

SECTION 27 41 16 - AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. The Request for Proposals, Instruction to Offerors, and General Conditions of the Contract including any Supplementary Conditions apply to all Work under this section.
- B. The Contractor acknowledges and warrants that he has closely examined all the Contract Documents, that they are suitable and sufficient to enable the Contractor to complete the Work in the time allotted for the Contract Sum as accepted by the Owner and Consultant, and that they include all Work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the Work in full compliance with all applicable codes, laws, ordinances, rules, and regulations.
- C. Execution of the Contract by the Contractor is a representation and warranty that the Contractor has carefully examined the Contract Documents, and represents and warrants that the Contractor is thoroughly familiar with the nature and location of the Work, the Site, the specific conditions under which the Work is to be performed, and all matters which may in any way affect the Work or its performance. The Contractor further represents that as a result of such examinations and investigations, the Contractor has thoroughly reviewed and understands the Contract Documents and their intent and purpose, and is familiar with all applicable codes, ordinances, laws, regulations and rules as they apply to the Work, and that the Contractor will abide by same.
- D. Claims for additional time or additional compensation as a result of the Contractor's failure to follow the foregoing procedure and to familiarize itself with all local conditions and the Contract Documents will not be permitted.
- E. Related Work Specified Elsewhere:
 - 1. All Division 1 Specification Sections apply to this Section.
 - 2. Power, signal conduits and back-boxes provided and installed under Division 26; except loudspeaker back-boxes and specialty back-boxes provided under this work for installation under Division 26.

1.2 SUMMARY OF WORK

- A. SCOPE:
 - 1. Supply and install sound and video systems including all apparatus and equipment, wiring, termination, labor, and services required to provide systems as specified and shown on drawings.

2. Supply and install any incidental equipment needed in order to meet the functional requirements stated herein and on drawings. This shall include all support and restraint for the fixed loudspeakers and projection equipment.
3. Set up and adjustment of specified hardware and software.
4. Furnish all test equipment and the services of the project engineer and the project manager to assist the Owner's representative in the acceptance testing.
5. Make any adjustments to any part of the system, including the re-aiming of loudspeakers, which may be found necessary during the acceptance testing.
6. Provide training in the operation of the systems to the person or persons selected by the Owner. Refer to in Part 3 paragraph below entitled "Training".

B. Coordination:

1. Schedule installation operations in sequence required in order to obtain best completion results.
2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
3. All specialty sub-Contracting including installation of all telecommunications lines and equipment as shown on the Contract Documents to be coordinated by the Contractor.

1.3 EQUIPMENT AND MATERIALS

A. The AV Contractor shall verify characteristics of elements of interrelated equipment specified under this section are compatible; coordinate work having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

B. By making requests for substitutions, the Contractor:

1. Represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified.
2. Represents that he will provide the same warranty for the substitution that the Contractor would for that specified.
3. Certifies that the cost data presented is complete and includes all related costs under this Contract, and waives all claims for additional costs related to the substitution which may later become apparent.
4. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects, including, but not limited to, in full compliance with all applicable codes, laws, ordinances, rules, and regulations and completion in the time allotted for the Contract Sum as accepted by the Owner and Consultant.

1.4 SUBMITTALS

- A. All submittals shall be in accordance with the general provisions of the Contract, including General and Supplementary conditions and other Division 1 Specification Sections.
1. Audio-Visual Consultant will not review partial submittals.
 2. Audio-Visual Consultant will review up to two (2) submittals of any one submittal topic.
 3. The cost Audio-Visual Consultants time for additional submittal reviews due to non-conformance with the requirements listed herein will be borne completely by the Audio-Visual Contractor.
- B. Pre-Award Submittal: This submittal must justify in the judgment of the Consultant, the Architect, and the Owner that the Audio-Visual Offeror meets the specified requirements, that he has the capability to perform the specified work for a project of this size and scope, and that he is capable of the necessary business and technical arrangements for this installation and the pursuant warranty service. Submit the following:
1. A detailed brochure describing its capabilities in terms of facilities, personnel, experience background, examples of similar installations, distribution arrangements with manufacturers and financial capability (including satisfaction of the project bonding requirements).
 2. Proof that contracting firm has at least ten (10) years experience in the fabrication, assembly, and installation of audio-visual systems of similar magnitude and quality as specified herein.
 3. Information identifying any and all local agents and/or subcontractors assisting in the work.
 4. Identification of all sources of labor for all fabrication and installation throughout the duration of the project.
 5. Evidence of all necessary licenses and approvals to perform the specified work.
 6. Information on how and by whom it will fulfill the requirements of the warranty period. Response time to service requests must be within six (6) hours of notification.
 7. Information about three (3) representative projects, similar in scope to this project, completed within the past five (5) years. Include the Project Name, Project Location, Owner's Name, Owner's Address, Owner's Phone, and a contact person employed by the Owner familiar with the Audio Visual system.
 8. Equipment to be furnished, per Part 2, "Products" below.
 - a. Submit a statement of subcontractors, franchises, distributorship, dealerships, arrangements and agreements with manufacturers of equipment to be used for this work.

- b. Submit a complete bill of quantities, including all material, components, devices and equipment required for this work. The bill of quantities shall be tabulated respective of each and every system as specified, in the order of the specification section 2 below, and shall contain the following information for each item listed:
 - 1) Quantity.
 - 2) Description.
 - 3) Manufacturer's name.
 - 4) Manufacturer's model number.
- 9. Credentials of its project engineer for review and approval. This person shall:
 - a. Be a university graduate engineer in electrical or electronic engineering or physics, and have at least five (5) years experience with similar electronic & optical specialty systems or other educational experience background as approved by the Architect, the Consultant and the Owner.
 - b. Observe at all times a good working relation with the Architect's and Owner's representatives, and cooperate with engineers and technicians assigned by the Owner, who are charged with the operation and maintenance of the system.
 - c. Provide all technical liaisons between the Audio-Visual Contractor, the Architect, the Owner and the Consultant(s). This shall include participation in meetings and conferences. He will be required to be present at the project site for final inspection, approve the operating and maintenance manuals, and provide the specified instruction to designated members of the Owner's staff.
 - d. Be responsible for supervision of all technical work that is part of the contract. This supervision includes the following:
 - 1) Preparation of all construction Drawings from information within the specifications and the Drawings, including approval and signing of all shop Drawings.
 - 2) Supervision of shop fabrication and field installation work to assure conformance with the contract Drawings, the specifications, and the approved shop Drawings to assure workmanship of the highest quality. He shall oversee the testing of all assemblies and sub-assemblies prior to delivery to the project site.
 - e. Take a leading role in the specified testing of the completed installation to assure himself for the Audio-Visual Contractor that all specifications are met. Work with and assist the Consultant in his final testing for approval and acceptance of the system for the Owner.
- 10. Proof of the firm's current membership in (or at least two (2) supporting staff memberships in) two (2) or more of the following professional Audio Visual organizations for two (2) or more years:
 - a. NSCA: National Systems Contracting Association
 - b. ICIA: International Communications Industries Association

- c. AES: Audio Engineering Society
 - d. USITT: United States Institute for Theatre Technology
11. Credentials of supporting staff who have received current factory certifications from any/all equipment manufacturers whose franchise agreements require it and who meet the following qualifications:
- a. The supervisor of the work of this section shall have at least five (5) years direct professional experience with devices, equipment, and system installation of the type and scope specified herein.
 - b. All personnel engaged in the installation of this Section shall have at least three (3) years direct experience with devices, equipment, and system installations of the type and scope specified herein.
 - c. The contractor shall furnish with their proposal; credentials of supporting staff who have received current factory certifications from any/all equipment manufacturers whose franchise agreements require it including but not limited to:
 - 1) The Contractor shall employ a Crestron Certified Programmer or engage the services of a CAIP (Crestron Approved Independent Programmer) to provide the control system programming for this project.
 - 2) The Contractor shall employ a Crestron Digital Media Certified Engineer (DMC-E) to provide the digital media signal distribution design for this project.
 - d. In addition, submit proof of at least two (2) current staff member certifications in one (1) or more of the following:
 - 1) NICET-II (Certification by National Systems Contractor's Association)
 - 2) NICET-III (Certification by National Systems Contractor's Association)
 - 3) C-EST (Certification by National Systems Contractor's Association)
 - 4) R-ESI (Certification by National Systems Contractor's Association)
 - 5) CTS-D (Certification by International Communications Industries Association)
 - 6) CTS-I (Certification by International Communications Industries Association)
12. Credentials of Control System Programmer:
- a. The Contractor shall employ a Level 3 or Level Ace control system certified programmer to provide the control system programming for this project. Submit proof of certification.
13. Substitutions of equal equipment beyond the alternatives listed will be permitted only in accordance with Division 1. If a requested substitution requires a change in any of the contract drawings, a revised drawing must be submitted as part of the substitution request. If an alternative listed is discontinued prior to

installation, the Contractor shall submit a substitution request to provide the manufacturer's replacement model. The Audio-Visual Consultant shall be the final judge of the acceptability of substitutions.

- a. All drawings shall be clear and legible. The minimum text size for all drawings shall be 1/8" high.

C. Post Award Submittals: submit within 30 days of award.

1. Submit four (4) copies and one (1) reproducible (CD-ROM [drawings as .dwg; documents as .pdf; software as per manufacturer's directions]) of the following:
 - a. A statement of subcontractors, franchises, distributorship, dealerships, arrangements and agreements with manufacturers of equipment to be used for this work.
 - b. Complete bill of quantities, including all material, components, devices and equipment required for this work. The bill of quantities shall be tabulated respective of each and every system as specified, in the order of the specification section 2 below, and shall contain the following information for each item listed:
 - 1) Quantity
 - 2) Description
 - 3) Manufacturer's name and model number
 - 4) Manufacturer's specification sheet
2. Samples of approval by the Architect of all finishes/materials which will be visible to the public. Including at least receptacles and controls with associates trim plate and each type of loudspeaker baffle and/or grille.
3. Schedule: Within fourteen (14) calendar days of the receipt of the notice to proceed the Audio-Visual Contractor shall prepare and submit for approval, in accordance with the General Conditions, a schedule which shall include, but is not limited to, the following:
 - a. Submission of shop drawings, samples and layouts for all items described herein.
 - b. Start and Completion date(s) for field installation work.
 - 1) Installation date(s) of all wires and cables in conduits and required cable trays.
 - 2) Date when fully-operational equipment racks will be fully tested and ready for Audio-Visual Consultant's observation.
 - 3) Delivery date(s) of all systems and subsystems to the project site.
 - c. Start and Completion date(s) for shop fabrication work.
 - d. Date of submission of samples for approval by the Architect of all finishes/materials which will be visible to the public. Refer to Part 1 paragraph entitled "Submittals" for additional information.
 - e. Programming of all remote control and Digital Signal Processing driven devices.

