

SECTION 27 41 16 –AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the Related Documents identified in Division 01 Section "Summary."

1.2 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all other Sections of the Specifications for requirements that affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- D. Throughout this specification, the term "Contractor" shall refer to the Audiovisual Systems Contractor unless otherwise indicated.

1.3 EXAMINATION OF SITE AND DOCUMENTS

- A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority (Owner) will not be responsible for errors, omissions and/or charges for extra work arising from General Contractor's or Trade Contractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that they are familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.

1.4 DOCUMENTS

- A. Refer to audiovisual system drawings, appendix, and the project construction drawings for information related to the work specified herein.
- B. Audiovisual system documents include this printed specification plus the following drawings:
 - 1. AV series drawings

1.5 RELATED WORK SPECIFIED ELSEWHERE

- A. Carefully examine all of the Contract Documents for requirements which affect the Work of this Section.

1.6 SCOPE OF WORK

- A. Furnish and install sound, video, and communication systems as shown on drawings and as specified herein, complete with all apparatus, equipment, power supplies, wiring, labor, and services necessary to ensure a complete working system. Verify completeness of equipment listed and correctness of type numbers. Furnish and install supplementary equipment needed to meet system requirements, without claim for added payment.
- B. The plans, specifications, and other Contract Documents are to be considered together and are intended to be mutually complementary, so that any work shown on the plans though not specified in the specifications, and any work specified in the specifications though not shown on the plans, is to be executed by the Contractor as a part of this contract. Should a conflict occur in or between or among any parts of the Contract Documents that are entitled to equal preference, the better quality or greater quantity shall govern, unless the Owner's authorized representative directs otherwise. Figured dimensions shall take precedence over scaled dimensions.
- C. To meet these performance requirements:
 - 1. Furnish all equipment, including any items not specified but required to provide a completed system. Verify the completeness of equipment listed in this Section and the correctness of type numbers.
 - 2. Use all equipment specified in the manner specified. Clarify any misunderstandings prior to bid submission, and offer alternates as appropriate.
 - 3. Verify each component's conformance with its manufacturer's published specifications and other requirements as stated in this Section.
 - 4. Check in detail each item of equipment provided, each portion of the installation, and the complete installation to ensure that the intent of this Section is achieved.
- D. The work includes, but is not limited to, the following:
 - 1. Submission of shop drawings prior to fabrication.
 - 2. Verification of dimensions and conditions at the job site.
 - 3. Installation in accordance with these specifications, manufacturer's recommendations, and all applicable code requirements.
 - 4. Setup and adjustment of signal processing, system tests and adjustments, written report, demonstration for approval, participation in acceptance tests, and final adjustments as required.
 - 5. Programming and documenting of all software controlled devices including initial setup of presets in all devices.
 - 6. Coordination with the Electrical contractor
 - 7. Coordination with the Lighting contractor.
 - 8. Coordination with the Fire Alarm Systems Contractor
 - 9. Coordination with Tel/Data Contractor and other Low Voltage Contractors
 - 10. Coordination with Owner's Audio-Visual Personnel
 - 11. Coordination with the Owner's IT department and installers
 - 12. Performance standards, without claim for additional payment
 - 13. System documentation.
 - 14. Instruction of owner's operating personnel.
 - 15. Maintenance services for one year.
 - 16. Warranty.

1.7 FORMAT OF BID RESPONSE

- A. Submit bids clearly identifying separate prices for each of the following. For Paragraph 1 below, furnish prices good for not less than 60 days from the date of submittal of this bid. For Paragraph 2 below, furnish price good for not less than one year from the date of submittal of this bid.
 - 1. Base price to furnish and install video, audio, and audiovisual equipment and systems as identified in this Section, excluding that equipment identified in the documents as Add Alternate. Provide both overall system price plus unit pricing for each item of equipment.
 - 2. Addition to base price if warranty and service (Paragraph 1.25 of this Section) is extended from one year to two years.
- B. Identify any and all pricing dependencies, wherein the price of one item or group of items is dependent the quantity of another item. Similarly identify any and all dependencies in the pricing or terms of services (e.g. warranty, user instruction), wherein the price or terms of any service is dependent on the quantity of any equipment item.
- C. Identify the project team by name, role in the project, and relevant experience. Identify senior manager with overall project responsibility, operations manager, or other individual responsible for labor scheduling, project manager responsible for project coordination, project engineer, and on-site supervisor.
- D. Identify the party providing graphical design and programming services for remote control systems. Similarly identify the party providing graphical design and programming for digital audio processing systems. Indicate experience and relevant qualifications for each.
- E. Provide a tentative project schedule, showing major milestones, and with sufficient detail to indicate that the required installation period is reasonable and will be met.
- F. Explanation of any suggested substitute equipment or methods, identifying the impact on equipment, installation, and change in overall price. State the system price as specified, and any change in price due to this substitution. State clearly the benefit offered by this substitution. Provide manufacturer's specifications or other descriptive literature as appropriate. If requested, make samples available, at no cost to the Owner.
- G. Acknowledge receipt of all bid addenda.

1.8 BIDDER QUALIFICATIONS

- A. With bid submittals, include bidder qualifications:
 - 1. Evidence that the bidder has been in business for at least five years prior to bid date, and that the principal line of business of the bidder is the sale and installation of commercial-grade audiovisual systems.
 - 2. References, including names and telephone numbers of individuals who may be contacted, showing satisfactory completion of three or more projects similar in scope and type to that specified herein, and with similar schedules.
 - 3. Provide additional evidence of satisfactory completion of audio-visual system installations involving suspended loudspeakers and complex control system integration.
 - 4. Number of full-time technicians the Bidder has in his employ that hold CTS certification as installers, as issued by InfoComm International.
 - 5. Number of full-time programmers the Bidder has in his employ that hold certification (Crestron Certified Programmer or other) in the use of Crestron control programming and

user interface development software. Alternately, the name of a third-party programming firm that will perform programming on this project and that holds certification as an independent Crestron Services Provider.

6. Each vendor shall include a description of the professional and technical experiences background, qualifications and expertise of the organization's key personnel assigned to this project. The description shall show that bidder possesses the demonstrated skills and experience in specific areas of the project scope. In addition, Bidder shall identify a project manager for the project and shall provide resumes of all personnel who shall be assigned to this project. Bidder shall estimate the percentage of time each individual shall be working on this project.
7. Discussion of any subcontract labor the Bidder plans to assign to this project, and whether any subcontract labor will be working on the job-site. Identify all subcontractors to be working on the job-site.
8. Evidence of ability and affirmation of intent to meet the warranty and service requirements stated herein.

1.9 SUBSTITUTIONS

- A. Furnish explanation of any suggested substitute equipment or methods, identifying the impact on equipment, installation, and change in overall price. State the system price as specified, and any change in price due to this substitution. State clearly the benefit offered by this substitution. Provide manufacturer's specifications or other descriptive literature as appropriate. If requested, make samples available, at no cost to the Owner.

1.10 EXISTING CONDITIONS

- A. Verify all existing conditions. Refer to the Owner for coordination and clarification before the bid date of any discrepancies concerning existing conditions, drawings, and specifications. Clarify with the Owner all locations including conduit and cable routings. Where discrepancies occur and pre-bid instructions have not been obtained, abide by the Owner's decision.
- B. Provide all additional conduit and cable required for the installation. Refer to drawings of other Sections for identification of conduit and cable provided by other trades.
- C. Furnish, install, and terminate all required wire and cable into conduit provided by other trades.
- D. Comply with all requirements regarding the use of cable with respect to spread of fire. Refer to General Construction drawings for identification of air plenum and other spaces having special cabling requirements. Field survey the jobsite to determine spaces having special cabling requirements. It is the responsibility of the Contractor to provide wiring that is in compliance with all applicable building codes of the authority(ies) having jurisdiction.
- E. Comply with all requirements regarding the proper installation of equipment for seismic considerations. It is the responsibility of the Contractor to employ installation methods that are in compliance with all applicable building codes of the authority(ies) having jurisdiction.
- F. Perform any work related to firestopping under the direction of an individual certified by Hilti as having successfully completed the Life Safety for Contractors firestop course. Provide evidence of course completion upon request.

1.11 FEES, PERMITS, AND NOTICES

- A. Perform all work in compliance with all applicable requirements of the authority(ies) having jurisdiction. Take out and maintain all construction permits, pay all fees, and file all notices, all at no additional cost to the Owner.
- B. Where mounting or rigging systems require the design or design approval of a licensed Structural Engineer, pay all associated fees and expenses. Make no claim for additional payment.

1.12 COORDINATION

- A. Employ labor compatible with all on-site trades.
- B. Attend regular project meetings as scheduled by the General Contractor or Architect.
- C. Adhere to rules of the jobsite, such rules including but not limited to those regarding safety, personal identification, hours of access, elevator use, and parking.
- D. Provide a weekly status report to the Owner's authorized representative, identifying work performed during the previous week, work anticipated during the upcoming week, and any anticipated shortages of material or equipment.
- E. Supply low-voltage wire for, and make terminations at, low-voltage control devices not in contract, including but not limited to projection screens and lighting dimming systems.
- F. Coordinate with the Owner and other trades to achieve complete systems in all respects, but with particular note of the following:
 - 1. Backboxes for ceiling-mounted loudspeakers
 - 2. Electric projection screens
 - 3. Above-ceiling supports for video/data projectors (furnished and installed within the work of this Section)
 - 4. Personal computers (furnished and installed by others)
 - 5. Writing and tack boards (furnished and installed by others)

1.13 MATERIAL AND EQUIPMENT

- A. Provide materials and equipment conforming to the applicable requirements of:
 - 1. Underwriter's Laboratories
 - 2. National Electrical Code
 - 3. American National Standards Institute
 - 4. Federal Communications Commission
- B. References shall meet the latest edition of that standard.
- C. Provide materials and equipment new and free from use, and covered by the applicable manufacturer's warranty.
- D. Notify the Owner if, in the Contractor's opinion, superior performance can be obtained from alternate materials or equipment from that identified in this specification.

- E. Certain items of equipment are specified by manufacturers' type numbers to indicate an acceptable standard of quality and performance. Substitutions of equal equipment beyond the alternatives listed will be permitted only if such equipment is listed in an addendum to this specification. Address requests for listing of substitutions to the Architect. With any request for substitution, include measured data proving the equivalence of the proposed substitute in quality and performance. The Architect shall be the final judge of the validity of the data submitted.
- F. Provide only current-model materials and equipment. Do not provide obsolete or discontinued models unless specifically directed to do so in the Equipment section of this Section. Review all materials and equipment immediately prior to installation, and inform the Owner's authorized representative of any obsolete or discontinued items.

1.14 DELIVERY, STORAGE AND HANDLING

- A. All equipment shall be appropriately packed for shipment.
- B. All shipping costs to the job site are the responsibility of the Audiovisual Contractor. Determination of the shipping method and company is the responsibility of the Audiovisual Contractor in order to meet the published project schedule.
- C. Completed systems shall be shipped FOB inside and in place.
- D. Note that drop shipment of equipment to the Owner's site directly from the manufacturer, or other supplier will not be allowed.
- E. Upon delivery all materials shall be stored under cover in a clean and dry location. Materials which are damaged during shipping, storage or handling or are otherwise not suitable for installation shall be removed from the job site and replaced, at no additional cost to the Project, with acceptable materials.

1.15 CLEANUP AND TRASH DISPOSAL

- A. Maintain a clean and safe working area free from debris and waste materials. Clean work areas daily.
- B. Except for items to be reused or returned to the Owner, or as otherwise directed, remove trash and packing materials from the jobsite, and dispose of offsite in a legal manner. Do not allow trash to accumulate at the jobsite.

1.16 SUBMITTALS

- A. Submittal Requirements and Procedures
 - 1. Provide submittals in accordance with requirements of Section 01 33 00 – Submittal Procedures and as detailed herein.
- B. Submittal Format
 - 1. Unless directed otherwise, provide submittals electronically in PDF and CAD formats. Provide documents in full size and suitable for printing by the reviewer. Clearly identify each document within its file name.

C. Alternates

1. With system bid price, submit prices for equipment and installation of additional or reduced quantities of equipment as stated herein. Unless otherwise stated, all items herein are part of the base bid system. Input and output jacks, test points, terminal blocks and wiring for add or deduct alternate equipment should be included in the Alternate.

D. Staffing

1. Key Project Personnel
 - a. Provide names, resumes, addresses, mobile and office phone numbers, and e-mail addresses of key project personnel.
2. Field Supervisor
 - a. Before beginning installation, submit the name of the employee who will be the on-site field supervisor through the completion of this project.

E. Milestone Dates

1. Submit tentative list of milestone dates, including but not limited to the following, noting any important dependencies and adjustments to be made in the event of delays:
 - a. Dates for each Submittal
 - b. Shop fabrication completion
 - c. Initial shipment of equipment to site
 - d. Start of installation on site
 - e. Second shipment of equipment to site
 - f. Additional shipments of equipment to site
 - g. Control system programming completion
 - h. Field testing
 - i. Correction of punch list items
 - j. Training

F. Equipment List

1. Before ordering equipment or beginning work, submit to the Owner's authorized representative for approval a detailed list showing quantities and manufacturer and model number for items of equipment to be used in assembling these systems, including all items of equipment, accessories, and installation materials specified herein. For each item, indicate quantity to be employed within each room or subsystem, and total quantity. Order this list in sequence as the referenced equipment appears in the specification, with references to specification paragraph numbers or equipment schedule line numbers, if applicable. Provide this list not later than 30 calendar days after execution of the contract. With this list, provide a statement of assurance that the system design has been reviewed in its entirety, and that the Equipment List defines all equipment and materials necessary for the project.

G. Product Literature

1. With the equipment list, attach product literature for all items of equipment submitted, identifying the function, connections, weight, dimensions, mounting method, electrical and cooling requirements, and other descriptive information for each item, and including a color photograph. Where literature serves more than one item (e.g. varying sizes,

finishes, channel counts, etc.), mark to indicate intended item. Order these data sheets alphabetically by manufacturer or in sequence as the referenced equipment appears in the specification. Do not organize by space where the referenced equipment is employed. Provide manufacturers' published data sheets; do not provide third-party catalog pages or HTML pages.

H. Review of Electrical and Network Infrastructure

1. Within 30 days after execution of the contract, provide a written statement indicating that empty conduits, junction boxes, data outlets, and electrical power systems needed to support the work of this Section have been reviewed and found to be acceptable. Identify any deficiencies.
2. Review and confirm that audiovisual system conduit as shown on the Drawings and where applicable, as built drawings, is sufficient and appropriately sized for system.
3. Note where conduit system is not sufficient and indicate any additional conduit required for system.

