessions of instruction will be given in order to learn how to maintain and troubleshoot the system. A maintenance binder shall be provided by the Contractor with all manufacturer-specific operating and maintenance information for each piece of equipment used. On large jobs, the binders will be sub-divided into individual audio, video and control binders. Provide training on at least the following system features:
    a. Firmware upgrades
    b. Helpdesk features
    c. Complete use of system as outlined in the Commissioning section plus advanced troubleshooting.

D. Training Video

1. A training video shall be produced and cover all aspects of the systems operation.
2. Each page of all user interfaces shall be explained and recorded while gestures are made on the screen. Each button on the user interface shall be explained and demonstrated.
3. All portable equipment that connects to the system shall be demonstrated both in their physical connection and routing method at the user interface.
4. All patch bays shall be explained and demonstrated.
5. All source equipment shall be explained in both physical loading of media and transport control as well as user interface control.
6. Demonstrate on basic troubleshooting.
7. Provide training on items as outlined in the Commissioning section of this document.
8. Demonstrate system start up and shut down.
9. Explain and demonstrate help files associated with touch panels.
10. Audio and video files shall be combined and burned to DVD for distribution to each department.
11. Provide professional MP4 with searchable index of topics covered.
12. Provide label with client's logo, room name/number, title, length and topics covered.

E. A training manual specific to this system will be written covering the basic and advanced functional techniques necessary to operate the system in a reliable and fully functional condition. The Contractor shall submit hard color copies of the training manual as well as a soft copy in PDF or DOC format. Provide a hard copy of the training manual for each person to be trained. This manual shall include:

1. All contact information, including emergency and after-hours phone and pager numbers, for requesting service assistance from the Contractor.
2. A 11x17 set of as-built drawings of the completed project (a full-sized set will be issued to the client for their use, a half-size set will be attached to the inside back door of the main equipment rack).
3. A table of contents at the beginning of the manual.
    a. The manual will begin by explaining basic information such as manual references, abbreviations, any assumptions made by the author, prerequisites required, numbering convection, etc.
    b. It will then proceed to the manual objectives.
    c. Explain what the end user should understand after reading the manual.
    d. It will cover the basics of the user interface including start up and shut down procedures, log on procedures, access privileges, operator password, levels of security, file structure, etc.
    e. The manual shall proceed to describe each user interface and its function. It will cover every layer of the interface and how to navigate through them.
    f. Each of the system presets shall be explained and the physical setup of the equipment and floor plan during presets shall be illustrated. Source equipment shall have their routing scheme explained and illustrated. Portable equipment and its connection to the system shall be explained and illustrated.
    g. The manual will end by explaining basic troubleshooting procedures and equipment care instruction.

4. The Contractor’s maintenance instructions, which will include the manufacturer’s maintenance instructions found on the factory manuals to keep the manufacturer’s warranty in force.
5. A list of consumables (lamps, fuses, batteries, etc.) required to keep the system operating over time, along with sources of supply (if not readily available).
6. The Contractor shall compile and submit all factory warranty registration forms or cards for each piece of equipment furnished for this project.
7. A form requesting feedback from the end user as to how the manual can be improved and a section to report errors discovered.
    a. The Contractor shall make the corrections and improvement suggestions after receiving feedback from the users. This will be completed at no charge to the client. The manual will contain a date stamp and version number. Each feedback and error correction manual reissue will include a new version number.

F. Initial Use Support

1. Provide standby trainer/system engineer during the first two public events.

1.13 MAINTENANCE

A. The Contractor shall, within the warranty period, schedule two visits to inspect and perform preventive maintenance on the system. The first visit shall be six months after the commencement of the warranty period. The last visit shall be just prior to the end of the warranty period.

B. Cache for event logging must be set to record unlimited events until the Contractor's first maintenance site visit. After the Contractor's first maintenance site visit, the cache can be limited to the Owner specified level.

C. The Contractor shall use qualified service personnel to conduct all maintenance work.

D. All maintenance work shall be performed during regular working hours unless the Owner agrees to pay the difference in labor rates for overtime or night time work.

PART 2 - PRODUCTS

2.01 General

A. Quality of Products

1. Materials and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the specified systems.
2. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.
3. Each material, device or piece of equipment provided herein shall comply with all the manufacturer's published specifications for that item.
4. Equipment shall be from the manufacturer’s current stock and shall not be stored longer than 1 year prior to installation, unless written approval to do otherwise is provided by the manufacturer and submitted for review by the Owner.

5. All products shall be a product of firms regularly engaged in the manufacturing of electrical, electronic or optical equipment. The equipment shall be the latest model or type offered which meets the applicable specifications at the time of the submittal. Discontinued items replaced by newer models or versions are prohibited and should not be submitted for review.
6. Quality of workmanship and fabrication of all equipment and components, which are custom fabricated, shall be comparable to professional equipment produced by specialized manufacturers of the trade involved and will be verified by inspection. Only firms having 5 years of experience in all aspects of the fabrication and installation of similar systems will be allowed to perform the work.
7. All materials and products shall be new and of professional quality. Unless specifically stated in the drawings or specifications, no existing or used materials will be installed.

B. Quantity

1. Provide the quantity of products as shown on the Contract Drawings, or as otherwise indicated herein.
2. The equipment listed in section 2.2 consists of all major equipment for the project. The Contractor shall integrate into the system design and provide any additional components, wiring, programming, etc., to complete a functional system operating as described within the specifications and the for construction drawings.
3. Components or equipment not specified or indicated on the drawings that are required to make a fully functional systems per the Owner's requirements and the design intent, shall be furnished and installed by the Contractor, and shall be submitted for Owner review.

C. Preference

1. Where more than one manufacturer is listed herein as acceptable or equivalent, no preference is intended or implied by the order of listing.

D. In the event that a specified piece of equipment or product has been superseded, discontinued or is no longer available from the manufacturer, the Contractor shall submit a request for substitution of the originally specified product. The substitute product shall be the manufacturer's most current model of the specified product, or if the line has been discontinued, a product by the same manufacturer with specifications meeting or exceeding, and as close as possible to those of the originally specified product. Refer to Alternatives and Substitutes section for clarification.

E. Provide Complete

1. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.

F. Provide New

1. All materials provided under the Work of this Section shall be new, shall be the manufacturer's latest design/model, and shall be permanently labeled with the manufacturer's name, model number and serial number.
2. Products and materials shall be clean, free of defects, damage and corrosion.

G. Similar

1. Similar devices shall be of the same manufacturer, unless specifically noted otherwise in these specifications.

H. Safety Agency Listing

1. All devices provided under the Work of this Section that are connected to the Project electrical system shall be listed by Underwriters Laboratories (UL) or other Nationally Recognized Electrical Testing Laboratory acceptable to the Authorities having jurisdiction at the Project site, and shall be so labeled. Absent such listing, comply with Regulatory Requirements applicable to Unlisted Equipment.

I. Power Rating

1. All devices provided under the Work of this Section that are connected to the Project electrical system shall provide stable performance in full accordance with these specifications when operated on main service which complies with ANSI standard tolerances for voltage, frequency, transients and related parameters.

J. Circuit Protection

1. All active devices shall include integral fuse or circuit breaker protection.
2. All circuit breakers shall be fully magnetic.
3. Protection devices shall be located to facilitate examination, resetting and/or replacement without the need to disassemble or demount the associated device.
4. Contractor-fabricated items shall be provided with either indicating type circuit breakers or fuses of the clear glass cartridge type, mounted in fuse holders which will indicate a blown or defective fuse.

K. Continuous Use

1. All active circuitry shall be solid state and shall be rated for continuous use. All circuit components shall be operated in full compliance with the manufacturer's recommendations and shall contain sufficient permanent identification to facilitate replacement.