- f. Completion dates(s) for the following tests:
 - 1) Performance tests on all individual A/V components as they are received from the manufacturer in the Audio-Visual Contractor's shop.
 - 2) Performance tests on completed assemblies and subassemblies assemblies, including all racks in the Audio-Visual Contractor's shop.
 - 3) Performance tests on the completed systems as a whole prior to shipment to the project site.
 - 4) General performance testing of systems at the project site.
- g. Completion dates for the following Shop and Field Observations.
 - 1) Shop fabricated assembly and subassembly observation.
 - 2) Substantial Completion Observation at the project site.
 - 3) Final acceptance observation at the project site.
- h. Submission date for operating, maintenance manuals, as-built drawings, documentation and closeout materials.
- i. In the event the Audio-Visual Contractor wishes to deviate from the schedule once it is established and approved, he may do so only receiving written approval from the General Contractor.

D. Field and Shop Drawing Submittal:

- 1. Submit four (4) half-size copies and one (1) CD-ROM copy of the following:
 - a. Corrected items from aforementioned submittals. All resubmitted drawings shall be identified with clouded changes. Label each cloud with delta number and date of resubmitted.
 - b. Control panel Layouts: Developed drawings of all control system panel layouts.
 - c. Functional Diagram: single-line block diagram showing interconnection of all components, receptacles, terminal blocks, controls, transformers and loudspeakers in addition to the active elements. Include terminal and cable numbers, all system and component labels. Show detailed system component information including but not limited to manufacturer's name, model number, any specialized part number option and all input and output connection information, for each piece of equipment. No drawing codes shall be permitted. Mount one (1) full-scale original or photograph (not blueprint) copy behind acrylic in the control booth for each system.
 - d. Receptacle Location Plan: a plan of the relevant parts of the building showing locations and designations of all receptacles. Mount one (1) scaled original or photographic copy of this diagram behind acrylic in the sound control booth and/or near equipment racks.
 - e. Floor plans, at scale of Contract Documents, showing the locations throughout the project of all receptacles, conduits, wireways, trays, pullboxes, junction boxes, equipment racks equipment and other devices with appropriate designations and fill.

- f. Riser diagrams, showing all elevations, room numbers, conduit sizes, types and fills, box sizes and types, devices, equipment and rack designations.
 - g. Equipment rack elevation drawings scaled (1-1/2" = 1'-0" or larger):
 - 1) Front Elevations: include equipment designation, manufacturer's name, model number, rack location and rack designation.
 - 2) Rear Elevations: include AC power wireways and route of wiring harnesses.
 - 3) Sections: include depth of all equipment components.
 - h. Patch bay elevations, showing all patch bay appearances and designations.
 - i. Samples for approval by the Architect of all finishes/materials that will be visible to the public including at least receptacles and controls with associated trim plate and each type of loudspeaker baffle and/or grille.
 - j. Cable schedules and run sheets, associates with each equipment rack and/or any isolated piece of equipment or device, including cable designation, type, manufacturer and manufacturer's type number, wire color, device and terminal designation and device location, keyed to both the system block diagram and equipment rack elevation drawings.
 - k. Contractor fabricated items, detailed drawings showing all components, devices and equipment, including dimensions, component values, terminal designations, types, locations, manufacturer's name and model number.
 - l. Loudspeaker cluster and monitor loudspeaker supports stamped and signed by an engineer licensed in the project state. Include all loads, location of attachment to building structure, complete layout of all components, devices and equipment, including dimensions, methods of assembly, and connections to supporting construction, details of hardware, locations, manufacturer's name and model number. All design calculations, loads, etc. shall be shown.
 - m. Drawings shall be 1/4" = 1'-0" scale minimum. Permissible scales shall be 1/4", 3/4", 1", 1-1/2", and 3" = 1'-0" and full scale.
 - n. A bound volume or volumes of comprehensive specifications for all material, devices, components and equipment selected for use in this section, whether modified or not, provided as required under "Post Award Submittals" above.
- E. Digital Signal Processor (DSP) System Submittal for Owner Review:
- 1. Prior to programming the Digital Signal Processing (DSP) system, the Contractor shall submit shop drawings per the project standards showing all screen layouts and control descriptions of all system functions to the Owner for review and comment prior to actual programming of the system. Shop drawings shall include screen layouts of the DSP software "Control pages" for all "configuration-presets" and "parameter-presets". Submit electronic versions of the DSP software to the Consultant for review and approval. The Contractor shall incorporate all Owner comments into the programming of the systems.
 - 2. Prior to delivery of the systems to the job site, the Contractor shall demonstrate fully functioning systems in the Contractor's facilities that include the DSP

system programming. This demonstration shall coincide with the Owner's Representatives observation of Completed Sub Assemblies (Refer to Part 3 paragraph entitled "System Performance Tests"). The Owner will review and comment upon the remote control programming, and the Contractor shall incorporate all Owner comments into the programming of the systems.

3. After the installation of the AV systems has been deemed substantially complete, but prior to final acceptance of the system, the Owner shall have a review period of thirty (30) days to observe the operation of the DSP system. At the end of this review period, the Owner may request programming changes relating to the look and feel of the operation pages or the functionality of commands. The Contractor shall make these changes prior to acceptance of the systems.

F. Control System Submittal for Owner Review:

1. Prior to programming the remote control system, the Contractor shall submit shop drawings per the project standards showing all control screen layouts, graphical user interfaces (GUI) and control descriptions of all remote control system functions to the Owner for review and comment prior to actual programming of the system. Submit in native file format and hard copy form. Shop drawings shall include control screen layouts of the touch panel pages for each venue, web page layouts (as required in Part 2 below). Submit electronic versions for Owner review. The Contractor shall incorporate all Owner comments into the programming of the systems.
2. Prior to delivery of the systems to the job site, the Contractor shall demonstrate fully functioning systems in the Contractor's facilities that include the remote control programming. This demonstration shall coincide with the Owner's Representatives observation of Completed Sub Assemblies (Refer to Part 3 paragraph entitled "System Performance Tests"). The Owner will review and comment on the remote control programming submittal, and the Contractor shall incorporate all Owner comments into the programming of the systems.
3. After the installation of the AV systems has been deemed substantially complete, but prior to final acceptance of the system, the Owner shall have a review period of thirty days to observe the operation of the remote control system. At the end of this review period, the Owner may request programming changes relating to the look and feel of the remote control panels or the functionality of commands. The Contractor shall make these changes prior to acceptance of the systems.
4. Digital Signal Processing and control system programming files, touch panel, & other control page & Graphical User Interface layouts in native file format and hard copy form.

G. Shop Test Statement Submittals:

1. Submit four (4) copies electronically, photographs and state of the following prior to shipping fabricated equipment racks to Project site:
 - a. A bound volume, or volumes, of results of performance tests and adjustment data, including all test procedures specified in Part 3 paragraph

- entitled "System Performance Tests". Example Shop Test Statement submittal templates are available from the Consultant upon request.
- b. Submit a written request for equipment rack observation certifying that equipment racks are completely assembled, tested and ready for inspection.
 - c. Detailed interior and exterior photos of assembly supporting claim for readiness for inspection.
- H. Final Submittals: Submit the following Record Drawings developed from the final "as built" systems:
1. Four (4) half-size (15"x21") print copies of each of the block diagrams, plans, risers, patch bay drawings, rack elevations, cable schedules and detail drawings. All reproducible drawings shall be also submitted on USB 2.0 flash drive media or CD-ROM.
 - a. One (1) complete set of Functional diagrams dry mounted to matte board and wall-mounted under clear acrylic cover.
 - b. One (1) additional set of rack elevation drawings and sheets provided and respectively mounted in the associated equipment rack with a protective plastic cover.
 - c. Alternately, and at the Owner's discretion, two (2) complete sets of half-size drawings, laminated and spiral bound may be furnished in lieu of the item "a." above.
 2. No more than thirty (30) days after Acceptance Testing, submit three (3) copies of each of the following manuals prior to, and as a requirement of, Owner Acceptance of the work of this section:
 - a. Equipment operating instructions; complete, comprehensive instructions for the operations of all contractor-fabricated devices and equipment items provided as part of the work of this section.
 - b. Manufacturer's installation, operating and service information including schematic diagrams for each item of equipment furnished. Order the equipment manuals in the order of the specifications. Provide tabs between each equipment manual. Provide a detailed index at the front of each manual indicating specification reference number, manufacturer's trade name, model number and part description. Provide three (3) copies to the Owner after they have been reviewed and approved by the Audio-Visual Consultant.
 - c. Printed material within contractor-fabricated equipment and systems operating manuals shall be bond paper copies, offset or letterpress printed. Drawings, charts and graphs shall be bond paper offset printed. The systems contractor-fabricated equipment instruction manuals shall be composed using a single, consistent visual format and writing style; text shall be derived from component equipment manufacturer's instruction manuals and may include reproductions of artwork and other materials.
 3. Submit four (4) copies of each of the following schedules, lists, and data prior to, and as a requirement of, Owner Acceptance of the work of this section:

- a. All source code for any contractor provided or programmed equipment on CD-ROM.
 - b. Final bill of quantities; complete bill of quantities all material as delivered, including a separate schedule of portable equipment.
 - c. Equipment schedule; complete, final schedules of equipment and devices provided in each room, by room number and name.
 - d. Performance, test and adjustment data; comprehensive documentation of all performance verification and correction procedures and measurements, including raw and equalized house curves and equalizer settings.
 - e. Maintenance and spare parts schedules; a comprehensive tabulation of equipment, devices, miscellaneous parts and maintenance items, including manufacturer's name, address, model number, systems use and miscellaneous information.
4. No more than thirty (30) days after Acceptance Testing, provide one (1) copy of the following:
 - a. Certificates; any and all licenses, certificates of operation and/or compliance as required.
5. The system will not be accepted until these documents are reviewed and approved by the Owner's Representative.