I. Shop Drawings

1. Submit the following items for approval by the Owner's authorized representative before starting work. Provide full-size drawings, with text size not smaller than 10-point when printed at full scale. Submit all drawings in a single submittal, unless specified otherwise.
 - a. Functional Diagrams
 - a) Detailed equipment and signal flow block diagrams showing proposed interconnections between all equipment
 - 2) Equipment types and model numbers
 - 3) Diagrams showing internal signal routing for digital signal processing devices
 - 4) Termination, grounding, and other wiring details
 - 5) Other wiring diagrams as require by the project
 - b. Audio Digital Signal Processor (DSP) Programming
 - 1) Submit programming file(s) and printed PDF diagrams showing proposed internal signal routing, processing, and control within audio DSP systems
 - c. Equipment Rack Elevations Drawings
 - 1) Show locations of all rack-mounted components within equipment rack
 - 2) Indicate equipment types and model numbers.
 - 3) Indicate any custom assemblies, with references to assembly details.
 - 4) Indicate generic functional descriptions of all components.
 - d. Patch Panel Layout Drawings
 - 1) Show locations of all patch points and labeling.
 - e. Cable Schedules and Drawings
 - 1) Schedule complete with all wiring requirements for the project
 - 2) Drawings showing cable pull assemblies
 - f. Receptacle and Device Plan Drawings
 - 1) Drawings showing locations of all system equipment and access points, including all connection panel, control panel, and equipment locations.
 - g. Equipment Installation Drawings

- 1) Drawings showing locations and mounting methods for all wall and ceiling mounted equipment. Show geometry of any projection systems.
 - h. Loudspeaker Installation Drawings
 - 1) Drawings of loudspeaker mounting arrangements
 - 2) Drawings of anchoring system for loudspeaker suspension.
 - i. Video Projection Drawings
 - 1) Drawings of projector mounting arrangements and sight line studies showing proper alignment and dimensions with the projection screen and projection equipment.
 - j. Stamped Drawings
 - 1) Drawings of all final assemblies of loudspeaker and projector suspension equipment stamped by a licensed structural engineer.
 - k. Panel Drawings
 - 1) Drawings showing layouts and finishes of control and connection panels, with operational labels, identification tags, and all other details to be provided for fabrication.
 - 2) Layouts of hardware control panels showing pushbutton labeling
 - 3) Panel schedule listing all panels individually with size, mounting condition (surface or flush), back box size and panel finish color
 - 4) Drawings of custom panel details
 - l. Custom Millwork and Metalwork Drawings
 - 1) Drawings showing fabrication details of custom millwork and metalwork items, including projector and loudspeaker stands and mounts, control panel enclosures, projection benches, etc.
- J. Control Panel Design Documentation
 1. Provide the following for each graphical user interface employed in the system. Provide in a timely manner so that reasonable review comments do not affect project schedule.
 - a. Preliminary color layouts of control panel pages with narrative annotations demonstrating the following:
 - 1) Graphical standard
 - 2) System functionality
 - 3) Navigation between pages
 - 4) Button functions
 - b. Fully-functional control panel emulated within programming environment (AMX, Crestron, Extron, etc.) or alternately, physical touch panel with supporting control system hardware. Provide fully-programmed panel for review of layout, legends, colors, status feedback, page flips, and other factors by the Owner's authorized representative.
- K. Touch Screen Control Panels
 1. Submit the following for approval prior to programming
 2. First Submittal
 - a. Timing:
 - b. Line drawings of touch panel layouts with button functions listed.

- c. Detailed narrative and demonstration mockup/simulation of all touch panel programming based on design process specified herein.
 - d. Three fully designed sample screens for evaluation of graphical look.
 - 3. Second Submittal
 - a. Timing:
 - b. After approval of first touch panel submittal, submit electronic color images of touch panel layouts.
 - L. Radio Frequencies List
 - 1. List of radio frequencies used by system. Coordinate frequency usage with Owner's designated representative prior to submitting shop drawings.
 - M. Finishes and Samples
 - 1. Obtain Consultant and Architect approval of all panel and furniture finishes prior to fabrication. The Architect will specify exact finishes.
 - 2. Submit samples of the following to the Owner's authorized representative for review and approval:
 - a. Cable marking materials
 - b. Panels
 - c. Custom loudspeaker grilles
 - d. Custom loudspeaker cabinet finishes
 - e. Any other exposed equipment specified for the project, as requested by the Owner.
 - N. Other
 - 1. Descriptions of proposed functionality, operating procedures, or implementations not identified in this Section.
 - O. Copies
 - 1. If and only if requested, submit up to five (5) printed copies of all required submittals. Otherwise, submit one (1) electronic copy.
- 1.17 CLOSEOUT DOCUMENTATION
- A. Report of Post-Completion Tests. Prepare a report on the post-completion tests defined in this section identifying the failure of any subsystems to perform as required in this Section.
 - B. System Documentation. Submit a draft of the final system documentation for approval prior to its publication. Provide draft copies of all items on-site for inspection during the demonstration and acceptance testing of the system; submit final copies thereafter.
 - C. Training Materials. Submit a draft outline of the training program and preliminary copies of any materials to be distributed during the training program.
 - D. Acceptance Test. Submit a draft of the final system acceptance test for approval prior to its performance.

1.18 FUNCTIONAL REQUIREMENTS

A. Auditorium

1. Sound Amplification Systems

- a. Reinforcement of speech and music from wired microphone receptacles and wireless microphone systems to listeners in the Auditorium through a centralized group of loudspeakers located above the stage
- b. Supplemental reinforcement of audio signals to listeners in the front of the Auditorium through front-fill loudspeakers installed in the face of the stage apron
- c. Supplemental reinforcement of audio signals to listeners in the rear seating section of the Auditorium through electronically delayed loudspeakers
- d. Reinforcement of stereo audio through left and right loudspeaker clusters located above the stage (see Alternates)
- e. Operator controlled mixing of microphone signals using a mixing console located on the Control Room counter or on a table at the front of house mix location
- f. Automatic mixing of dedicated wired microphone inputs and wireless microphone systems (lavalier and handheld) using an automatic mixer system
- g. Playback of pre-recorded audio material using a rack mounted computer, analog stereo inputs, and a Bluetooth audio receiver located in an equipment rack located in one of the stage wings
- h. Recording from ceiling-suspended microphones and main audio system signals using Owner-Furnished recording devices
- i. Monitoring of audio mixing console signals through control room monitor loudspeakers on control room countertop.
- j. Preset switching and routing for preset event modes and loudspeaker configurations
- k. Assistive listening system using portable wireless FM receivers
- l. Muting of all audio signals in response to fire alarm control signal from fire alarm system

2. Broadcast and Recording Wiring System

- a. Video and audio tie lines from locations throughout the Auditorium to patch panels in the Control Room main AV equipment racks

3. Equipment Racks

- a. Main equipment racks located within Control Room
- b. Stage manager equipment rack in stage wing (see drawings for location)

1.19 AUDIO SYSTEMS PERFORMANCE REQUIREMENTS

- A. The overall space-average acoustical frequency response criterion, as measured within the coverage area of the permanently-installed loudspeakers, is within ± 3 dB of a spectrum which is flat from the low-frequency limit band listed below to 2500 Hz and slopes downward thereafter at a rate of 3 dB per octave to 12,500 Hz. Test signals shall be broad-band "pink" noise applied to any system input, measured using 1/3-octave filters centered on ANSI preferred frequencies.

Loudspeaker Type	Low-Frequency Limit
Central Cluster	40 Hz
Full Range Playback	80 Hz
Fill Loudspeakers	150 Hz

- B. The spatial level uniformity criterion, throughout the coverage area of the system, is that amplified sound levels shall not vary more than ± 4 dB as measured using a test signal consisting of an octave band of "pink" noise centered at 4,000 Hz.
- C. Measurements of system performance will be made using a calibrated ANSI or IEC precision sound level meter set for "slow" meter damping and flat response, 4 feet above the floor (seated ear height) within the system coverage area. All interior finishes and furnishing shall be in place, and system gain shall be adjusted to provide levels of at least 70 dB or 10 dB above background noise levels, whichever is higher, at the measuring locations for these tests.
- D. To meet the acoustical performance criteria, be responsible for setting the initial adjustments of loudspeakers, equalizers and other signal-processing equipment, pads, and gain controls and, under the direction of the Owner's authorized representative, during demonstration and acceptance testing, making the final adjustment of these items.
- E. Adjust all equalizers to realize maximum gain and optimal tonal balance from the sound system throughout the audience area.
- F. Output level of all program sources arriving at switching or routing equipment shall be within ± 0.25 dB of each other as measured at the input to the switcher or router. Provide pads, line amplifiers or other gain control devices as required to achieve this specification.
- G. The audio system shall meet or exceed the following electrical specifications, measured at any outlet in the system.
 - 1. Signal to Noise Ratio: Not poorer than 60 dB peak noise to RMS signal.
 - 2. Frequency Response: ± 3.0 dB, 20Hz to 20 KHz.
 - 3. Total Harmonic Distortion: 1%, 20Hz to 20 KHz.

1.20 VIDEO SYSTEMS PERFORMANCE REQUIREMENTS

- A. Provide systems that meet the performance requirements stated in this section. Perform any work required to modify the performance of the system in order to meet these requirements. Perform whatever tests are necessary to confirm compliance with these requirements, before commencement of acceptance testing.
 - 1. Analog Video Signal Distribution and Cabling
 - a. The video distribution and cabling system shall meet or exceed the following electrical specifications, measured at any point in the system. Compliance with these specifications shall be determined by introducing a standard video reference signal at points normally used for origination (e.g., camera, media player, workstation) and measuring the signal characteristics at points normally serving as destinations (e.g., monitor, projector, media encoder). Note that these are end-to-end performance requirements to be met under all conditions of switcher re-entrance.
 - b. For purposes of this paragraph, the distribution and cabling system shall consist of workstation interfaces, wideband equalizing and distribution amplifiers, wideband video switchers, and all interconnecting cabling.
 - 1) Frequency Response (analog & digital systems): ± 0.5 dB, DC to 100 MHz (± 0.5 dB, DC to 5.0 MHz for NTSC encoded composite video signals). ± 3.0 dB for digitally encoded HD-SDI signals.
 - 2) Jitter Amplitude (digital systems): Less than 0.2 unit intervals at HD-SDI rate.

- 3) Risetime: 250 V/microsec minimum.
 - 4) Crosstalk: 45 dB minimum below nominal signal level at 5.0 MHz, 35 dB minimum below nominal signal level at 100 MHz.
 - 5) Signal to Noise Ratio: 60 dB minimum, peak noise to RMS signal, unweighted DC to 100 MHz.
 - 6) Signal Gain: 1.00 terminated into 75 ohms.
 - 7) Line and Field Tilt: Less than 2%.
 - 8) Differential Gain: Less than 3%.
 - 9) Differential Phase: Less than 3 degrees.
 - 10) Color Timing (where applicable): Within 2 degrees at 3.58 MHz.
 - 11) Input Return Loss: 40 dB minimum at 5.0 MHz.
 - 12) Path Length Inequality (for Y/C and RGB cable sets where the signals are not subject to subsequent matrixing or encoding): Within 12" of cable, or 1.6 nsec.
- c. Where cable length results in the deterioration of gain and frequency response characteristics and cable compensation equipment is not specified, the system shall be adjusted for best performance. The Contractor shall demonstrate that any inability to meet gain and frequency response specifications is due solely to length of cable.
2. Digital Signal Distribution and Cabling
- a. Provide digital signal distribution system with the following features:
- 1) EDID management
 - 2) HDCP compliant
 - 3) HDMI, DVI and DisplayPort signal transport
 - 4) Troubleshooting tools
 - 5) Support for video formats up to and including 1920x1200.
 - 6) Manufacturer-approved cabling
3. Displays (Monitors and Projectors)
- a. All displays shall meet manufacturers' published specifications for brightness, contrast, focus, convergence, linearity, distortion, and purity, across the entire range of horizontal and vertical scan frequencies of which the display is capable. In the absence of such specifications, no convergence, linearity, distortion, or purity errors shall be visible from a viewing distance equal to the image width, and brightness, contrast, and focus shall meet standard performance guidelines.
- b. Projectors shall be installed and adjusted so that the resultant images are free from all keystone distortion, barrel distortion, and vignetting.
- c. Projectors shall exhibit correct color balance, both at black and at peak white, and proper gray scale tracking.
- d. All displays shall meet manufacturers' published specifications for horizontal and vertical scan frequency ranges. Where appropriate, adjustments shall be made to allow for automatic scan locking across specified ranges. Image quality specifications discussed above shall be met throughout the horizontal and vertical scan frequency ranges.

1.21 REMOTE CONTROL SYSTEMS PERFORMANCE REQUIREMENTS

A. General Requirements

1. Provide programming and otherwise configure control system to achieve fully functional system. Coordinate with the Owner. In addition to all other operating controls, ensure that the conditions in this section are met.
2. Provide programming and otherwise configure control system to achieve control as identified below. Sections below do not define panel layouts; refer to functional requirements and drawings.
3. Maximum system delays, under all conditions of control system loading, shall be as follows:
 - a. 250 milliseconds, from control panel command initiated by operator, to control panel indication acknowledging receipt of command.
 - b. 250 milliseconds, from control panel command to projection screens, volume controls, and media playback devices; to control system command issued to controlled device.
 - c. 1000 milliseconds, from control panel command to assign a source to the video projector and sound system, to control system commands issued to projector and switchers.
4. Reliability
 - a. Operation shall be 100% reliable. Occasional spurious operation shall not be accepted.
 - b. Every control panel pushbutton shall work as intended when pressed just once. The excuse of "Try it again" shall not be acceptable.
 - c. Equipment shall remain operable from its own front panel even when under control from the remote control system. For example, unused outputs on a video router shall be available for manual operation even when other outputs are being switched by the control system.
 - d. When a portable control panel is disconnected and re-connected, the panel shall return to normal operation with system status correctly indicated for all functions. If necessary, an initialization pushbutton may be used to force a panel update.
5. Usability
 - a. A sub-page or individual function which appears on two different pages shall operate in the same way on each page.
 - b. Feedback (tally) shall be accurate 100% of the time. If true feedback cannot be achieved, then feedback generated by the control system must be 100% accurate. If such feedback cannot be accurately generated, then momentary tally (to confirm pushbutton press only) shall be used.
 - c. Every function required for proper operation of the audiovisual system shall be under the control of the remote control system, regardless of whether or not that function is in use. For example, a video document camera may have an Internal/External mode function, permitting the display of an external device such as a notebook computer. If the user inadvertently selects External mode, the document camera will be inoperable. The Internal/External mode function shall therefore be under control of the remote control system, so that when the document camera is selected for display, Internal mode is forced.
 - d. Functions with an inherent delay (eg. video projector turn-on and warm-up) shall be accompanied by an indication of time remaining until ready (touch panels only). Otherwise, there shall be no perceptible delay either in system response or in status indication.
 - e. Ramping functions (such as volume control) shall operate smoothly, with a ramp rate of approximately 5 seconds from minimum to maximum. System response to ramping commands shall be immediate, and there shall be no perceptible delay in the response of any bargraph indicator.