L. Construction

1. All electronic equipment shall be of the "dead-front" type and shall be designed for standard 19" EIA rack mounting, unless otherwise indicated.
2. Steel frames and enclosures shall be designed and wired to eliminate all induced currents within both the units and the systems.
3. All bolted connections shall be made with self-locking devices.
4. Coordinate all consoles and panels so that the general appearance is similar, or as directed by the Owner.
5. All operating panels shall be at least 1/8" thick aluminum.
6. Provide locking panel covers on all recessed, semi-recessed or surface mounted control panels not located in the equipment rooms, unless specifically noted otherwise. Panel locks shall be flush with no protrusions beyond the panel face when the door is closed. Recessed control panels shall be recessed within the back box to a depth sufficient to permit a locking hinged panel cover to completely close without affecting any device within the enclosed area.

M. Circuit Boards/Modules

1. All printed circuit boards or modules shall be mechanically secured by bolt or friction-loading guide, in addition to any electrical connector attachment, and shall include an integral extraction grip.
2. Printed circuit boards shall be connected to associated circuitry via soldered connections or precious metal positively keyed card edge connectors.
3. All Contractor-fabricated printed circuit boards shall be at least 1/16" thick G-10 glass fabric epoxy base, copper plated to a minimum density of 2.0 oz./sq. ft. on one or both sides, and finished with 60/40 tin/lead solder either hot rolled or plated over the copper. All holes through the boards shall be plated through and solder filled. All boards shall be permanently identified with a designation that matches that of the mating connector or board position in the assembly.

N. Identification

1. Provide permanent intelligible identification on, or adjacent to, all connectors, receptacles, controls, fuses, circuit breakers, patching jacks, and the like. This identification shall clearly and distinctly indicate the function of the item and shall be numbered or lettered to correspond with the function, circuit and location consistent with field and shop drawings.

O. Modular Products

1. The drawings show conventionally packaged components to convey design intent.
2. Card cages to have front and rear closure panels to provide a finished appearance.
3. Except as noted below, modules of different functional types are permitted to share the same card cage/mounting frame and/or power supplies as applicable and if mechanically and electrically compatible.
4. With amplifier input driven 10 dB beyond input level required to produce full rated output, amplifier shall withstand indefinitely any of the following load conditions without instability of operation of main over current protection (i.e. no blown fuses or circuit breakers).
    a. "Short" circuit of 0.1 ohm.
    b. Open circuit (no load).
    c. Rated load impedance.
5. Maintain sense of signal polarity from input to output.

P. Keys

1. Key all boxes, cabinets, enclosures, panels, controls, doors and related provided for similar usage within a system identically. For each unique key type, provide a quantity of ten. Stamp each key with a reference designation.
2. Submit a schedule of keying to the Owner. Where so noted, provide Project Standard lock cylinders and keys; coordinate with the work of other Sections.

Q. Assistive Listening System (RF)

1. An assistive listening system using wireless radio frequency (RF) transmitter and headsets will allow personal monitoring of the audio program for the hearing impaired. The transmitter will be a frequency agile unit with no less than 30-channel capability and will broadcast the main audio program to personal headsets used by hearing impaired audience members. The system and quantity of headsets supplied shall conform to the

ADA requirements (section 219 and 706) for the space. Stereo headset type and hearing aid compatible (T-Coil) listening devices are required; ear-bud type devices are not acceptable. Supply a drop-in type battery charging system capable of servicing multiple receivers, with sufficient charging capacity to charge each receiver simultaneously. Follow the table below for quantity requirements.

Capacity of Seating in Assembly Area	Minimum Number of Required Receivers	Minimum Number of Required Hearing Aid Compatible Receivers
50 or Less	2	2
51 to 200	2, plus 1 per 25 seats over 50 Seats *1	2
201 to 500	2, plus 1 per 25 seats over 50 Seats *1	1 per 4 Receivers *1
501 to 1000	20, plus 1 per 33 seats over 500 *1	1 per 4 Receivers *1
1001 to 2000	35, plus 1 per 50 seats over 1000 seats *1	1 per 4 Receivers *1
2001 and over	55, plus 1 per 100 seats over 2000 seats *1	1 per 4 Receivers *1

*1 Or fraction thereof

R. Provide enclosure systems including, but not limited to racks, cabinets, cases and related panels and accessories as specified herein, or approved equivalent. Provide size and quantity as shown on drawings. Provide color as specified by Architect. If no color is shown on drawings, submit manufacturer's standard color chips for selection.

S. Cable Tray: Provide aluminum ladder style cable tray with flange in side rails where called out in drawings. Size the cable tray to accommodate all wire that must pass through it. Provide all supporting hardware and accessories.

1. Ladder Style Cable Tray
    a. P-W Industries.
    b. Equal by Hubbell.
    c. Approved equal.

T. Floor Mounted Equipment Racks: Provide each bay with basic frame, vented locking rear door, top panel with single 10” fan, certified seismic floor anchor kit, ganging hardware, except where otherwise indicated, at each ensemble of bays, provide end (side) panels to provide complete enclosure.

1. Rack cabinet, heavy duty welded 14ga. CRS, single bay of maximum dimensions 83-1/8"(H) x 24"(W) x 32.5"(D); floor supported with accessory louvered side rack side panel.
    a. Mid Atlantic WRK Series.
    b. Equal by Atlas/Soundolier.
    c. Approved equal.
2. Turret cabinet:

a. Mid Atlantic Slim 2 Series.
b. Equal by Atlas/Soundolier.
c. Equal by Hammond Manufacturing.

3. Wall cabinet, tilt out:
   a. Atlas/Soundolier AWR Series.
   b. Mid Atlantic WRS Series.
   c. Equal by House of Metal Enclosures (HOME).
   d. Equal by Hammond Manufacturing.
4. Wall Mounted cabinet:
   a. Atlas/Soundolier 300 Series.
   b. Mid Atlantic DWR Series.
   c. Equal by Hammond Manufacturing.
5. Floor mounted pivoting rack:
   a. Mid Atlantic SR-40-22 Swing Rack.
   b. Equal by Atlas/Soundolier.

U. Rack Panels and Accessories: Rack Mounting Screws: Screws 10-32; length as required for at least 1/4" excess when fully seated; oval head with black plastic non marring cup washer or equivalent ornamental head; nickel, cadmium or black plated; Phillips, Allen Hex, Square-Tip or Torx drive. Slotted screws are not acceptable.

1. Blank Panels:
   a. Atlas/Soundolier S19 Series.
   b. Zero ZP112000 Series.
   c. House of Metal Enclosures (HOME) Series PM.
   d. Middle Atlantic Products BL, SB or HBL Series.
2. Vent Panels:
   a. Middle Atlantic ETF Series.
   b. Equal by Atlas/Soundolier.
   c. Equal by Zero.
   d. Equal by House of Metal Enclosures (HOME).
3. Shelf:
   a. Middle Atlantic Products U Series.
   b. Atlas/Soundolier SH19 Series.
   c. Zero A52 Series.
4. Drawer:
   a. Atlas/Soundolier SD Series.
   b. Middle Atlantic Products UD Series.
   c. House of Metal Enclosures (HOME) SD Series.
   d. Zero A43/A36 Series.
5. Compact Disc Holder: Middle Atlantic Products Model RSH-4A.
6. VCR Holder: Middle Atlantic Products Model RSH-4A.
7. LP/Laser Disc/Binder Holder: Middle Atlantic Products Model LP.
8. Rackmount Computer Keyboard: Middle Atlantic RM-KB.
9. Equipment Custom Rackmount Shelf: Middle Atlantic Products Model RSH-4A Series.
10. Rackmount Computer Keyboard.
    a. Mid Atlantic RM-KB series.
    b. Approved equal.

11. Computer Monitor Rackmount.
    a. Mid Atlantic RM-MM series.
    b. Approved equal.
12. Horizontal Lacer Bars
    a. Mid Atlantic LBP-IR4, LBP-1S, LBP-1P.
    b. Equal by Atlas/Soundolier.