1.5 QUALITY ASSURANCE

- A. Unless otherwise stated, all electrical, electronic and optical equipment shall be a product of firms regularly engaged in the manufacture of electrical, electronic or optical equipment. The equipment shall be the latest model or type offered which meets the applicable specifications at the time of the submittal. Discontinued items replaced by newer models or versions are prohibited and should not be submitted for review. It shall be the Contractor's responsibility to provide the Audio-Visual Consultant with information regarding discontinued products listed as alternatives in the specification. If an alternative listed is discontinued prior to installation, the Contractor shall submit a substitution request to provide the manufacturer's replacement model.
- B. Quality of workmanship and fabrication of all equipment and components, which are custom fabricated shall be comparable to professional equipment produced by specialized manufacturers of the trade involved and shall be verified by observation. Only firms having 10 years experience in all aspects of the fabrication and installation of similar systems shall be allowed to perform the work.
- C. All materials and products shall be new and of professional quality. Unless specifically stated in the drawings or specifications, no existing or pre-owned materials shall be installed.
- D. The work specified herein, and in each of the allied sections, shall be accomplished by a single Audio-Visual Contractor experienced in the design, fabrication, installation, checkout and warranty contract management of systems such as those described in each section. This Audio-Visual Contractor shall have complete responsibility for the

systems described herein and shall be the single contract point for the Architect, the Consultant and/or the Owner with respect to all work specified herein.

E. Contractor Qualifications:

1. The Contractor shall have a minimum of five (5) years experience in the fabrication, assembly, and installation of audio-visual systems of similar magnitude and quality to that indicated for this project.
2. The Contractor shall possess a current Contractors license in the appropriate category(ies) in the project state at the time of proposal.
3. The Contractor shall provide the response to service requests within 4 hours during the warranty period.
4. The Contractor shall employ a qualified project engineer on its staff assigned to this project. (Refer to Part 1 paragraph 1.5.E "Post-Award Submittal" subparagraph 12 "credentials of project engineer...").
5. The Contractor shall have current membership in (or employ at least two (2) staff with individual memberships in) one (1) or more professional Audio Visual organizations for two (2) or more years. (Refer to Part 1 paragraph 1.5.E "Post-Award Submittal" subparagraph 11 "Proof of firm's current membership in...").
6. The Contractor shall employ qualified staff assigned to this project. (Refer to Part 1 paragraph 1.5.E "Post-Award Submittal" subparagraph 13 "credentials of supporting staff...").
7. The Contractor shall employ a level 3 or Ace level control system certified programmer to provide the control system programming for this project.
8. The Contractor shall employ a Crestron Digital Media Certified Engineer (DMC-E) to provide the digital media signal distribution design for this project.
9. The Contractor shall be a currently certified VBrick partner at VSP or VNCP level. Alternately, the contractor may sub-contract the services of a certified vendor to perform all VBrick integration and configuration services.

1.6 WARRANTY AND SERVICE

- A. The AV Contractor shall warrant the installation free of faulty workmanship.
- B. All components, including solid-state devices, warranted free of defects for a period of one (1) year from date of final acceptance. This minimum warranty provision shall not diminish the terms of individual equipment manufacturers' warranties.
- C. Paint and exterior finishes, fuses and lamps excluded from above warranties except when damage or failure results from defective materials or workmanship covered by warranty.
- D. Provide maintenance service for a period of one (1) year after acceptance of installation. Service shall consist of at least two (2) semiannual visits to the site for checking and adjustment of equipment.

- E. Response: Provide four (4) hour telephone warranty service, with 48-hour on-site technical response time. Provide a technician on call from 7 a.m. to 9 p.m. seven (7) days a week.

PART 2 - PRODUCTS

2.1 GENERAL

A. OWNER FURNISHED, CONTRACTOR INSTALLED EQUIPMENT

1. The owner intends to furnish the following pieces of equipment. The contractor shall provide all necessary cable, connectors, miscellaneous hardware, engineering and installation labor, and depot level support for all owner furnished, contractor installed equipment for the duration of the project warranty as described above.
2. AV Contractor shall develop a schedule indicating delivery dates necessary for the receipt of all Owner Furnished equipment to ensure an on-time completion of the Work of this section. This schedule shall be coordinated with the Owner, GC and Consultant.
 - a. [TUNE-ofe] HD Cable television tuners model:TBD
 - 1) Furnish mounting shelves
 - b. [PC-ofe] Apple Mac mini (Team, Breakout and Interview rooms)
 - 1) Furnish mounting brackets
 - c. [PC-ofe] Small form factor Windows PC (Classrooms) model:TBD
 - 1) Furnish mounting shelves

B. EQUIPMENT FURNISHED BY OTHER TRADES FOR INSTALLATION UNDER THIS SECTION

1. The other trades shall furnish the following pieces of equipment. The contractor shall provide all necessary cable, connectors, miscellaneous hardware, engineering and installation labor, and depot level support for all equipment furnished by others for installation under this section, for the duration of the project warranty as described above.
 - a. NONE

C. ADDITIVE ALTERNATES

1. Provide additive alternate unit pricing for the following items where indicated on drawings. Include all necessary equipment, hardware, cable and labor (installation and programming) for a fully functional installation.
 - a. Team Room in-room remote control panels and

D. MASTER QUOTES

1. Master quotes have been generated for the following items:
 - a. CONTROL SYSTEMS
 - 1) Contact: Crestron Electronics, Ryan Baumann, (480) 297-5347
 - b. TEACHING STATIONS
 - 1) Contact: Euro Design Systems, (877) 306-5337
 - c. CONTROL SYSTEM PROGRAMMING
 - 1) Contact: BMA Software Solutions Marc Laveccia, (714) 455-2717
 - d. DIGITAL MEDIA DISTRIBUTION SYSTEM
 - 1) Contact: VBrick Systems, Kevin Jensen, (866) 296-6946

E. SAFETY LABORATORY LISTINGS:

1. All equipment powered from the mains shall be labeled as listed by a testing laboratory acceptable to the local code authority. Underwriter's Laboratories, Edison Testing Laboratories, or the City of Los Angeles testing lab usually meet this requirement.

2.2 AUDIO AMPLIFIERS AND SIGNAL PROCESSORS

- A. (AMP1) AMPLIFIER, 70V (160W)
 1. Acceptable
 - a. Crown 1160A
 - b. Consultant approved equal.
- B. (AMP2) AMPLIFIER, 70V (150W)
 1. Acceptable
 - a. Ashly TRA-2150
 - b. Consultant approved equal.
- C. (AMP3) TWO CHANNEL MICRO-AMPLIFIER (2x20W)
 1. Acceptable
 - a. Aurora Multimedia AS-AMP1
 - b. Consultant approved equal.
- D. (AMP4) AMPLIFIER, 70V, 4 CH (150W)
 1. Acceptable
 - a. Ashly TRA-4150
 - b. Consultant approved equal.
- E. (DSP1) DIGITAL SIGNAL PROCESSOR TYPE-1
 1. Features:
 - a. Four card slot frame

- b. Dante digital audio interface
- 2. Acceptable
 - a. Symetrix SymNet EDGE
 - 1) Furnish (2) 4 i/p AEC modules
 - 2) Furnish (1) 4 i/p analog module
 - 3) Furnish (1) 4 o/p analog module
 - b. Consultant approved equal.
- F. (DSP2) DIGITAL SIGNAL PROCESSOR TYPE-2
 - 1. Features:
 - a. Four card slot frame
 - b. Dante digital audio interface
 - 2. Acceptable
 - a. Symetrix SymNet EDGE
 - 1) Furnish (4) 4 i/p AEC modules
 - b. Consultant approved equal.
- G. (DSP3) DIGITAL SIGNAL PROCESSOR TYPE-3
 - 1. Features:
 - a. Four card slot frame
 - b. Dante digital audio interface
 - 2. Acceptable
 - a. Symetrix SymNet EDGE
 - 1) Furnish (2) 4 i/p analog modules
 - 2) Furnish (2) 4 o/p analog modules
 - b. Consultant approved equal.
- H. (DSP4) DIGITAL SIGNAL PROCESSOR TYPE-4
 - 1. Features:
 - a. Four card slot frame
 - b. Dante digital audio interface
 - 2. Acceptable
 - a. Symetrix SymNet EDGE
 - 1) Furnish (1) 4 i/p analog module
 - 2) Furnish (3) 4 o/p analog modules
 - b. Consultant approved equal.
- I. (DEEMBED) HDMI AUDIO DE-EMBEDDER

1. Acceptable
 - a. Extron HAE 100
 - b. Consultant approved equal.

2.3 AUDIO TRANSDUCERS

- A. (S1) LOUDSPEAKER, CEILING RECESSED, 6.5"
 1. Features
 - a. coordinate grille color with architect
 2. Acceptable
 - a. Tannoy CMS series consisting of:
 - 1) CMS 601DC PI
 - 2) CMS 601PI Back Can
 - b. Consultant approved equal.
- B. (S2) LOUDSPEAKER, CEILING RECESSED, 5"
 1. Features
 - a. coordinate grille color with architect
 - b. Blind mount for installation in accessible ceilings only
 2. Acceptable
 - a. Tannoy CMS series consisting of:
 - 1) CMS 501 DC BM
 - b. Consultant approved equal.
- C. (S2) LOUDSPEAKER, CEILING RECESSED, 5"
 1. Features
 - a. coordinate grille color with architect
 - b. Pre-install mount for installation in inaccessible ceilings
 2. Acceptable
 - a. Tannoy CMS series consisting of:
 - 1) CMS 501 DC PI
 - 2) CMS 501PI Back Can
 - b. Consultant approved equal.
- D. (S3) LOUDSPEAKER, FLAT-PANEL SUPPORT (UNDER MOUNT)
 1. Features
 - a. coordinate custom color with architect
 - b. custom sized to match display
 - c. custom configured for two channel operation

2. Acceptable
 - a. Leon Speaker Hz313
 - b. Consultant approved equal.
- E. (S4) LOUDSPEAKER, OUTDOOR, SURFACE MOUNT, 6"
 1. Features
 - a. coordinate custom color with architect
 2. Acceptable
 - a. Tannoy Di6T + K-ball mounting option
 - b. Consultant approved equal.
- F. (S5) LOUDSPEAKER, IN-WALL FLUSH MOUNT
 1. Features
 - a. coordinate grille color with architect
 - b. furnish rough-in backbox
 2. Acceptable
 - a. Tannoy iW6TDC + backcan
 - b. Consultant approved equal.
- G. (ALS) Hearing Assistance System (Classrooms):
 1. Features
 - a. Front panel audio input level.
 - b. Multiple available channels (17).
 - c. Balanced line input.
 - d. Adjustable RF power Output.
 - e. Multi function LED Battery Level indication on receiver.
 - f. LCD Display of system status on receiver and transmitter.
 2. Electrical Characteristics
 - a. 72-76 MHz frequency band, ensure frequency compatibility with local RF environment and other equipment.
 - b. Signal to noise ratio 60dB (wide band channels).
 - c. Output power (full) 100mW.
 3. Acceptable:
 - a. Transmitter (ALS): Listen Technologies LT-800-072 or approved equal. (furnish quantity indicated on drawings)
 - b. Custom Detuned Antenna: Contact Tim Schaeffer @ (801) 233-8992 or approved equal. (furnish 1 per transmitter)
 - c. Rack Mount Kit: Listen Technologies LA-326 or approved equal. (furnish 1 per transmitter)
 - d. Receiver, programmable: Listen Technologies LR-500-072 or approved equal. (furnish 4% of fixed seats)