6. Control Panel Graphics

- a. A conservative graphical standard suitable for an educational application shall be developed and adhered to. This standard shall include the following:
 - 1) Limited color palette, generally with colored pushbuttons on a light background
 - 2) No background texture or wallpaper
 - 3) Limited number of typefaces and type sizes for legends
 - 4) Pushbuttons properly aligned horizontally and vertically
 - 5) Consistent and logical use of color - ie. green for normal condition, red for alert.
 - 6) There shall be no perceptible delay in control panel page flips. Page flips shall be executed without any spurious flashes of unwanted pages or sub-pages.
 - 7) Control panel pushbuttons shall not be present for functions which will not be required (eg. DVD record) or which are not supported in the application (MCU functions for a video codec without an integral MCU).
 - 8) In absence of specific direction from Owner or Consultant use Crestron "Standard" Theme or similar as a basis for touch panel graphics.
- b. Develop panel graphics within an independent graphics design program, Adobe PhotoShop or similar, that provides 32-bit color selection and color matching, color and grey scale shading, infinitely-variable light source direction and intensity, and custom typefaces. Import panel graphics thus developed into Crestron VisionTools or AMX TPDesign panel creation software. Do not perform initial graphics development within these Crestron or AMX applications.

7. User Interface Development

- a. Interview end-users and other individuals as determined by the Owner and the Owner's authorized representative to identify requirements for graphical user interfaces on touch screen control panels. Following such interviews, develop conceptual layouts of panel graphics and navigation, and identify functions to be available on each menu page. Adhere to relevant standards or templates as directed. Review with the Owner and the Owner's authorized representative before beginning software development.
- b. Provide all programming and related services as required to implement a fully operable system.
- c. Coordinate with the drawings and with other paragraphs in this section.

8. Other

- a. Configure control system hardware and programming so that the system will recover from a loss of power to any portion of the system or to the system as a whole without operator intervention. Configure so that control system does not lockup during loss of power, and that manual operation of equipment is possible under all conditions.
- b. Provide resistive pull-ups or other means as required to reliably interface to low-voltage remote control systems provided by others, including (but not limited to) projection screens.
- c. Provide other hardware and programming not specifically enumerated herein in order to provide a complete and functioning system that meets the performance requirements identified in this Section.

B. Remote Control System Functional Requirements

1. The system shall provide a "session finished" function, which resets the room to its default state. All media shall be stopped and ejected, projectors powered down, playback audio muted, projection screens raised, etc.
2. There shall be no "system off" state, and there shall be no need to turn the system on. Operating controls and sound amplification shall remain operable at all times. Video projectors shall be powered only when projection is requested.
3. Source pushbuttons shall be present for all possible sources at all times. The system shall determine the presence or absence of signal, and if absent, indicate to the user that the selected source is not available.
4. Except for the following, there shall be no dependent actions. Each action available to the user shall be directly selected by the user when the user desires.
5. Selection of a projection source shall also energize the appropriate video projector and lower the projection screen.
6. The remote control system shall provide control of power sequencing through remotely controllable power outlets, either standalone or integrated within power management and distribution devices.
7. Audio overflow between rooms shall be enabled at the source room for selection at the receiving room(s). Touch screen controls to select overflow from other rooms shall be greyed out unless overflow has been enabled at the source room.

C. Control Panel Functional Requirements

1. General
 - a. Control panels shall be password protected.
 - b. Control panels shall have a hidden function allowing access to protected pages for more technical functions. Technical user pages shall be password protected.
 - c. Control panels shall include manual controls for independent manual operation of video projection screens and video projectors.
 - d. Mirrored operation of all Auditorium touch screen control panels
 - 1) Lectern
 - 2) Stage Rack
 - 3) Control Room/Portable

1.22 NETWORKING

- A. Implement Quality of Service on all Ethernet switches as recommended by Digital Audio Networking Best Practices and TV Studio Networking Best Practices
- B. Coordinate IP addressing scheme with Owner for possible connection of AV network to Owner's building network.
- C. Specified Ethernet switches are expected to be integrated into VLAN/IP addressing scheme.

1.23 DOCUMENTATION

- A. Provide all documentation identified below. Maintain all of this documentation (except for additional copies beyond the quantities identified here which the Contractor may keep at their office) on-site for use by the Owner, Contractor, or other parties as authorized by the Owner.
- B. Provide draft copies of all documentation for inspection during the demonstration and acceptance testing of the system. Provide finished copies, in the required quantities, before the start of the warranty period.

- C. Provide documentation that conforms to room names or numbers as approved by the Owner. Where applicable, show Owner's room numbers rather than builder's room numbers.
- D. Provide (in addition to other elements required by the Training Program) the following articles.
 - 1. Complete Technical Manuals. Provide five copies of detailed technical manuals, tab indexed, containing both the information necessary for the performance of routine maintenance by the Owner's staff, as well as that needed for corrective maintenance and upgrading by the Contractor's (or other qualified) technicians. To this end, include the following information:
 - a. Table of contents.
 - b. General system descriptions and block diagrams.
 - c. Detailed system descriptions.
 - d. Detailed as-built system wiring diagrams and cable schedules.
 - e. Simplified line diagrams showing the essential parts of the completed installation, by room, and their functional relations, including all jacks, keyed by number to patch panels.
 - f. List of settings and adjustments for semi-fixed controls and configuration settings.
 - g. Lists of equipment incorporated, including manufacturer, model number, and serial number where applicable.
 - h. List of all IP addresses assigned to components within the system.
 - i. Electronic copy of source code in uncompiled, editable form for any custom-written software or scripts, including but not limited to remote control system operating software, touch screen control panel page design, and audio system design within audio digital signal processing system. Terms for provision of this source code shall be substantially similar to those identified within the Sample Software License attached as Appendix B.
 - 1) In addition to providing this source code with project documentation, provide additional copy to the Owner's design consultant.
 - 2) In addition to providing this source code with project documentation, and where file structure of host device (eg. control processor) permits, save copy of code within the host device for access by technicians during service. Provide additional memory as required.
 - j. Schedule of required preventive maintenance.
 - k. Lists of any special tools or test equipment necessary for system maintenance.
 - l. Lists of consumables (fuses, lamps, etc.) and spare parts, and recommended stock levels for each.
 - m. Lists of manufacturers with addresses and telephone numbers.
 - n. Manufacturer's specifications, operating instructions, and service information sheets, arranged alphabetically by manufacturer. However, if the system incorporates fewer than five of a particular equipment item, extra copies of these documents shall not be required. Bind these documents separately from the other sections of the manuals described above.
 - o. Completed warranty cards from all equipment furnished.
 - 2. Simplified Line Diagram. Show the essential parts of the completed installation and their functional relations. Include all receptacles, labeled as on the receptacle plates, and all jacks, numbered according to their position on the system patch panel ("A", "B", etc. for horizontal rows, and "1", "2", etc. for vertical columns). Bind one copy of the diagram into each instruction manual. Mount one copy of the diagram behind clear plastic on the wall near the equipment rack, or as directed. Reduce the mounted copy to 11" x 17" maximum size; ensure that it is legible at that size.

3. Electronic Drawings Files. Provide electronic copies of all as-built drawings in AutoCAD (current release) format on flash media device or Owner's preferred media.
4. Operating Manuals. Provide five copies of complete instructions for operating all audiovisual systems in all modes of operation and as necessary to fulfill all functional requirements. Include both detailed step-by-step instructions for the inexperienced user and summary instructions suitable for quick reference. Provide self-contained documents specific to the application; do not refer to manufacturers' instruction sheets. Provide in format (e.g. 3-ring binder, laminated card, etc.) as directed.

1.24 OWNER INSTRUCTION

- A. Upon completion of the installation, conduct a training program, to provide the Owner's staff with operating, basic preventive maintenance, and system-level troubleshooting knowledge of all equipment subsystems. **Provide 12 hours of instruction consisting of four sessions of three hours each.** Conduct this training program at the project location, or at a location selected by the Owner. Schedule at the mutual convenience of the Owner and Contractor, after demonstration and acceptance testing. Schedule multiple sessions over a one-year or two-year period across both Fall and Spring school sessions.
- B. Provide training materials free from any copyright restrictions, and upon request from the Owner, furnish a reproducible set of these materials.
- C. In addition, and upon request from the Owner, provide a fully qualified technician to attend and provide support during two events using the facility. Provide this technician upon reasonable notice, at any time during the first month of system operation.
- D. Approximately six months after completion of the installation, conduct a follow-up training program, consisting of one four-hour session. Conduct this training program at the project location, and schedule at the mutual convenience of the Owner and Contractor.
- E. Approximately six months after completion of the installation, the Contractor shall provide remote a control systems review making any minor changes as the Owner may request based on the configuration at system sign-off.

1.25 WARRANTY, MAINTENANCE, AND SUPPORT PROGRAM

A. Duration of Program

1. Provide complete warranty, maintenance, and support program for a period of one year from the date of final acceptance of the system, regardless of the terms stated by equipment manufacturers. Final acceptance shall be deemed to include clearing all punch list items and delivering final documentation.
2. Provide extended warranty for any item of equipment warranted by its manufacturer for more than one year. Provide extended warranty of comparable nature (i.e. parts only, parts & labor, on-site vs. depot repair, etc.) and comparable duration to the manufacturer's warranty.
3. Provide with bid annual cost to extend the preventive maintenance agreement from two to five years after completion.

B. Warranty

1. Guarantee all equipment and installations to be free of faulty workmanship and defective components for the duration of the program. Cover all electrical, electronic, mechanical, optical, and other equipment provided under this Section, and all mounting, connecting, wiring, adjusting, and other installation work. During this time, replace defective material and repair faulty workmanship at no charge to the Owner.
2. Guarantee all Contractor-provided programming for the duration of the program. During this time, correct any programming errors or conditions that prevent the system from performing as specified.
3. Install, align, and service all equipment employing technicians authorized by the respective manufacturers. Perform no work in any manner nor with any labor that voids manufacturer warranties. Where modifications to standard equipment are required, assume manufacturer's warranty.
4. Provide telephone response by qualified support technician within one hour of receiving a service request, and within four hours by the arrival of a technician, if required. Maintain a 24-hour-per-day, 365-day-per-year telephone response facility for receipt of service calls; provide this telephone and on-site service irrespective of time of day, 365 days per year.
5. Video projectors and other electronic devices whose performance deteriorates due to drift during the program shall be considered defective and requiring alignment or other repair at no charge to the Owner.
6. Provide the warranty service specified above at the Owner's location. Regardless of the terms of any manufacturer's warranty, do not require any carry-in service.
7. If any equipment item found to be faulty cannot be repaired quickly, and will thus be unavailable for use by the Owner for a period greater than 24 hours, and upon request from the Owner, make available a functional replacement unit at no charge. Install this replacement unit in a timely fashion so that system operation is restored within a 24 hour period from the initial failure. Permit such replacement unit to remain available to the Owner until the original unit is repaired and reinstalled.
8. At the completion of the program, provide to the Owner a record of all work performed and parts replaced.

C. Preventive Maintenance

1. For the duration of the program, provide maintenance service after final acceptance of the installation. During this period, provide at least two visits annually to the site for preventive maintenance and general system checking. During these visits, install any software or firmware upgrades to the extent these upgrades are made available at no

charge from the manufacturer and are approved in advance by the Owner. Schedule these visits at approximately six month intervals.

2. In addition to preventive maintenance, provide one further visit, scheduled upon the Owner's request, to replace the lamps within any video/data projectors. Employ new lamp as made available by the Owner; coordinate the return and refurbishment of any lamp modules.

D. Content and Use Licenses

1. For the duration of the program, provide or perform all services required as part of manufacturer's annual maintenance agreements or other manufacturer-imposed conditions. Maintain all content and software use licenses. Continue or extend all specified manufacturer support agreements and extended warranties, including those support agreements and extended warranties shown as line items within the Equipment Schedule. Pay all costs and fees; provide complete services package so that no charges are incurred by the Owner during the term of the program. To the extent that any manufacturer requires direct invoicing to the Owner, carry such costs within the contract price, with the understanding that such costs may be assigned to the Owner upon further discussion.

PART 2 - EQUIPMENT

2.1 INSTALLATION MATERIALS, CABLES, AND INSTALLATION COMPONENTS

A. Audio Input Lines

1. Use cable with a foil-shielded pair of stranded #22 AWG conductors, with a stranded shield drain wire. For single pair, use a miniature cable, nominal outside diameter 0.135". Use of multi-pair cable is optional. Provide plenum rated equivalent as required.
 - a. Belden 8451
 - b. Liberty 22-1P-EZ
 - c. West Penn 452

B. Audio Portable Cables

1. For line and microphone level audio umbilical cords use cable with stranded #20 AWG conductors, braided shield, and EPDM rubber jacket.
 - a. Belden 8412
 - b. Equal

C. Loudspeaker Wiring

1. Provide unshielded loudspeaker wiring for connection to loudspeakers and loudspeaker receptacles. For lines in rigid conduit or electrical tubing, use stranded or solid conductors. For lines in flexible conduit or electrical tubing and for all wiring to equipment within equipment racks, use only stranded conductors.
2. Use color-coded #12 AWG conductors for all loudspeakers and electronically-delayed loudspeakers except for 70 V ceiling-mounted loudspeakers and loudspeaker receptacles.
 - a. Belden 8477
 - b. West Penn 227
 - c. Approved Equal
3. For all ceiling-mounted loudspeaker wiring using 70.7 Volt lines provide color-coded #18 AWG loudspeaker wiring.
 - a. Belden 8461
 - b. West Penn 224
 - c. Approved Equal
4. Use color-coded #14 AWG conductors for all loudspeaker receptacle wiring.
 - a. Belden 8473
 - b. West Penn 226

D. 75 Ohm Video Input/Output Lines

1. Provide video lines with a maximum loss of 20dB at 750 MHz for single run.
2. For cable length runs between 0 and 300 feet:
 - a. Canare L-5CFB
 - b. Belden 1505A
 - c. West Penn 819
3. For cable length runs between 300 and 500 feet:

- a. Canare L-7CFB
 - b. Belden 1694A
 - c. West Penn 6350
- 4. For multi-cable RGBHV runs under 100 feet:
 - a. Belden 1279P
 - b. Extron MHR-5
 - c. West Penn 255CRGB
- E. Category Wiring
 - 1. Provide shielded Category 6 8-conductor twisted pair cable with 23 AWG solid conductors and bandwidth of 350 Mhz for computer data and audiovisual transport wiring.
 - a. Belden DataTwist series
 - b. Equal
- F. HDBT Wiring
 - 1. Provide shielded Category5e 8-conductor twisted pair cable tested to 350 Mhz and suitable for use with the supplied video distribution system.
 - a. Crestron DM-CBL-8G
 - b. Equal
- G. Fiber-Optic Wiring, Two Fiber
 - 1. Provide multi-mode, OM3, two-fiber cable for connection from wall plates to patch bays.
 - a. Belden B9C037
 - b. Equal
- H. Fiber Optic Wiring, Six Fiber
 - 1. Provide multi-mode OM3, six-fiber cable for connection between equipment racks. Terminate all fibers with connectors.
 - a. Belden B9C039
 - b. Equal
- I. Antenna Wiring
 - 1. Provide coaxial antenna wiring for connections from wireless transmitters and receivers to antenna connection panels.
 - a. Belden 7810A
 - 1) Equal
- J. Microphone and Line Level Patch Panel
 - 1. Provide programmable patch panels to fulfill the requirements shown on the functional diagram. Wire jacks with bridging and normalled-through connections as detailed. Use patch panels which include designation strips with transparent plastic label covers; vertical strips at each side and a three-line (minimum) horizontal strip for each row of jacks. Place jacks close to each other on the patch panel which are shown close to each other on the functional diagram. Locate each bridging jack above the associated normalled-through jack. Use bantam type tip-ring-sleeve jacks with cross-bar palladium or Western Electric #1 gold alloy switching contacts. Both factory-wired and shop-wired

patch panels are acceptable. Insulation-displacement terminals are included with the factory-wired patch panels specified herein; other terminal strips or terminal blocks may be substituted, including both solder and screw types. Supply two-foot long red patch cords with nickel-plated plugs. Attach patch cord holder to side of rack or wall near jack field.