V. Equipment Enclosure Ventilation: Provide UL Recognized devices. Connect to enclosure power, comply with applicable Codes.

1. Fan panel, 5 1/4" high painted steel rack panel with 4" diameter fans, each fan with chrome plated finger guard, low speed air flow, two fans per panel, total 120 CFM:
    a. Mid Atlantic QFP-2 Series.
    b. Atlas/Soundolier ES/IS Series.
    c. BGW Systems.
2. Thermostatic Fan control module, user definable temperature range with status LED's, temperature sensing probe.
    a. Middle Atlantic FC Series.
    b. Atlas/Soundolier CFT Series.

W. Equipment Enclosure Power and Signal Grounding: Comply with applicable Codes and applicable portions of Division 26. Provide UL Listed devices, Specification or Hospital Grade. Provide all junction boxes, raceway, fittings, wire, supports and fastenings as required for complete installation. Unless otherwise noted, provide receptacles of NEMA 5-15R configuration.

1. Full height receptacle strip, Isolated Ground:
    a. Wiremold 3000 Plugmold IG Series.
    b. Middle Atlantic PD series vertical power strips.
2. Full height receptacle strip, three or more circuits, Isolated Ground:
    a. Wiremold 3000 Series with Specification Grade IG 5262 Series receptacles.
    b. Middle Atlantic PD series vertical power strip.
3. Wireway, lay in, NEMA 1: Any meeting NEMA 1 and UL870. Size as required.
4. Flexible metal conduit: Comply with Division 26.
5. Sequencing Power System:
    a. The Contractor is to design and build power sequencing and surge suppression systems that will control and distribute power in the equipment racks. The system will be designed to sequentially connect power to all of the audio-visual equipment in the equipment racks. Outlets are mounted to the unit's back plate or on a remote strip. If the project utilizes a control system, the sequencing power system will be controlled by the software configurable control system. The touch panel's shut down button will prompt a second time asking "Are you sure you want to shut the system down?" A positive response will activate system shut down. A push button control station's shut down button will be pressed twice to shut down the system. If the project does not include a control system, the Contractor is to provide a dedicated sequential controller in the equipment racks.

1) 15 amp or greater power capacity.
2) 3-prong 15 amp 120VAC isolated ground outlets (provide required amount).
3) Individual sequencing steps for each outlet.
4) Adjustable power-up time delay and outlet sequencing intervals.
5) Modular power raceway systems shall be constructed of 18-gauge min-spangle galvanized steel.
6) Remote controllable via contact closures (if applicable).
7) Status indicator on touch panel (if applicable).

b. Approved subject to above:
1) Middle Atlantic RLM-XX, RM-XX, R-XX or M-XX Modular Power Raceway Series.
2) Middle Atlantic USC-6R Universal Sequencing Controller.
3) Equal by Atlas Soundolier.

6. Signal Grounding bus bar, insulated from enclosure frame:
a. Atlas/Soundolier BBG Series mounted on standoff insulators.
b. Zero A32 Series.
c. Middle Atlantic.
d. Panelboard Isolated Ground bus kit by manufacturer of Project Panelboards specified in Division 26.

7. Multi-Outlet Assembly, Surge Suppressing, UL Listed. Comply with ANSI/IEEE C62.41-1980. Provide at least six receptacles. Provide equivalent to:
a. Surgex SX RT series.
b. EFI Electronics Corporation Model 153.
c. MCG Electronics, Inc. Model 296 (subject to UL Listing).

8. Computer Grade Uninterruptible Power System, UL Listed. Provide continuous, no-break power with sine wave output. Provide Transient Over-Voltage (TOV) Surge Suppression; comply with ANSI/IEEE C62.41-1980, Category A and Category B. Provide complete isolation from Line. Provide output voltage regulation to ANSI C84.1 for computing equipment. Provide output KVA, switch-mode power supply rated, not less than 150% of connected load indicated. Provide one for each Central Processing Unit, Digital Signal Processor and automated control console. Provide equivalent to:
a. Best Power Technology, Inc. "Micro-Ferrups" Series.
b. Best Power Technology, Inc. "Axxium" Series.

X. Audio Patching and Related:

1. Audio Patching Jack Assemblies; jackfield two times forty-eight (2x48) jacks: Factory pre-wired to insulation displacement connection system, normals brought out to connection system, connection system on backplane of jackfield chassis or a separate unit on cable harness, 2 row by two times forty-eight (2x48) jack array of Bantam Plugs:
a. ADC Pro Patch Mark IV (Bantam).
b. Bittree Audio TT (Bantam).
c. Switchcraft TTP96FA (Bantam).

2. Audio Patching Jack Assemblies; jackfield 48 jacks: Factory pre-wired to insulation displacement connection system, normals brought out to connection system, connection system on backplane of jackfield chassis or a separate unit on cable harness, 2 row by 24 jack array of 1/4" tip-ring-sleeve Longframe pattern jacks:

a. ADC Pro Patch Mark IV Long Frame.
b. Bittree Audio Long Frame ¼".

3. Audio Patching Cords: Manufactured to match mechanically, electrically and materials with audio patching jack assemblies specified herein. Flexible shielded cable, length as required. Provide with non-corroding metal. Provide equivalent to:
   a. ADC Pro Patch ¼" Long Frame Patch Cords.
   b. ADC Pro Patch Bantam.
   c. Bittree ¼" Long Frame Patch Cords.
   d. Bittree Audio TT (Bantam) Patch Cords.
   e. Provide Quantity:
      1) Two foot: Eight for each 2x24 Audio Jackfield.
      2) Two foot: Sixteen for each 2x48 Audio Jackfield.
4. Audio Patching Cords, Adapter: Manufactured to match mechanically, electrically and materials with audio patching jack assemblies specified herein. Flexible shielded cable, length six feet. Provide with non-corroding metal 1/4" tip-ring-sleeve longframe pattern plug one end equivalent to Neutrik. Provide opposite end, Circular Audio Connector, Cord, as specified herein. Provide equivalent to:
   a. Patch to Male:
      1) Audio-Line 310 Series.
      2) Pro Co Sound C-PJ/MXB-B-6-P2H.
   b. Patch to Female:
      1) Audio-Line 310 Series.
      2) Pro Co Sound C-PJ/FXB-B-6-P2H.
   c. Provide Quantity:
      1) Patch to Male: Provide 12.
      2) Patch to Female: Provide 12.
5. Patching Cord Holders: Provide adjacent to each jackfield. Provide quantity as required to store patching cords specified herein:
   a. Audio Accessories Maxi Holder.
   b. Trompeter Electronics Model CH-50.
   c. Pomona Electronics 4408.

Y. Video Patching and Related:

1. Video Patching Jack Assemblies; jackfield (2x32) isolated jacks: 75 Ohm digital and analog capable, ((2x32) jack array, 3GHz bandwidth, SMPTE 259M and 292M compliant:
   a. Canare (MD-Series)
   b. Bittree (Mini-WECO)
   c. ADC (PV-Series)
2. Video Patching Cords: Manufactured to match mechanically and electrically with video patching jack assemblies specified herein. Flexible shielded cable, length as required. Provide with non-corroding metal. Provide equivalent to:
   a. Canare (Mid-size Video Patch Cord)
   b. Bittree (Mini-WECO Patch Cord)
   c. ADC (ST series Patch Cord)
   d. Provide Quantity:
      1) Two foot: twelve for each 2x32 Video Jackfield.

Z. Data Patching and Related:

1. Data Patching Jack Assemblies; jackfield two times twenty-four (2x24) jacks. Meet or exceed Category 6 requirements described in TIA/EIA-568-C.2-1 as well as the Class E requirements described in ISO/IEC 11801-B.:
    a. Leviton eXtreme 6+ Quickport Patch Panel (or equal).
2. Provide patch cords for patch points as required.

