

SECTION 27 41 16**INTEGRATED AUDIOVISUAL AND LIGHTING SYSTEMS - DRAFT****PART 1 - GENERAL****1.1 GENERAL****A. SUMMARY**

1. This section includes the labor, materials, equipment, and services necessary to furnish and install the AV systems.
2. Description of Scope
 - a. Board Room
 - 1) General
 - a) Provide a complete, turnkey, audiovisual system supporting Board meetings, staff presentations, public comment sessions, workshops, training activities, community engagement events, recording, streaming, and participation by both in-person and remote audiences.
 - b) The audiovisual system requirements are performance based. Specifications establish the required functions, operating capabilities, performance criteria, and basis of design but do not necessarily indicate every component, accessory, connection, or programming requirement.
 - c) The Audiovisual Systems Integrator shall be responsible for the complete system design, engineering, coordination, installation, programming, testing, commissioning, training, and documentation required to provide a turnkey and fully operational system.
 - d) Provide all equipment, software, licenses, accessories, mounting hardware, interfaces, cabling, connectors, adapters, power supplies, programming, configuration, and incidental materials required for complete system operation.
 - e) Contractor is responsible for providing and coordinating audiovisual systems with architectural, electrical, information technology, lighting control, furniture, millwork, and other related work.
 - f) All work described in this section shall be provided by the Contractor including demolition, electrical, finishes, technology, structural, and any other work required to make the room fully functional and complete for Owner use.
 - g) The existing audiovisual equipment rack is anticipated to remain in service as the primary equipment location.

Field-verify its condition, available space, power, cooling, grounding, and suitability before reuse.

- h) Provide field verification of all cabling and pathways.
- i) Evaluate equipment and infrastructure identified for reuse. Test, recommission, reconfigure, and integrate reusable components into the completed system. Notify the Owner and Consultant of equipment that is incompatible, defective, or unsuitable for continued use.
- j) Configure the systems to provide simple operation for routine meetings while retaining the functionality required for operator-assisted meeting production, recording, and streaming.
- k) Provide commissioning, system optimization, staff training, record documentation, configuration files, software backups, and operational support required for successful long-term use.

b. Audio Systems

- 1) Provide speech reinforcement and audio reproduction with consistent coverage and clear intelligibility throughout the Board Room.
- 2) Support Board members, staff presenters, public comment participants, remote participants, presentation sources, multimedia playback, recording, and streaming.
- 3) Retain and reuse the existing Board Room table microphones.
- 4) Field-verify the existing table microphones, cabling, connectors, power requirements, mounting conditions, and supporting infrastructure before integration.
- 5) Connect the existing board member wired microphones to the new digital signal processor.
- 6) Provide the interfaces, microphone preamplification, phantom power, cabling, adapters, terminations, and accessories required to integrate the existing table microphones into the completed system.
- 7) Test each existing table microphone and its associated signal path. Notify the Owner and Consultant of microphones, cabling, connectors, or supporting infrastructure that are defective, incompatible, or unsuitable for continued use.
- 8) Provide new loudspeakers, digital signal processing, amplification, wireless microphone systems, and related interfaces required for complete operation.
- 9) Configure the digital signal processor to provide microphone mixing, automatic microphone management, equalization, dynamics control, feedback management, routing, conferencing, recording, streaming, and loudspeaker management.

- 10) Provide automatic processing and routing for routine meetings while allowing authorized operators to access the functions required for advanced meeting production.
- 11) Coordinate audio feeds with the video production, recording, streaming, and remote-conferencing systems.
- 12) Configure the system to support future expansion without requiring replacement of the primary system architecture.

c. Presentation and Display Systems

- 1) Provide presentation systems supporting content from laptops, mobile devices, and other presentation sources during meetings, workshops, training sessions, and public events.
- 2) Provide wired and wireless presentation capabilities suitable for Board members, staff, guest presenters, and other authorized users.
- 3) Provide two large-format projection systems with motorized projection screens approximately 200 inches and 160 inches diagonal. Field verify dimensions and installation conditions for replacement of the existing screens.
- 4) Locate and configure the projection systems to provide clear visibility of meeting materials, presentations, video content, and other displayed information for Board members, staff, and visitors.
- 5) Provide Category 6 cabling and HDBaseT signal transport for all wired presentation video inputs connected to the audiovisual system.
- 6) Provide all transmitters, receivers, signal converters, interfaces, power supplies, terminations, and accessories required for complete and operational presentation video input connections.
- 7) Provide source selection, signal distribution, format conversion, scaling, and routing required to display presentation content at the appropriate room display or production-system destination.
- 8) Make presentation content available to the existing video production switcher and the recording, streaming, and remote-participation systems so remote audiences can view the content presented within the room.
- 9) Coordinate projector, screen, mounting, structural, electrical, audiovisual cabling, and control requirements with the related work of other trades.

d. Video Production Systems

- 1) Reuse and integrate the existing video production switcher to support live meeting coverage, recording, streaming, remote participation, and public access to Board proceedings.
- 2) Provide camera coverage of Board members, presenters, public comment locations, and general room activities.

- 3) Connect cameras to the existing video production switcher using category-cable-based transport or SDI. Category-cable-based transport may include HDBaseT, NDI, or another approved network-based video protocol compatible with the existing switcher and completed system.
- 4) Evaluate the existing switcher inputs, camera outputs, transport distances, infrastructure, required image quality, control requirements, and production workflows to determine the appropriate transport method for each camera.
- 5) Provide all category cabling, coaxial cabling, transmitters, receivers, encoders, decoders, signal converters, network interfaces, licenses, terminations, and accessories required to connect each camera to the existing video production switcher as part of a complete turnkey system.
- 6) Verify compatibility of all new and reused cameras, signal-transport components, presentation sources, and production-system components with the existing video production switcher before installation.
- 7) Provide production capabilities allowing camera images, presentation content, graphics, and other approved sources to be combined into complete meeting programs.
- 8) Support manual production control for operator-assisted meetings and simplified recall of common production configurations for routine operation.
- 9) Provide camera presets, source selection, scene recall, monitoring, routing, and other production functions required for the documented meeting workflows.
- 10) Configure production outputs for in-room monitoring, recording, streaming, remote participants, and meeting archives as required.
- 11) Evaluate existing camera equipment and supporting infrastructure for continued use. Reuse existing equipment only when fully compatible with the completed system and capable of meeting the specified performance requirements.

e. Recording and Streaming Systems

- 1) Provide recording and streaming systems supporting live broadcasts, meeting archiving, remote viewing, and public information distribution.
- 2) Record presentation content, camera coverage, program audio, and other required meeting sources as a coordinated program.
- 3) Support simultaneous recording and live streaming where required by the Owner's operating workflow.
- 4) Provide operators with status monitoring and control of recording and streaming functions through the audiovisual control interface.

- 5) Coordinate system outputs and file formats with the Owner's content-management, streaming, and meeting-archiving platforms.
- 6) Provide an architecture capable of accommodating future expansion and changes to the Owner's recording, streaming, and content-management workflows.

f. Presentation and Display Systems

- 1) Provide presentation systems supporting content from laptops, mobile devices, and other presentation sources during meetings, workshops, training sessions, and public events.
- 2) Provide wired and wireless presentation capabilities suitable for Board members, staff, guest presenters, and other authorized users.
- 3) Provide two large-format projection systems with motorized projection screens approximately 200 inches and 160 inches diagonal. Dimensions to be field verified for replacement of existing screens.
- 4) Locate and configure the projection systems to provide clear visibility of meeting materials, presentations, video content, and other displayed information for Board members, staff, and visitors.
- 5) Provide source selection, signal distribution, format conversion, scaling, and routing required to display presentation content at the appropriate room display or production-system destination.
- 6) Make presentation content available to the video production, recording, streaming, and remote-participation systems so remote audiences can view the content presented within the room.
- 7) Coordinate projector, screen, mounting, structural, electrical, and control requirements with the related work of other trades.

g. Video Production Systems

- 1) Provide a video production system supporting live meeting coverage, recording, streaming, remote participation, and public access to Board proceedings.
- 2) Provide camera coverage of Board members, presenters, public comment locations, and general room activities.
- 3) Provide production capabilities allowing camera images, presentation content, graphics, and other approved sources to be combined into complete meeting programs.
- 4) Support manual production control for operator-assisted meetings and simplified recall of common production configurations for routine operation.

- 5) Provide camera presets, source selection, scene recall, monitoring, routing, and other production functions required for the documented meeting workflows.
- 6) Configure production outputs for in-room monitoring, recording, streaming, remote participants, and meeting archives as required.
- 7) Evaluate existing camera equipment and supporting infrastructure for continued use. Reuse existing equipment only when it is fully compatible with the completed system and capable of meeting the specified performance requirements.

h. Recording and Streaming Systems

- 1) Provide recording and streaming systems supporting live broadcasts, meeting archiving, remote viewing, and public information distribution.
- 2) Record presentation content, camera coverage, program audio, and other required meeting sources as a coordinated program.
- 3) Support simultaneous recording and live streaming where required by the Owner's operating workflow.
- 4) Provide operators with status monitoring and control of recording and streaming functions through the audiovisual control interface.
- 5) Coordinate system outputs and file formats with the Owner's content management, streaming, and meeting archiving platforms.
- 6) Provide an architecture capable of accommodating future expansion and changes to the Owner's recording, streaming, and content-management workflows.

i. Control Systems

- 1) Provide an integrated audiovisual control system with intuitive touchscreen interfaces suitable for operation by administrative staff.
- 2) Provide control of presentation sources, projection systems, audio systems, cameras, video production, recording, streaming, and integrated room-lighting functions.
- 3) Provide a simplified operating mode for routine meetings and an advanced operating mode for authorized production personnel.
- 4) Integrate common video production functions into the touchscreen interface, including source selection, camera selection, camera preset recall, production scene recall, recording control, and streaming control.
- 5) Provide system status, operational feedback, and clear indication of active sources, displays, microphones, recording functions, and streaming functions where applicable.