- e. Ear Speakers: LA-164 or approved equal.
 - f. Neck loop: LA-166 or approved equal. (furnish 2 per transmitter)
 - g. High Capacity Alkaline Batteries: Listen Technologies LA-361 or equal by Duracell® or Eveready®. (furnish 2 per receiver)
 - h. Receiver storage case, 8-unit: LA-322 or approved equal (furnish 1 per transmitter)
 - i. ADA Compliance Kit: LA-304 or approved equal
- H. (MIC1) MICROPHONE, GOOSENECK
 - 1. Features/ Requirements
 - a. Programmable mute button
 - b. Hyper Cardioid pickup pattern
 - c. Coordinate color with Architect
 - 2. Acceptable
 - a. AKG CK47 capsule
 - b. AKG GN30E gooseneck module
 - c. AudioTechnica AT8666RSP desk stand with programmable mute
 - d. Consultant approved equal.
- I. (MIC2) MICROPHONE, CEILING SUSPENDED, CARDIOID
 - 1. Acceptable
 - a. ClockAudio C3100-RF-CP
 - b. Consultant approved equal.
- J. (WLS1) MICROPHONE, WIRELESS, DIGITAL, DUAL CHANNEL COMBO SYSTEM
 - 1. Features/ Requirements
 - a. Coordinate frequency selection w/ local rf traffic, submit for approval.
 - b. Encrypted transmission
 - 2. Acceptable
 - a. Shure ULX-D Series consisting of:
 - 1) ULXD4D receiver w/rack kit (qty. 1)
 - 2) ULXD2/B58 handheld transmitter (qty. 2)
 - 3) ULXD1/ bodypack transmitter (qty. 2)
 - 4) WL183 omni lavalier microphone (qty. 2)
 - 5) SBC200 Dual docking/charging station (qty. 2)
 - 6) SB900 Li-Ion rechargeable battery pack (qty. 4)
 - b. Consultant approved equal.
- K. (RFDA) ANTENNA DISTRIBUTION AMPLIFIER
 - 1. Acceptable
 - a. Shure

- b. Consultant approved equal.

2.4 DIGITAL MEDIA DISTRIBUTION SYSTEM

A. SYSTEM HARDWARE/SOFTWARE

1. Acceptable

- a. Furnish the following hardware/software packages.
 - 1) VBrick Enterprise Media System Standard Edition Portal (VEMS)
 - a) Furnish mfg. recommended server hardware.
 - 2) VBrick VEMS Mystro channel guide
 - a) Furnish mfg. recommended server hardware.
 - 3) VBrick H.264 Distributed Media Engine (DME) model 7570
 - a) Furnish mfg. recommended server hardware.
 - 4) VBrick Gold level tech support upgrade (1 year)
 - 5) VBrick Professional Services
 - a) Furnish as required to facilitate seamless integration with other associated software packages.

B. (STREAM) HD VIDEO STREAMING ENCODER

1. Acceptable

- a. VBrick Rich Media Studio HD
 - 1) Furnish all required accessories and mounting hardware
- b. Consultant approved equal.

2. Quantity

- a. Furnish
 - 1) Rich Media Studio Appliance 6

C. (ENCODFRM) HD VIDEO STREAMING ENCODER FRAME/MODULES

1. Acceptable

- a. VBrick 9000 series modular encoding system consisting of:
 - 1) Rack mount chassis, 8RU, 11 slots, furnish redundant PSU's.
 - 2) 9000 series H.264 Audio/Video encoding module
 - 3) 9000 series blades for use with chassis system
 - 4) Furnish all required accessories and mounting hardware
- b. Consultant approved equal.

2. Quantity

- a. Furnish

- | | | |
|----|---------------------|---|
| 1) | Rack Mount Chassis | 1 |
| 2) | AV encoding modules | 5 |
| 3) | 9000 series blades | 3 |

D. (DECODE) HD VIDEO STREAMING DECODER

1. Acceptable
 - a. VBrick 9000 series modular decoding system consisting of:
 - 1) Appliance enclosure 2 slots.
 - 2) 9000 series H.264 Decoding Audio/Video module
 - 3) Furnish all required accessories and mounting hardware
 - b. Consultant approved equal.
2. Quantity
 - a. Furnish

1)	Appliance chassis	4
2)	AV decoding modules	8

2.5 VIDEO

A. (DVD-BR) DIGITAL VIDEO DISC PLAYER

1. Features
 - a. RS-232
 - b. Blu-Ray capable
2. Acceptable
 - a. Oppo BDP-103
 - b. Consultant approved equal.

B. (CAM1) CAMERA, PTZ, SDI

1. Acceptable
 - a. Panasonic AW-HE60SN/SE
 - 1) furnish manufacturers quick release mount brackets for all cam niche locations including those w/o cameras installed.
 - 2) power remotely (CAMPSU)
 - b. Consultant approved equal.
2. Quantity: Furnish quantity indicated on drawings plus 2 portable units in pelican style rolling case.

C. (CAM2) CAMERA, PTZ, SDI

1. Acceptable
 - a. Panasonic AW-HE120W

- 1) furnish manufacturers quick release mount brackets for all cam niche
 - 2) power remotely (CAMPSU)
 - b. Consultant approved equal.
- D. (DOC) DOCUMENT CAMERA, SWIVEL MOUNT
 - 1. Acceptable
 - a. Wolf Vision model VZ-3s
 - 1) Furnish and install rotating base plate model into teaching station work surface allowing unit to store out of the way when not in use.
 - 2) Furnish custom viewing platform inlaid in teaching station
 - b. Consultant approved equal.
- E. (DAVSW1) DIGITAL AUDIO/VIDEO MATRIX SWITCH - Type 1
 - 1. Acceptable
 - a. Crestron DM-MD8x8
 - 1) Furnish modules as indicated
 - b. Consultant approved equal.
- F. (DAVSW2) DIGITAL HD VIDEO SWITCHER - Type 2
 - 1. Acceptable
 - a. Crestron DM-MD16x16
 - 1) Furnish modules as indicated
 - b. Consultant approved equal.
- G. (DAVSW3) DIGITAL AUDIO/VIDEO MATRIX SWITCH - Type 3
 - 1. Acceptable
 - a. Crestron DM-MD32x32
 - 1) Furnish modules as indicated
 - b. Consultant approved equal.
- H. (DVSW) DIGITAL VIDEO SWITCHER
 - 1. Acceptable
 - a. Panasonic AW-HS50N
 - b. Consultant approved equal.
- I. (CCU) DIGITAL CAMERA CONTROL UNIT
 - 1. Acceptable
 - a. Panasonic AW-RP50N
 - b. Consultant approved equal.
- J. (DMRX1) DIGITAL MEDIA RECEIVER WITH SCALER

1. Acceptable
 - a. Crestron DM-RMC-SCALER-C
 - b. Consultant approved equal.
- K. (DMRX2) DIGITAL MEDIA RECEIVER WITH SCALER
 1. Acceptable
 - a. Crestron DM-RMC-200-C
 - b. Consultant approved equal.
- L. (DMTX1) DIGITAL MEDIA TRANSMITTER
 1. Acceptable
 - a. Crestron DM-TX-401C
 - b. Consultant approved equal.
- M. (DMTX2) DIGITAL MEDIA TRANSMITTER (WALL PLATE)
 1. Acceptable
 - a. Crestron DM-TX-200-C-2G
 - b. Consultant approved equal.
- N. (FP1) FLAT PANEL DISPLAY-TYPE 1
 1. Acceptable
 - a. NEC P402 40" flat-panel display
 - 1) Integrate OFE Apple Mac Min Computer and web cam.
 - 2) Mount: Chief LTMU Series
 - b. Consultant approved equal.
- O. (FP2) FLAT PANEL DISPLAY-TYPE 2
 1. Acceptable
 - a. NEC X461S 46" flat-panel display
 - 1) Integrate OFE Apple Mac Min Computer.
 - 2) Mount: Chief LTMU Series
 - b. Consultant approved equal
- P. (FP3) FLAT PANEL DISPLAY-TYPE 3
 1. Acceptable
 - a. NEC X551S 55" flat-panel display
 - 1) OPS-PCAF-WS Slot Based Single Board Computer
 - 2) Mount: Chief XTMU Series
 - b. Consultant approved equal
- Q. (FP4) FLAT PANEL DISPLAY-TYPE 4

1. Acceptable
 - a. SHARP PN-E702 70" flat-panel display
 - 1) Furnish AOpen DE Single Board Computer
 - 2) Mount: Chief XTMU Series
 - b. Consultant approved equal
- R. (SDIDA) HD/SDI DISTRIBUTION AMPLIFIER
 1. Acceptable
 - a. Extron MDA 4V HD/SDI
 - b. Consultant approved equal.
- S. (SDI/HDMI) HD/SDI to HDMI TRANSCODER
 1. Features/ Requirements
 - a. Passes embedded audio
 2. Acceptable
 - a. BlackMagic mini-converter SDI to HDMI
 - b. Consultant approved equal
- T. (SDI/RGB) HD/SDI to RGB TRANSCODER
 1. Features/ Requirements
 - a. Audio de-embedding
 - b. HD Component Analog video out
 2. Acceptable
 - a. BlackMagic mini-converter SDI to Analog
 - b. Consultant approved equal
- U. (HDSCALE) HDMI SCALER
 1. Acceptable
 - a. Crestron HD-SCALER
 - b. Consultant approved equal.
- V. (HDMIDA) DISTRIBUTION AMPLIFIER
 1. Acceptable
 - a. Crestron HD-DA2
 - b. Consultant approved equal.
- W. (HDMISW1) HDMI SWITCH 8x2
 1. Acceptable
 - a. Crestron HD-MD8x2
 - b. Consultant approved equal.