AA. Fiber Patching and Related:

1. Fiber Patching Jack Assemblies. Meet or exceed all TIA/EIA-568-C requirements:
    a. Leviton Opt-X Ultra Fiber Rack Mount Enclosure (or equal).
2. LC type adapters.
3. Provide patch cords for patch points as required.

2.02 PRODUCTS

A. Major System Components

DEVICE ID	DESCRIPTION	MANUFACTURER	MODEL	ACCESSORIES
ALA	ASSISTIVE LISTENING ANTENNA	LISTEN TECH	LA-123	
ALR	ASSISTIVE LISTENING RECEIVER	LISTEN TECH	LR-5200-072	
ALT	ASSISTIVE LISTENING TRANS.	LISTEN TECH	LT-800-072-01	
ANT	ANTENNA	SHURE	UA8	AS REQUIRED FREQUENCY BAND
BC1	BATTERY CHARGE	LISTEN TECH	LA-380	
BC2	BATTERY CHARGE	SHURE	SBC200	
CIM	CONTROL INTERFACE MODULE	QSC	QIO-GP8x8	
CT1	CONTROL	QSC	AXON C1	
DSP1	DIGITAL SIGNAL PROCESSOR	QSC	CORE 110F v2	AS REQUIRED LICENSES
ERK1	EQUIPMENT RACK	MIDDLE ATLANTIC	MRK-4431	SEE SECTION BELOW FOR ACCESSORY REQUIREMENTS
HP	HEADPHONE	LISTEN TECH	LA-402	
MPY	MEDIA PLAYER	DENON	DN-350UI	
NL	NECK LOOP	LISTEN TECH	LA-430	
NWS1	NETWORK SWITCH	QSC (NETGEAR)	NS26-1440++	PROPER FIBER MODULE IF REQUIRED
PA1000/8V	POWER AMPLIFIER	QSC	CX-Q 4K8	
PA200/8V	POWER AMPLIFIER	QSC	MP-A80V	
PA3000/4V	POWER AMPLIFIER	QSC	CX-Q 8K8	
PM1	PAGING MICROPHONE	TELEX	US602FL	AS REQUIRED MOUNTING BRACKET
PM2	PAGING MICROPHONE	SHURE	MX412D/C	
SB1	SUBWOOFER	JBL	ASB6115	MOUNTING BRACKETS, MOUNTS AND HARDWARE AS REQUIRED

SC1	CEILING SPEAKER	JBL	Control 24CT	AS REQUIRED BACKCAN AND ACCESSORIES
SC2	CEILING SPEAKER	JBL	Control 226C/T	AS REQUIRED BACKCAN AND ACCESSORIES
SH1	HORN SPEAKER	JBL	CSS-H15	MOUNTING BRACKETS, MOUNTS AND HARDWARE AS REQUIRED
SP1	SPEAKER	JBL	AM5212/00	MOUNTING BRACKETS, MOUNTS AND HARDWARE AS REQUIRED
SP2	SPEAKER	JBL	AM5212/26	MOUNTING BRACKETS, MOUNTS AND HARDWARE AS REQUIRED
TPC1	TOUCH PANEL CONTROL	QSC	TSC-101-G3	
WLM	WIRELESS MICROPHONE	SHURE	ULXD2/SM58	
WMAA	WIRELESS MIC ANTENNA AMP	SHURE	UA834	
WMR1	WIRELESS MIC RECEIVER	SHURE	ULXD4D	

B. The above list of Major System Components only outlines the major items necessary to allow the system to function as designed. It lists no power supplies, balancing transformers, power splitters, modular cards or other auxiliary components required to achieve a functioning system. Contractor is required to supply all components needed to provide a complete and operable system as outlined in the contract documents. The full set of construction documents are to be used when preparing a bid. This list is not intended to provide a full bill of materials.

C. Patch bays shown on plans and elevations are for placeholder information only. Contractor is to determine the exact amount of patch needed as per single line diagrams.

2.03 FINISHES

A. Any item or component of the Work of this Section which is visible shall comply with the following. Finishes noted or scheduled on the Contract Drawings shall take precedence. Submit all color samples of all items visible to public for approval.

1. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the Owner.
2. Paint loudspeaker cabinets to match exactly the surrounding and adjacent surfaces. Submit paint sample to Owner’s representative for approval.
3. Unless otherwise noted, receptacle or device plates subject to connection or operating force shall be stainless steel or hard anodized aluminum. Provide plates which generally match the appearance of project standard receptacle or device plates in view in the same area. For anodized aluminum, submit samples of standard colors for selection by Owner.
4. Operating panels shall be steel, primed, painted with thermosetting epoxy paint, with legends silk-screened in contrasting color, and coated with clear epoxy thermosetting coating; or aluminum, hard anodized, with legends engraved and filled with contrasting color, all coated with clear epoxy thermosetting coating.

5. All steel surfaces shall be treated with primer equivalent to zinc phosphate and finish painted with baked enamel or painted with a thermo setting epoxy paint.
6. All aluminum surfaces, except those used as operating surfaces, shall be anodized and then painted with a thermo setting epoxy paint.

B. Custom Fabricated Plate Screws

1. Match the finish of the screws used to mount the custom fabricated plates with the finish of the custom fabricated plate.

C. Ceiling Loudspeaker Grilles

1. Paint loudspeaker grilles to match exactly the surrounding and adjacent surfaces (when speakers are recessed). Apply paint to permit servicing of loudspeakers without damage to finish of adjacent or adjoining surfaces. Provide uniform appearance. Do not obstruct grille openings with paint. Submit paint sample to Owner's representative for approval.

D. Equipment or Cover Plates

1. Paint equipment or cover plate to match exactly the surrounding and adjacent surfaces when require by architect.

E. Manufacturer's logos

1. Remove all manufacturers' names, logos, or other symbols from speakers or other objects placed in view of the public.

2.04 ALTERNATES AND SUBSTITUTES

A. Substitutions of equal equipment beyond the alternatives listed will be permitted only in accordance with Division 1. If a requested substitution requires a change in any of the contract drawings, a revised drawing must be submitted as part of the substitution request. The Owner's Representative shall be the final judge of the acceptability of substitutions. The burden of proof of equivalence is the responsibility of the Contractor.

B. Acceptance of a product shall not, in any form or manner, relax the system performance requirements of this Specification and the performance characteristics of the product.

C. The Contractor shall submit for review a complete list of proposed substitutions for approved equipment listed in Part 2.

D. For all substitutions, the Contractor shall provide the manufacturer's independent test data to demonstrate that the proposed alternatives to the approved equipment comply with the specifications. Specifications shall contain at least all information available for the specified product.

E. The Contractor shall submit a description and drawings showing all changes to the Contract Documents that the proposed substitution will require for proper functionality and operation.

F. Proposed substitutions shall not affect dimensions shown on the Contract Document except as submitted for review and approved by the Owner.

G. Any redesign or construction costs required to integrate the proposed substitution shall be the responsibility of the Contractor. Any costs incurred by the Owner, Owner's representatives, Architect, Engineers or Consultants attributable to the integration of a proposed substitution shall be borne by the Contractor.

H. Any proposed substitution shall have no adverse effect on other trades, the construction schedule or specified warranty requirements.

I. The functionality, performance, general appearance and quality of the proposed substitution shall be equivalent to or superior to those of the specified item.

J. Any change to the Contract (deductive or additive cost) associated with a proposed substitution shall be submitted to the Owner for review at the time the substitution is proposed and accompanying a substitution request documentation.

K. The Contractor shall provide the same warranty for the substitution that the Contractor would for the specified product.

L. The Contractor shall coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects equal to the designed system before the substitution was made. In the event that the substituted material or equipment fails to meet performance testing standards after installed, the Contractor shall replace substituted material or equipment with those initially specified.

PART 3 - EXECUTION

3.01 GENERAL

A. Perform the Work of this Section in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.

B. Furnish and install (herein, "provide") all materials, devices, components, and equipment required for complete, operational systems.