- 6) Coordinate control interfaces with all audiovisual devices and related building systems necessary for complete operation.
- 7) Program, test, and commission all control functions, presets, operating modes, interlocks, and user interfaces as part of the turnkey system.

j. Lighting Control Integration

- 1) Existing Board Room lighting fixtures shall remain in service.
- 2) Field-verify the existing lighting fixtures, voltage and electrical service, dimming capabilities (0-10V), control components, interfaces, and available integration capabilities before completing audiovisual control programming.
- 3) Provide new switching panel to provide power distribution and 0-10V dimming control for (6) existing circuits in Board Room.
 - a) Existing wall switches utilized to control lighting fixtures shall be removed and replaced by new, centralized, remote-switching panel to be installed in control room without impacting Owner's use of the space.
- 4) Integrate available 0-10V dimming lighting-control functions with the audiovisual control system to support meeting operation, presentations, public comment, recording, streaming, and general occupancy.
- 5) Provide a lighting control preset button station to replace the bank of switches at the entry door from the rest of the building.
- 6) Provide lighting preset recall from the audiovisual touchscreen interface.
 - a) Provide preset lighting scenes appropriate for Board meetings, presentations, public comment periods, recording and streaming, and general room use.
 - b) Configure lighting presets to provide appropriate illumination for in-room visibility, projected-image viewing, and camera image quality.
- 7) Provide the audiovisual control programming, interfaces, gateways, licenses, and accessories assigned to the audiovisual work.
- 8) Maintain operation of the existing lighting-control stations and normal lighting controls unless otherwise indicated.
- 9) Test and commission each integrated lighting preset under actual room conditions and coordinate final scene levels with the Owner and Consultant.

k. Audiovisual Infrastructure

- 1) Provide audiovisual cabling, network connectivity, equipment mounting, equipment-rack modifications, interfaces,

- terminations, labeling, and supporting components required for a complete installation.
- 2) Coordinate cable pathways, power, grounding, network connections, structural supports, equipment clearances, ventilation, and service access with the related project disciplines.
 - 3) Verify existing pathways, cabling, network connections, equipment mounts, rack components, and other infrastructure before reuse.
 - 4) Replace or modify existing infrastructure that is defective, incompatible, insufficient, or incapable of supporting the specified system performance.
 - 5) Permanently label audiovisual equipment, cables, terminations, patching points, and network connections using a coordinated identification system.
 - 6) Provide system testing, acceptance testing, commissioning, staff training, operating instructions, record drawings, cable schedules, software files, configuration backups, warranties, and other closeout documentation required for the turnkey system.

I. OPTION 1: Network Camera System

- 1) Provide a network-based camera production system integrated with the audiovisual processing and control platform in place of the base video production switching architecture.
- 2) Integrate network-connected cameras directly with the audiovisual system for camera selection, preset recall, signal routing, display management, recording, and streaming.
- 3) Provide the processing, switching, monitoring, control, network, and licensing capabilities required to perform the specified production functions without a separate dedicated video production switcher.
- 4) Provide common control of camera selection, room operation, presentation routing, recording, and streaming through the audiovisual user interface.
- 5) Provide automated framing and camera preset recall for Board members, presenters, and public comment participants where supported by the selected camera system.
- 6) Demonstrate that the proposed architecture provides the image quality, switching performance, latency, reliability, monitoring, recording, streaming, and operator-control capabilities required for Board meetings.
- 7) Include all network switches, licenses, processing resources, control interfaces, monitoring tools, and accessories required for a complete and operational system.

m. OPTION 2: Intelligent Camera Production and Tracking System

- 1) Provide the network camera system described under Option 1 with an intelligent camera production platform supporting automated meeting coverage.
- 2) Provide automated presenter tracking, active-speaker framing, dynamic shot composition, and automatic camera selection.
- 3) Supplement programmed camera presets with camera automation capable of responding to changing presenters, public comment participants, seating arrangements, and room configurations.
- 4) Coordinate camera automation with microphone activity, audiovisual control states, presentation modes, and production-system operation as applicable.
- 5) Allow an authorized operator to override automated camera selection and framing at any time.
- 6) Configure the system to avoid unnecessary camera movement, abrupt switching, obstructed views, and inappropriate framing during live meetings.
- 7) Provide configuration, calibration, testing, staff training, and commissioning required for reliable automated operation.
- 8) Demonstrate system performance under representative Board meeting, presentation, public comment, remote-participation, recording, and streaming conditions.

1.2 REFERENCES

A. Codes and Standards

1. All materials, equipment, and installation shall comply with any applicable codes or standards. These are at the discretion of the Authority Having Jurisdiction (AHJ) and may be updated. Refer to the latest adopted and published versions.
2. The following list is noted for reference only. The Contractor shall be responsible for complying with all applicable codes, standards, and regulations.
 - a. National, State, and Local Building codes applicable to the work
 - b. National Electric Code (NEC)
 - c. National Fire Protection Association (NFPA)
 - d. Occupational Safety and Health Administration (OSHA)
 - e. American National Safety Institute (ANSI)
 - f. National Electrical Manufacturers Association (NEMA)
 - g. AVIXA A102.01 – Performance Contracting for Audiovisual Systems
 - h. AVIXA F501.01 – Cable Labeling for Audiovisual Systems
 - i. ANSI/AVIXA DISCAS-1.0 – Display Image Size for 2D Content
 - j. AES (Audio Engineering Society) Recommended Practices
 - k. AES67 – High-Performance Streaming Audio-over-IP Interoperability (where applicable)
 - l. IEEE 802.3 – Ethernet (wired networking, PoE)

- m. IEEE 802.11 – Wireless LAN (Wi-Fi)
- n. ANSI E1 Entertainment Technology Standards applicable to equipment installed in performance spaces, including coordination and safety practices
- o. Americans with Disabilities Act (ADA)
- p. 2010 ADA Standards for Accessible Design – Assistive Listening Systems (Sections 219 and 706)

B. Nationally Recognized Testing Laboratory (NRTL)

- 1. All equipment required by OSHA to be NRTL approved for the intended use shall be labeled as such.
- 2. Equipment that is not NRTL approved will not be accepted until approved and labeled.

1.3 SUBSTITUTIONS

- A. Any requests or proposed substitutions for equipment noted in this section must comply with Division 01 requirements for substitutions.
- B. All substitutions requested for review must be approved in writing by Owner/Consultant prior to bidding to be considered to have met the requirements of this section.
- C. Any manufacturer requesting approval of a substitution must meet the minimum qualified requirements noted in Part 2.
- D. The products and equipment in this section are specified to provide the necessary function, appearance, and physical properties necessary to meet the design requirements. The inclusion of specific equipment in this section is to establish a standard of quality and shall not be understood to be limiting competition.
- E. To be considered as an equal, any products submitted for substitution must meet the requirements noted in this section. The Owner/Consultant may request follow-up data or demonstration to prove that equipment meets minimum requirements. This shall be provided at no cost to the Owner.
- F. The Contract Documents are based on design work utilizing specific equipment. If a substitution is accepted, the Contractor shall be responsible for coordinating necessary infrastructure, support, or finishes changes to accommodate substituted equipment. Any re-design required from the Consultant will require an Additional Service Contract with the Contractor.

1.4 SUBMITTALS

A. General Requirements

- 1. All submittal documents shall meet the Division 01 requirements.
- 2. Submittals shall be provided to align with the comprehensive schedule. The Contractor shall provide ample time for review process to be

conducted. Any delays in procurement or installation due to Submittal issues will be the sole responsibility of the Contractor.

3. Submittals, other than physical samples, are to be provided in .pdf format and organized for easier review.
4. A title page(s) shall be provided with all submittals that provides
 - a. Project Name
 - b. Location
 - c. Contractor Name(s)
 - d. Contractor's Project Manager Contact information
 - e. Section Number and Title
 - f. Revision #, if applicable
 - g. Date submitted
 - h. Area for review stamping by Consultant and Architect.
 - i. Additionally, provide a page for any selections or clarifications required from the Architect or Consultant that specifically notes the item, location in the submittal, and the required selection (e.g. color, finish, etc.)
5. Acceptance of submittals does not alleviate the requirement to provide a full working system as required by the Contract Documents.
6. The following subsections (B-E) describing submittals shall be considered elements of a comprehensive submittal package. These can be submitted separately for review. However, portions may be required to be reviewed together (ex, Product Data with Shop Drawings) to successfully complete review of the submittal package. Partial submittals of any subsection is not acceptable unless approved in writing prior to submittal.

B. Product Data

1. Bill of Materials (BoM): The Contractor shall provide a BoM of all equipment to be provided as part of the section. The BoM shall be organized to match the paragraphs order of the specification and shall include Manufacturer name, part number, part name, and quantities for all elements. The BoM can be used as the Table of Contents for the rest of Product Data portion.
2. Product Data: This portion of the submittal consists of technical documentation (data sheets, brochures, etc.) for all standard equipment. Please organize Product Data in the same order as listed in this section for expeditious review. Product Data that is not submitted in order will require additional review time to coordinate with this section.
3. Manufacturer's data sheets shall list the necessary information required to confirm the function and performance of each product submitted. Specific products being submitted shall be highlighted or otherwise called out to prevent confusion about specific products.