- X. (HDMISW2) HDMI SWITCH 2x1
 - 1. Acceptable
 - a. Extron SW2HDMI
 - b. Consultant approved equal.
- Y. (HDMITX, HDMIRX) HDMI EXTENDER PAIR
 - 1. Acceptable
 - a. Crestron HD-EXT-1C HDMI Extension Kit with
 - 1) (HDMITX) HD-TX1C Transmitter
 - 2) (HDMIRX) HD-RX1C Receiver
- Z. (SDI88) HD/SDI MATRIX 8x8
 - 1. Acceptable
 - a. Matrix Switch Corp. model MSC-HD88L
 - 1) optional control panel
 - b. Consultant approved equal.
- AA. (EMBED) HD/SDI AUDIO EMBEDDER
 - 1. Acceptable
 - a. Black Magic Audio to HD/SDI Mini Converter
 - b. Consultant approved equal.
- BB. (VP1) VIDEO PROJECTOR - TYPE 1
 - 1. Acceptable
 - a. Panasonic PT-DZ770K
 - 1) Furnish 2 spare lamps & filter per unit
 - 2) Furnish motorized zoom lens, field verify size
 - 3) Furnish lockable mounting platform
 - b. Consultant approved equal.
- CC. (VP2) VIDEO PROJECTOR - TYPE 2
 - 1. Acceptable
 - a. Panasonic PT-EZ570U
 - 1) Furnish 1 spare lamp & filter per unit
 - 2) Furnish motorized zoom lens, field verify size
 - 3) Furnish lockable mounting platform
 - b. Consultant approved equal.
- DD. (VP3) VIDEO PROJECTOR - TYPE 3
 - 1. Acceptable

- a. Christie HD10K-M
 - 1) Furnish 1 spare lamp & filter per unit
 - 2) Furnish motorized zoom lens, field verify size
 - 3) Furnish lockable mounting platform
- b. Consultant approved equal.

EE. (DVP) DIGITAL VIDEO PROCESSOR

- 1. Features/ Requirements
 - a. 7 Inputs (SD/HD-SDI, DVI, RGB, YUV, YC, CV) , to 2k resolution
 - b. 4 Outputs (DVI) 2048x1200/channel
 - c. Edge Blending
 - d. PiP
- 2. Acceptable
 - a. Christie Vista Spyder 374
 - b. Consultant approved equal

2.6 REMOTE CONTROL SYSTEM

- A. General: The Control Systems consist of three (3) parts: Remote Control and Monitoring, and DSP Control and Monitoring.
 - 1. The contractor shall provide programming for the remote control systems as described below and shown on the Category AV drawings. The Contractor shall submit shop drawings of all control screen layouts and control descriptions to the Architect for review and comment prior to actual final programming and installation.
 - 2. Provide bi-directional feedback on all screens for all devices.
 - 3. Labels and Text: Avoid abbreviations and acronyms. Device selection and control buttons will be labeled with clear text descriptions. Transport control buttons will use graphical icons. Lettering is 1/8" minimum sans serif font, maintaining background to text contrast. Use contrasting color to highlight function or feedback status.
 - 4. Use positive logic. Avoid conditions that may cause command synchronization conflicts. Provide power sensors or other devices to ensure that positive logic conditions are maintained. Use RS-232 or RS-422 devices that provide feedback of equipment status to the control system.
 - 5. Feedback shall be indicated in a logical manner on the touch screen at all times. The status of each controllable device shall be polled to reflect the most accurate state of the overall system condition at all times.
 - 6. Link functions to require the fewest number of use actions to control the audiovisual equipment.

7. Each media selection clears the previous audio and visual selection (i.e. “CD SELECT” clears the audio as well as video selection of “DVD SELECT”).
8. Default conditions shall be established for the system at power-up including device, warm-up routine, power conditions, switcher status and other default conditions.
9. Buttons (hard and soft) shall incorporate pilot lights or inverted illumination capabilities.
10. The programming shall be “foolproof” to the extent that each operation or sequence of operations does not cause the control system to become inoperable to interfere with further procession, correct operations or execution of commands.
11. Provide the following modules for control as required:
 - a. Relays.
 - b. Serial and Infrared (IR).
 - c. RS 232 and RS 422 with adjustable baud rate.
 - d. Logic Input Control.
12. Provide the following control system accessories as required:
 - a. Control Bus Terminal Block: Crestron CNTBLOCK or approved equal.
 - b. Power Supply: CNPWS-75 or approved equal.
 - c. Supply Com ports, IR ports and/or modules as necessary.
 - d. Provide additional accessories, including sync and power sensors, as required to provide a fully operational system.
 - e. Provide minimum 30-minute UPS backup for the RC units.
13. The Contractor shall be responsible for developing and implementing, with the assistance and oversight of the Consultant and Information Services personnel, a facility-wide Web-based Asset Management solution. This will include Crestron Fusion® Server Edition. This solution must include at least the following features:
 - a. New, manufacturers recommended, Information Services approved, dedicated, rack mounted server, monitor keyboard and mouse. Installed in the AV control room (unless directed otherwise). Alternately, should the Owner so desire, the software may be loaded onto a Virtual server.
 - b. Crestron Fusion® Server Edition with all necessary site licenses (+20% expansion)
 - c. Remote monitoring and control of all applicable AV devices furnished under this scope. Furnish interfaces as necessary.
 - d. Multiple customizable layers or levels of organization.
 - e. Equipment scheduling capabilities such as turn on / turn off at specific times.
 - f. Provide Web client interfaces.
 - g. Email Notification.
 - h. Database integration.
 - i. Ability to generate customized reports.

- j. Mobile PDA integration.
- k. Furnish Crestron QM-RMC control modules and optional display modules as required to provide full command, control and monitoring of all facility-wide flat-panel displays and projectors furnished under this scope.

B. Remote Control Submittals and Owner Review:

1. Prior to programming the remote control system, the Contractor shall submit shop drawings per the project standards showing all control screen layouts and control descriptions of all remote control system functions to the Owner's Representative and AV Consultant for review and comment prior to actual programming of the system. Shop drawings shall include control screen layouts of the Crestron touch panel pages for each panel, Crestron layouts (accessible by any AV PC computer on the AV network), DSP software "Control pages" for all preset configurations. Submit electronic versions of the software and to the Consultant for review and approval. The Contractor shall incorporate all Owner comments into the programming of the systems.
2. Prior to delivery of the systems to the job site, the Contractor shall demonstrate fully functioning systems in the Contractor's facilities that include the remote control programming. This demonstration shall coincide with the Owner's Representatives observation of Completed Sub Assemblies (Refer to Section 3.2). The Owner will review and comment upon the remote control programming, and the Contractor shall incorporate all Owner comments into the programming of the systems.
3. After the installation of the AV systems has been deemed substantially complete, but prior to final acceptance of the system, the Owner shall have a review period of forty-five days to observe the operation of the remote control system. At the end of this review period, the Owner may request programming changes relating to the look and feel of the remote control panels or the functionality of commands. The Contractor shall make these changes prior to final acceptance of the systems.

C. Control System Help Menu:

1. Provide a detailed context sensitive help section to aid the operation and use of the media system. The help section shall provide a "novice" user with enough information to use every aspect of the programmed, controllable devices.
2. Provide a help button on every "page".
3. The help button on each "page" shall open the section of the help menu specific to that "page". Every button on that "page" shall be detailed in such section of the help menu.

D. Touch Screen Layout Description:

1. Programming: System Screens shall be ordered, mapped, and the buttons defined as deemed necessary by the Consultant. The goal of the remote control system programming is to provide a simple, user-friendly interface to the audio-visual

system. With this in mind, each button on the remote control panels may initiate control of multiple devices to streamline operation of the system.

2. Template: Utilize Crestron “True Blue” template as the basis for the professional “look and feel” of the touch screen programming.
3. Title Screen: Contractor shall obtain bitmap file of the Owner’s logo for this screen. Touching the screen in any location will bring user to the Main Menu screen. This is the default start up screen for power up and sleep mode.

E. Remote Control Submittals and Owner Review:

1. Prior to programming the remote control system, the Contractor shall submit shop drawings per the project standards showing all control screen layouts and control descriptions of all remote control system functions to the Consultant and Owner for review and comment prior to actual programming of the system. The Contractor shall incorporate all Consultant and Owner comments into the programming of the systems.
2. Prior to delivery of the systems to the job site, the Contractor shall demonstrate fully functioning systems in the Contractor’s facilities that include the remote control programming. This demonstration shall coincide with the Owner’s Representatives observation of Completed Sub Assemblies (Refer to Paragraph 3.2). The Consultant and Owner will review and comment upon the remote control programming and the Contractor shall incorporate all Consultant and Owner comments into the programming of the systems.
3. After the installation of the AV systems has been deemed substantially complete, but prior to final acceptance of the system, the Owner shall have a review period of 90 days to observe the operation of the remote control system. At the end of this review period, the Owner may request programming changes relating to the look and feel of the remote control panels and/or the functionality of commands. The Contractor shall make these changes, at no cost to the Owner, prior to final acceptance of the systems.

F. Remote Control Software Programming:

1. To ensure the quality and consistency of the controls program and its wide range of responsibilities, the Consultant has worked with BMA Software Solutions to develop the control system programming and user interface for this project. BMA Software Solutions can be contacted at (714) 455.2717 or via email at marc@bmasoftwareolutions.com for a master quote.
2. When working with BMA, the Audiovisual Contractor shall coordinate and adhere to the following:
 - a. The Audiovisual Contractor must provide complete system engineering to BMA prior to the beginning of code development.
 - b. The Audiovisual Contractor must coordinate installation schedule with BMA, and arrange for staging, initial upload and testing at the Audiovisual Contractor's facility prior to delivery to client.

- c. The Audiovisual Contractor must involve BMA in deciding any equipment/connection changes before the changes are confirmed.
- d. BMA will go on-site for loading and troubleshooting only if an engineer employed by the Audiovisual Contractor accompanies them.
- e. Where possible, the Audiovisual Contractor should coordinate to provide Internet connection at job site to allow remote access and programming.
- f. As needed and where reasonable, the Audiovisual Contractor will provide needed hardware to BMA for software development.
- g. The Audiovisual Contractor must be an authorized CRESTRON dealer in good standing.
- h. BMA and the Audiovisual Contractor must provide required controls software programming to access all commonly used features for each item to be controlled;
- i. BMA and the Audiovisual Contractor must submit touch panel layouts to consultant and client for approval, either electronically or as printed screen copies;
- j. BMA and the Audiovisual Contractor must revise touch panels as required prior to the acceptance of the system and provide at no extra charge any reprogramming of the control system or touch panels requested by the Owner within thirty days of acceptance of the system for user functionality issues;
- k. The final programming product must incorporate the Owner's logo as part of the start-up screen; Contact Owner for appropriate graphics sources.