C. Contractor is to supervise the installation of back boxes and terminal cabinets installed by the Division 26 Contractor. Contractor is to verify that correct boxes are installed in their proper locations before any drywall has been installed.

3.02 EXAMINATION

A. Immediately report to the Consultant any discrepancies between the specifications and drawings. This includes discrepancies between the technical specification documents and actual field dimensions or findings that may hinder installation work, conflict with other trades, or cause delays.

B. Carefully examine all details that affect all aspects of the systems described in the specifications and drawings.

1. Examine, coordinate and confirm all drawings and details.
2. Examine, coordinate and confirm all electrical power requirements, conduits, raceways, boxes, and etc.
3. Examine, coordinate and confirm work of other trades that may influence the outcome of the design, specification, and performance of the systems.

3.03 PREPERATION

A. This installation section is only meant as a guideline for the Contractor. The Contractor shall be responsible for executing all installation work in a manner that is in accordance to industry-accepted standards or governing codes, whichever is more stringent. Installation activities shall be executed in an organized and orderly manner. These steps include, but are not limited

to, pre-delivery testing, delivery, unloading, installation, equipment / cable labeling, programming, set-up / calibration / alignment / adjustment, testing, commissioning, training, and documentation.

B. Protect all existing work surfaces, furniture, equipment, fixtures and etc. before commencing installation work. Any damage to the existing physical and electrical property due to installation work shall be the responsibility of the Contractor.

C. Immediately hand over any de-installed equipment to the Owner for safe-keeping if equipment is to be reused.

D. Carefully remove any obstructions such as fixed seating, ceiling tiles, furniture, equipment and etc. that would obstruct or hinder the installation work. Damage caused by undue care in moving these items shall be responsibility of the Contractor.

E. Examine, coordinate, and confirm the cleanliness of the work site before commencing the portion the installation work that involves dust-sensitive electronic or electrical equipment such as audio mixers, switchers, projectors, control processors, computers, cameras, etc. Dust-sensitive equipment that is installed in a work site with air borne dust and dirt shall be properly protected. For example, a video camera on a wall-mounted bracket is protected by a clean plastic bag to prevent dust from contaminating it. Seal the bag's opening using adhesive tape.

F. Prior to commencing installation work, ensure that the surrounding areas are clean and promote ease of installation work.

G. Ensure that all equipment rack and equipment locations are clean before commencing installation work.

H. Unless specified otherwise, furnished products / equipment shall be tested, delivered and installed. And, all systems shall be tested and commissioned to fully operational and properly configured condition.

I. All electrical equipment shall be burned-in or tested at the Contractor's shop before delivery. This pre-installation test shall reveal any equipment that is faulty, malfunctioning or dead out of the box ahead of time.

J. All radio frequency (RF) operated devices shall be tested on-site prior to installation to determine blind spots, RF interference, or any other transmission / reception problems. The Contractor shall be responsible for costs associated with providing additional support or accessory equipment (antennas, amplifiers, cables, etc.) and / or services to improve signal transmission / reception.

K. Provide all support equipment (ladders, man-lifts, tools, etc.) required to complete the installation work in a safe and expeditious manner.

L. Obtain any plan approvals, permits and licenses required by inspection authorities prior to execution of any installation work. The Contractor shall be responsible for all associated fees and costs incurred while fulfilling this requirement.

M. Ensure that all equipment is accessible for operation and maintenance work. Under no circumstance shall equipment be inaccessible or inconveniently located.

N. Aside from the systems' operational features, provide equal attention to the overall aesthetics of the installed equipment and cabling. Special attention to aesthetics shall be extended to equipment or cabling in public spaces.

O. Firmly secure all fixed equipment and hardware in place and ensure that they are plumb and / or square. An exception to this shall be portable or movable equipment.

P. Structurally mounted equipment: All equipment shall be mounted in accordance to all applicable safety codes, standards and practices. The one that provides for the most stringent rule shall prevail. All mounting hardware shall have a load rating by, at least, a factor of 5 (500% or greater) in reference to the weight of the equipment to be mounted or suspended. An exception to the rule shall be existing local safety codes or standards requiring greater load capacities.

Q. Seismic restraints: Abide by all the seismic restraint requirements described in all applicable building codes in force at the work site. If no provisions exist for a particular situation, follow these minimal recommendations.

1. Fixed equipment: Mount and brace to the building structure to minimize potential hazards to personnel and damage to property during any kind of seismic event.
2. Floor mounted equipment: Bolt equipment securely to the floor to prevent from toppling during any kind of seismic event
3. Vertical-mounted columns: Apply braces to the vertical column in four opposing directions back to the mounting surface. This will minimize sway in any direction. Provide a separate, flexible restraint (e.g. aluminum braided aircraft cable) with a capacity of 5 times the weight of the total mounting system. The same applies to the anchor to which the flexible restraint is attached and the method of attachment to the structure.
4. No equipment, equipment supports, or mounts must fail before the structure fails.
5. Seismic restraint measure must not interfere with fire stopping.
6. Notwithstanding compliance with these minimum recommendations, it is the Contractor's responsibility to ensure that the seismic restraint measures taken are adequate for the circumstances, including, if required, verification by an independent structural engineer. The cost of all such engineering shall be the responsibility of the Contractor.
7. Penetration of the Slab: Verify that any mounting or restraint work that requires deep or thorough penetration of the slab shall not damage embedded materials including, but not limited to, slab tensioning devices or conduit. Verify the slab by X-ray or other method before proceeding. The Contractor shall be responsible for all costs associated with this investigation.

3.04 INSTALLATION

A. Follow manufacturer's instructions for installing, operating, configuring, and programming their equipment. Do not perform modifications to equipment that would void its warranty.

B. Pull and terminate all cables, and interconnect all equipment and components in accordance with approved drawings. Install audio-visual cover plates and faceplates onto all boxes.

C. Loudspeaker Assembly Installation

1. Loudspeakers:

a. Verify proper installation of loudspeaker enclosures and related support.
b. Verify that no loudspeaker assembly is subjected to stresses or loading effects in any way contributing to possible extraordinary failure.
c. Connect loudspeaker assemblies to the appropriate 70 volt-line transformer tap as applies. Verify specified polarity. Use insulated crimp connectors or insulated "bobtail" splices applied with manufacturer's recommended ratchet tooling. Wago Wall-Nuts 773 Series or equal are acceptable. Wire nuts or "Scotchlock" connectors shall not be acceptable.
d. Verify that loudspeaker grille openings and loudspeaker components are clear of paint after finishing.
e. Perform preliminary loudspeaker tests specified herein. Correct non-conforming conditions.
f. Adjust 70 volt-line transformer taps as required to realize uniform sound pressure level as specified herein. Document final 70 volt-line transformer taps on the Record Drawings.
g. Correct all conditions giving rise to noise, rattle or other extraneous sounds owing to operation of a loudspeaker assembly under any specified operating condition.

2. Packaged Loudspeakers:
   a. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of packaged loudspeakers. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction. Submit in timely manner.
      1) Comply with applicable Code and the requirements of the Authorities having jurisdiction.
      2) Provide safety factor greater than six or as required by Code, whichever is greater.
   b. Mounting shall:
      1) Permit each packaged loudspeaker to be re-oriented at least plus or minus 5o from angles shown on the Contract Drawings for optimum coverage.
      2) Maintain precise location and orientation of each packaged loudspeaker component after such adjustment when subject to vibration of loudspeaker components due to operation at full specified system output level, and when subject to normal building motion and Code defined seismic induced building motion.
      3) Use rigid metal support members, such as threaded rod with locking nuts.
   c. Test each packaged loudspeaker prior to installation at design locations. Test at least polarity and freedom from buzzes, rattles and objectionable distortion, using procedures specified herein. Correct non-conforming conditions.
   d. Do not apply any load to building structure without first obtaining written approval of the Owner. Obtain per Project procedures.

e. During Acceptance Testing, adjust orientation of packaged loudspeakers as directed to achieve optimum coverage. Provide workers and ladders as required. Perform such adjustment with no claim for additional cost or time.

f. Do not suspend or orient the loudspeaker cluster prior to verification by the Owner or Owner's representative, that the intended location is correct with respect to as-built conditions such as the final dimensions of the space.