- a. Acceptable patch panel:
 - 1) Audio Accessories WEP262-SH
 - 2) BittreeB48DC-NNPIT/E3 M20U12L
 - a) Quantity: As required per drawings
- b. Acceptable patch cord:
 - 1) Audio Accessories LFR-24
 - 2) Bittree LPC 24 00-110
 - a) Quantity: 20
- c. Acceptable patch cord holder:
 - 1) Audio Accessories MAXI
 - 2) Pomona 4408
 - a) Quantity: 4

K. Video Patch Panel

- 1. Provide 75 ohm patch panels for video signals.
 - a. Acceptable patch panel:
 - 1) Audio Accessories 432D4P/SVJ-2TX
 - 2) Bittree B48T-2WTHD
 - 3) ADC equal
 - a) Quantity as required per drawings
 - b. Acceptable patch cord:
 - 1) Audio Accessories VPC-24
 - 2) Bittree VPCM 24 00 – 75
 - 3) ADC equal
 - a) Quantity: 10
 - c. Acceptable looping plug:
 - 1) ADC LP-S1625 Standard Size HD Looping Plug
 - 2) Equal
 - a) Quantity: 8

L. Category Patch Panel

- 1. Provide 24-port rack-mount shielded category 6 patch panel. Provide one 2-foot patch cable per wired port on patch bay.
 - a. Leviton 4S255-S24 w/ 6ASHD-S6A snap-in jacks
 - b. Hubbell Equal
 - 1) Quantity: as required per drawings

M. Fiber Optic Patch Panel, Singlemode ST

1. Provide 12-port rack-mount singlemode fiber optic patch panel with ST connectors. Provide ST connectors with captive dust caps. Provide one 2-foot patch cable per wired port on patch bay.
 - a. Acceptable patch panel:
 - 1) Camplex HF-OPRP-1
 - 2) Approved equal
 - a) Quantity: per drawings
 - b. Acceptable patch cord:
 - 1) Camplex
 - 2) Equal
 - a) Quantity: 10

N. Connectors

1. Connectors from the following manufacturers shall be considered acceptable. Install connectors appropriate for the installed cable and equipment interface.
 - a. ADC
 - b. Amp
 - c. Amphenol
 - d. Canare
 - e. H.H. Smith
 - f. Kings
 - g. Neutrik
 - h. Pomona
 - i. Switchcraft
 - j. Trompeter
 - k. Approved equal

O. Input Connection Plates

1. All plates are black anodized aluminum with engraved or laser etched white lettering unless otherwise noted.
 - a. Wall-mounted plates: custom color/finish by architect OR stainless/brushed aluminum
 - b. Wall-mounted plates in stage areas (behind proscenium): black
 - c. Wall-mounted plates at catwalk and overhead areas: black
 - d. Wall-mounted plates in Control Room: black
 - e. Floor-Box Mounted plates: black

P. Press Feed

1. Provide jacks and transformer as shown to combine low-impedance line level outputs and match them to inputs of consumer-type ("Hi-Fi") recording equipment. Provide three-pin receptacles to interface "pro-level" recording equipment to same low-impedance line level outputs. Locate in audio equipment rack. Provide custom assembly on panel using the following components:
 - a. Phono Receptacles

- 1) Use female phono ("RCA") panel mounted jacks, as shown below, which are insulated from the mounting panel and which use D-holes or other positive means to prevent jack rotation. Provide sufficient clearance so that inserted plugs do not short to the plate.

- b. Three-pin Receptacle
- c. Provide three-pin receptacle with black finish, for connection to "pro-level" equipment.

Q. Microphone Extension Cable

1. Provide 25-foot long rubber-covered flexible microphone extension cables. Fit each flexible extension cable with black three conductor XLR microphone receptacles. Provide one microphone cable per microphone.
 - a. Wireworks C25
 - b. Pro Co M25
 - c. Approved equal assembly
- 1) Quantity: As required by number of microphones provided.

R. Isolation Transformer

1. Jensen Transformer JT-11SSP-6M
2. ProCo LOT-1
 - a. Quantity: As required

S. Dual Line Output Transformer

1. Jensen Transformer DIN-2LO-11FL
2. Equal

T. Dual Two-Way Microphone Splitter

1. Jensen Transformer DIN-MS-2P
2. Equal

U. Audio Combiner

1. Provide passive audio combiner network. Provide with power supply as required. Mount in equipment rack.
 - a. RDL STD series
 - b. Equal

V. Terminal Blocks

1. Provide DIN-rail mounted terminal blocks where indicated on functional diagrams for microphones and line level lines.
 - a. Acceptable manufacturers:
 - 1) Wago
 - 2) Entrelec
 - 3) Equal

2. Provide DIN-rail terminal blocks, barrier strips or euro-style blocks for loudspeaker level lines.

W. Surface Mount Electrical Gang Boxes

1. Provide surface mount electrical gang boxes for all surface and pipe mount audiovisual devices in project. Coordinate mounting condition and requirements with electrical contractor. Provide in black or white as required to match faceplate.
 - a. FSR SMWB Series
 - b. Leviton BKBX Series
 - c. Electronic Theatre Controls Equal

X. Rack-Mounted Power Strips

1. For racks with sequenced power control provide modular vertical power strips complete with outlet modules, internal wiring and connectors, internal jumpers, wiring to external circuits, external wiring junction boxes, blank plates, and mounting hardware as required to deliver a complete, fully enclosed, and functional assembly.
 - a. Middle Atlantic MPR Series

Y. Loudspeaker Rigging and Suspension Equipment

1. See Paragraph 2.5F Loudspeaker Rigging and Suspension Equipment.

2.2 AUDITORIUM AUDIO INPUT EQUIPMENT

A. Wireless Microphone System

1. Provide all antennas, transmitters, and receivers by a single manufacturer.
2. Provide digital wireless microphone system with AES 256-bit encryption, Dante audio networking, allow up to 16 active transmitters on one 6 Mhz TV channel, switching diversity.
3. Provide all required power supplies and accessories to achieve intent of Drawings.
4. Provide complete with rack-mounting kits.
5. Provide with rack shelves for charging stations.
6. Provide antenna with all required hardware to mount to wall and point at stage.
 - a. Four-Channel Receiver
 - 1) Shure ULXD4Q
 - 2) Equal
 - a) Quantity: 1
 - b. Handheld Transmitter
 - 1) ULXD2/SM58
 - 2) Equal
 - a) Quantity: 2
 - c. Belt Pack Transmitter
 - 1) ULXD1
 - 2) Equal
 - a) Quantity: 2
 - d. Lavalier Microphone

- 1) Shure MX150/O
 - 2) Equal
 - a) Quantity: 2
 - e. Rechargeable Battery
 - 1) Shure SB900
 - 2) Equal
 - a) Quantity: 2
 - f. Charging Station w/ power supply
 - 1) Shure SBC200-US
 - 2) Equal
 - a) Quantity: 2
 - g. Charging Station w/o power supply
 - 1) Shure SBC200
 - 2) Equal
 - a) Quantity: 1
 - h. Remote Antenna Amplifier
 - 1) Shure UA834
 - 2) Equal
 - a) Quantity: 2
 - i. Active Directional Antenna
 - 1) Shure UA874
 - 2) Equal
 - a) Quantity: 2
 - j. Wall-Mount for Active Directional Antenna
 - 1) Atlas Sound AD-19B (black)
 - 2) Equal
 - a) Quantity: 2
- B. Lectern Microphone
- 1. Provide microphone with shock isolation. Supply microphone with 18-inch long flexible extension tube, stand clamps and foam windscreen. These microphones are intended for general use at lecterns, or on stands for reception of speech or music at distances of approximately 12 to 24 inches from source to microphone. For units without electronic vibration isolation provide additional shock-mount stand adapter. Install one microphone on lectern. Second microphone is provided for portable use.
 - a. Countryman Isomax 4RF, M4HP5RF24EB
 - b. Clock Audio C 35E-RF
 - c. Equal
 - 1) Quantity: 2
- C. Microphone Stage Box
- 1. Provide microphone with shock isolation. Supply microphone with 18-inch long flexible extension tube, stand clamps and foam windscreen. These microphones are intended for general use at lecterns, or on stands for reception of speech or music at distances of approximately 12 to 24 inches from source to microphone. For units without electronic

vibration isolation provide additional shock-mount stand adapter. Install one microphone on lectern. Second microphone is provided for portable use.

- a. Countryman Isomax 4RF, M4HP5RF24EB
- b. Clock Audio C 35E-RF
- c. Equal
- 1) Quantity: 2
- d.

2.3 AUDITORIUM PLAYBACK EQUIPMENT

A. Computer

- 1. Provide small form-factor computer with current and compatible windows operating system. Provide with 27" LCD monitor, 2 TB hard drive, 8 GB RAM. Dual output HDMI or Display Port output. Provide with wireless keyboard and mouse. Provide with Ethernet-audio enabled network interface and any required license for receiving and transmitting digital audio to the digital audio network. Load with DSP software and dashboard program setup for control over audio DSP, amplifier monitoring and audiovisual system diagnostics
 - a. Dell i5 7050 Micro w/ Dante Virtual sound card and Dante Via.
 - b. HP Equal w/ Dante Virtual Sound Card and Dante Via
 - 1) Quantity: 2 Stage Rack & Control Booth

B. Wireless Keyboard and Mouse

- 1. Provide RF wireless keyboard and separate wireless mouse, with both transmitters served by single 2.4GHz RF receiver. Provide system rated for 100 foot range.
 - a. Gyration Air Mouse Go Plus with Compact Keyboard
 - b. SMK Link Equal
 - 1) Quantity: 1 Set

C. AV Input Plate, Network

- 1. Provide Dante-based input/output plate with 2-channel Bluetooth audio input, pairing button, RCA and 3.5 mm stereo analog input, 3.5mm stereo analog output. Provide unit that that receives power and signal via Power Over Ethernet.
 - a. Atterotech unD6IO-BT
 - b. Equal
 - 1) Quantity: 1

2.4 AUDITORIUM AUDIO CONTROL AND AMPLIFICATION EQUIPMENT

A. 32-Channel Digital Audio Mixing Console (Owner Provided)

- 1. Provide digital audio mixing console with 64x64 MADI interface and a minimum of 32 analog microphone inputs and 2 stereo line input pairs. Provide with a minimum of 6 auxiliary outputs. Provide any additional switches, input cards, etc. necessary for the function of the console as shown on the functional diagrams. Provide for location of mixing console on countertop in control room and at front of house mix location.
 - a. Soundcraft Perform S3 (Existing)

- b. Equal
 - 1) Quantity: 1
- B. Digital Audio Mixing Console Option Cards
 - 1. Provide MADI compatible Option Cards with 64x64 Capacity. Provide cards compatible with mixing console and stage box connections. Replace existing cards.
 - a. Soundcraft CAT 5 MADI
 - 1) Quantity: 2
- C. Digital Audio Mixing Console Network Cable (25 Foot)
 - 1. Provide heavy-duty flexible portable network cable for patching digital audio mixing console to wall panel network ports.
 - a. Lex Products Ethercon RJ45 Cable, 25'
 - 1) Quantity: 2
- D. Digital Audio Mixing Console Network Cable (50 Foot)
 - 1. Provide heavy-duty flexible portable network cable for patching digital audio mixing console to wall panel network ports.
 - a. Lex Products Ethercon RJ45 Cable, 25'
 - 1) Quantity: 2
- E. Digital Audio Mixing Console Patch Cables (3 Foot)
 - 1. Provide heavy-duty flexible portable network cable for patching digital audio mixing console to wall panel network ports.
 - a. Lex Products Ethercon RJ45 Cable, 3'
 - 1) Quantity: 8
- F. Digital Mixing Console Input/Output Box (Stage Box)
 - 1. Provide rack-mountable remote I/O device compatible with digital mixing console. Provide device with 32 analog microphone inputs with console-controllable pre-amplifiers, 8 analog line level outputs on 3-pin XLR connectors which connects to the digital mixing console over Digital Audio Protocol. Provide device which can simultaneously receive channels and send channels of full bit rate digital audio over the single UTP connection. Provide all required input card, switches, etc, to connect I/O to console per functional diagrams.
 - a. Soundcraft Mini Stagebox 32R
 - b. No equal
 - 1) Quantity: 1 Stage Rack
- G. Digital Mixing Console Input/Output Box (Stage Box)
 - 1. Provide rack-mountable remote I/O device compatible with digital mixing console. Provide device with 16 analog microphone inputs with console-controllable pre-amplifiers, 8 analog line level outputs on 3-pin XLR connectors which connects to the digital mixing

console over digital audio protocol. Provide device which can simultaneously receive channels and send channels of full bit rate digital audio over the single UTP connection. Provide all required input card, switches, etc, to connect I/O to console per functional diagrams.