C. Shop Drawings

1. The shop drawings shall be produced and submitted to confirm the planned installation details from the Contractor.
2. Shop drawings shall indicate complete coordinated information for installation of all equipment and systems to be provided as part of the Contract. Indicate the following clearly:
 - a. Field Verified dimensions. Contractor is responsible for all dimensions.
 - b. Coordinated services and infrastructure
 - c. Necessary connections and installation details
 - d. Any other details required to communicate the planned installation
3. The shop drawings shall not be a direct copy of the Contract Documents. Direct copies of the Contract Documents will not be reviewed. The Contractor may request a copy of the Consultant's plan, section, and elevation drawings in .dwg format to use as a guide, if desired.
4. Shop Drawing sets shall be:
 - a. Neat, clear, organized, and easy to read
 - b. Produced with Computer Drafting application
 - c. At a scale not less than $\frac{1}{4}" = 1'-0"$ for plans and sections and $1" = 1'-0"$ for details.
 - d. On sheets not smaller than 11"x17"
5. Shop Drawing sets shall include, at a minimum:
 - a. Plans, sections, and elevations indicating detailed installation locations of all equipment and coordinated services or obstructions.
 - b. Detail drawings of specialty equipment or assemblies to be provided.
 - c. Functional diagrams that include all information about connection of equipment elements for functional operation.
 - d. Assembly details for any equipment to be attached to the building.
6. Any shop drawings that depict suspension of overhead loads or attachment of equipment to structure shall be reviewed and stamped by a Professional Engineer licensed to practice in the jurisdiction where the project is located.
7. Any changes in the field shall be documented and included as part of the Closeout Documents

D. Samples

1. User Interface (UI)
 - a. The Contractor shall provide printout or electronic views of all User Interface (UI) elements included in the control systems. UI elements may include, but are not limited to:
 - 1) Touchscreens
 - 2) Button stations
 - 3) Console programming interfaces

- 4) Custom interface elements, as required
 - b. UI submittals shall clearly indicate functionality, navigation structure, labeling, access levels, and operational logic. Submittals shall be sufficiently detailed to permit meaningful review by the Architect, Consultant, and Owner.
 - c. If UI submittals will be phased, the Contractor shall include a proposed UI submission schedule within the submittal package.
 - d. Owner approval of all User Interface designs is required prior to final programming and implementation. Review or acceptance by the Architect or Consultant alone does not constitute Owner approval.
 - e. The Contractor shall schedule and conduct a formal User Interface review meeting with the Consultant, the Owner, and designated Owner operations personnel. The review shall confirm alignment of layout, workflow, terminology, access levels, and operational modes with Owner expectations.
 - 1) The UI review meeting shall occur prior to completion of system programming. Revisions identified during this review shall be incorporated into the final UI design without additional cost to the Owner.
 - f. All fixed and portable User Interface control surfaces shall comply with applicable accessibility requirements.
 - 1) Touchscreens, button stations, and primary control interfaces shall comply with ADA mounting height, reach range, and clear floor space requirements.
 - 2) Touchscreen layouts shall support accessible operation, including legible text, appropriate contrast, and logical navigation.
2. Physical Samples
- a. Certain items will require a physical review to understand color, finish, or texture choices.
 - b. Upon request, provide a physical sample, for review only, to the Owner at an address stipulated by the Owner.
 - 1) Provide any detailed information to highlight product attributes that need to be reviewed
 - 2) Indicate at the time of delivery whether the sample is to be returned, kept, or destroyed after review. If to be returned, provide instructions and full support (financial and logistical) for facilitating the return of sample product.
3. Mock-ups
- a. If installation details require mock-up for review prior to completing installation, review of said markup to be scheduled with Owner and

Consultant well ahead of time. Please provide a minimum of 10 business-days' notice ahead of expected review date for any onsite review.

- b. Any need for a mock-up required by the Owner or Design Team will be specifically noted in the Contract Documents. If the Contractor requests such a review, the Consultant, at the direction of the Owner, will accommodate requests as available. Reimbursable expenses may be required if site visit is beyond the Contracted limits.
- c. If a mock-up requires re-work or revisions that necessitate a follow-up review, the Contractor shall provide a day-rate fee plus expenses to the Consultant for additional time required.

1.5 CLOSEOUT DOCUMENTS

- A. All closeout documents shall meet the Division 01 requirements.
- B. As-Installed Drawings: Provide a comprehensive and accurate set of drawings, based on the shop drawings, that indicate any installed conditions. Include any field changes in this set as clear revisions.
- C. Manuals:
 - 1. Provide a cover sheet(s) indicating Name of the project, Date of Completion, Owner, , Contractor, Consultant, Warranty dates, Suggested follow-up review or inspection dates, and any other key project data.
 - 2. Provide a BoM indicating all equipment provided, organized by room (including support spaces) that notes location and quantity of all equipment.
 - 3. Provide a comprehensive list of contact information for support from the Contractor and Manufacturer to include help lines, services lines, or other means of support communication.
 - 4. Provide a copy of the Owner accepted turnover equipment list for any loose equipment or accessories. This shall be signed by the Contractor and designated representative of the Owner.
 - 5. Operation and Instruction Manuals:
 - a. Brief description of the operation of the system and subsystems with quick-start guides
 - b. Manufacturer's operation instruction manuals
 - c. Quick troubleshooting guide noting locations of electrical panels, upstream control equipment, and suggested solutions to common problems
 - 6. Owner's Manuals, Review Checklists, and Maintenance Records
 - a. Provide copies of any Owner's manuals provided by manufacturers.
 - b. Include any copies of warranties or guarantees provided by the manufacturer including limitations and process for claims.
 - c. Cataloged replacement parts list provided as part of the Contract

- d. Any test results, commissioning reports, or other data produced as part of the installation of the equipment.
 - e. Spare copies of any specialty keys for racks or panels
7. Programming Files: Provide a copy on USB flash drive and acceptable temporary cloud service of any custom programming or start-up files developed for the installation for any control equipment. The Contractor shall maintain a copy of these files to be turned over to the Owner at any time within (10) years of final turnover of equipment.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications

- 1. The Contractor shall have completed a minimum of five (5) projects of similar size, scope, and complexity within the last five (5) years prior to bidding on this project.
- 2. References for completed projects shall be provided upon request and shall be representative of the systems and environments described in this section.
- 3. This requirement shall apply to any subcontractors or other affiliates employed by the Contractor in the execution of work associated with this section.
 - a. Upon request, the Contractor shall provide the names, roles, and scope of responsibility for all subcontractor teams planned to work on the project
 - b. Additional review may be required to evaluate the qualifications and experience of any proposed subcontractor.
- 4. The Contractor shall provide a list of bidding subcontractors as part of the bid tabulation for review by the Consultant.
- 5. Professional Certifications
 - a. The Contractor shall employ personnel holding current AVIXA Certified Technology Specialist certifications, including CTS-I and/or CTS-D, where applicable to the scope of work being performed.
 - b. Personnel performing system design, engineering, or programming functions shall hold certifications appropriate to their role and responsibilities.
 - c. The Contractor and/or subcontractors shall hold current manufacturer-specific certifications for any proprietary equipment, platforms, or systems included in the project where such certifications are required or recommended by the manufacturer for installation, configuration, or commissioning.
 - d. Documentation of certifications shall be provided upon request and shall be valid at the time of bidding and during system installation and commissioning.

B. Coordination

1. Project Type Orientation

- a. The Contractor shall fully understand the type of project that they are working on prior to commencing work on the project.
- b. Any confusion about the primary function or purpose of the building, space, or system type should be clarified with the Owner prior to undertaking the work.
- c. The Consultant will provide orientation support for the Contractor upon request and with proper notice and organizational support from the Contractor.

2. Project Management

- a. The Contractor and any subcontractors performing work related to this section shall have a qualified Project Manager and site supervisor of the team working on the project available at all times.
- b. The Project Manager shall be clearly identified to the Consultant and shall be available any time that the Consultant is onsite for reviews.
- c. Any rigging or suspension of loads overhead shall be supervised by an Entertainment Technician Certification Program (ETCP) Certified Rigger. The Certification number and qualifications shall be made available upon request.

3. Pre-Installation Meetings

- a. Prior to commencing work covered by this section, a pre-installation meeting shall be scheduled by the Contractor to confirm the understanding of all parties involved.
- b. The Owner and Consultant shall be included in this meeting invitation and shall participate if available. Provide minimum (14) calendar days notice prior to this meeting.

4. Field Measurements

- a. The Contractor shall verify all measurements in the field prior to fabrication or installation of any equipment that could be adversely impacted by field conditions.
- b. Any significant deviations from the Contract Documents shall be noted to the Owner for possible revisions and clarifications.
- c. Any changes to the design required due to field measurements shall be accommodated by the Contractor without requiring additional payment or time from the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. All products shall be shipped and handled in accordance with the Manufacturer's recommendations until installed. This should include maintaining

and protecting original containers and packing materials until installation or turnover is complete.

- B. All installed equipment shall be protected during construction from activities that could damage the equipment. This could include paint, dust, debris, water, etc.
- C. Any equipment damaged prior to Owner turnover and training shall be replaced with new equipment at no cost to the Owner.

1.8 PROJECT CONDITIONS

- A. The Contractor shall fully understand the conditions of the site prior to bidding or beginning work. The Owner will not be responsible for additional cost due to conditions that should have been known to the Contractor.
- B. The Contractor shall be responsible for verifying that job conditions are suitable to receive the Work of this Section. Any existing conditions that may adversely affect execution of the Work shall be identified and resolved prior to commencement of installation.
- C. Equipment shall be installed only when construction activities permit a safe, clean and secure installation environment. The Contractor shall protect all equipment from dust, debris, moisture, and physical damage until final turnover to the Owner.
 - 1. Additional site condition requirements described in Part 3 of this section.
- D. The Contractor shall coordinate the work of all trades to prevent conflicts in installation in the field. Notify the Owner in writing for any discrepancies, conflicts, or omissions in the design and field conditions that may require alterations or adjustments.
 - 1. If adjustments or revisions are required, the Contractor shall provide adequate details in written or drawn form to the Owner to describe the conditions and suggested remedies.
 - 2. Upon approval of revisions required for field conditions, the Contractor shall complete the work without additional cost to the Owner.

1.9 WARRANTY

- A. The Contractor shall provide all systems and equipment professionally installed and free from defects in craftsmanship, manufacturing, or installation.
- B. Provide a minimum of a 2-year warranty on all systems and equipment described in this section and related documents.
 - 1. The warranty shall not be contingent on any action required by the Owner.
 - 2. The warranty period on the systems described in this section shall not begin until the systems have been accepted by the Owner as complete. This date shall be noted to the Owner in writing and included in the Closeout Documents submittal.