3.05 LABELING AND IDENTIFICATION

A. All cables and connecting blocks shall be clearly, logically and permanently marked and identified by the following means:

1. Use cable labels similar to the Panduit Polyolefin Self-laminating Labels for inkjet or LaserJet printers or any other means acceptable to the Consultant. Cable labels should be machine printed and not handwritten.
2. Cable labels should be placed approximately 12 cm. from each end of the cable.
3. Labeling conventions shall be clear, logical, and must be acceptable to the Consultant.
4. Include all cable identification numbers on all wiring diagrams and cable schedules.
5. For fiber optic cables, use cable identification products such as the Panduit Label Core series or any other means acceptable to the Consultant.
6. For connector and terminal blocks, label using Wago, Phoenix or any means acceptable to the Consultant.

B. All cover plate, switches, panels, outlets, etc. labeling shall be engraved and filled, or silk-screened or by any other means acceptable to the Consultant. Do not use Dymo, Brother Ptouch, or other similar labeling products.

C. Protective Devices

1. Identification of fuses and circuit breakers shall indicate protected circuitry, rating of protective device and voltage across open circuited protected device.

D. Panels and Receptacles

1. Panel surfaces shall be engraved and filled or silk screened with identification, or shall be provided with 1/16 inch (minimum) thick laminated plastic labels with engraved block characters at least 1/8 inch high fastened to the equipment by stainless steel screws or rivets. Provide white characters on black background unless otherwise noted. Do not use Dymo, Brother Ptouch, or other similar labeling products.

E. All equipment shall be labeled in a clear, logical manner or by any other means acceptable to the Consultant.

1. For equipment identification, use 'badges' made of aluminum or plastic or any other acceptable material with engraved and filled, or silk-screened labeling. Stick these badges using industrial-strength doubled-sided 3M adhesive tape. Label schemes should be clear, logical, and simple or by any other means acceptable to the Consultant. Indicate equipment labeling schemes on all elevation and plan drawings showing the front and / or rear of the equipment racks. The reader should be able to easily reference the label description to specific equipment in the Operation and / or Maintenance Manuals. Do not use Dymo, Brother Ptouch, or other similar labeling products.

3.06 WIRING

A. General

1. This section does not apply if the drawings incorporate a wire schedule.

B. Audio Signal Wiring Classification:

1. Type A-l: Microphone level wiring less than -30 dBu, 20 Hz to 20 kHz.
2. Type A-2: Line level wiring -30 dBu to +24 dBu, 20 Hz to 20 kHz.
3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBu, from 20 Hz to 20 kHz.

C. Video/Graphics and Related Signal Wiring Classification:

1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 100.0 MHz.
2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.

D. Control Signal Wiring Classifications:

1. Type C-1: DC control wiring 0 to 50 volts.
2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.

E. Additional Wiring Classifications:

1. Type M-1: DC power wiring 0 to 48 volts.
2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.

F. Wiring Combinations: Except as indicated herein, conduit, wire ways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Contract Drawings.

1. Types A-1, C-1, and M-1.
2. Types A-2, C-l, C-2, and M-l, runs less than 20 feet.
3. Types A-2, C-1, and M-1.
4. Types A-3, C-1, C-2, and M-1.
5. Types A-2, V-1, and V-3.
6. Types V-1, V-2, V-3, and C-1.
7. Types M-2 and C-3.

3.07 WIRE AND CABLE INSTALLATION

A. Provide permanent identification of run destination at all raceway terminations.

B. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

C. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels, connector shell or equipment enclosures.

D. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards. Outside buildings, make splices only in designated manholes and/or hand holes. Protect splices outside of buildings with splicing kits equivalent to Scotch-cast Re-enterable. Make splices only with connectors or terminal devices specified herein. Document all splices on Record Drawings.

E. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.

F. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.

G. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

H. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

I. Secure all wire and cable run vertically for continuous distances greater than 30 feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar approved devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

J. All Category type cable, connectors and plugs shall be color coded for easy visual distinction. Color coded insert type boots shall be installed on all Category type plugs. A colored coded ring will be provided on all chassis connectors (i.e. Neutrik ACRF-#). Cable connecters shall be equipped with Neutrik BSE-# color coded bushings. The Color code shall be as follows if there is no client standard:

1. Data LAN =Yellow
2. HDBaseT =Green
3. Audio Network =Red
4. AV LAN =Orange
5. KVM-USB Extenders =Grey
6. AV UTP =White
7. AV STP =Blue

3.08 CONNECTOR AND SIGNAL POLARITY CONVENTION

A. Maintain consistent absolute signal polarity at all connectors, patch points and connection points accessible in the system. Where applicable, a positive polarity electrical signal shall yield positive acoustic pressure from the loudspeakers.

B. Audio signal connector convention: AES14-1992 (ANSI S4.48-1992) AES standard for professional audio equipment - Application of connectors, Part 1, XLR-type polarity and gender.

Signal	Connector	Wire
Signal Phase	Pin 2	Red or White

Signal Anti-Phase	Pin 3	Black
Signal Ground	Pin 1	Drain Wire

C. Voice/Data Connector Convention: Comply with EIA/TIA-568C.

3.09 WIRING PRATICE

A. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At Contractor's option, such terminals may be located in the equipment racks or at backboards provided. Coordinate such selection with Project construction sequence and test procedures specified herein.

B. Identify all wire and cable clearly with permanent labels wrapped about the full circumference within one inch of each connection. Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations. Provide any of the following:

1. Continuous permanent imprint; equivalent to Clifford of Vermont, Inc. "Quik-Pull".
2. Direct hot stamp.
3. Heat shrinkable factory hot stamped; equivalent to Brady sleeve Heat shrink.
4. Adhesive strip printed labels wrapped the full circumference of the wire and sealed with clear heat shrink tubing; equivalent to Thomas and Betts or Panduit Insta-code with clear heat-shrunk tubing equivalent to Alpha.

C. Apply all crimp connectors only with manufacturer's recommended ratchet type tooling and correct crimp dies for connector and wire size. Plier type crimp tooling shall not be acceptable.

D. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.

E. Make all connections to screw-type barrier blocks with insulated crimp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided. Make neat, intelligible markings with indelible markers equivalent to "Sharpie".

F. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

G. Use only rosin core 60/40 tin/lead solder for all solder connections.

H. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

I. Termination and build out resistors and related circuit correction components shall be visible. Do not install in connector shells or internally modify equipment. Show locations on Record Drawings.

J. Correct any and all of the following unacceptable wiring conditions:

1. Deformed, brittle or cracked insulation.

2. Insulation shrunken or stripped further than 1/8-inch away from the actual point of connection within a connector, or on a punch block.
3. Cold solder joints.
4. Flux joints.
5. Solder splatter.
6. Non-grommet, non-bushed, or non-insulated wire or cable entries.
7. Deformation or improper radius of wire or cable

3.10 SIGNAL GROUNDING PROCEDURES

A. Comply with National Electrical Code.

B. Unless otherwise noted maintain a unipoint ground scheme.

C. Signal and electrical system grounds shall be isolated except at the Project ground field connection.

D. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

E. Ground and bond equipment racks and similar equipment enclosures containing powered equipment exclusively via the Isolated Ground conductors provided under Division 26. INSULATE RACK MOUNTING, ANCHORAGE, AND RACEWAY CONNECTIONS.

F. At each rack, provide an Isolated Ground bus within the rack. At each rack, provide a lug bonded to the rack frame with a #8 TW stranded wire to the rack Isolated Ground bus.