G. (RC1) REMOTE CONTROL SYSTEM - TYPE 1

- 1. Acceptable:
 - a. Crestron CP3
 - b. expansion modules as required
- 2. Consultant Approved Equal

H. (RC2) REMOTE CONTROL SYSTEM - TYPE 2

- 1. Acceptable:
 - a. Crestron CP2E
 - b. expansion modules as required
- 2. Consultant Approved Equal

I. (RC3) REMOTE CONTROL SYSTEM - TYPE 3

- 1. Acceptable:
 - a. Crestron MPC-M5
 - b. expansion modules as required
- 2. Consultant Approved Equal

J. (RM2) WIRED REMOTE CONTROL PANEL- TYPE 2

- 1. Acceptable:

- a. Crestron TSW-750-B-S
 - b. expansion modules as required
 - 2. Consultant Approved Equal
 - K. (TP) TOUCH PANEL, 15", TABLE TOP TILT MOUNT
 - 1. Acceptable
 - a. Crestron V15-C
 - 1) Furnish all required accessories and mounting hardware
 - L. (TP1) TOUCH PANEL, 24", TABLE TOP TILT MOUNT
 - 1. Acceptable
 - a. Crestron V24-C
 - 1) Furnish all required accessories and mounting hardware
 - M. (TP2) TOUCH PANEL, 7", TABLE TOP TILT MOUNT
 - 1. Acceptable
 - a. Crestron TSW-750-B-S
 - 1) Furnish tabletop mounting kit (TSW-750-TTK) and all required accessories and mounting hardware
 - N. (WRC) WALL MOUNTED ROOM CONTROLLER
 - 1. Acceptable
 - a. Crestron Room Controller MP-B10
 - O. (WLSRC) WIRELESS HANDHELD ROOM CONTROLLER
 - 1. Acceptable
 - a. Crestron Room Controller TPMC-3X
 - 1) Furnish desktop docking/charging station (TPMC-3X-DS)
 - 2) Furnish all required accessories
 - P. (DGE) DIGITAL GRAPHICS ENGINE
 - 1. Acceptable
 - a. Crestron DGE-2
- 2.7 A/V DATA NETWORK DISTRIBUTION SYSTEM
- A. (DSWCH1) 8 PORT MANAGED LAN SWITCH
 - 1. Acceptable
 - a. Cisco 8 Port WS-C2960-8TC-L Managed Switch
 - 1) Furnish SFP module as required.

B. (DSWCH2) 48 PORT MANAGED POE+ SWITCH WITH UPLINK

1. Features
 - a. All ports POE+
2. Acceptable
 - a. Cisco Catalyst 2960-48PST-L
 - 1) Furnish uplink modules as necessary
 - b. Consultant approved equal

C. (D-#) Data Patch Panel

1. Features:
 - a. Rack Mountable, 2RU
 - b. Category 6 Rated
 - c. 48 Port Configuration
2. Acceptable
 - a. Leviton eXtreme 6+ Universal Patch Panel (69586-U48) with one factory certified patch cable per two ports (AVC shall furnish patchbays in sufficient quantity to fulfill the functional intent of the drawings.)
 - b. Consultant approved Equal

D. (USBTX) USB EXTENDER TRANSMITTER

1. Acceptable
 - a. Extron USB Extender Transmitter

E. (USB RX) USB EXTENDER RECEIVER

1. Acceptable
 - a. Extron USB Extender Receiver

F. (AVPC) Control & Monitoring Computer:

1. Features:
 - a. Small form factor chassis (SF) with (1) low-profile PCI, (1) PCIe Gen1x16, (1) PCIe Gen 2x16 slots
 - b. ATX motherboard with minimum 2.93 GHz i7-870 processor, 4GB DDR3-1333MHz RAM,
 - c. NVidia NVS300 512MB graphics card, dual output
 - d. SATA SuperMulti DVD Writer
 - e. Dual 3.5 inch, 160GB(min.), Solid-State hard drives, 7200 rpm, RAID 1
 - f. Dual 10/100/1000 Base Ethernet NICs
 - g. 104 key PS2 keyboard
 - h. Three button laser wheel mouse.
 - i. Windows 7 Pro, 64 bit
 - j. Provide Middle Atlantic custom CPU rack kit.

- k. Optional 3-year next business day onsite service plan
 - l. Install and fully configure all relevant control and monitoring software packages.
 - m. Furnish 20" Rackmounted, clamshell LCD Monitor+ Keyboard+ Mouse (PCMON / KEY / MSE)
2. Acceptable:
- a. Hewlett Packard HP Z400 Workstation and ancillary components/options
 - b. Consultant approved equal.

2.8 PROJECTION SCREENS

A. Electrically Operated, Surface-Mounted, Front-Projection Screen – Type 1

- 1. **143" Nominal Diagonal**, 16:9 format, Surface-Mounted, Electrically Operated, Tab-tensioned, Roll-up Front Projection Screen.
- 2. Acceptable Manufacturers/Models:
 - a. Draper Premier or approved equal.
- 3. Furnish screen unit completely housed in an extruded aluminum case. Mount top of screen fabric to metal roller, with roller supported on brackets with self-aligning bearings.
- 4. Case: Metal motor compartment, with hinged or removable access panel to motor compartment, electrical outlet box and finished with manufacturer's standard prime coat.
- 5. Motorized Roller Unit: Size and capacity recommended by screen manufacturer. Use instant reversing, gear drive motor with permanently lubricated ball bearings, automatic thermal overload protection, and limit switches to automatically stop screen in "up" and "down" positions. Stop action shall be positive to prevent coasting.
- 6. Control: Provide a 3-button low voltage remote control switch ("up", "stop" and "down") in a box with cover plate for flush wall mounting. Refer to Category AV drawings for location. Equip screen with associated (LVC) low voltage relay interface option.
- 7. Control Cable: Belden 9156 or approved equal. Provide, install, and terminate per manufacturer's recommendations control cable from switch to screen motor.
- 8. Screen Fabric: Manufacturer's standard, opaque, seamless, flame and mildew resistant, as follows:
 - a. Draper Grey XH600V or approved equal.
- 9. Mount top of screen fabric on roller with roller lock or other pull-down limit, and bottom of fabric formed into pocket enclosing tubular steel batten.
- 10. Screen Size: **Image size shall be 70" high by 124.6" wide** (16:9 aspect ratio). Provide a minimum of 3" of black screen masking on the sides of the image area

and 2" at the bottom. **Provide 4" of black screen masking above the top extents of the image area.**

11. Contractor shall verify mounting condition prior to ordering. Inform the Architect and Consultant immediately of any discrepancies.

- a. Mounting Height (Bottom of Case): 10'-8" AFF

12. Quantity: Furnish quantity indicated on AV drawings.

B. Electrically Operated, Surface-Mounted, Front-Projection Screen – Type 2

1. **110" Nominal Diagonal**, 16:9 format, Surface-Mounted, Electrically Operated, Tab-tensioned, Roll-up Front Projection Screen.
2. Acceptable Manufacturers/Models:
 - a. Draper Premier or approved equal.
3. Furnish screen unit completely housed in an extruded aluminum case. Mount top of screen fabric to metal roller, with roller supported on brackets with self-aligning bearings.
4. Case: Metal motor compartment, with hinged or removable access panel to motor compartment, electrical outlet box and finished with manufacturer's standard prime coat.
5. Motorized Roller Unit: Size and capacity recommended by screen manufacturer. Use instant reversing, gear drive motor with permanently lubricated ball bearings, automatic thermal overload protection, and limit switches to automatically stop screen in "up" and "down" positions. Stop action shall be positive to prevent coasting.
6. Control: Provide a 3-button low voltage remote control switch ("up", "stop" and "down") in a box with cover plate for flush wall mounting. Refer to Category AV drawings for location. Equip screen with associated (LVC) low voltage relay interface option.
7. Control Cable: Belden 9156 or approved equal. Provide, install, and terminate per manufacturer's recommendations control cable from switch to screen motor.
8. Screen Fabric: Manufacturer's standard, opaque, seamless, flame and mildew resistant, as follows:
 - a. Draper Grey XH600V or approved equal.
9. Mount top of screen fabric on roller with roller lock or other pull-down limit, and bottom of fabric formed into pocket enclosing tubular steel batten.
10. Screen Size: **Image size shall be 54" high by 96.1" wide** (16:9 aspect ratio). Provide a minimum of 3" of black screen masking on the sides of the image area and 2" at the bottom. **Provide 12" of black screen masking above the top extents of the image area.**

11. Contractor shall verify mounting condition prior to ordering. Inform the Architect and Consultant immediately of any discrepancies.
 - a. Mounting Height (Bottom of Case): 10'-6" AFF
 12. Quantity: Furnish quantity indicated on AV drawings.
- C. Electrically Operated, Recessed, Front-Projection Screen – Type 3
1. **Nominal 122" Diagonal;** 16:9 format, Recessed, Electrically Operated, Tab-tensioned, Roll-up Front Projection Screen.
 2. Acceptable Manufacturers/Models:
 - a. Draper Premier or approved equal.
 3. Furnish screen unit completely housed in an extruded aluminum case. Mount top of screen fabric to metal roller, with roller supported on brackets with self-aligning bearings.
 4. Case: Extruded aluminum with self-finishing, seamless bottom plate, finished with manufacturer's standard prime coat. Order factory preset drywall and plaster flange stops to accommodate project ceiling conditions. Case shall be made available for shipping independent of screen material to facilitate rough-in and division of labor.
 5. Motorized Roller Unit: Size and capacity recommended by screen manufacturer. Use instant reversing, gear drive motor with permanently lubricated ball bearings, automatic thermal overload protection, and limit switches to automatically stop screen in "up" and "down" positions. Stop action shall be positive to prevent coasting.
 6. Control: Provide a 3-button low voltage remote control switch ("up", "stop" and "down") in a box with cover plate for flush wall mounting. Refer to Category AV drawings for location. Equip screen with associated (LVC) low voltage relay interface option.
 7. Control Cable: Belden 9156 or approved equal. Provide, install, and terminate per manufacturer's recommendations control cable from switch to screen motor.
 8. Screen Fabric: Manufacturer's standard, opaque, seamless, flame and mildew resistant, as follows:
 - a. Draper Grey XH600V or approved equal.
 9. Mount top of screen fabric on roller with roller lock or other pull-down limit, and bottom of fabric formed into pocket enclosing tubular steel batten.
 10. Screen Size: **Image size shall be 60" high by 106.8" wide** (16:9 aspect ratio). Provide a minimum of 5" of black screen masking on the sides of the image area and 2" at the bottom. **Provide 12" of black screen masking above the top extents of the image area.**
 11. Contractor shall verify mounting condition prior to ordering. Inform the Architect and Consultant immediately of any discrepancies.