- a. Soundcraft Mini Stagebox 16R
- b. No equal
 - 1) Quantity: 1 Control Booth

H. Audio Network I/O Interface

- 1. Provide 1RU rack-mounted Audio Network interface for use with secondary analog mixing console or analog interface with existing mixing console. Provide device with minimum of 16 digital channels and 16 analog line level outputs on 3-pin XLR connectors which connects to the digital mixing console over Digital Audio Network. Provide device which can simultaneously receive channels and send channels of full bit rate digital audio over the single UTP connection through a network switch..
 - a. Atterotech Synapse-D16MIO w/ Gator Case GR-2L and Custom Rack Panel
 - b. Focusrite RedNet Equal w/ Gator Case GR-2L and Custom Rack Panel
 - 1) Quantity: 1

I. Audio Master Clock

- 1. Provide Audio Master Clock. Provide system compatible with Mixing console and Audio Network interface.
 - a. Black Lion audio Micro Clock MKIII XB
 - 1) Quantity: 1

J. Audio Network Master Clock

- 1. Provide Audio Master Clock compatible with external Audio Master clock and audio Network. Provide system compatible with audio network within performing arts area.
 - a. Studio Technologies Mode 5401 Dante Master Clock
 - 1) Quantity: 1

K. Digital Signal Processor

- 1. Provide digital signal processing system with inputs and outputs as shown on drawings, and the following functions. Provide all required devices, accessories, switches and cables to achieve a complete working system.
 - a. Feedback suppression
 - b. Nine bands of parametric equalization per signal input group
 - c. Crossover
 - d. Compressor
 - e. Digital delay
 - f. Signal limiting
 - g. Digital audio signal routing
 - h. Signal flow as shown on sound system functional drawing(s)
 - i. Volume control
 - j. Dante digital audio networking

2. Manufacturers

a. Basis of Design: Symetrix Radius

- 1) Symetrix Radius NX 12x8
 - a) Quantity: 1
- 2) Symetrix xIn 12
 - a) Quantity: 1
- 3) Symetrix xOut 12
 - a) Quantity: 1
- 4) Additional Symetrix components as required to provide specified functionality

b. Acceptable Alternates:

- 1) Equivalent system using QSC Q-SYS components
- 2) Equivalent system using Biamp Tesira components

L. Ethernet Switch

1. Provide SNMP capable, POE enabled, managed, gigabit Ethernet switches as required to support a Dante audio network and NDI network with functionality equivalent to networks shown on drawings and control system network. Provide Ethernet products compliant with IEEE 802.3.

- a. HP Aruba
- b. Cisco

M. Digital Signal Processor Preset Descriptions

1. Provide digital signal processing settings as described below. Exact determination of digital processor settings is an iterative process and final settings should be determined and documented with careful field measurements. Configure the default mode (with no muting) when master power switch is turned on. Configure so that all inputs are routed to appropriate outputs unless complete routing/rewiring of the internal DSP software devices is required. Presets are described below as parameter changes that do not require a muting and reinitializing of the digital signal processor. Provide access to muting presets through control system if included with project.

a. Presets required:

- 1) Eight Presets Minimum

N. Digital Signal Processor Control Surface

1. Provide digital signal processing control surface with motorized faders for individual volume controls and master volume. Provide with control of wireless and wired microphones as shown on drawings. Exact determination of settings is an iterative process. Determine settings with owner.

- 1) Mystery Electronics EM12 with Rack mount

O. Power Amplifier Serving Main Loudspeakers

1. Provide four-channel power amplifier with balanced bridging inputs and variable-speed fan(s). Provide amplifier which is 2-rack space units high. Provide amplifier which supplies at least 1200watts (nominal) per channel at 8-ohms. Provide amplifiers with switchable low and high impedance output modes per channel.

- a. Crown DCi 4|1250
- b. Lab.gruppen C68:4
- c. Equal

1) Quantity: 2

P. Power Amplifier Serving Front-Fill Loudspeakers

1. Provide four-channel power amplifier with balanced bridging inputs and variable-speed fan(s). Provide amplifier which is 2-rack space units high. Provide amplifier which supplies at least 300-watts (nominal) per channel at 8-ohms and at least 600-watts (nominal) per channel at 4-ohms. Provide amplifiers with switchable low and high impedance output modes per channel.

- a. Crown DCi 4|300
- b. Lab.gruppen C16:4
- c. Equal

1) Quantity: 1

Q. Power Amplifier Serving Underbalcony Loudspeakers

1. Provide 8-channel power amplifier with balanced bridging inputs and variable-speed fan(s). Provide amplifier which is 2-rack space units high. Provide amplifier which supplies at least 300-watts (nominal) per channel at 8-ohms and at least 300-watts (nominal) per channel at 4-ohms. Provide amplifiers with switchable low and high impedance output modes per channel.

- a. Crown DCi 8|300
- b. Lab Gruppen C 20:8X

1) Quantity: 1

2.5 AUDITORIUM LOUDSPEAKER COMPONENTS

A. Loudspeaker Manufacturer

1. All loudspeakers shall be supplied by the same manufacturer, except where that manufacturer does not make one of the specified loudspeakers.

B. Central Cluster Line Array Loudspeaker

1. Provide 2-way full range compact line array loudspeaker with dual 8-inch low-frequency drivers with 2-inch voice coils, and three high-frequency compression driver with 1.4-inch voice coil. Provide with all necessary suspension hardware to achieve mounting position and geometry as shown on Drawings, including supplemental steel as required to create rigging points above loudspeaker. Provide loudspeaker and mounting hardware with finish as directed by architect. Provide with all required inter-box link power and signal cables.

- a. Fulcrum FL283
- b. Equal

- 1) Quantity: 5

C. Line Array Loudspeaker Suspension Hardware

1. Provide suspension frame hardware for suspension of line array loudspeakers. Provide components from same manufacturer and compatible with line array loudspeaker provided.
 - a. Fulcrum Acoustics Fly bar kit and Pull up bar kit
 - b. Equal
 - 1) Quantity: 1

D. Front Fill Loudspeaker

1. Provide compact 2-way loudspeaker with 5-inch concentric driver.
 - a. Tannoy AMS5ICT – Black with Yoke Mounts
 - b. Equal
 - 1) Quantity: 4

E. Rear Fill/Underbalcony Loudspeaker

1. Provide compact 2-way loudspeaker with 5-inch concentric driver.
 - a. Tannoy AMS5ICT – Black with Yoke Mounts
 - b. Equal
 - 1) Quantity: 4

F. Loudspeaker Rigging and Suspension Equipment

1. Provide loudspeaker rigging for loudspeaker clusters and suspended loudspeakers. Suspend loudspeaker components from brackets and any necessary suspension frames to minimize total number of attachment points to building or other structure. Provide with a sufficient number of suspension points to allow field adjustment of loudspeaker aiming, +/-5 degrees minimum in all axes.
2. During fabrication and installation verify that adequate clearance from all other hanging components and structural steel is provided.
3. Provide any additional rigging hardware necessary for the safe and proper installation of the loudspeakers.
4. Provide safety cables to prevent individual loudspeaker cluster components from falling in case of failure or loosening of the primary component support.
5. Paint all exposed components as directed by the Owner's authorized representative.
6. Manufacturers
 - a. Ape Rigging
 - b. Polar Focus
 - c. Approved Contractor-fabricated assembly (submit evidence of successful completion of previous projects with bid)
7. Submit all drawings of the complete final loudspeaker rigging assemblies to a licensed structural engineer and obtain stamped copies of the drawings. Drawings must detail all connections from attachment to building structure to loudspeaker.

G. Control Room Monitor Loudspeaker

1. Provide active 2-way compact monitor loudspeaker with 8-inch low-frequency driver and dome tweeter. Provide with table stand to elevate loudspeaker above mixing console.
 - a. PreSonus Sceptre S-8
 - b. Dynaudio LYD 8
 - 1) Quantity: 2

H. Desktop Stand for Control Room Monitor Loudspeaker

1. Provide desktop stand to elevate control room monitor loudspeaker above mixing console.
 - a. IsoAcoustics
 - b. Equal
 - 1) Quantity: 2

2.6 AUDITORIUM LEFT/RIGHT STEREO LOUDSPEAKER SYSTEM (DELETE ALTERNATE 1)

A. Left/Right Cluster Line Array Loudspeaker

1. Provide 2-way full range compact line array loudspeaker with dual 8-inch low-frequency drivers with 2-inch voice coils, and three high-frequency compression driver with 1.4-inch voice coil. Provide with all necessary suspension hardware to achieve mounting position and geometry as shown on Drawings, including supplemental steel as required to create rigging points above loudspeaker. Provide loudspeaker and mounting hardware with finish as directed by architect. Provide with all required inter-box link power and signal cables.
 - a. Fulcrum FL283
 - b. Equal
 - 1) Quantity: 10 (5 per side)

B. Line Array Loudspeaker Suspension Hardware

1. Provide suspension frame hardware for suspension of line array loudspeakers. Provide components from same manufacturer and compatible with line array loudspeaker provided.
 - a. Fulcrum Acoustics Fly bar kit and Pull up bar kit
 - b. Equal

C. Power Amplifier Serving Main Loudspeakers

1. Provide four-channel power amplifier with balanced bridging inputs and variable-speed fan(s). Provide amplifier which is 2-rack space units high. Provide amplifier which supplies at least 1200watts (nominal) per channel at 8-ohms. Provide amplifiers with switchable low and high impedance output modes per channel.
 - a. Crown DCi 4|1250
 - b. Lab.gruppen C68:4
 - c. Equal
 - 1) Quantity: 3

2.7 AUDITORIUM EQUIPMENT RACKS AND ACCESSORIES

A. Gangable Floor-Standing Equipment Rack

1. Locate in equipment rack closet in control room. Use modular rack with bolt-together frame, side panels, locking rear door, and vented, locking front door, which accepts extra panel-mounting angles. Fill in unused rack space with blank solid panels, per industry best practices for air flow. Recess rack rails to allow front doors to close when patch cords are in use. Provide rack, accessories, and filler panels in smooth (not wrinkle) matte black finish. Provide rack with minimum 30-inch depth.

- a. Middle Atlantic WRK-XX32 Series Assembly
- b. Lowell Manufacturing LGR-XX32

1) Quantity: 2

B. Cooling Fan for Gangable Floor-Standing Equipment Rack

1. Provide cooling fan compatible with and from same manufacturer as Gangable Floor-Standing Equipment Rack specified above. Provide with thermostatic automatic fan control.

- a. Middle Atlantic MW-4QFT-FC
- b. Lowell Manufacturing equivalent

1) Quantity: 2

C. Caster Base for Gangable Floor-Standing Equipment Rack

1. Provide caster base compatible with and from same manufacturer as Gangable Floor-Standing Equipment Rack specified above, with locking casters.

- a. Middle Atlantic CBS-BGR
- b. Lowell Manufacturing equivalent

1) Quantity: 2

D. Swing-Out Equipment Rack (Stage Equipment Rack)

1. Provide wall-mounted equipment rack with pivoting center section, floor base, and vented, lockable front door. Fill in unused rack space with blank solid panels, per industry best practices for air flow. Provide rack, accessories, and filler panels in smooth (not wrinkle) matte black finish. Provide with thermostatically controlled fan kit.

- a. Middle Atlantic DWR-18-26PD
- b. Lowell Manufacturing equivalent

1) Quantity: 1

E. Cooling Fan for Swing-Out Equipment Rack

1. Provide cooling fan compatible with and from same manufacturer as Swing-Out Equipment Rack specified above. Provide with thermostatic automatic fan control.

- a. Middle Atlantic DWR-FK32 w/ FC-2-215-1CA
- b. Lowell Manufacturing equivalent

1) Quantity: 1

F. Vertical Modular Power Raceway – Gangable Floor-Standing Equipment Rack

1. Furnish equipment racks with permanently-mounted 3-conductor AC power receptacles with sufficient outlets to meet system needs plus at least 2 spares per rack. Provide raceway configured with separately circuited receptacle groups as required to distribute load across multiple circuits. Provide whip with plug to match for connection to power outlet box as indicated on the power plan drawings. Provide with all power modules, wiring jumpers, wiring tails, blank covers, and other accessories required to produce a fully contained assembly configured per the Drawings and as required to meet all specified functionality.
 - a. Middle Atlantic MPR-9A w/ (4) RLM-20IGA and (4) M-20IGA modules
 - b. Juice Goose CQ-PD1-4, CQ2200, CQ2000 (special order IG version)
 - c. Equal
 - 1) Quantity: As required (minimum 1 per rack)

G. Vertical Modular Power Raceway – Swing-Out Equipment Rack

1. Furnish equipment racks with permanently-mounted 3-conductor AC power receptacles with sufficient outlets to meet system needs plus at least 2 spares per rack. Provide raceway configured with separately circuited receptacle groups as required to distribute load across multiple circuits. Provide whip with plug to match for connection to power outlet box as indicated on the power plan drawings. Provide with all power modules, wiring jumpers, wiring tails, blank covers, and other accessories required to produce a fully contained assembly configured per the Drawings and as required to meet all specified functionality.
 - a. Middle Atlantic MPR-3A raceway w/ (1) RLM-20IGA and (2) M-20IGA modules
 - b. Juice Goose equivalent
 - c. Equal
 - 1) Quantity: 1

H. High Density Vertical Power Strip

1. Furnish equipment racks with permanently-mounted 3-conductor AC power receptacles with sufficient outlets to meet system needs plus at least 2 spares per rack. Provide raceway configured with 24 20A outlets. Connect to remotely controlled outlets per the Drawings and as required to meet all specified functionality.
 - a. Middle Atlantic PD-2420SC-NS
 - b. Juice Goose equivalent
 - 1) Quantity: As required (minimum 1 per rack)

I. System Power Control

1. Provide a relay-controlled power switching system with a master power switch and power-on indicator for the system. Connect the master power switch to control each receptacle in the rack except for one spare receptacle. Label unswitched receptacles "UNSWITCHED". Connect power for rack illumination to bypass the system master power switch. Provide a means to cycle the system power amplifiers on sequentially at intervals of approximately one second whenever the power switch is activated. Connect to remote control system and other power controllers per the Drawings.
 - a. Middle Atlantic USC-6R
 - b. Atlas Sound SACR-191

- c. Juice Goose CQ1520
 - 1) Quantity: 1

J. Uninterruptible Power Supply

- 1. Provide 1000VA minimum rack-mounted UPS system to provide power-surge and power-loss protection to digital signal processor system.
 - a. Middle Atlantic UPS-1000R
 - b. APC SUA1000RM2U
 - c. Powerware 5125 1000 RM
 - 1) Quantity: 1

K. Rack Work Light

- 1. Provide locally switched utility lighting. Connect to unswitched receptacle. Mount in back of equipment rack.
 - a. Atlas Sound RWL-2
 - b. Equal
 - 1) Quantity: 3

L. Rack Lighting

- 1. Littlite Raklite RL-10-D-LED
- 2. Equal
 - a. Quantity: 3

M. 2 Rack Unit Locking Storage Drawer

- 1. Provide 2 rack space locking rack mounted drawer.
 - a. Middle Atlantic D2-LK
 - b. Raxxess SDR-2 w/ lock
 - 1) Quantity: 2