G. At each ensemble of racks, provide a single labeled Isolated Ground tubular-clamp bus bar terminal strip to land the individual rack Isolated Ground bus ground conductors. Connect the main Isolated Ground conductor from the Technical Power panel board at this point.

H. Equipment signal ground shall be to the Isolated Ground System via the green wire of the equipment power cord. Where equipment uses two wire power cord, provide #12 green bond wire to rack IG bus bar. At equipment, provide crimp lug and suitable hardware for bonding.

I. Shielded cables of this section shall be grounded exclusively to Isolated Ground by a single path. Shield shall be tied to Isolated Ground at one end only, i.e., at the low potential (receiving) end of run, unless otherwise noted.

J. Unless otherwise noted, at audio jackfields, tie source shield at jackbay frame. Float shields at connections to output jacks. Bus each row of jack frames and run individual #12 green ground wire for each row to rack IG bus bar.

K. Signal Ground provisions shall realize less than 0.15 ohms to the primary ground connection.

3.11 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION

A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.

B. Within each equipment enclosure, provide a full-height multi-circuit ISOLATED GROUND outlet strip with branch circuit count as shown on drawings; locate on the left side of the equipment enclosure, as viewed from the rear. In each enclosure provide number of receptacles required by present and future equipment indicated on drawings, plus at least two

spare receptacles. Provide flexible steel raceway and junction box for connection of power service. Bond internal raceway to rack frame.

C. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.

D. Maintain separation of wiring classifications as specified herein. Separately dress, route and land microphone and line level cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level and control cables on the left side of the equipment enclosure, as viewed from the rear.

E. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

F. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

G. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.

H. At jackfields, provide service loop to permit removal of jackfields from rack sufficient to conveniently access all jack contacts for routine cleaning and maintenance. Organize the service loop and harness such that reasonable reconnection of jacks and jack normals is possible without cutting apart the harness.

I. Coordinate the design and execution of wire harnessing of multi-bay rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multipin connectors and related interconnect systems as specified elsewhere herein.

J. At each equipment backboard, provide UL Listed surge suppressing multi-outlet assembly with at least six receptacles.

3.12 ADJUSTING AND TESTING

A. Test Equipment

1. Furnish, store and maintain test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section. Maintain all test equipment at the job site while work is in progress from installation of equipment racks until Owner Acceptance of this Work; thereafter remove all of this test equipment from the job site. Provide all required test cables, jigs and adapters. Provide at least one of the following items or approved functional equivalents:
2. Audio Systems:
    a. Wide Band Oscilloscope (Tektronix THS700 Series).
    b. True RMS Analog / Digital Volt-Ohm Multimeter (Fluke 187 Series or equal).

c. Low Distortion Audio Frequency Sine Wave Oscillator (Gold Line TS1).
d. Measurement Microphones (Earthworks M30, Bruel & Kjaer 4007, Josephson 550).
e. Sound System Optim5ization and Acoustic Measurement Analyzer (Goldline TEF, Meyers SIM, SIA Smaart, WinMLS, EASERA).
f. Harmonic Distortion Analyzer (Sound Technology or Tektronix AA 501A) or Swept Spectrum Analyzer, HP 3580A, or Swept Test System, Audio Precision or Neutrik).

3. Communications and Related:
   a. Level II, Cat5e Cable Pair Tester (Microtest, HP, Scope, Fluke or Siemons set up to meet Category 5e parameters).
   b. Outside Plant Voice Cabling Plant Tester – capable of detecting shorts, opens, reversals, mis-wiring and crosstwists (Siemon STM-8 or equal by Mod-Tap).
   c. Metallic cable pair tester (Wavetek Corporation, Instruments Division, model LANTech 100).
   d. Tone Test Set.
   e. Optical Time Domain Reflectometer (OTDR) for fiber optics.
   f. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

B. System Performance Testing and Adjusting Procedures

1. Upon completion of the installation of all equipment in an area, perform the following tests and record results. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Correct all non-conforming conditions prior to requesting Acceptance Review and Testing. Perform at least the following procedures:
2. Mechanical: Verify:
   a. Integrity of all support provisions.
   b. Absence of debris of any kind, tools, etc.
3. Power and Isolated Ground: Verify:
   a. Isolation of Isolated Ground system from raceway and related ground.
   b. Grounding of devices and equipment. Integrity of signal and technical power system ground connections.
   c. Proper provision of power to devices and equipment.
4. Signal Wiring: Verify:
   a. Integrity of all insulation, shield terminations and connections.
   b. Integrity of soldered connections. Absence of solder splatter, solder bridges.
   c. Routing and dressing of wire and cable.
   d. Continuity, including conformance with wire designations on running sheets, field and shop drawings.
   e. Absence of ground faults.
   f. Polarity.

5. Use the proper sequence of energizing systems to minimize the risk of damage.
6. Audio Systems:
    a. Electronic Tests; confirm:
        1) Gain at 1 kHz.
        2) Maximum output.
        3) Input clipping level.
        4) Frequency response.
        5) Total harmonic distortion.
        6) Signal-to-Noise ratio.
        7) Signal-to-Crosstalk ratio.
    b. Electro/Acoustic Tests:
        1) Uniformity of coverage.
        2) Electronic and acoustic frequency response/one-third octave equalization. Transfer function measurement shall be as close to flat as possible. Measure at ear level. Representative of the Owner will direct final adjustment.
        3) Maximum continuous sound pressure level (in the reverberant field). Drive systems with broadband pink noise. Sustain for at least five minutes with no system damage. Measure for "A" and "C" weightings at ear level on loudspeaker axis. Turn off noise.
        4) Acoustic signal-to-noise ratio referenced to the specified maximum continuous sound pressure level in the reverberant field. Measure for "A" and "C" weightings at ear level on loudspeaker axis with mechanical systems operating. Present comparison with previous measurement.
        5) Acoustic gain before feedback. Locate acoustic source (4-inch loudspeaker/pink noise generator) two feet from system microphone. Measure at system microphone position and at most distant listener position at ear level. Present comparison.
7. Fiber System:
    a. Fiber:
        1) Conduct optical loss test.
        2) Conduct optical time domain reflectometer test.
8. Diagnostic Monitoring System:
    a. Demonstrate complete operation.
9. System Overall:
    a. Verify levels.
    b. Provide permanent "wedge" type labels on all controls, as applies, to indicate correct settings after systems performance testing and adjustment procedures have been successfully completed.

C. Loudspeaker Assembly Testing and Adjusting Procedures

1. Upon completion of the installation of all loudspeakers in an area, perform the following tests and record results. Correct non-conforming conditions, unless the cause is clearly outside the Work of this Section, in which case submit the apparent cause to the Owner.
2. Loudspeaker Line Impedance: At terminal cabinets at equipment rooms, measure the impedance of each loudspeaker line. Sweep from at least 20 Hz to at least 16 kHz.

3. Loudspeaker Polarity: Test the acoustic polarity of all loudspeakers using an Acoustic Polarity Tester.
4. Freedom From Buzzes, Rattles and Objectionable Distortion: Individually apply to each loudspeaker line a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output voltage. Listen carefully for buzzes, rattles and objectionable distortion.
5. Uniformity of Coverage: Apply broadband Pink Noise. Adjust level to approximately 70-80 dBA at measurement locations. Measure in 4 kHz octave band at ear level. Adjust loudspeaker aiming and 70 Volt loudspeaker taps for uniformity of coverage.

D. Equipment Rack and Equipment Testing and Adjusting Procedures

1. Conduct procedures in fabrication shop. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report with color photographs of each equipment rack, front and back. Request and coordinate verification of submitted test data by the representative of the Owner. Correct all non-conforming conditions prior to shipment to Project Site. Perform at least the following procedures:
2. Preliminary: Verify:
    a. Grounding of devices and equipment. Integrity of signal and electrical system ground connections.
    b. Proper provision of power to devices and equipment.
    c. Integrity of all insulation, shield terminations and connections.
    d. Integrity of soldered connections. Absence of solder splatter, solder bridges.
    e. Absence of debris of any kind, tools, etc.
    f. Routing and dressing of wire and cable.
    g. All wiring, including polarity and continuity, including conformance with wire designations on running sheets, field and shop drawings.
    h. Mechanical integrity of all support provisions.
3. Rig temporary power and grounding: Comply with all applicable Codes, regulations and ordinances.
4. Determine the proper sequence of energizing systems to minimize the risk of damage. Energize. Burn in for at least 120 hours.