- a. Mounting Height: 11'-6" AFF
- 12. Quantity: Furnish quantity indicated on AV drawings.
- D. Electrically Operated, Surface-Mounted, Front-Projection Screen – Type 4
 - 1. **386" Nominal Diagonal, 4.48:1** format, Surface-Mounted, Electrically Operated, Tab-tensioned, Roll-up Front Projection Screen.
 - 2. Acceptable Manufacturers/Models:
 - a. Draper Premier or approved equal.
 - 3. Furnish screen unit completely housed in a custom case. Mount top of screen fabric to metal roller, with roller supported on brackets with self-aligning bearings.
 - 4. Case: Metal motor compartment, with hinged or removable access panel to motor compartment, electrical outlet box and finished with manufacturer's standard prime coat.
 - 5. Motor Unit: Size and capacity recommended by screen manufacturer. Use instant reversing, gear drive motor with permanently lubricated ball bearings, automatic thermal overload protection, and limit switches to automatically stop screen in "up" and "down" positions. Stop action shall be positive to prevent coasting.
 - 6. Control: Provide a 3-button low voltage remote control switch ("up", "stop" and "down") in a box with cover plate for flush wall mounting. Refer to Category AV drawings for location. Equip screen with associated (LVC) low voltage relay interface option.
 - 7. Control Cable: Belden 9156 or approved equal. Provide, install, and terminate per manufacturer's recommendations control cable from switch to screen motor.
 - 8. Screen Fabric: Manufacturer's standard, opaque, seamless, flame and mildew resistant, as follows:
 - a. Draper Grey XH600V or approved equal.
 - 9. Mount top of screen fabric on roller with roller lock or other pull-down limit, and bottom of fabric formed into pocket enclosing tubular steel batten.
 - 10. Screen Size: Image size shall be 84" high by 376.3" wide (4.48:1 aspect ratio). Provide a minimum of 3" of black screen masking on the sides of the image area and 2" at the bottom. Provide 24" of black screen masking above the top extents of the image area.
 - 11. Contractor shall verify mounting condition prior to ordering. Inform the Architect and Consultant immediately of any discrepancies.
 - a. Mounting Height (Bottom of Case): 13'-6" AFF
 - 12. Quantity: Furnish quantity indicated on AV drawings.
- E. Electrically Operated, Surface-Mounted, Front-Projection Screen – Type 5

1. **171” Nominal Diagonal**, 16:9 format, Surface-Mounted, Electrically Operated, Tab-tensioned, Roll-up Front Projection Screen.
 2. Acceptable Manufacturers/Models:
 - a. Draper Premier or approved equal.
 3. Furnish screen unit completely housed in an extruded aluminum case. Mount top of screen fabric to metal roller, with roller supported on brackets with self-aligning bearings.
 4. Case: Metal motor compartment, with hinged or removable access panel to motor compartment, electrical outlet box and finished with manufacturer's standard prime coat.
 5. Motorized Roller Unit: Size and capacity recommended by screen manufacturer. Use instant reversing, gear drive motor with permanently lubricated ball bearings, automatic thermal overload protection, and limit switches to automatically stop screen in "up" and "down" positions. Stop action shall be positive to prevent coasting.
 6. Control: Provide a 3-button low voltage remote control switch ("up", "stop" and "down") in a box with cover plate for flush wall mounting. Refer to Category AV drawings for location. Equip screen with associated (LVC) low voltage relay interface option.
 7. Control Cable: Belden 9156 or approved equal. Provide, install, and terminate per manufacturer's recommendations control cable from switch to screen motor.
 8. Screen Fabric: Manufacturer's standard, opaque, seamless, flame and mildew resistant, as follows:
 - a. Draper Grey XH600V or approved equal.
 9. Mount top of screen fabric on roller with roller lock or other pull-down limit, and bottom of fabric formed into pocket enclosing tubular steel batten.
 10. Screen Size: **Image size shall be 84” high by 149.5” wide** (16:9 aspect ratio). Provide a minimum of 3" of black screen masking on the sides of the image area and 2" at the bottom. **Provide 9” of black screen masking above the top extents of the image area.**
 11. Contractor shall verify mounting condition prior to ordering. Inform the Architect and Consultant immediately of any discrepancies.
 - a. Mounting Height (Bottom of Case): 12'-3” AFF
 12. Quantity: Furnish quantity indicated on AV drawings.
- F. Electrically Operated, Recessed, Front-Projection Screen – Type 6
1. **Nominal 155” Diagonal**; 16:9 format, Recessed, Electrically Operated, Tab-tensioned, Roll-up Front Projection Screen.
 2. Acceptable Manufacturers/Models:

- a. Draper Premier or approved equal.
3. Furnish screen unit completely housed in an extruded aluminum case. Mount top of screen fabric to metal roller, with roller supported on brackets with self-aligning bearings.
4. Case: Extruded aluminum with self-finishing, seamless bottom plate, finished with manufacturer's standard prime coat. Order factory preset drywall and plaster flange stops to accommodate project ceiling conditions. Case shall be made available for shipping independent of screen material to facilitate rough-in and division of labor.
5. Motorized Roller Unit: Size and capacity recommended by screen manufacturer. Use instant reversing, gear drive motor with permanently lubricated ball bearings, automatic thermal overload protection, and limit switches to automatically stop screen in "up" and "down" positions. Stop action shall be positive to prevent coasting.
6. Control: Provide a 3-button low voltage remote control switch ("up", "stop" and "down") in a box with cover plate for flush wall mounting. Refer to Category AV drawings for location. Equip screen with associated (LVC) low voltage relay interface option.
7. Control Cable: Belden 9156 or approved equal. Provide, install, and terminate per manufacturer's recommendations control cable from switch to screen motor.
8. Screen Fabric: Manufacturer's standard, opaque, seamless, flame and mildew resistant, as follows:
 - a. Draper Grey XH600V or approved equal.
9. Mount top of screen fabric on roller with roller lock or other pull-down limit, and bottom of fabric formed into pocket enclosing tubular steel batten.
10. Screen Size: **Image size shall be 76" high by 135.3" wide** (16:9 aspect ratio). Provide a minimum of 5" of black screen masking on the sides of the image area and 2" at the bottom. **Provide 4" of black screen masking above the top extents of the image area.**
11. Contractor shall verify mounting condition prior to ordering. Inform the Architect and Consultant immediately of any discrepancies.
 - a. Mounting Height: 11'-6" AFF
12. Quantity: Furnish quantity indicated on AV drawings.

2.9 RACKS, WIRE, CONNECTORS AND MISCELLANEOUS HARDWARE

A. (ER) Full Height Stationary Equipment Racks (AV Control):

1. Features:
 - a. 44, 1-3/4" rack space elevation.
 - b. Accepts EIA standard 19 panel width, 32" deep.

- c. 1/2", 3/4", 1", 1-1/2", electrical knockouts, top and bottom rear.
 - d. 12 Ga. construction.
 - e. Ventilated top and bottom elevation panel.
 - f. Furnish thermostatically controller 8" top-fan unit and filtered air intake
 - g. Furnish (min. 1/2") high-density rubber insulation pad under entire base.
 - 2. Acceptable: Middle Atlantic WRK-series or approved equal.
 - 3. Quantity:
 - a. Equipment rack(s): As shown on drawings.
 - b. Side panel: 1 pair, each side by side assembly.
 - c. Top panel: 1 each equipment rack.
 - d. Rear door: 1 each equipment rack.
 - e. Mid rails: 1 pair each equipment rack.
 - f. Cable Chase (4"): 1 each equipment rack
- B. (ER) Full Height Hosted Equipment Rack (Exec. Tiered Classroom):
- 1. Features:
 - a. 41, 1-3/4" rack space elevation.
 - b. Accepts EIA standard 19 panel width, 32" deep.
 - c. 1/2", 3/4", 1", 1-1/2", electrical knockouts, top and bottom rear.
 - d. 12 Ga. construction.
 - e. Ventilated top and bottom elevation panel.
 - f. Furnish thermostatically controller 8" top-fan unit and filtered air intake
 - g. Furnish (min. 1/2") high-density rubber insulation pad under entire base.
 - 2. Acceptable: Middle Atlantic AXS-series or approved equal.
 - 3. Quantity:
 - a. Equipment rack(s): As shown on drawings.
 - b. Side panel: Integrated.
 - c. Top panel: 1 each equipment rack.
 - d. Rear door: 1 each equipment rack.
 - e. Mid rails: 1 pair each equipment rack.
 - f. Service Tracks: 1 pair each equipment rack.
- C. (ER) Mid Height Wall Mount Equipment Rack (Exec. Flat Classroom):
- 1. Features:
 - a. 24, 1-3/4" rack space elevation.
 - b. Accepts EIA standard 19 panel width, 30" deep.
 - c. 1/2", 3/4", 1", 1-1/2", electrical knockouts, top and bottom.
 - d. 16 Ga. construction.
 - e. Ventilated top and bottom elevation panel.
 - f. Furnish mfgs. optional UPS and mounting kit.
 - 2. Acceptable: Middle Atlantic SR-series or approved equal.
 - 3. Quantity:

- a. Equipment rack(s): As shown on drawings.
 - b. Side panel: Integrated.
 - c. Top panel: Integrated
 - d. Rear door: n/a
 - e. Mid rails: 1 pair each equipment rack.
- D. Equipment Rack, Open Frame (Millwork)
 - 1. Acceptable:
 - a. Middle Atlantic SRSR Series
 - 1) Size per drawings
 - 2) Coordinate carefully with millwork for adequate accommodation
 - b. Consultant Approved Equal
- E. (CUBBY): Cable Cubby
 - 1. Acceptable
 - a. Extron Cubby 600 with all necessary adapter plates and connectors
 - b. Consultant Approved Equal
- F. (FB1, FB4): Floorbox, Multi-Signal
 - 1. Acceptable
 - a. Wiremold Evolution EFB10S (Classrooms)
 - 1) Furnish quantity indicated on drawings
 - 2) Furnish Bracket Module equal to EFB10S-5GMB (qty. 1)
 - 3) Furnish Bracket Module equal to EFB10-MB (qty. 1)
 - 4) Furnish two Mounting Brackets as required
 - 5) Furnish device mounting plates for all services (power and data) as required.
 - 6) Coordinate cover style and finish with architect
 - b. Consultant Approved Equal
- G. (FB2, FB3): Floorbox, Multi-Signal (Conference and Breakout rooms)
 - 1. Acceptable
 - a. Wiremold Evolution EFB6S
 - 1) Furnish quantity indicated on drawings
 - 2) Furnish Bracket Module equal to EFB6SM (qty. 2)
 - 3) Furnish two Mounting Brackets as required
 - 4) Coordinate cover style and finish with architect
 - b. Consultant Approved Equal
- H. Mount, Monitor, Tilt (FPx)
 - 1. Features:
 - a. Size as required for monitors indicated above.