- C. During the warranty period, any service calls shall be responded to within 24 hours with repairs or temporary accommodations set in place within 48 hours of response to service call.
 - a. The warranty shall cover any defective materials, equipment, or installation.
 - b. Any labor, temporary accommodations, or replacement equipment shall be provided to the Owner at no-cost.
 - c. All work shall be scheduled at the Owner's convenience.
- D. Any warranties provided by a manufacturer that may extend beyond the warranty provided by the Contractor shall be transferred fully to the Owner.
- E. Pre-Expiration Inspection
 - 1. The Contractor shall schedule a review of the systems and equipment installed 1-month prior to the expiration of the warranty period.
 - 2. Any items noted by the Contractor or Owner during this review shall be remedied to align with the requirements of the Warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Products specified establish the Basis of Design (BOD) for performance, functionality, and integration capability required to support the design intent described in Part 1.
- B. Substitutions shall comply with Division 01 and Substitutions section of this specification.
- C. Where acceptable manufacturers are listed, Contractor shall select a single manufacturer per system category to maintain consistency and serviceability.
- D. Dante networked audio transport shall operate on a single Primary network architecture. Secondary Dante network topology is not required for this project.
- E. Quantities shall be as indicated on the Drawings and schedules where possible, loose equipment or accessory quantities may be listed below as needed. Contractor shall provide all equipment required for a fully functional system.

2.2 DIGITAL SIGNAL PROCESSING (DSP)

- A. General Requirements
 - 1. Provide digital signal processing platform suitable for professional audiovisual system operation.
 - 2. DSP platform shall support sufficient input and output capacity to support system configuration for full operation.

3. DSP shall support network-based audio transport including Dante and AES67.
4. DSP shall support configurable signal routing, mixing, processing, and control integration.
5. DSP system shall be fully programmable and coordinated with system control requirements.

B. Digital Signal Processor

1. Performance Requirements

- a. Processor shall provide integrated digital audio signal processing, AV bridging, device control, and automation within the Q-SYS platform.
- b. Network audio capacity shall be at least 160 input channels by 160 output channels and 80 input streams by 80 output streams.
- c. Provide 24 channels of onboard analog audio I/O comprising eight mic/line inputs, eight line outputs, and eight channels individually configurable as mic/line input or line output.
- d. Audio processing and Q-LAN network audio transport shall use 32-bit floating-point architecture.
- e. Processor shall include at least 8 input channels by 8 output channels of Software-based Dante audio, expandable by license to 64 input channels by 64 output channels.
- f. Provide support for Q-LAN, AES67, Dante, VoIP, WAN, and media-streaming audio transport.
- g. Acoustic echo cancellation capacity shall be at least 24 channels.
- h. USB-C AV bridging shall support at least 16 input channels by 16 output channels of audio at 48 kHz and USB HID routing.
- i. Provide four 2.5 GbE network interfaces, including two interfaces suitable for redundant network audio and two independently configurable auxiliary interfaces.
- j. Control interfaces shall include two RS-232 ports and eight general-purpose inputs by eight general-purpose outputs.
- k. Processor shall be 1RU rack-mountable.
- l. Processor shall operate from 100 to 240 VAC, 50/60 Hz.

2. Basis of Design

- a. QSC CORE 24f Q-SYS Networked Audio, Video, And Control Processor (Qty: 1).

C. Network Audio I/O Expander

1. Performance Requirements

- a. Provide a network audio input and output expander native to the specified digital signal processing and control platform.
- b. Expander shall provide a minimum of eight mic/line-level inputs, eight software-configurable analog input or output channels, and eight line-level outputs.

- c. Mic/line inputs shall provide software-configurable preamplifier gain and individually selectable 48 VDC phantom power.
- d. Analog inputs shall accept balanced signals with a maximum input level of not less than +24 dBu.
- e. Analog outputs shall provide a software-configurable operating range from approximately -36 dBu through +24 dBu.
- f. Audio conversion shall operate at 48 kHz and 24-bit resolution.
- g. Expander shall provide a minimum of eight general-purpose control inputs and eight general-purpose control outputs.
- h. Expander shall provide dual Gigabit Ethernet ports supporting redundant network operation.
- i. Expander shall support redundant peripheral operation with a second matching unit where indicated.
- j. Outputs shall incorporate relay muting to prevent power-up transients and support redundant peripheral configurations.
- k. Expander shall be configurable, monitored, and managed through the associated digital signal processing platform software.
- l. Expander shall be suitable for installation in one standard rack unit and include required rack-mounting hardware.
- m. Provide all connectors, licenses, accessories, programming, and configuration required for a complete and operational system.

2. Basis of Design

- a. Q-SYS QIO-24f.

2.3 TOUCHPANEL CONTROL INTERFACES

A. General Requirements

- 1. Provide integrated audiovisual control system for operation of all connected systems.
- 2. Control system shall provide centralized control of audio, video, and system power functions.
- 3. Control system shall be fully programmable and coordinated with DSP and networked devices.
- 4. Provide all required control processors, touch panels, cabling, and accessories for a complete operating system.

B. Performance Requirements

- 1. Touchpanel shall provide a 10.1-inch projective-capacitive multitouch display native to the Q-SYS control platform.
- 2. Display resolution shall be 1920 by 1200 pixels with brightness of at least 380 nits and 24-bit color.
- 3. Power and network communications shall be supported through Power over Ethernet.
- 4. Orientation shall be configurable for portrait or landscape operation.

5. Provide mounting provisions for standard United States and European wall or junction boxes.

C. Basis of Design

1. QSC TSC-101-G3 Q-SYS 10.1" PoE Touch Screen Controller For In-Wall Mounting. Color - Black Only (Qty: 2).

2.4 LOUDSPEAKER SYSTEMS

A. Line Array Loudspeaker (Projector Screen Wall)

1. Basis of Design
 - a. JBL CBT 70J-1 JBL CBT 70J-1 Array Spkr Blk (Qty: 2).
2. Acceptable Manufacturers
 - a. Renkus-Heinz
 - b. Fulcrum Acoustic

B. Ceiling Loudspeakers

1. Performance Requirements
 - a. Provide a commercial-grade, two-way, blind-mount ceiling loudspeaker with integral back can and zero-bezel grille.
 - b. Loudspeaker shall include a nominal 6.5-inch low-frequency transducer and a high-frequency dome transducer coupled to a directivity-matched waveguide.
 - c. Effective frequency range shall extend from not greater than 65 Hz through not less than 20 kHz.
 - d. Rated coverage shall be nominally 135 degrees conical.
 - e. Rated continuous noise power shall be not less than 60 watts when operated in low-impedance mode.
 - f. Maximum continuous sound pressure level shall be not less than 106 dB at 1 meter.
 - g. Loudspeaker shall include an integral low-loss transformer suitable for 70-volt and 100-volt distributed loudspeaker systems.
 - h. Transformer shall provide selectable taps through 60 watts for 70-volt operation and through 60 watts for 100-volt operation.
 - i. Loudspeaker shall provide a nominal 16-ohm bypass setting.
 - j. Input connections shall be made through a removable terminal block with parallel input and loop-through connections.
 - k. Enclosure shall consist of a flame-resistant baffle and steel back can suitable for installation in air-handling spaces.
 - l. Loudspeaker shall include a removable magnetic grille, tile bridge rails, C-ring, mounting hardware, grille safety tether, and cutout template.
 - m. Loudspeaker shall be listed to UL 1480 and UL 2043 and shall be suitable for use in air-handling spaces.

- n. Provide manufacturer-recommended processing, equalization, mounting accessories, supports, and hardware required for a complete installation.
- 2. Basis of Design
 - a. Q-SYS AD-C6T-ZB, white. (Qty: 6)
- C. Subwoofer (Ceiling)
 - 1. Basis of Design
 - a. QSC AD-C8T-SWZB-WH 8" In-Ceiling Subwoofer, Blind Mount Ceiling Speakers, 70/100v Transformer (Qty: 2).

2.5 AMPLIFICATION

A. General Requirements

- 1. Provide professional power amplifiers suitable for continuous operation in installed audiovisual sound reinforcement systems.
- 2. Amplifiers shall be specifically compatible with the associated loudspeaker systems and digital signal processing platform.
- 3. Amplifiers shall incorporate protection circuitry for thermal, short-circuit, overload, and loudspeaker fault conditions.
- 4. Amplifiers shall support network monitoring and control where indicated.
- 5. Provide all accessories, mounting hardware, network connections, and interconnecting cables required for a complete and operational installation.

B. Power Amplifier

- 1. Performance Requirements
 - a. Amplifier shall provide eight independently configurable output channels rated for at least 250 W maximum output per channel.
 - b. Each output channel shall directly support 2-ohm, 4-ohm and 8-ohm low-impedance loads and 70 V and 100 V constant-voltage loads without manual output-mode switching.
 - c. Provide eight balanced line-level analog inputs routable to the network audio system or directly to amplifier outputs.
 - d. Network audio and control shall be native to the Q-SYS platform through redundant Gigabit Ethernet connections.
 - e. Onboard signal processing shall include gain, polarity, IIR and FIR filtering, delay and output limiting.
 - f. Output frequency response shall extend from 20 Hz to 20 kHz within +0.2 dB and -0.7 dB at 8 ohms.
 - g. Amplifier shall be 2RU rack-mountable and shall operate from 100 to 240 VAC.
 - h. Provide GPIO comprising at least four general-purpose inputs and two configurable relay outputs.

2. Basis of Design

- a. QSC MPA-Q 8x250 8-Channel 250w/ch Q-SYS Network Amplifier (Qty: As Required).

C. Power Amplifier

1. Performance Requirements

- a. Amplifier shall provide four independently configurable output channels rated for at least 500 W maximum output per channel.
- b. Each output channel shall directly support 2-ohm, 4-ohm and 8-ohm low-impedance loads and 70 V and 100 V constant-voltage loads without manual output-mode switching.
- c. Provide four balanced line-level analog inputs routable to the network audio system or directly to amplifier outputs.
- d. Network audio and control shall be native to the Q-SYS platform through redundant Gigabit Ethernet connections.
- e. Onboard signal processing shall include gain, polarity, IIR and FIR filtering, delay and output limiting.
- f. Output frequency response shall extend from 20 Hz to 20 kHz within +0.2 dB and -0.7 dB at 8 ohms.
- g. Amplifier shall be 2RU rack-mountable and shall operate from 100 to 240 VAC.
- h. Provide GPIO comprising at least four general-purpose inputs and two configurable relay outputs.

2. Basis of Design

- a. QSC MPA-Q 4x500 4-Channel 500w/ch Q-SYS Network Amplifier (Qty: As Required).