E. Telecommunications Cabling Testing

1. Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
2. Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-C.2 and TIA-

568-C.3. Visually confirm Category 6 marking of outlets, cover plates, outlet/connectors, and patch panels.

3. UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connected.
4. For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568- C.3 and TIA-526-14-A using Method A, Optical Power Meter and Light Source for multimode optical fiber. For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568- C.3 and TIA-526-7 using Method A, Optical Power Meter and Light Source]. Perform verification acceptance tests.
5. Perform testing for each outlet as follows:
    a. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA/EIA-568-B.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.
    b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3. E. Final Verification Tests
    c. Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

3.13 CLEANING

A. Clean each section or area of where the work was conducted after completion to permit immediate use of the area. Remove and discard all refuse, rubbish, and debris.

B. The Contractor shall ensure that all recyclable and environmentally-hazardous waste materials are disposed properly.

C. Make good all existing structures, surfaces, and utilities affected by cutting, coring, mounting, drilling, or other new work.

D. Clean all furnished equipment of dust, dirt, finger prints, smudge, and other material prior to calling for a Substantial Performance of Work Review or Completion of Work Review.

3.14 PROTECTION

A. During the installation phase and up to the date of achieving Substantial Performance of Work, protect finished or unfinished work against damage or loss. In the event of such damage or loss, immediately replace or repair such work or equipment at no cost to the Owner.

3.15 ACCEPTANCE REVIEW, TESTING PROCEDURES AND COMMISIONING

A. Complete all Work of this Section. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, less reduced set of Record Drawings. Notify the Owner in writing that the Work of this Section is complete and fully complies with the Contract Documents. Request Acceptance Review and Testing by returning Attachment “A” to the Design Consultant. The representative of the Owner will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this Work. These Procedures may be performed at any hour of the day or night as required by the representative of the Owner to

comply with the Project Schedule and avoid conflict with these procedures from possible ongoing work of other Separate Contracts and/or the Owner's operations. Provide all specified personnel and equipment at any time without claim for additional cost or time.

B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of this Section. Provide quantity of technicians as required to comply with Project Schedule.

C. In Addition, Provide:

1. Set of hand and power tools appropriate for performance of adjustment of and corrections to this Work.
2. Include spare wire and connectors and specified tooling for application.
3. Ladders, scaffolding and/or lifts as required to access loudspeakers and other high devices.
4. Test equipment to include but not limited to:
    a. Dual channel FFT-based audio analyzer
    b. Video test generator with color bars, grayscale, alternating pixel, multi-burst, crosshatch and % windows.
    c. InfoComm Projection Shoot-Out DVD
    d. Digital Video Essential Professional DVD
    e. Category cable tester, cable length, short, open and miswire test.
5. Complete set of latest stamped, actioned submittals of record for reference.
6. Complete set of Shop and Project Site Test Reports.
7. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

D. Demonstrate: Complete operation of all systems and equipment, including Portable Equipment.

1. General
    a. Configure room for each type of event and demonstrate audio-visual system.
    b. Connection of portable equipment. (Laptop, document camera, etc.)
    c. Demonstrate to the Consultant that all functions and equipment for the system work properly when installed as a complete system.
    d. The Contractor shall demonstrate the satisfactory operation of all controls and adjustment circuits of the system.
    e. Demo room scheduling software where applicable.
    f. Room combining and dividing presets.
    g. Demonstrate system startup and shut down procedures.
2. Audio
    a. Route audio to program speakers.
    b. Route audio to monitor speakers.
    c. Patch each audio tie line into system.
    d. Route audio signal to auxiliary speakers.
    e. Connect microphone to each panel input and route through system.
    f. Demonstrate and document gain structure through the system.
    g. Demonstrate and document with a dual channel FFT-based audio meter the following:

1) Polarity of each driver in each cabinet.
2) Crossover point of high, mid and low section of each loudspeaker.
3) dB SPL levels from 1-4 kHz at various position in the audience area.
4) dB SPL level of high, mid, low and sub frequency bandwidth at crossover.
   (a) Audio routed to ceiling speakers.
   (b) Audio Conferencing.
   (c) Wireless microphones.
   (d) Demonstrate that the audio system is properly time aligned and equalized.
   (e) Assistive listening system.
   (f) Production intercom system.

3. Control
   a. Communication between control system and AV equipment, including feedback if device supports 2-way communication
   b. User interface operation.
   c. Password protection of user interface.
   d. Touch panel features and each page of control.
   e. Touch panel help file.
   f. Help desk features.
   g. All programmed presets.
4. The Contractor 's personnel and test equipment shall be made available to the Consultant in order that:
   a. Selected tests and measurements previously made by the Contractor can re-run.
   b. Other tests may be made at Consultant's discretion.
   c. Additional tests or measurements may be made due to changes in field conditions.
5. It is estimated that the acceptance tests and demonstrations will require approximately two hours, unless construction or installation problems or deviations from the specifications are discovered.

E. Adjust: As directed by the representative of the Owner.

F. Correct: In timely manner, failure to comply with the Contract Documents, as reasonably determined by the representative of the Owner.

G. Acceptance Documentation

1. Official acceptance of the system covered by this specification will occur when the Design-Builder receives the following written documents:
   a. A letter from the Consultant to the Architect acknowledging Final Acceptance of the system stating compliance with all articles of the specifications.
   b. A letter from the Architect to the Contractor stating that all related work has been completed to his satisfaction. Until these documents are

received, the installation is not formally complete. The official date of acceptance shall be the date of the letter from the Architect to the Contractor described above.

3.16 CLOSEOUT

A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify Owner of completion of Punch List.

B. Portable Equipment: Furnish all portable equipment and spares to the designated representative of the Owner, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.

C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.

D. Project Record Documents: Submit.

E. Keys: If applicable, replace construction locks with permanent locks. Transmit keys to Owner.

F. Training: Conduct specified training and submit training manuals.

G. Warranty: Submit Warranty dated to run from date of Acceptance of the Work of this Section.

3.17 OWNER'S RIGHT TO USE EQUIPMENT

A. Acceptance of the Work of this Section will be after completion of corrections and adjustments required by the "Punch List" which results from Acceptance Review and Testing of the completed installation. The Owner reserves the right to use equipment, material and services provided as part of the Work of this Section prior to Acceptance without incurring any obligation to Accept any equipment or completed systems until all Punch List work is complete and all systems comply with the Contract Documents; or accept any claim for additional cost or time.

Attachment "A"

NOTICE OF COMPLETION
&
REQUEST FOR FINAL INSPECTION

We hereby give notice that the work associated with the Audio-Visual system, at the project named below, is completed and fully complies with the contract documents issued to the Contractor. The required submittals below have been marked as completed.

- ☐ Programming
- ☐ Test Reports
- ☐ Operation Manual
- ☐ Maintenance Manual
- ☐ Training Manual
- ☐ Training
- ☐ Warranty Certificates
- ☐ Record Drawings

We request commissioning and verification testing be scheduled with the Owner's Representative for final system sign off. Attached is a list of test equipment for review and acceptance.

PROJECT INFORMATION

Project Name:	Project Phase:
Project Address:	

CONTRACTOR INFORMATION

Name:	Company:	
Address:		
Signature:		Date:

Note to Contractor: Provide all test equipment for final inspection as described in the specification.
Please complete and fax or email this form to Veneklasen Associates attention AV Department
Fax (310) 396-3424 Email dyoung@veneklasen.com

END OF SECTION