N. Rack Shelf for Small Devices

- 1. Middle Atlantic UFA-14.5 w/ UFA-2 faceplate
 - a. Quantity: 3

2.8 TELEVISION STUDIO SYSTEM

A. Main Console Desk

1. Provide customized modular desk with rack components, wire managements and posts for monitor arms.
 - a. Winsted E-SOC Control Station with units configured as shown on drawings
 - b. Equal
 - 1) Quantity: 1

B. Portable Equipment Rack

1. Provide movable rack with large casters, side panels, locking rear door, and vented, locking front door, which accepts extra panel-mounting angles. Fill in unused rack space with blank solid panels, per industry best practices for air flow. Provide rack, accessories, and filler panels in smooth (not wrinkle) matte black finish. Provide rack with minimum 30-inch depth.
 - a. Middle Atlantic PTRK-2126MDK
 - b. Marshall Furniture Equal
 - c. Spectrum Industries Furniture Equal
 - 1) Quantity: 1

C. Pan/Tilt/Zoom Camera

1. Provide NDI-capable, HD-SDI equipped, audio-embedding, HD video camera with automated pan/tilt/zoom operation. Provide with all required connecting cables and power supplies. Provide camera in black per owner.
 - a. Panasonic AW-HN40HK Provide with 5 year warranty
 - b. Sony Equal
 - 1) Quantity: 4

D. Camera Controller

1. Provide IP-based camera controller for remote pan/tilt/zoom cameras.
 - a. Panasonic AW-RP50
 - b. Sony Equal
 - 1) Quantity: 1

E. Pipe Mount for PTZ Camera

1. Provide all mounting hardware required to mount PTZ camera securely to 1.9" OD lighting pipe.
 - a. Quantity: 4

F. Wall Mount for PTZ Camera

1. Provide steel wall mount for pan/tilt/zoom camera.
 - a. Panasonic FEC-40WMK
 - b. Equal
 - 1) Quantity: 4

G. Rack-Mount Multi-Monitor

1. Provide rack-mount unit with four LED backlighted 4 inch high resolution displays. Provide each display with HD-SDI inputs
 - a. Datavideo TLM-434H
 - b. Marshall V-MD434-3GSDI
 - c. Equal
 - 1) Quantity: 1

- H. Control Room Video Monitor
 - 1. Provide 24-inch diagonal flat-panel LCD with matte screen, 16:9 aspect ratio, 1920x1080 resolution, HDCP support, 3G-SDI and HDMI input. Provide unit from one of the following manufacturers..
 - a. JVC ProHD DT-N24F
 - 1) Quantity: 2
- I. Control Room Video Monitor
 - 1. Provide 24-inch diagonal flat-panel LCD with matte screen, 16:9 aspect ratio, 1920x1080 resolution, HDCP support, and HDMI input. Provide unit from one of the following manufacturers..
 - a. Samsung S24E650BW
 - 1) Quantity: 2
- J. HD-SDI to HDMI Converter Scaler
 - 1. Provide HD-SDI to HDMI scaler support input resolutions up to 2018x1080p/60Hz.
 - a. Decimator Design Decimator 2
 - b. Equal
 - 1) Quantity: 4
- K. DVI Distribution Amplifier 1x2
 - 1. Provide a minimum of 1 input by 2 outputs DVI distribution amplifier.
 - a. Extron DVI DA4
 - b. Equal
 - 1) Quantity: 1
- L. HDMI Distribution Amplifier 1x4
 - 1. Provide a minimum of 1 input by 4 outputs HDMI distribution amplifier.
 - a. Extron DA4 HD 4K
 - b. Equal
 - 1) Quantity: 1
- M. Broadcast Switcher
 - 1. Provide broadcast switcher with the following features:
 - a. NDI Inputs: 16
 - b. HD-SDI inputs: 4
 - c. HD-SDI outputs: 4
 - d. Local video outputs: 3
 - e. Stream outputs: 2
 - f. 4k UHD support
 - g. Balanced analog audio input and output
 - h. Clip ingestion from watched folders
 - i. Multi-screen, multi-view output
 - j. Key layers:3
 - k. Internal storage: 2 x 3 TB minimum
 - l. Software audio mixer
 - m. Clip server
 - n. CG Graphics
 - o. Pan/tilt/zoom camera control
 - p. Dante audio
 - q. Telestrator
 - r. Test and title package
 - s. ISO recording
 - t. Small control panel with joystick camera control

2. Provide unit with keyboard and mouse.
 - a. NewTek TriCaster TC1 Base Bundle w/ Advanced Edition Software (Academic)
 - b. Equal
 - 1) Quantity: 1
- N. NDI Camera Interface
 1. Provide devices to convert HDMI and HD-SDI signals to NDI.
 - a. NewTek NC1 Studio I/O Module
 - 1) Quantity: 1
- O. Ethernet Switch
 1. Provide SNMP capable, managed, gigabit Ethernet switches as required to support a Dante audio network with functionality equivalent to audio network shown on drawings and control system network. Provide Ethernet products compliant with IEEE 802.3.
 2. Provide switch with single-mode fiber, LC connector interfaces to create ring topology, per Drawings.
 3. Create VLANs per drawings.
 - a. HP Aruba
 - 1) Quantity: 1
- P. HD-SDI To Fiber
 1. Provide a 4K capable (minimum) HD-SDI to Fiber Converter
 2. Provide for portable use at camera tripod areas within auditorium
 - a. AJA FiDO Single Channel 3G to ST Fiber
 - b. Equal
 - 1) Quantity: 6
- Q. Fiber to HD-SDI
 1. Provide a 4K capable (minimum) Fiber Converter to HD-SDI
 2. Provide for TV Studio use and extension from Auditorium
 - a. AJA FiDO-2R Dual Channel Fiber to SDI converter/receiver
 - b. Equal
 - 1) Quantity: 3
- R. Tripod Mounted Camera
 1. Provide HD-SDI camera shoulder mounted style, HD video camera. Provide with included lens.
 - a. JVC GYHM850C14 1/3" ProHD Shoulder Mount Camcorder with Canon 14X ENG Zoom Lens
 - 1) Quantity: 3
- S. Variable Speed zoom/focus controller
 1. Provide variable zoom and focus controller compatible with stand and camera
 - a. JVC HZAS1G
 - 1) Quantity: 3
- T. Studio Tripod 17.5 lb Capacity
 1. Provide Studio Tripod compatible with camera and with 17.5 lb capacity
 - a. Benro S8
 - b. Manfrotto Equal
 - 1) Quantity: 2
- U. Studio Tripod 22.5 lb Capacity
 1. Provide Studio Tripod
 - a. Benro S8

- b. Manfrotto Equal
- 1) Quantity: 1

V. Studio Tripod Dolly

- 1. Provide tripod dolly
 - a. Benro
 - b. Manfrotto Equal
 - 1) Quantity: 3

W. Tripod Pan Bar

- 1. Provide Tripod Pan Bar
 - a. Brenro
 - b. Manfrotto Equal
 - 1) Quantity: 3

2.9 TELEVISION STUDIO AUDIO EQUIPMENT

A. Wired and Wireless Microphone System

- 1. Connect existing audio systems to existing audio console

B. Lavalier Microphone, Wired

- 1. Provide omni-directional lavalier microphone.
 - a. Audio-Technica AT899
 - 1) Quantity: 4

C. Audio Network I/O Interface

- 1. Provide 1RU rack-mounted Audio Network interface for use with existing mixing console
Provide device with minimum of 16 digital channels and 16 analog line level outputs.
 - a. Atterotech Synapse-D16MIO
 - b. Focusrite RedNet Equal
 - 1) Quantity: 1

D. Control Room Monitor Loudspeaker

- 1. Provide active 2-way compact monitor loudspeakers with 3 inch low-frequency driver and dome tweeter. Provide with table stand to elevate loudspeaker above mixing console.
- 2. Provide with short table stand to elevate loudspeakers above mixing console.
 - a. Genelec 6010B
 - b. M-Audio Studiophile AV 40
 - c. Equal
 - 1) Quantity: 2

E. Ethernet Switch

- 1. Provide SNMP capable, managed, gigabit Ethernet switches as required to support a Dante audio network with functionality equivalent to audio network shown on drawings and control system network. Provide Ethernet products compliant with IEEE 802.3.
 - a. HP Aruba
 - b. Cisco
 - 1) Quantity: 1

2.10 TELEVISION STUDIO CABLES

A. Extension Cables

1. Power Cables
 - a. Provide 12/3 SO edison extension cables with color-coded length marker and knotted tie line in length as quantities below
 - 1) 25 foot: 5
 - 2) 50 foot: 2
2. Ethernet Cables
 - a. Provide black heavy-duty Cat5e extension cable with snagless RJ-45 connectors and quantities below.
 - 1) 5 foot: 25
 - 2) 10 foot: 10
 - 3) 25 foot: 15
 - 4) 50 foot: 10
3. Microphone Cables
 - a. Provide 25-foot long rubber-covered flexible microphone extension cables. Fit each flexible extension cable with black three conductor XLR microphone receptacles. Provide one microphone cable per microphone.
 - 1) Wireworks C25
 - 2) Pro Co M25
 - 3) Approved equal assembly
 - a) 10 foot: 5
 - b) 25 foot: 5
 - c) 50 foot: 10
4. HD-SDI Cables
 - a. Provide black heavy-duty RG-6 HD-SDI extension cable with BNC connector and quantities listed below.
 - 1) 10 foot: 5
 - 2) 25 foot: 5
 - 3) 50 foot: 10

2.11 TELEVISION STUDIO TELEPROMPTER

- A. Provide a complete teleprompter system including Stand Mounted Provide Cat # based cabling system with USB power connection to production system.
- B. Tally Light Controller
 1. Provide tally light controller with power distribution. Locate in control room equipment rack.
 - a. MetaSETZ TLC-8S
 - 1) Quantity: 1
- C. Camera Mount Tallylight
 1. Provide Tallylight compatible with controller and with camera mount
 - a. metaSETZ TL-2-C
 - 1) Quantity: 4
- D. Tallylight Adapters and Cables
 1. Provide Cat 6 cables with RJ45 connectors, 1/8 jacks to Intercom cable adapters and standard XLR cables for use with Tally light and Intercom system
 - a. Quantity: As Needed

2.12 TELEVISION STUDIO TALLY LIGHT SYSTEM

- A. Provide a production system controlled Tally Light system. Provide Cat # based cabling system with USB power connection to production system.
- B. Tally Light Controller
 - 1. Provide tally light controller with power distribution. Locate in control room equipment rack.
 - a. MetaSETZ TLC-8S
 - 1) Quantity: 1
- C. Camera Mount Tallylight
 - 1. Provide Tallylight compatible with controller and with camera mount
 - a. metaSETZ TL-2-C
 - 1) Quantity: 4
- D. Tallylight Adapters and Cables
 - 1. Provide Cat 6 cables with RJ45 connectors, 1/8 jacks to Intercom cable adapters and standard XLR cables for use with Tally light and Intercom system
 - a. Quantity: As Needed

2.13 AUDITORIUM VIDEO SYSTEM INPUT EQUIPMENT

- A. Custom Multimedia Enabled Lectern
 - 1. Provide custom lectern with all related audio, video and control equipment securely installed.
 - 2. Provide lectern with the following features:
 - a. Standard 19-inch equipment rack mounting
 - b. Locking casters
 - c. Space for two laptops to sit on work surface
 - d. Space for cable management (specified below)
 - e. Pull-out drawer for document camera.
 - f. Reading light
 - g. Clock
 - h. Gooseneck microphone
 - i. AC power distribution
 - j. Locking storage drawer or compartment
 - k. Angled mount for touch panel.
 - l. Custom school logo on front of lectern
 - 3. Wood Species and Finish: per Architect
 - 4. Hardware Finish: per Architect
 - 5. Acceptable Manufacturers:
 - a. Miller's Millwork
 - b. Marshall Furniture
 - 1) Quantity: 1
- B. Lectern Equipment
 - 1. Integrate specified equipment within lectern specified above. Coordinate installation with Owner's Designated Representative. Secure all equipment neatly within lectern. Provide

- a means for coiling, storing, and securing excess umbilical cabling within lectern. Provide with all required power supplies and distribution.
2. Cable Management
 - a. Provide cable management enclosure mounted in lectern. Provide with cables and cable umbilical as shown on the functional diagram. Label all cables near connector with function. Install in top of lectern as directed by Owner's Designated Representative.
 - b. Provide unit with the following:
 - 1) Two 120V AC Power Outlets
 - 2) Two powered USB outlets
 - 3) HDMI cable with retractor
 - 4) UTP network cable with retractor
 - a) Extron Cable Cubby 1200 assembly
 - b) Equal
 - c) Quantity: 1
 3. Gooseneck Microphone Mount
 - a. Provide gooseneck microphone mount flush-mounted in top of lectern. Provide with finish chosen from manufacturer's standard options as directed by Architect.
 - 1) FSR T3-MJ-XXX
 - 2) Equal
 - a) Quantity: 1
 4. Cables
 - a. HDMI
 - 1) Extron HDMI Ultra/15
 - 2) Crestron CBL-HD-20
 - a) Quantity: 2
 - b. UTP Network Cable
 - 1) Lex Products Ethercon RJ45 Cable, 15'
 - 2) Equal
 - a) Quantity: 1
 5. Cable Adapters
 - a. DVI to HDMI
 - 1) Extron HDMIF-DVIDM
 - 2) equal
 - a) Quantity: 2
 - b. Displayport to HDMI
 - 1) Extron DPM-HDMIF
 - 2) equal
 - a) Quantity: 2
 6. Umbilical Cord

- a. Provide 15-foot long umbilical cord for lectern with power, data, and signal cables bundled within a flexible synthetic mesh, clearly labeled and provided with appropriate strain relief. All cables in the umbilical should be designed for hard usage and repeated handling. Use of cables designed for installation in conduit will not be accepted.

1) Quantity: 1

2.14 AUDITORIUM VIDEO SYSTEM PROCESSING AND CONTROL EQUIPMENT

A. Manufacturer

1. Basis of Design: Crestron DigitalMedia
2. Acceptable Alternate: AMX Enova/DXLink Series

B. Integrated Audiovisual Matrix Switcher and Controller

1. Provide audiovisual matrix switcher and integrated system control processor with the following properties:
 - a. Local HDMI inputs: 4
 - b. Local RGB inputs: 2
 - c. Remote category cable digital video inputs: 2
 - d. Local HDMI outputs: 2
 - e. Remote category cable digital video outputs: 2
 - f. Bidirectional RS-232 ports: 2
 - g. Logic inputs: 4
 - h. IR Outputs: 4
 - i. Program audio output
 - j. Ethernet support
 - k. HDCP key management
 - l. EDID management
 - m. Fast HDMI switching
 - n. CEC signal management
 - o. HDBT-compatible projector output
 - p. iPad control license or application credit
 - q. Integrated wireless presentation system

- 1) Crestron DMPS3-4K-350-C-AIRMEDIA
- 2) Extron Equal
- 3) AMX Equal

a) Quantity: 1

C. PoE+ Power Supply for Integrated Audiovisual Matrix Switcher and Controller

1. Provide PoE+ power supply compatible with integrated audiovisual matrix switcher and controller.
 - a. Crestron PW-4830DUS
 - b. Extron Equal
 - c. AMX Equal

1) Quantity: 1

D. HDMI Wall Plate Transmitter

1. Provide one-gang digital transport input panel with support for HDMI, DVI and DisplayPort video signal formats. Provide unit with support for HDMI and analog stereo audio signal formats. Provide device which transports all video signals digitally to the A/V switcher over a single CAT5e cable. Provide with cover plate suitable for wall box or floor box as required.