2.6 WIRELESS PRESENTATION SYSTEM

A. Basis of Design

1. Performance Requirements

- a. Provide a commercial-grade wireless presentation receiver supporting presentation from compatible Windows, macOS, Chrome OS, iOS, and Android devices.
- b. Receiver shall support wireless presentation through the facility Ethernet network and an integral dual-band Wi-Fi access point.
- c. Integral wireless connectivity shall support 2.4 GHz and 5 GHz operation using IEEE 802.11a/b/g/n/ac/ax protocols.
- d. Receiver shall support native screen-sharing protocols, manufacturer-provided applications, browser-based presentation, and compatible wireless presentation adapters.
- e. Receiver shall support simultaneous display of multiple presentation sources.

- f. Receiver shall include one HDMI input for connection of a local wired presentation source.
- g. Receiver shall provide one HDMI output supporting resolutions through 3840 by 2160 at 60 Hz.
- h. HDMI output shall support HDCP 2.2, EDID management, and CEC display control.
- i. Receiver shall provide USB host connections for integration of compatible conferencing cameras, microphones, loudspeakers, and other USB peripherals.
- j. Receiver shall provide a balanced stereo analog audio output.
- k. Receiver shall provide dual Gigabit Ethernet ports.
- l. Receiver shall support enterprise network security, encrypted content transmission, IEEE 802.1X authentication, and Active Directory integration.
- m. Receiver shall support remote configuration, firmware management, monitoring, and cloud-based device management.
- n. Receiver shall be powered using IEEE 802.3at PoE+ or a manufacturer-approved external power supply.
- o. Provide antennas, mounting hardware, power equipment, licenses, cables, programming, and accessories required for a complete and operational installation.

2. Basis of Design

- a. Crestron AM-3200-WF AirMedia Receiver 3200 with Wi-Fi Network Connectivity, quantity one.

2.7 VIDEO CAMERAS

1. General Requirements

- a. Provide additional PTZ cameras in addition to existing installed cameras.

2. PTZ Camera

a. Performance Requirements

- 1) Provide a professional robotic pan-tilt-zoom camera suitable for live production, recording, streaming, and automatic presenter tracking.
- 2) Camera shall incorporate a 4K CMOS image sensor with not less than 8 megapixels of effective resolution.
- 3) Camera shall provide a minimum 20-times optical zoom lens.
- 4) Lens shall provide a horizontal field of view ranging from approximately 3.5 degrees at telephoto to not less than 60 degrees at wide angle.
- 5) Camera shall support video resolutions through 3840 by 2160 at 60 frames per second through the HDMI output.

- 6) Camera shall support video resolutions through 1920 by 1080 at 60 frames per second through the 3G-SDI output.
- 7) Camera shall provide simultaneous HDMI, 3G-SDI, USB, and IP video outputs.
- 8) Camera shall include native NDI HX3 connectivity without requiring an additional permanent license.
- 9) Camera shall support H.264, H.265, MJPEG, RTSP, RTMP, SRT, and compatible network-streaming protocols.
- 10) Camera shall provide integral automatic presenter tracking and group-framing capabilities without requiring an external tracking computer.
- 11) Camera shall provide not fewer than 255 programmable camera presets.
- 12) Camera shall support remote control through IP, RS-232, RS-485, VISCA, and manufacturer-provided web interfaces.
- 13) m. Camera shall provide a minimum pan range of plus or minus 170 degrees and a tilt range from minus 30 degrees through plus 90 degrees.
- 14) Camera shall include a built-in tally indicator and line-level audio input.
- 15) Camera shall support image flip and automatic video inversion for upright or inverted mounting.
- 16) Camera shall be powered using IEEE 802.3at PoE+ or the manufacturer-provided external power supply.
- 17) Provide manufacturer-approved mounting hardware, safety restraints, power equipment, network licenses, cables, configuration, and accessories required for a complete installation.

b. Basis of Design

- 1) PTZOptics PTZOptics Move 4K 20X Ptzoptics Move 4k, A Third Generation PTZ Camera, (Qty: 2).

2.8 MEETING CAPTURE APPLIANCE

A. General Requirements

1. Meeting capture appliances suitable for the recording and streaming of meetings and other events.

B. Basis of Design

1. Epiphan Pearl Mini - 3yr SupportPlan+ Pearl Mini - 3yr Supportplan+ (Qty: 1).

2.9 PROJECTORS

A. General Requirements

1. Provide professional laser projection systems suitable for educational, presentation, performance, scenic projection, and large-format image display applications.
2. Projectors shall be furnished with lenses, mounting systems, structural attachment hardware, safety devices, and accessories required for a complete and operational installation.
3. Coordinate final lens selection, throw distance, image size, projection geometry, and mounting requirements with field conditions prior to procurement.
4. Projectors shall support the native resolution, brightness, and signal formats required by the system design.
5. Provide all mounting adapters, extension columns, projector security hardware, and accessories required for a complete and operational installation.

B. Projector

1. Performance Requirements

- a. Projector shall use a three-chip 3LCD laser-light-source imaging system with equal color and white light output of at least 13,000 lumens.
- b. Native resolution shall be 1920 by 1200 WUXGA with pixel-shifting 4K Enhancement processing.
- c. Laser light-source life shall be at least 20,000 hours in the manufacturer's normal operating mode.
- d. Optical system shall accept interchangeable powered lenses and support powered lens shift, zoom and focus with lens-position memory.
- e. Installation capabilities shall include front, rear and ceiling projection, portrait orientation and 360-degree installation.
- f. Signal connectivity shall include HDMI, HDBaseT and 3G-SDI digital video inputs and wired Ethernet control.
- g. Provide geometric correction, edge blending and multi-projector color and brightness matching capabilities.
- h. Projector shall be provided with a compatible middle-throw zoom lens having the throw range required for the scheduled image geometry.
- i. EPSON EB-PU2113W Laser Projector, Interchangeable Lens, 13,000 Lumens, WUXGA with 4KE, White shall be provided with an eplm10 lens - mid zoom #3 - throw ratios for wuxga: 3.32 - 5.06(<9k lm), 2.42 - 3.71 (9k to 20k lm) for 4k: 2.34 - 3.59 (up to 20k lm).

2. Basis of Design

- a. Epson V11HA65920 EPSON EB-PU2113W Laser Projector, Interchangeable Lens, 13,000 Lumens, WUXGA with 4KE, White. (Qty: 2)

- b. Epson V12H004M0A EPSON ELPLM10 Lens - Mid Zoom #3 - Throw Ratios for WUXGA: 3.32 -5.06(<9k lm), 2.42 - 3.71 (9k to 20k lm) For 4K: 2.34 - 3.59 (up to20k lm). (Qty: 2)
 3. Acceptable Manufacturers
 - a. Panasonic
- 2.10 PROJECTION SCREENS
 - A. General Requirements
 1. Provide projection screens suitable for the associated projection system and viewing environment.
 2. Projection screens shall be furnished complete with mounting hardware, trim components, controls, and accessories required for a complete and operational installation.
 3. Coordinate final screen dimensions, mounting conditions, and viewing requirements with the field conditions prior to procurement.
 4. Screen surfaces shall be suitable for the associated projector brightness, viewing angles, and content requirements.
 - B. Projection Screen
 1. Performance Requirements
 - a. Projection screen shall be a motorized, recessed flush-mount assembly for indoor installation.
 - b. Viewing surface shall have a nominal 160-inch diagonal and 16:9 aspect ratio.
 - c. Screen material shall be determined by Contractor.
 - d. Viewing surface shall support reproduction of high-resolution projected images without visible texture at normal viewing distances.
 - e. Provide manufacturer-compatible motor power, mounting hardware and control interface required for the scheduled control system.
 2. Basis of Design
 - a. Screen Innovations S3TF160PW 160 - Solo3 -16:9 (Qty: 1).
 3. Acceptable Manufacturers
 - a. Draper
 - b. Da-Lite
 - C. Projection Screen
 - a. Projection screen shall be a motorized, recessed flush-mount assembly for indoor installation.
 - b. Viewing surface shall have a nominal 200-inch diagonal and 16:9 aspect ratio.
 - c. Screen material shall be determined by Contractor..

- d. Viewing surface shall support reproduction of high-resolution projected images without visible texture at normal viewing distances.
- e. Provide manufacturer-compatible motor power, mounting hardware and control interface required for the scheduled control system.

2. Basis of Design

- a. Screen Innovations S3TF200SG 200 - Solo3 -16:9 - (Qty: 1).

2.11 LCD DISPLAYS

A. General Requirements

- 1. Provide professional commercial-grade LCD display devices suitable for continuous operation in educational, presentation, monitoring, production support, and audiovisual applications.
- 2. Displays shall be designed for commercial installation and shall not utilize consumer-grade products.
- 3. Provide all mounting hardware, interface adapters, power supplies, trim components, and accessories required for a complete and operational installation.

2.12 LCD DISPLAY

A. Basis of Design

- a. Planar Systems 998-1443-00 24in Wide Black FHD IPS LED LCD (Qty: 2).

2.13 LIGHTING CONTROLS AND POWER SWITCHING

A. Mini Relay Panel

- 1. Provide a branch-fed relay panel for switching and control of architectural lighting branch circuits.
- 2. Shall include or be capable of:
 - a. Eight individually controlled relay outputs for branch-fed circuits.
 - b. Operation at 120 or 277 VAC, as required by the electrical system.
 - c. Latching relay switching suitable for entertainment lighting loads.
 - d. Individual relay current monitoring and manual override.
 - e. Configurable relay sequencing to limit simultaneous load energization.
 - f. Control from Vision.Net architectural control stations and other system control inputs.
 - g. Wall-mounted steel enclosure with locking door and provisions for field wiring.
- 3. Quantity: (1)
- 4. Acceptable Product(s):

- a. Vari-Lite RigSwitch+ Architectural 8-Channel Branch-Fed
- b. or approved equal

B. Interface Module

1. Provide a system interface module for connection of the architectural lighting control system to third-party serial devices and programming equipment.
2. Shall include or be capable of:
 - a. One RS232 interface for communication with compatible third-party control systems.
 - b. One USB interface for system programming, commissioning, firmware updates, and maintenance.
 - c. Communication with the architectural lighting control network.
 - d. Receiving commands, providing status information, and triggering system actions through RS232 communication.
 - e. Mounting on standard 35 mm DIN rail or surface mounting.
 - f. UL listed and plenum rated.
 - g. Operation from 24 VDC external power supply.
3. Quantity: (1)
4. Acceptable Product(s):
 - a. Vari-Lite – Vision.Net RS232 and USB Module
 - b. or approved equal

C. Architectural Button Station

1. Provide a wall-mounted button station for local control of architectural and entertainment lighting functions.
2. Shall include or be capable of:
 - a. Seven programmable control buttons.
 - b. Configuration of individual buttons for preset recall, on/off, raise/lower, or other programmed system functions.
 - c. Execution of multiple system commands from a single button where programmed.
 - d. Programmable button backlighting for identification and status indication.
 - e. Communication with and operation as part of the architectural lighting control system.
 - f. Installation in a standard single-gang wall box.
 - g. Custom button engraving identifying functions as indicated on the Drawings.
3. Quantity: (1)
4. Acceptable Product(s):
 - a. Vari-Lite – Vision.Net 7-Button Control Station
 - b. or approved equal

2.14 POWER DISTRIBUTION AND SEQUENCING

A. Performance Requirements

1. Provide power distribution units and power sequencing in all non-portable equipment racks as required for installed equipment.
2. Provide controlled power-up and power-down sequencing to protect connected equipment and prevent inrush or turn-on transients.
3. Sequence, at minimum, the following equipment:
 - a. Power amplifiers
 - b. Wireless microphone receivers
 - c. AV-over-IP encoders and decoders
 - d. Video processors
 - e. Projectors and projection-related equipment
 - f. Mixing consoles and stage boxes where rack-mounted
4. Do not sequence the following:
 - a. Primary DSP/control processor; provide unswitched power to maintain system control and monitoring capability.
 - b. AV-dedicated network switches to maintain connectivity and monitoring.
5. Provide delayed turn-on of power amplifiers after upstream signal processing devices have stabilized.
6. Provide delayed turn-off of signal processing devices after amplifiers have powered down.
7. Provide network connectivity for monitoring and control integration with the audiovisual control system.
8. Provide surge protection and overcurrent protection appropriate for connected loads.
9. Provide sufficient switched and unswitched outlets to support installed equipment with minimum 20 percent spare capacity.
10. Provide front-panel status indication of power and fault conditions.
11. Basis of Design
 - a. Furman.
12. Acceptable Manufacturers
 - a. Furman
 - b. Middle Atlantic
 - c. Tripp Lite

2.15 POWER CONDITIONING

A. Performance Requirements

1. Provide rack-mounted power conditioning units for all equipment racks.
2. Provide surge suppression rated for professional audiovisual installations.

3. Provide EMI and RFI noise filtration suitable for audio and video equipment.
4. Provide overvoltage shutdown protection where utility voltage exceeds safe operating range.
5. Provide minimum 15-amp or 20-amp capacity as required by connected loads.
6. Provide sufficient outlets to serve connected equipment with minimum 20 percent spare capacity.
7. Provide front-panel voltage and status indication.
8. Provide compatibility with installed rack-mounted power sequencing system.

B. Basis of Design

1. Furman.

C. Acceptable Manufacturers

1. Furman
2. Middle Atlantic
3. Tripp Lite

2.16 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Performance Requirements

1. Provide rack-mounted online or line-interactive UPS units for designated all non-portable equipment racks.
2. Provide pure sine wave output suitable for audiovisual and network equipment.
3. Provide minimum runtime of 10 minutes at calculated connected load unless otherwise indicated.
4. Support network monitoring and status reporting compatible with the audiovisual control system.
5. Provide automatic voltage regulation.
6. Provide surge suppression and battery-backed outlets for designated critical equipment.
7. Provide sufficient capacity to support connected loads with minimum 20 percent spare capacity.
8. Do not connect power amplifiers or high-inrush loads to battery-backed outputs unless specifically indicated.

B. Basis of Design

1. APC Smart-UPS series.

C. Acceptable Manufacturers

1. APC
2. Eaton
3. Tripp Lite

2.17 OPTION 1: NETWORK-BASED PTZ CAMERAS

A. General Requirements

1. Remove existing PTZ cameras and replace with network-based PTZ cameras.

B. Performance Requirements

1. Network PTZ conference camera shall provide motorized pan, tilt, and optical zoom operation with at least 20x optical zoom.
2. Horizontal field of view shall extend to at least 60 degrees at the wide-angle setting.
3. Image sensor shall be a minimum 1/1.8-inch low-noise CMOS type with progressive scanning.
4. Camera shall support network video transport, power, control, discovery, firmware management, and signal routing through the Q-SYS platform over a Gigabit Ethernet connection.
5. Bridged video resolutions shall include 1920 by 1080 at 30 frames per second.
6. Provide HDMI output supporting resolutions through 2160p30 and 3G-SDI output supporting resolutions through 1080p60.
7. Camera shall support simultaneous use of either HDMI or 3G-SDI output, selectable through the control system; simultaneous operation of both physical outputs is not required.
8. Pan range shall be at least plus or minus 170 degrees, and tilt range shall extend from at least minus 30 degrees to plus 90 degrees.
9. Imaging controls shall include focus, exposure, white balance, shutter adjustment, image rotation, and digital noise reduction.
10. Minimum illumination shall not exceed 0.5 lux with automatic gain control enabled.
11. Network interface shall be 1000Base-T Ethernet with IEEE 802.3af PoE Type 1, Class 3 power support.
12. Provide local 12 VDC power input for installations not using PoE.
13. Camera shall support inverted mounting and shall include a surface or wall mounting bracket suitable for the specified installation.
14. Camera shall support preset recall from control system for automated aiming and camera switching from control system.

C. Basis of Design

1. Q-sys NC-20x60 Q-SYS Network PTZ Conference Camera. (Qty: 6)

2.18 OPTION 2: AI-ASSISTED CAMERA SWITCHING AND TRACKING SYSTEM

A. General Requirements

1. Provide an automated, AI-assisted camera switching and tracking system.

B. Performance Requirements

1. AI accelerator shall provide computer-vision-based scene analysis for automated presenter tracking, active-speaker framing, camera switching, and room-control trigger zones.
2. Appliance shall operate as a native Q-SYS peripheral and shall be configured and commissioned through Q-SYS Designer Software and VisionSuite Designer.
3. Camera automation shall support up to 14 Speaker Spotlight cameras, one Presenter Spotlight camera, and one audience-facing Conductor camera.
4. Vision-assisted framing shall support detection and framing of up to 25 audience members, with audio-location-based framing for larger audiences.
5. Maximum presenter-tracking distance shall be at least 30 m when used with the specified long-range Q-SYS PTZ camera and half-body framing.
6. Provide one VisionSuite room per Q-SYS Core and Q-SYS design.
7. Appliance shall be 1RU rack-mountable and shall include the manufacturer's rack-mounting rail hardware.
8. Network connectivity shall provide four Q-SYS LAN interfaces using RJ45 connectors.

C. Basis of Design

1. Q-sys Vsa-100 Q-SYS Visionsuite AI Camera Automation Accelerator.

2.19 PLATES, CABLING, AND SIGNAL TRANSPORT

A. General Requirements

1. Contractor shall inspect and verify the condition, capacity, compatibility, and suitability of existing infrastructure indicated for reuse and shall reuse such infrastructure where required to support the completed audiovisual systems.

B. Audiovisual Wall Plates

1. Performance Requirements

- a. Provide separate plates for audio, video, data, RF, and loudspeaker connections unless otherwise indicated.
- b. Provide plates sized appropriately for connector quantity and type; avoid excessive gang configurations where a single custom plate is more suitable.
- c. Provide custom engraved labeling for all connectors.
- d. Provide permanent, machine-engraved or laser-etched labeling identifying signal type, destination, and circuit designation consistent with project schedules.
- e. Provide labeling on both plate face and rear termination where accessible.

- f. Provide stainless steel or powder-coated steel faceplates suitable for institutional environments.
 - g. Provide NEMA 1 back boxes sized appropriately for connector depth and cable bend radius.
 - h. Coordinate conduit entry and back box sizing to avoid overfill and maintain serviceability.
 - i. Provide strain relief for all rear terminations.
 - j. Provide blank filler panels where future capacity is indicated.
- 2. Acceptable Manufacturers – Plates and Hardware
 - a. FSR
 - b. Covid
 - c. Liberty
 - d. Custom fabricated engraved stainless steel plates by approved fabricator
- 3. Acceptable Connector Manufacturers
 - a. Neutrik
 - b. Switchcraft
 - c. Canare

2.20 INSTALLED CABLING

A. General Requirements

- 1. Contractor shall inspect and verify the condition, capacity, compatibility, and suitability of existing infrastructure indicated for reuse and shall reuse such infrastructure where required to support the completed audiovisual systems.

B. Analog Audio Cables

- 1. Performance Requirements
 - a. Balanced microphone and line-level audio cable shall be twisted pair, shielded, low-capacitance type.
 - b. Cable shall be minimum 22 AWG stranded copper conductors.
 - c. Cable shall be rated CM, CMR, or CMP as required by installation environment.
 - d. Cable jacket shall be suitable for permanent installation in conduit, cable tray, or plenum space as applicable.
 - e. All terminations shall be made using manufacturer-approved tooling and methods.
- 2. Reference Manufacturer
 - a. Belden 9451
- 3. Acceptable Manufacturers

- a. Belden
- b. West Penn Wire
- c. Liberty

C. Loudspeaker Cables

1. Performance Requirements

- a. Loudspeaker cable shall be stranded copper conductors suitable for professional sound reinforcement systems.
- b. Conductors shall be 100 percent copper. Copper-clad aluminum conductors are not acceptable.
- c. Cable gauge shall be selected based on load impedance, amplifier output, and distance as required.
- d. Minimum conductor size shall be 12 AWG for low-impedance loudspeaker circuits unless otherwise indicated.
- e. 70V or constant-voltage loudspeaker circuits shall be minimum 14 AWG unless otherwise indicated.
- f. Cable shall be rated for installation environment (CM, CMR, or CMP as required).
- g. Jacket shall be durable and suitable for installation in conduit or cable tray.
- h. All loudspeaker circuits shall be home-run unless specifically shown otherwise.
- i. All terminations shall utilize manufacturer-approved connectors, terminal blocks, or speakON connectors where indicated.
- j. All loudspeaker circuits shall be polarity verified and impedance-tested during commissioning.