- a. Crestron DM-TX-4K-100-C-1G (color per Architect)
- b. AMX Equal

1) Quantity: 2

E. HDMI Wall Plate Transmitter, Point-to-Point

1. Provide one-gang digital transport input panel with support for HDMI, DVI and DisplayPort video signal formats. Provide device which transports all video signals digitally to a compatible receiver over a single CAT5e cable. Provide with cover plate suitable for wall box or floor box as required.

- a. Crestron HD-TX-101-C-1G-E (color per Architect)
- b. Extron Equal

1) Quantity: 2

F. HDMI Transmitter, Point-to-Point

1. Provide digital transport device with support for HDMI, DVI and DisplayPort video signal formats. Provide device which transports all video signals digitally to a compatible receiver over a single CAT5e cable.

- a. Crestron HD-TX-101-C-E
- b. Extron Equal

1) Quantity: 1

G. HDMI Wall Plate Receiver, Point-to-Point

1. Provide digital transport receiver with HDMI output compatible with transmitters specified above.

- a. Crestron HD-RX-101-C-E
- b. Extron Equal

1) Quantity: 3

H. DigitalMedia Scaling Receiver

1. Provide scaling Digital Media receiver with HDMI output and bi-directional RS232 port.

- a. Crestron DM-RMC-4K-SCALER-C

1) Quantity: 1

2.15 AUDITORIUM VIDEO SYSTEM OUTPUT EQUIPMENT

A. Video Projector

1. Provide lampless video projector with 12,000 ANSI lumen output (minimum), laser phosphor light engine, 2500:1 contrast ratio (minimum), HDBaseT input, and a native aspect ratio of 16:10 and minimum resolution of 1920x1200 (WUXGA). Provide projector

with motorized zoom lens and recallable zoom, focus and lens shift presets. Verify final throw distance to projection screen, screen size and geometry before ordering lens. Provide video projector with color as directed by Architect.

- a. Sony VPL-FHZ120L w/ lens (color by Architect)
- b. Christie Digital D13WU-HS w/ lens
- c. Panasonic PT-RZ12KU w/ lens
- d. Equal

1) Quantity: 1

B. Video Projector Mount

1. Provide adjustable ceiling mount for video projector.

- a. Chief Manufacturing RPMAUW w/ hardware as required
- b. Christie OneMount
- c. Panasonic equal

1) Quantity: 1

C. Control Room Video Monitor

1. Provide 24-inch diagonal flat-panel LCD with matte screen, 16:9 aspect ratio, 1920x1080 resolution, HDCP support, and HDMI input. Provide unit from one of the following manufacturers.

- a. Samsung SAS24E650BW
- b. HP equal
- c. NEC equal
- d. LG equal

1) Quantity: 1

2.16 AUDITORIUM CONTROL SYSTEM EQUIPMENT

A. Touch Screen Control Panel

1. Provide 7" diagonal touch screen control panel. Provide touch panel that can be controlled and powered by a single Category cable.

- a. Crestron TSW-760-B-S (black)
- b. AMX Equal

1) Quantity: 3

B. Tabletop Kit for Touch Screen Control Panel

1. Provide tabletop mounting kit for 7" diagonal touch screen control panel. Permanently mount one touch screen control panel on lectern using tabletop mount.

- a. Crestron TSW-760-TTK-B-S (black)
- b. AMX Equal

1) Quantity: 2

C. Rack Mount Kit for Touch Screen Control Panel

1. Provide rack mount kit for 7" diagonal touch screen control panel. Mount one touch screen control panel in Stage Equipment Rack using rack mount kit.
 - a. Crestron TSW-560/760-RMK-1
 - b. AMX Equal
 - 1) Quantity: 1

D. Cables

1. Provide serial interface cables, infrared emitters, and line amplifiers as required to control devices shown on the Drawings.

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

- A. Supply racks, wire, conduits, and raceways required to provide a complete system. Unless specifically instructed to the contrary, install all system wiring in steel conduit. Do not exceed 30% fill in conduits. Insulate all conduit from the equipment rack(s); connect conduits mechanically and electrically to the system ground point. Coordinate with the Owner and the Owner's authorized representative.
- B. If and only if directed to do so by the Owner's authorized representative, omit conduit for loudspeaker wiring above accessible ceilings; attach loudspeaker wiring neatly to building structure or other firm support. Allow no loudspeaker wiring to rest on suspended ceiling material or touch any heat sources.
- C. Where conduit or EMT is not indicated on drawings, install cable exposed and supported on J-hooks that maintain proper cable bend radius and prevent kinking or crimping. Do not lay cable directly on ceiling or on floor in under-floor application; secure with hook-and-loop cable wrap; do not secure with tie-wraps.
- D. Use separate wiring pathways for microphone-level circuits (below -20 dBm), video and line-level audio circuits (up to +30 dBm), loudspeaker circuits (above +30 dBm), control circuits, and power circuits. Space all low-voltage pathways far from power circuits per conduit separation distances table shown on drawings.
- E. Do not splice lines in conduit. Use only cables which are insulated from the conduit and from each other for the entire conduit length. Connect each input receptacle by an individual, insulated line to the system equipment rack.
- F. Terminate all conductors. Use appropriate connectors for video cables and for audio cables which mate to equipment connectors. Use appropriately-sized crimp-on spade lugs for unconnectorized audio or remote-control wiring unless conductors are to be inserted into setscrew-type terminal blocks. If conductors are to be inserted into setscrew-type terminal blocks, tightly twist wire strands together.
- G. Adhere to industry standards for wiring terminations, conductor color coding, and connector pin assignments.
- H. Secure equipment firmly in place, including projectors, control panels, loudspeakers, conduit, amplifiers, racks, cables, etc. For all overhead mounted devices, provide secondary attachment to provide support in case of failure of primary support. Make fastenings and supports adequate to support their loads with a safety factor of at least three.
- I. To each accessory or loose piece of equipment (e.g. computer interface, interconnection cable, handheld remote control), permanently affix or attach a machine-printed label or tag showing the item's assigned room name or number, as approved by the Owner, in neat numerals at least 3/8 inch high.
- J. Provide video and audio patch panels with minimum 33% spare capacity (one unused patch panel hole for every three jacks). Fill all unused holes with hole plugs.
- K. Assemble and install equipment racks to permit access to connections and adjustments on rear of rack mounted components and to permit removal of components for servicing. For any

components which, for purposes of adjustment or calibration, must be removed from an equipment rack while in use, provide adequate service loops in all connecting cables.

- L. Install work neatly, with boxes, equipment, etc. plumb and square.
- M. Install the system in cooperation with other trades in order to achieve coordinated progress and satisfactory final results. Watch for conflicts with work of other trades on the job. Execute, without claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or preserve symmetry and a pleasing appearance.
- N. Wire all equipment racks and fabricate all equipment subassemblies at off-site facilities. Fully test all equipment subassemblies before delivery to the jobsite. Limit work at the jobsite to mounting, interconnecting, and system-level testing of equipment.
- O. Certify to the Owner the satisfactory performance of completed equipment assemblies before shipping to the installation site. Permit the Owner or his authorized representative to witness the off-site testing of such equipment assemblies.
- P. Clearly, consistently, logically, and permanently mark switches, connectors, jacks, relays, receptacles, electronic equipment, and other equipment. Engrave and paint-fill all panel and receptacle markings, directly on the material on which controls or receptacles are mounted. Fill engraving with black or white paint, whichever contrasts best with panel finish, or as directed by the Owner's authorized representative. Use no hand-lettering, embossed tape (e.g. Dymo labels), or any adhesive-attached or otherwise mechanically-attached labels for any labels visible to operators or the public during normal operation. Use adhesive-attached or screw-attached engraved labels on manufactured assemblies, such as amplifiers, which would otherwise require disassembly for direct engraving. Use Kroy or similar "letter quality" or "near letter quality" mechanically-produced lettering for patch panel labels. Insert patch panel labels into clear plastic-covered label holders.
- Q. Where data communications cables connect directly to A/V equipment and are concealed from view, affix project standard data jack label to A/V equipment in visible location.
- R. Permanently mark cables with an identifying label within 1-12" of each end, employing a consistent identifying scheme. Use printed adhesive cable markers to mark cables, or other labels intended for the purpose. Allow no un-marked cables in the system.
- S. Install all switching devices and connectors for circuits where hazardous voltages are present within metal enclosures. Provide positive electrical ground for all such enclosures. Provide protective covers, clearly marked to indicate nominal voltage levels, on all terminal strips where such voltages are present.
- T. Exercise care in wiring to avoid damage to cables and other equipment. Maintain bend radius of minimum 10 times cable diameter for all coaxial, multiconductor, and fiber optic cables. Use terminal strips or blocks in all audio and control lines entering or leaving the system equipment rack(s). Make all joints and connections with rosin-core solder or with mechanical connectors appropriate for the application. Execute all wiring installation in strict adherence to standard industry practices.
- U. Provide strain relief for all connections to portable equipment, where those connections are made on terminal blocks, Phoenix connectors, or by similar means without inherent strain relief. Provide similar strain relief to connections within floor boxes where cabling may flex when serviced. Provide this strain relief by mechanically attaching cables to case of equipment. Do not use adhesive-backed plates.

- V. Take precautions to prevent electromagnetic and electrostatic interference.
- W. Install all equipment to provide safe operation.
- X. Provide ventilation as required to maintain equipment within the manufacturer's specified temperature limits.
- Y. Except for coaxial and RF relays, install all relays in sockets or in an otherwise removable manner. Do not solder directly to relay terminals.
- Z. Mount central loudspeaker cluster components using metal supports (3/8" minimum diameter metal rod) such that loudspeakers may be reoriented +/-5 degrees for optimum coverage, but will maintain precise orientation after adjustment. Provide safety cables to prevent individual loudspeaker cluster components from falling in case of failure or loosening of the primary component support. Paint all exposed components as directed by the Owner's authorized representative.
- AA. Ground each audio cable shield at one point and one point only. Terminate shields at the "floating" end with insulating collars or plastic tape. Connect all electronics grounds to a common point on the equipment rack(s). Ground this point and the rack(s) to the building main service ground point using a ground cable sized for a DC resistance of less than 0.1 ohm. For example, for a ground run of 150 ft., use a No. 8 AWG conductor; run ground conductor in conduit. Use "isolated ground" receptacles for all system power. Connect these receptacle grounds together and ground them separately from all other power system grounds to the building main service ground point using a ground cable sized for a DC resistance of less than 0.1 ohm.
- BB. Locate audio, video, control, and other receptacles as directed by the Owner's authorized representative. Except for receptacles mounted in equipment cabinets, in floor boxes, or designated as surface-mounted, flush-mount other receptacles on cover plates in gang boxes recessed in vertical surfaces. Provide plate finish as approved by the Owner's authorized representative.
- CC. Field verify all junction box sizes prior to fabricating cover plates. Except where specifically dimensioned, control and connection plate layouts shown on drawings are not scaled. Size plates as necessary to hide joints and gaps between backboxes and surrounding wall.
- DD. Where cover plates are not fitted with connectors, provide bushed hole(s) through cover plate in sizes and quantities required. Do not allow cables to enter or exit boxes without cover plates installed.
- EE. For all A/V connections provide receptacle plates and panels consistent with architectural specifications. Prior to installation submit to the Architect for approval samples of proposed plates, receptacles, and panels.
- FF. Neatly gather cables exiting at base of lectern, teaching station, or other item of movable furniture. Cover cables with seamless loose fitting sleeve of expanded braided polyester, Alpha Wire GRP-series or similar. Provide harness of length as shown on drawings. Secure at base of furniture with strain relief.
- GG. Paint or provide approved factory finishes for all system components exposed to public view, as directed by the Owner's authorized representative.

- HH. If any item of equipment includes exposed controls which are not used in system operation, and if those controls cannot be locked, capped, or concealed behind a security cover, mount said item of equipment recessed behind a blank rack panel.
- II. Provide interior lighting for all equipment racks. Provide a single 120VAC fixture inside the rack at the top, located to provide general illumination of the rear of all equipment items. Provide a switch for this fixture inside the rack. Equip each rack with a permanently-mounted 3-conductor isolated grounded AC power strip(s) with sufficient outlets to meet system needs plus at least four (4) spares.
- JJ. Provide steel blank and vent panels on all equipment racks to fill any unused rack spaces, per industry best practices for optimizing airflow. Use panels with factory-applied finishes to match the color of the rack itself unless otherwise directed by the Owner's authorized representative.
- KK. Terminate all unused inputs and outputs. Where termination of video signals is required, use terminators specified and set termination switches (if any) on equipment to OFF. On system functional drawings, indicate the locations of all terminators.
- LL. Provide protective flush covers for all floor-mounted connections when not in use.
- MM. Identify all communications systems requiring licensing, including wireless microphones, wireless intercoms, wireless assistive listening systems, microwave transmission systems, and other systems. Initiate the licensing procedure for each such system and identify, in general form, the steps to be followed by the Owner to complete the licensing process. Perform this work in a timely manner so that appropriate licenses are in place at the time of system acceptance by the Owner.
- NN. Save all unused products accessories and turn over to Owner at checkout.

3.2 PROTECTION AND REPAIR OF EXISTING FINISHES AND STRUCTURES

- A. Cut and patch all holes required for this installation.
- B. Make good all materials and finishes cut into or damaged during installation.
- C. Maintain clean and safe working conditions. Clean the premises where dirtied, and clean all equipment, removing all dirt, dust, stains, and fingerprints. The Contractor is liable for any damage caused by his employees and subcontractors to the property of others.

3.3 ELECTRONIC TEST EQUIPMENT

- A. Provide the following test equipment for use during initial tests and adjustments and during acceptance testing and final adjustment of the systems.
 - 1. Continuously Variable Sine Wave Generator - 20 Hz to 20,000 Hz range within +/-1 dB with less than 0.5% THD at 1 volt output into 600 ohms.
 - 2. AC Voltmeter with frequency response within +/-1 dB from 20 to 20,000 Hz, 0.0001 volts to 100 volts, minimum input impedance 0.1 megohm.
 - 3. Multimeter (VOM) (may be included with AC Voltmeter).
 - 4. Impedance Measuring Device, capable of measuring at 1,000 Hz and within each loudspeaker's passband (at center of passband or at least one octave removed from crossover frequency), minimum range 0 to 1,000 ohms.

5. Light meter, capable of measuring illuminance (footcandles) and luminance (footlamberts).
6. NTSC color video test signal generator, capable of generating SMPTE color bars, multiburst, modulated ramp or staircase, and window signals, and with both composite and Y/C outputs.
7. Wideband video distribution amplifier, one input 3 output (minimum), with frequency response not worse than -3dB at 100 MHz.
8. NTSC color video monitor with blue-only capability.
9. RGB test signal generator, capable of generating the SMPTE RP 133 test pattern over the entire range of horizontal and vertical scan frequencies of video projector(s) specified.
10. RGB test signal generator, capable of generating color bars and white text (or alignment pattern) on black background over entire range of horizontal and vertical scan frequencies of video projector(s) specified. Provide generator with analog RGBHV or VGA output, and with digital HD-SDI and either DVI-D or HDMI output.
11. RGB video monitor capable of 15.75KHz horizontal scan frequency and 60Hz vertical scan frequency.
12. Real Time Audio Analyzer: Shall provide a pink noise generator, a calibrated microphone and graphic representation of the audio spectrum in 1/3-octave increments.
13. Network cable Analyzer: Certification-grade cable analyzer suitable for testing up to TIA Category 6A cable and testing cable length, bandwidth, and attenuation.
14. Fiber Optic Cable Analyzer: Certification-grade optical power and fiber optic test kit suitable for testing fiber length, bandwidth, and attenuation.
15. Connectors, adaptors, cables, etc. to permit flexible interconnection of test equipment and convenient, reliable connection to receptacles, patch panels and amplifier terminal strips.
16. Laptop personal computer with software as required for adjustment of digital equalizers, scan converters, and other devices, and for reprogramming remote control system.
17. Test media for each type of playback device (Blu-Ray, DVD, audio CD, flash media device, etc.) Ensure content is suitable for public presentation and free from license restrictions. Where applicable, also provide blank media for recording.
18. Table to support test equipment at system equipment rack, minimum 30" square. (Required only during acceptance testing.)

- B. In addition to the test equipment identified above, ensure the availability of the manufacturers' product information as well as draft copies of system documentation to support system testing, alignment, and troubleshooting.

3.4 SHOP AND FACTORY TESTING

- A. The Audiovisual Contractor shall perform preliminary tests at their shop or factory before the system is shipped to the Owner's site. The Owner's Authorized Representative, Owner's Project Manager, Consultant or other designated representative may be present for these tests. These tests shall include Contractor provided equipment and any Owner provided equipment (equipment that the Owner shipped to the assembly site). The tests shall include equipment provided by other Vendors, if applicable, plus all installation service and materials.

3.5 INITIAL POST-COMPLETION TESTS

- A. Perform the following tests upon completion of the installation and before demonstration and acceptance testing with the Owner and the Owner's authorized representative.
- B. Remote Controls

1. Exercise every control pushbutton (physical or virtual) on every unique remote control panel in the system. Ensure system response is as specified, and if not specified, ensure reasonable system response. Ensure control panel tally and status indications as specified and reasonable.
2. Confirm that control system reports true feedback from controlled device where true feedback has been specified.
3. Check for reliable control system operation and freedom from erratic operation and random failures.
4. Confirm that portable wired panels operate at all connection locations. Confirm that wireless panels operate reliably throughout their intended range.
5. Ensure that subsystems properly communicate with each other (e.g. studio to control room, or auditorium to equipment room), and that operation is logical and consistent.
6. Ensure that system control via web browser or mobile device functions properly.

C. Sound Amplification System

1. Test every installed peripheral device and all connection points, and confirm correct input and output cabling and connections. Ensure that signals applied to input connection points reach mixing and amplification equipment, and that signals reach all output devices. Ensure proper stereo separation and polarity.
2. Set system gain structure for optimal signal to noise ratio. Match levels of like devices throughout the system. Ensure noise-free operation at all levels of amplification.
3. Ensure proper response of system volume controls. Set levels so that system cannot be driven into feedback, and that normal operating levels are established with volume controls at mid-range.
4. Set equalization, compression/limiting, delay, and other processing parameters to meet intended system functioning.
5. Test for correct operation of matrix mixers, reconfigurable signal processing devices, and other system elements during changes in system operating modes. Ensure that signal routing is properly set for each operating mode.
6. Test every patch point on system patch panels for correct wiring and labeling. Ensure that patch normalling is as specified.
7. Make test recordings on all recording devices. Playback these recordings and confirm recording signal quality.

D. Video System

1. Test every input device and connection, every output device and connection, and all intermediate switching and processing, and ensure proper signal paths. Ensure no cross-connection of channels in component systems.
2. Using standard reference signals, ensure proper image quality on all displays. Confirm the absence of smearing, streaking, dropouts, noise, or other visible errors. Confirm proper setup and communication of display identification data (EDID) and digital rights management (HDCP) parameters.
3. Ensure proper management and display of analog signals. Ensure that displays properly synchronize to applied computer sources, without shifts in position or brightness. Test over the full range of frequencies for which the display is designed.
4. Confirm proper image alignment for projectors. Confirm correct aspect ratio, center and corner focus, legibility, image size, image height above floor, and grey scale tracking.
5. Adjust gains through switchers and processing devices so that a given signal traveling through different signal paths shows imperceptible differences between paths. Likewise ensure color and brightness matching of adjacent displays where applicable.

E. Category Cabling

1. Verify that all jacks have been terminated properly and conform to ANSI/TIA/EIA-568-C.

2. Provide list of cable runs each with associated bandwidth and length information, as well as pass/fail for ANSI/TIA/EIA-568-C compliance.
- F. Fiber Optic Cabling
 1. Verify that all jacks have been terminated properly and conform to ANSI/TIA/EIA-568-C and related ANSI/TIA/EIA fiber optic standards.
 2. Provide list of fiber runs each with associated bandwidth and length information, as well as pass/fail for ANSI/TIA/EIA-568-C compliance.
- G. 75 Ohm Coax Video Cabling
 1. Verify that all jacks have been terminated properly and meet SMPTE SDI, HD-SDI, and 3G-SDI standards 259M, 274M, 292M, 296M, 344M, 327M, and 424M.
 2. Provide list of cable runs each with associated bandwidth and length information, as well as pass/fail for SMPTE SDI, HD-SDI, and 3G-SDI standards 259M, 274M, 292M, 296M, 344M, 327M, and 424M.
- H. General
 1. Physically inspect the system for completeness and workmanship. Ensure that specified labeling has been applied.
 2. Ensure that the preparation of final documentation is underway, and that draft copies are available at the jobsite.
 3. Ensure all loose and portable equipment has been delivered or otherwise accounted for.
- I. Summary Tests
 1. Review system functional description, and ensure that all specific system requirements can be met.
- J. Report
 1. Upon completion of the above tests, submit written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection and testing by the Owner's authorized representative.

3.6 DEMONSTRATION AND ACCEPTANCE TESTING

- A. Conduct tests to establish to the satisfaction of the Owner and the Owner's authorized representative that the system performs as required. Before beginning the acceptance testing, have reasonable assurance that such testing shall produce satisfactory results. Conduct testing in the presence of the Owner's authorized representative as well as the Owner, Architect, and General Contractor at their option, at a time mutually agreed to by all parties.
- B. Under the direction of the Owner's authorized representative, conduct tests as outlined below. Furnish any and all equipment and media necessary to perform these tests, and furnish evidence of proper calibration of all test equipment. Provide technical staff (system programmer, DSP programmer) to assist.
 1. System Performance Tests. Conduct spot checks of system performance to ensure performance requirements (Paragraph 1.20 of this Section) are met. Perform such tests as necessary to establish confidence that spot test results are representative of system performance as a whole.
 2. Operating Tests. Include tests to verify that system functional requirements (Paragraph 1.18 of this Section) are met, and that user controls operate properly.

3. Equipment Tests. Confirm the proper functioning of significant equipment items, and confirm required system control over these items.
 4. Final Adjustments. Make control adjustments as directed by the Owner's authorized representative. Provide covers, caps, or shaft-locks for controls not used in system operations. Make a record of these control settings for inclusion with the final documentation.
 5. Listening and Viewing Tests. Include subjective evaluations by persons listening and viewing from various positions under various operating conditions. Conduct such tests to verify system functioning under normal operating conditions.
- C. If the need for adjustment or modification becomes evident during testing, either continue testing, or interrupt testing to permit corrective action, as directed by the Owner's authorized representative. Perform retesting following any corrective action to the extent directed by the Owner's authorized representative.
- D. In addition to Contractor-directed testing, assist as required with specific testing as conducted by the Owner's authorized representative.

APPENDIX A – Touch Screen Control Panel Pages Functional Requirements

A.1 AUDITORIUM TOUCH SCREEN CONTROL PANEL PAGES

- A. Splash Screen w/ school supplied logo image
 - 1. Display message indicating current operating mode with request for user to confirm continuing in current mode or to change operating modes.
 - 2. Presentation Mode Changes:
 - a. Video Presentation
 - 1) Power on video projector
 - 2) Deploy projection screen
 - 3) Mute audio mixing console inputs
 - 4) Unmute microphone inputs
 - 3. Production Mode
 - a. Mute automatic mixer output within audio DSP
 - b. Unmute mixing console inputs
- B. Video Presentation and Production Mode Home Page buttons and functions
 - 1. Projection Screen Source Selection
 - a. Sources on left hand side of page
 - b. Source Buttons
 - 1) Computer HDMI inputs fly-out menu button
 - 2) Blu-ray Player
 - 3) Wireless Presenter
 - 4) Pan/Tilt/Zoom camera
 - c. Video preview window in center of screen
 - 1) Send to Video Projector button
 - a) Route selected source to video projector
 - 2. Audio Source Selection fly-out menu button
 - 3. Active video projector source indication
 - 4. Playback Controls fly-out menu button
 - 5. Playback controls of active playback device in center of screen, when applicable
 - 6. Video projector mute toggle button
 - 7. Camera Controls Page button
 - 8. Advanced Controls Page button
 - 9. Speech and Program volume/mute controls on right hand side of page (greyed out in Production Mode)
 - 10. Lighting Controls Quick Access Presets Banner
 - a. Quick access presets across top of screen
 - 1) Full Lighting
 - 2) Presentation
 - 3) All Lighting Presets (Lighting Controls Page button)
- C. Computer HDMI inputs fly-out menu

1. Auditorium floor plan with graphic representation of:
 - a. All input locations
 - b. Locations w/ connected devices
 - c. Locations w/ connected device actively routed to projection screen
 - d. Source Locations
 - 1) Stage Apron Left HDMI
 - 2) Stage Apron Right HDMI
 - 3) Mid Aisle HDMI
 - 4) Control Room HDMI
 - 5) Control Room HDMI Rack Panel
 - e. Touch sensitive selection of floor plan input location graphics described above
- D. Audio Source Selection fly-out menu
 1. Follow projector source (default)
 2. Stage Rack CD Player
 3. Stage Rack Bluetooth
 4. Stage Rack 3.5mm
 5. Stage Rack RCA
- E. Playback Controls fly-out menu
 1. Stage Rack Blu-ray player
 - a. Transport controls, disc menu, player menu setup, return, menu navigation
 2. Stage Rack CD player
 - a. Transport controls – play/pause, fast forward, fast reverse, stop, eject disc
- F. Camera Controls Page buttons and functions
 1. Camera video preview in center of screen
 2. Pan and tilt arrow pad controls, high and low speed settings
 3. Zoom in/out controls, high and low speed settings
 4. Camera preset selection (8 presets)
 5. Press and hold storing of camera presets
- G. Advanced Controls Page buttons and functions
 1. Do Not Disturb toggle button
 - a. Mute all pages except emergency page
 2. Lobby Chime button
 - a. Trigger audience recall chime.
 3. Video Projection Controls Page button
 4. Advanced Audio Controls Page button
 5. Control Room Preview monitor source selection fly-out menu button
 6. Advanced Video Routing Page Button
- H. Control Room Preview monitor source selection fly-out menu

1. Default – preview monitor follows projector
 2. Break-away option – route any source to preview monitor
 - a. Fly-out routing menu
 - b. See source list above
 3. Indication of which source has been routed to preview monitor
- I. Video Projection Controls Page buttons and functions
1. Video Projector
 - a. Power on/off
 - b. Reset to saved settings
 - c. Light engine hour usage readout for projector
 - d. Video projector mute toggle button
 2. Projection Screen
 - a. Up, down, stop
- J. Advanced Audio Controls Page buttons and functions
1. Individual microphone level and muting controls for all automatic mixer microphone inputs
 2. Muting and unmuting of loudspeaker groups (default is all zones unmuted)
 - a. Central Cluster Loudspeakers on/off
 - b. Side-Fill Loudspeakers on/off
 - c. Front-Fill Loudspeakers on/off
 - d. Rear-Fill Loudspeakers on/off
 - e. Subwoofer System on/off
 - f. Lobby Loudspeakers on/off
 3. Lobby Volume/Mute Control
 - a. Default muted at system startup
 4. Backstage Monitoring Volume/Mute Control
 - a. Default muted at system startup
 5. Aux-Fed Sub on/off
 - a. Default off at system startup
 6. Analog Mixing Console Inputs on/off
 - a. Re-route audio DSP to use analog mono/left/right inputs in place of digital mixing console mono/left/right signals when selected.
 - b. Default off at system startup
- K. Advanced Routing Page buttons and functions
1. Full access to all inputs and outputs with matrix switcher style source/destination/take sequence
 2. Option for audio breakaway
- L. Lighting Controls Page

1. Eight presets
2. Push and hold preset selection button to rename preset with soft keyboard entry

M. All Pages

1. Mode description at top of page
2. Speech and Program volume/mute controls on right hand side of page (greyed out in Production Mode)
3. Back button
4. Exit button

N. Additional functions, pages, and buttons per functional diagrams

APPENDIX B - Sample Software License

A. License Grant

1. (Vendor) hereby grants a license for use of the software described above. Use of this software is limited to the specific room(s) and/or contract(s) listed and subject to the terms listed below.
2. The Software may be used only in the specific locations defined in the above mentioned project and may not be ported to other locations or systems without the express written consent of (Vendor.)

B. Ownership and Intellectual Property

1. The Software is owned and copyrighted by (Vendor.) This license confers no title or ownership in the Software and does not constitute a sale of any rights of the Software.
2. The Software described herein represents not only the specific programming required in the pursuit of this Project, but also the extensive software library which (Vendor) has developed. Specifically, macros, procedures, code blocks, and the like are furnished with this Software, though specific development costs for these library functions are not included in the Project costs.
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