2. Acceptable Manufacturers

- 1) Belden
- 2) West Penn Wire
- 3) Liberty

D. Intercom Cabling

1. Performance Requirements

- a. Intercom cable shall be two-conductor shielded cable suitable for analog party-line intercom systems.
- b. Conductors shall be minimum 22 AWG stranded copper.
- c. Shield shall provide full coverage suitable for audio and power transport.
- d. Cable shall be rated for installation environment (CM, CMR, or CMP as required).
- e. Intercom circuits shall be home-run unless specifically indicated otherwise.

2. Reference Manufacturer

- a. Belden 9207
- 3. Acceptable Manufacturers
 - a. Belden
 - b. West Penn Wire
 - c. Liberty
- E. Control Cable
 - 1. Performance Requirements
 - a. Control cable shall be multi-conductor stranded copper suitable for low-voltage control applications.
 - b. Conductors shall be minimum 22 AWG stranded copper unless otherwise required by connected device manufacturer.
 - c. RS-232 control cable shall be twisted pair, shielded type suitable for serial communication.
 - d. Shield shall be continuous foil with drain wire or braided type providing full coverage.
 - e. For relay or contact closure circuits, cable shall be minimum two-conductor stranded copper.
 - f. For multi-contact GPIO interfaces, cable shall be multi-conductor type with individually insulated conductors within a common jacket.
 - g. Control cabling shall be rated CM, CMR, or CMP as required by installation environment.
 - h. Shield shall be grounded at one end only unless otherwise required by manufacturer.
 - i. All control cabling shall be home-run unless specifically indicated otherwise.
 - j. All terminations shall be made using manufacturer-approved connectors or terminal blocks.
 - k. All control circuits shall be tested for continuity and correct operation prior to system acceptance.
 - 2. Acceptable Manufacturers
 - a. Belden
 - b. West Penn Wire
 - c. Liberty
- F. Data Cabling
 - 1. Performance Requirements
 - a. Category cable shall be CAT6+ (F/UTP or better) suitable for audiovisual network applications.
 - b. Cable shall be solid conductor, 100 percent copper. Copper-clad aluminum conductors are not acceptable.
 - c. Cable shall support minimum 1Gbps bandwidth performance.

- d. Cable shall be rated CM, CMR, or CMP as required by installation environment.
 - e. Terminations shall be in accordance with TIA/EIA-568 standards.
 - f. Installed cabling shall be certified to CAT6+ performance standards using approved test equipment.
 - g. Certification test reports shall be submitted prior to system acceptance.
 - h. Category cabling shall be home-run to designated AV network switch or patch bay locations unless otherwise indicated.
 - i. Maximum horizontal cable length shall not exceed 90 meters excluding patch cords.
 - j. Patch cords shall be factory-terminated, CAT6A shielded assemblies.
 - k. Where HDBaseT transport is utilized, cabling shall comply with manufacturer distance limitations and shall be shielded CAT6A as specified herein.
 - l. HDBaseT cable runs shall not exceed manufacturer-supported maximum distance for required resolution and signal format.
 - m. HDBaseT patch cords shall match installed cable category and shielding type.
2. Reference Manufacturer
- a. CAT6+
 - 1) Belden 2412F
 - b. HDBaseT
 - 1) Belden 2183R
3. Acceptable Manufacturers
- a. Belden
 - b. Liberty
 - c. West Penn
 - d. Commscope

G. HDMI Cabling

1. Performance Requirements
- a. HDMI cabling shall support the required bandwidth for connected equipment resolution and frame rate as required.
 - b. HDMI cabling shall support minimum 4K60P unless otherwise indicated.
 - c. Where higher resolutions are specified, cabling shall support required bandwidth for those formats.
 - d. Passive HDMI cabling shall not exceed manufacturer-supported maximum distance for required signal format.
 - e. HDMI runs exceeding passive distance limitations shall utilize active optical HDMI cable or approved signal extension.

- f. Permanently installed HDMI cabling shall be in-wall rated (CMR or CMP as required).
 - g. HDMI connectors shall provide strain relief and secure termination at equipment rack locations.
 - h. HDMI patch cords shall be factory-terminated, professional-grade assemblies.
 - i. HDMI cabling shall maintain HDCP compliance where required by connected devices.
2. Acceptable Manufacturers
- a. Belden
 - b. Liberty
 - c. Extron

H. Serial Digital Interface (SDI/HD-SDI) Cabling

1. Performance Requirements
- a. Provide precision 75-ohm coaxial cable suitable for broadcast video transport.
 - b. Support SMPTE 424M (3G-SDI), and SMPTE 292M (HD-SDI).
 - c. Support 1080P (1920x1080) at 60 Hz.
 - d. Support embedded audio transport.
 - e. Provide solid bare copper center conductor.
 - f. Provide sweep-tested cable suitable for minimum 6 GHz performance.
 - g. Maintain impedance tolerance suitable for 342G-SDI transport.
 - h. Provide attenuation performance suitable for installed distance at 342G-SDI as indicated on the required.
 - i. Provide cable rated CM, CMR, or CMP as required by installation environment.
 - j. Provide home-run topology unless specifically shown otherwise.
 - k. Provide minimum 3-foot service loop at rack terminations.
 - l. Utilize true 75-ohm BNC connectors compatible with specified cable type.
 - m. Provide compression or crimp connectors installed with manufacturer-approved tooling.
 - n. Twist-on connectors are not acceptable.
 - o. Test all installed SDI cabling for continuity and verify signal integrity prior to system acceptance.
2. Reference Manufacturer
- a. Belden 1369R
3. Acceptable Manufacturers – Cable
- a. Belden
 - b. West Penn Wire

- c. Gepco
- 4. Acceptable Manufacturers – Connectors
 - a. Canare
 - b. Neutrik
- I. RF ANTENNA CABLING
 - 1. Performance Requirements
 - a. RF antenna cable shall be 50-ohm coaxial suitable for wireless microphone frequency ranges utilized in the project.
 - b. Cable shall be low-loss type equivalent to LMR-240 or better for permanently installed antenna runs.
 - c. For antenna runs exceeding 75 feet, cable shall be low-loss type equivalent to LMR-400 or better.
 - d. 75-ohm video cable (including RG-59 or RG-6) is not acceptable for wireless antenna transport.
 - e. Cable shall be rated for installation environment (CM, CMR, or CMP as required).
 - f. Connectors shall be true 50-ohm type compatible with wireless receiver and antenna distribution equipment.
 - g. Connectors shall be installed using manufacturer-approved tooling.
 - h. Acceptable Manufacturers – Cable
 - 1) Times Microwave (LMR Series)
 - 2) Belden
 - 3) West Penn Wire
 - i. Acceptable Manufacturers – Connectors
 - 1) Canare
 - 2) Neutrik
- J. 0-10V Dimming Cable
 - 1. General Requirements
 - a. Control cabling shall be suitable for Class 2 low-voltage 0-10V analog dimming control circuits.
 - b. Control cabling shall provide a minimum of one twisted pair of conductors for each independent 0-10V control circuit.
 - c. Conductors shall be stranded copper and sized as required for circuit length, connected load, and voltage drop.
 - d. Cable insulation and jacket ratings shall be suitable for the installed environment and applicable pathway and plenum requirements.
 - e. Cabling shall maintain polarity throughout each 0-10V control circuit.
 - f. Cabling shall be installed separately from power conductors except where the cable and associated equipment are specifically listed and permitted for installation with power conductors.

- g. Provide continuous cable runs between termination points except where intermediate terminations are specifically indicated.
- h. Terminate conductors at control devices, dimming interfaces, drivers, or other equipment in accordance with the equipment connection requirements.

2.21 LOOSE EQUIPMENT

A. General Requirements

- 1. Provide loose audiovisual equipment, microphones, loudspeakers, stands, cables, accessories, and support equipment required for operation of the audiovisual systems.
- 2. Loose equipment shall be delivered, tested, labeled, and coordinated with Owner operational requirements.
- 3. Provide all adapters, connectors, carrying cases, power supplies, batteries, and accessories required for complete functionality.
- 4. Coordinate final quantities, storage requirements, and accessory requirements with the Owner prior to procurement.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Supervision

- 1. The Contractor shall maintain a qualified superintendent onsite whenever audiovisual installation work is being performed.
- 2. The superintendent shall have documented experience on projects of similar size and complexity and shall be knowledgeable in the installation, coordination, and interconnection of audiovisual systems with other building systems.
 - a. Qualifications shall be demonstrated through prior project experience, manufacturer training, or relevant professional certifications and shall be submitted to the Architect or Consultant upon request.
- 3. Overhead suspension or rigging of equipment from structure or truss shall be supervised by an ETCP-certified Rigger where such work is included in the scope of the project.

3.2 LABOR

- A. Installation shall be completed by fully qualified and informed personnel with common labor support.

3.3 INSTALLATION, CLEANING, AND PROTECTION

- A. The Contractor shall install all equipment securely and in a plumb, level, and true condition. Equipment shall operate as intended for its application and within the manufacturer's published operational limits and performance capabilities. Compliance shall not require certification to manufacturer laboratory or anechoic specifications.
- B. All anchors, fasteners, mounting hardware, and accessories necessary for a complete and code-compliant installation in field conditions shall be included whether or not specifically identified in the Contract Documents and shall be provided at no additional cost to the Owner.
- C. All cabling shall include appropriate service loops, be properly supported and dressed, and incorporate strain relief to prevent damage to cable or connected equipment. Permanent terminations shall be provided. Splices or temporary connection methods are not acceptable unless specifically indicated in the Contract Documents.
- D. Equipment shall be installed to avoid damage to adjacent construction and systems. The Contractor shall protect installed finishes and equipment from damage throughout the construction period.
- E. Installation shall occur only when building conditions are suitable for sensitive electronic equipment. Prior to installation, the following conditions shall be met:
 - 1. Ambient temperature shall be maintained between 32 degrees and 104 degrees F (0 degrees to 40 degrees C), unless more restrictive manufacturer requirements apply.
 - 2. Relative humidity shall not exceed 90 percent and shall be non-condensing.
 - 3. Spaces shall be clean, dry, and maintained in a dust-controlled condition suitable for the installation of electronic equipment.
 - 4. Equipment shall be protected from ongoing construction dust, debris, moisture, and physical impact.
 - 5. The Contractor shall protect all equipment until final turnover to the Owner. Equipment or materials damaged prior to turnover shall be replaced at no cost to the Owner. Minor cosmetic damage may be repaired in the field subject to acceptance by the Owner and Consultant.
 - 6. The Contractor shall maintain a clean and orderly work area. All trash, packing materials, and construction debris shall be removed prior to turnover, including debris in technical and rack areas. Racks, panels, and plates shall be cleaned of dust and residue. Temporary equipment used during construction shall be removed prior to turnover.

3.4 LABELING

- A. All equipment, cabling, and connections shall be clearly and permanently labeled in accordance with AVIXA F501.02 Cable Labeling for Audiovisual Systems. Cabling shall be labeled at both ends to indicate origin and destination and shall correspond to record drawings.

- B. All cable labels shall be machine-printed, heat-shrink type, and permanently installed. Handwritten labels are not acceptable. Labeling shall remain legible after installation and shall match final record drawings.
- C. Panels and equipment shall be labeled to identify the serving electrical panel and circuit number.
- D. Any labels, signage, or posted information required by applicable codes or governing authorities shall be provided whether or not specifically identified in the Contract Documents.
- E. A permanent identification label shall be affixed to each main control rack and shall include:
 - 1. Project Name
 - 2. Completion Date
 - 3. Contractor Name
 - 4. Contractor Contact Number
 - 5. Consultant Name
 - 6. Consultant Contact Number

3.5 COMMISSIONING AND CLOSE-OUT

- A. Upon completion of the system installation, the Contractor shall conduct all necessary commissioning and turn-on activities required by the equipment manufacturer.
- B. Contractor shall perform functional performance testing of all audiovisual systems, including but not limited to control operation, signal routing, device functionality, system interoperability, and integration with other building systems.
- C. DSP configuration and tuning shall be completed and verified.
- D. Audio System Performance
 - 1. All sound system tuning shall be performed using instrument-based measurement, and SMAART or equivalent professional acoustic measurement software shall be used.
 - 2. Tuning performed "by ear" without measurement verification is not acceptable.
 - 3. The Contractor shall measure and document frequency response, level uniformity, and system behavior at representative listener positions within coverage zones of the audio system.
 - 4. The target frequency response shall be:
 - a. Within ± 6 dB from 63 Hz to 8 kHz, averaged across representative measurement positions,
 - b. With no octave-wide deviation exceeding ± 8 dB
 - c. Subject to the practical performance limits of the installed loudspeakers, amplification, DSP, and system configuration.

5. Coverage Uniformity

- a. Sound system coverage uniformity shall be evaluated in accordance with AVIXA-recommended practices, as applicable to the project type and space use.
- b. Unless noted otherwise in the Contract Documents, the system shall achieve:
 - 1) ± 6 dB level uniformity across the primary listening area for speech-focused and general audiovisual systems, or
 - 2) ± 3 dB to ± 4 dB level uniformity for performance-critical or music-focused systems, where required by the project program.
 - 3) Coverage uniformity requirements shall apply within the intended audience or listener plane and within the system's designed coverage areas. Areas outside intended coverage zones shall not be evaluated for compliance.
 - 4) Deviations caused by architectural constraints, room geometry, or unavoidable boundary effects shall not constitute non-compliance, provided the system has been installed and aimed in accordance with the approved design documents and meets the stated average coverage uniformity criteria.

6. Speech Intelligibility

- a. Speech intelligibility verification shall be performed using the Speech Transmission Index (STI) method in accordance with IEC 60268-16.
- b. Sound reinforcement systems intended for speech communication shall be adjusted and aligned to provide intelligible speech throughout the intended listener coverage areas.
- c. Minimum STI performance values for typical facility spaces shall be:
 - 1) Instructional environments including classrooms, lecture rooms, media centers, band rooms, choir rooms, orchestra rooms, and rehearsal spaces:
 - a) $STI \geq 0.66$
 - 2) Multipurpose and assembly environments including cafeterias, cafetoriums, and multipurpose rooms:
 - a) $STI \geq 0.62$
 - 3) Performing arts environments including auditoriums, theaters, and black box performance spaces when operating in speech reinforcement mode:
 - a) $STI \geq 0.60$
 - 4) Athletic environments including gymnasiums and similar high-noise recreational spaces:

- a) $STI \geq 0.50$
 - 5) Measurements shall be taken at representative listener positions throughout the intended coverage area.
 - 6) Measured STI values shall be averaged across representative listener positions within each coverage zone.
 - 7) Background noise levels present during testing shall be documented.
 - 8) Measurements shall be conducted with the sound reinforcement system operating under normal system configuration.
 - 9) For performing arts venues designed primarily for music performance, intelligibility results shall be interpreted relative to the architectural acoustics of the space and the intended reinforcement function of the sound system.
 - d. Failure to meet the required STI values due to system configuration, alignment, or tuning shall require corrective adjustment by the Contractor until compliance is achieved.
 - e. Performance targets shall be evaluated relative to the intended use of the space and shall not require compliance with manufacturer laboratory specifications, anechoic data, or conditions not achievable in the installed environment.
7. Video System Verification
- a. All video signal paths shall be tested for proper routing, format compatibility, resolution, refresh rate, and HDCP compliance where applicable.
 - b. Video switching systems, AV-over-IP systems, scalars, and processors shall be verified for correct input/output mapping and latency within manufacturer specifications.
 - c. Displays and projectors shall be calibrated for brightness, contrast, color balance, and geometry appropriate to the installed environment.
 - d. All video endpoints shall be verified for proper operation at their intended native resolution.
8. Network and AV Transport Systems
- a. All AV network devices shall be verified for correct addressing, VLAN assignment, QoS configuration, and redundancy where specified.
 - b. Dante, AES67, AV-over-IP, or similar transport systems shall be tested for stable clocking, subscription integrity, and uninterrupted signal transport under normal operating conditions.
 - c. All copper and fiber cabling used for AV systems shall be tested and documented in accordance with manufacturer and industry standards.

9. Control System Verification

- a. All control interfaces shall be tested for complete and accurate system operation, including source selection, routing, level control, power control, and preset recall.
 - b. Control system programming shall be verified for proper response, fail-state behavior, and recovery following power interruption.
 - c. Confirm operation of DSP muting function with fire alarm control signal.
 - d. All user interfaces shall reflect final programmed functionality and approved system operation.
10. Commissioning documentation shall include commissioning checklists, measurement positions, target criteria, final measurement data, DSP settings, video calibration settings, cable test results, network configuration summary, control system version documentation, and confirmation that each device has been powered, configured, and verified as operational.
 11. All commissioning reports shall be provided to the Architect for review.
 12. Any additional work required based on the results of testing or review shall be completed prior to turnover to the Owner.
 13. After all work, commissioning, and testing is completed, the Contractor shall conduct a mandatory Pre-Closeout Verification meeting prior to scheduling the Close-out Walk-Through with the Owner.
 - a. The Pre-Closeout Verification shall be attended by the Contractor, Owner, Consultant, and all relevant subcontractors responsible for commissioning and testing.
 - b. The purpose of the Pre-Closeout Verification is to confirm that all systems comply with the Contract Documents and are fully operational prior to Architect review.
 - c. Any deficiencies identified during the Pre-Closeout Verification shall be corrected prior to scheduling the Close-out Walk-Through.
 14. Following successful completion of the Pre-Closeout Verification, the Contractor shall schedule a Close-out Walk-Through with the Owner and Consultant.
 - a. The Contractor shall provide all necessary personnel, supervision, and equipment required for system demonstration, testing, and adjustment.
 - b. Any conditions found to not meet the Contract Documents during the Close-out Walk-Through shall be corrected at no cost to the Owner.

3.6 TRAINING AND OWNER INSTRUCTION

- A. After completion of close-out and correction of identified deficiencies, the Contractor shall provide training to the Owner's designated personnel in the operation, basic troubleshooting, and routine use of all installed systems.

- B. The instructor shall be qualified and experienced with the specific systems installed and shall be familiar with the final configuration of the project.
- C. Training requirements:
 - 1. Training shall be scheduled at the convenience of the Owner with not less than two weeks' advance notice.
 - 2. The space shall be dedicated to training during scheduled sessions, and no other construction activities shall occur during training.
 - 3. Individual training sessions shall not exceed three hours unless otherwise requested by the Owner.
 - 4. A written training agenda outlining topics, systems, and learning objectives shall be submitted to the Owner at the time of scheduling.
 - 5. Training sessions shall be video recorded in digital format and delivered to the Owner within five business days following each session.
 - 6. Training shall be structured in multiple sessions to allow the Owner's personnel to apply instruction between sessions unless otherwise approved by the Owner.
 - 7. Complete system documentation shall be provided as part of the training effort and shall include, at a minimum:
 - a. Manufacturer operation and maintenance manuals for all major equipment.
 - b. System-specific quick-start and operator guides tailored to the installed configuration.
 - c. Control system interface documentation describing system operation, signal flow, and typical workflows.
 - d. Recommended maintenance procedures and basic troubleshooting guidance.
 - e. Final record drawings and configuration files where applicable.
 - f. All documentation shall be provided in organized digital format by system and space and shall be delivered prior to or at the time of training.
- D. A minimum of sixteen hours of training shall be provided for the project unless otherwise noted in the Contract Documents.

3.7 EVENT ATTENDANCE

- A. The Contractor shall provide on-site technical support for the first primary Owner event following Substantial Completion.
- B. On-site support personnel shall be qualified to operate, monitor, and troubleshoot all installed systems and shall have participated in the installation or commissioning of the project.
- C. Event attendance shall include up to eight consecutive hours of on-site support and shall be included in the Contract Sum at no additional cost to the Owner.

END OF SECTION