2. Acceptable:
 - a. Chief PIWRF Series
 - b. Consultant Approved equal.
- I. Rack Panels:
 1. Blank Panels:
 - a. Features:
 - 1) 1/8" anodized brushed aluminum finish.
 - 2) 19" standard EIA width.
 - b. Acceptable: Lowell, Middle Atlantic or approved equal.
 - c. Quantity: As shown on drawings.
 2. Vent Panels:
 - a. Features:
 - 1) 16 Ga. perforated steel with black power coat finish.
 - 2) 60% minimum open area.
 - 3) 19" standard EIA width.
 - b. Acceptable: Lowell, Middle Atlantic or approved equal.
 - c. Quantity: As shown on drawings.
- J. Rack Kit(s):
 1. Features:
 - a. 1/6" anodized brushed aluminum finish.
 - b. Custom manufactured for each piece of equipment.
 - c. 19" standard EIA width.
 2. Acceptable: Middle Atlantic or manufactures optional rack kit.
 3. Quantity: 1 for each non-standard 19" EIA piece of equipment.
- K. (BAL/UBAL) Line Input Transformer +4dB output to -10dB input:
 1. Features:
 - a. Unbalances "Pro" to "Consumer IHF" Outputs.
 - b. Transformer isolation.
 - c. Passive device.
 2. Electrical Characteristics:
 - a. Bandwidth: -3dB at 0.25 Hz and 100 kHz.
 - b. Input impedance: 13 kohm.
 - c. Common Mode Rejection: greater than 60dB.
 - d. Insertion loss: 14dB
 3. Acceptable: Jensen ISO-MAX PC-2XR or approved equal.
 4. Quantity: 1 per unbalanced stereo input pair.

L. (ISO-A) 1:1 Line Transformer:

1. Features:
 - a. 1:1 turn ratio.
 - b. Transformer isolation.
 - c. Passive device.
2. Electrical Characteristics:
 - a. Bandwidth: -3dB at 0.25 Hz and 100 kHz.
 - b. Distortion: > 0.001% THD
 - c. Common Mode Rejection: greater than 60dB.
 - d. Insertion loss: less than 1.5 dB
 - e. Hum Rejection: greater than 60 dB.
3. Acceptable: Jensen ISO-MAX DM2-2XX or approved equal.
4. Quantity: Use as required.

M. Line Level Amplifier Interface:

1. Features:
 - a. Balances unbalanced "Consumer" line level signals.
 - b. Unbalances balanced "Pro" line level signals.
 - c. Servo Balanced inputs and outputs.
 - d. 600-ohm termination switch.
2. Electrical Characteristics:
 - a. Frequency response: -0dB +0.5 dB from 5 Hz to 100 kHz.
 - b. Distortion: 0.005 THD
 - c. Common Mode Rejection: greater than 45dB.
 - d. Insertion loss:
 - 1) - 14dB +-6dB ("Pro" to "Consumer")
 - 2) + 14dB, +- 6dB ("Consumer" to "Pro")
3. Acceptable: Aphex Model 124 or approved equal.
4. Quantity: 1 per "consumer" -10 dB unbalanced stereo pair.

N. (VC) Manual Volume Control for Ceiling Loudspeakers:

1. Features:
 - a. High quality auto transformer series for use in 70-Volt system
 - b. 10 step attenuation
 - c. Durable stainless steel plate with skirted black knob
 - d. Size appropriately for connected load
2. Acceptable: Lowell LVC Series or approved equal.

O. (ISO-V) Composite Video Hum Coil:

1. Features:

- a. Eliminates up to 20 V p-p ground induced hum on composite video signal lines.
 - b. Up to 60 dB hum reduction.
 - c. Average insertion loss is .25 dB @ 1MHz.
 - d. No differential phase or gain distortion.
 - e. BNC connectors.
 2. Acceptable: ADC HUM-1 or approved equal.
 3. Quantity: Use as required.
- P. (ISO-RGBHV) RGBHV Hum Suppressor:
1. Features:
 - a. High resolution video hum suppressor compatible with virtually any analog or TTL video signal.
 - b. Suppresses video hum, removing visible effects caused by ground loops.
 - c. Simple operation – no adjustment or calibration required.
 - d. No external power required.
 - e. Bandwidth: 390 MHz.
 2. Acceptable: Extron GLI350 or approved equal.
 3. Quantity: Use as required.
- Q. Rack Light and Power Conditioner:
1. Features:
 - a. Two adjustable lights to illuminate the rack panels.
 - b. Power line filters for spike and RFI control.
 - c. 15 amp power conditioning capacity.
 - d. Separate switches for lights and power loads.
 2. Acceptable: Furman PL-Plus or approved equal.
 3. Quantity: Provide 1 per equipment rack provided.
- R. (A-#) AUDIO PATCH PANEL:
1. Features:
 - a. 48x2 mini-WECO jacks
 - b. Programmable configuration
 2. Acceptable:
 - a. Bittree B96DC-FNSST/E3-M2OU12B series (AVC shall furnish patchbays in sufficient quantity to fulfill the functional intent of the drawings.)
 - b. Furnish (1) 36" patchcord per jack pair
 - c. Consultant approved equal
- S. (DM-#) DIGITAL MEDIA PATCH BAY
1. Features

- a. Shielded Twisted pair patch bay
 - b. Fully populate all jack locations
 - c. Furnish (1) 36" shielded patchcord per jack pair
 - 2. Acceptable
 - a. Leviton or Hubble (AVC shall furnish patchbays in sufficient quantity to fulfill the functional intent of the drawings.)
 - b. Consultant approved equal.
- T. (HD-#) HD/SDI DIGITAL VIDEO PATCH PANEL:
- 1. Features:
 - a. 32x2 mini-weco jacks
 - b. Full-normal configuration
 - c. Furnish (1) 36" patchcord per jack pair
 - 2. Acceptable:
 - a. Bittree B64T-2MWITHD series (AVC shall furnish patchbays in sufficient quantity to fulfill the functional intent of the drawings.)
 - b. Consultant approved equal
 - 3. Quantity
 - a. Patchbay: As shown on Drawings.
 - b. Patch Cables: Provide (24) 24" factory certified patch cables per patch bay.
- U. (F-#) Fiber Optic Patch panel
- 1. Features
 - a. Separate panels for single-mode and multi-mode patching.
 - b. Accepts (3) 12-fiber LC mounting modules
 - c. Rack mountable, 1 RU
 - d. Populate all module slots with connector panels.
 - e. Furnish slide mount kit for ease of access.
 - f. Furnish all necessary accessories.
 - 2. Acceptable: Leviton Opt-X Ultra Fiber Optic Patch Panel (5R1UH-S03) + (3)-Mounting plates (5F100-12P)
- V. Audio Terminal Blocks:
- 1. Features:
 - a. All mic, line level and DC control cables interconnecting with an equipment rack shall connect to an audio terminal block, prior to exiting the rack or landing on a piece of equipment.
 - b. Rated for stranded 20 GA - 24 GA wire.

2. Acceptable: WAGO Style modular terminal blocks (must be used in conjunction with cable ferrules).
- W. High-Level Audio Terminal Blocks:
1. All loudspeaker lines leaving an equipment rack shall be connected via barrier-type screw terminal blocks.
- X. Installed Wiring: (NOTE: Non-plenum versions listed, furnish plenum equivalents as required.)
1. Loudspeaker lines in conduit: standard electrical wire, stranded copper, color-coded, THHN/THWN type.
 - a. CONDUIT HAS BEEN SIZED FOR THHN
 - b. Low Z: AWG #12 unless otherwise noted
 - c. High Z: AWG #14 unless otherwise noted
 2. Mic and Line, twisted, shielded pair #22: equal to Belden 8761 or WestPenn/CDT (x)454 or consultant approved equal by Liberty.
 3. Production communication: dual twisted, shielded pair #20 equal to Belden 9402 OR two shielded pairs #20 equal to Belden 8762 or consultant approved equal by WestPenn/CDT or Liberty.
 4. Intercom, conduit sized for .401" cables:
 - a. AWG #18: West Penn #285 or consultant approved equal by Liberty.
 5. Video 75 ohm COAX, field/inter-rack runs greater than 150' feet, conduit sized for .300" OD cables:
 - a. RG-6/U Type in conduit: Belden 1694A, WestPenn/CDT 6350 or Canare L-5CFB or consultant approved equal by Liberty.
 6. Video 75 ohm COAX, field/inter-rack runs greater than 25 feet / less than 150', conduit sized for .250" OD cables:
 - a. RG-59/U Type in conduit: Belden 1505A, WestPenn/CDT 819 or Canare L-4CFB or consultant approved equal by Liberty.
 7. Video 75 ohm COAX, inter/intra-rack runs less than 25 feet
 - a. RG-59/U Type: Belden 1865A, WestPenn/CDT HD825 or Canare L-3CFB or consultant approved equal by Liberty.
 8. RGBHV Multi-channel 75 ohm COAX, conduit sized for 0.831" OD individual cables:
 - a. Terminate Cable lengths within 1/4" of each other.
 - b. Intra-Rack Wiring and resolutions of less than UXGA (1600x1200):
 - 1) Canare V5-3CFB
 - 2) Extron BNC-5 Mini HR (Mini High Res)

- c. Cable Runs Less Than 50 Feet and resolutions of less than UXGA (1600x1200):
 - 1) Canare V5-3CFB
 - 2) Extron BNC-5 Mini HR (Mini High Res)
- d. Cable Runs Greater Than 50 Feet but Less Than 100 feet and resolutions of less than UXGA (1600x1200) and for EOC runs from racks to <C#> Floor Boxes via Access Floor:
 - 1) Canare V5-4CFB (EOC Conduit and wireway sized for Canare V5-4CFB)
 - 2) Extron SHR-5 (Super High Res) (EOC – submit wirefill calculations for conduits and wireway).
- e. Cable Runs Greater Than 100 Feet or resolutions of UXGA(1600x1200) or greater:
 - 1) Canare V5-5CFB
 - 2) Extron SHR-5 (Super High Res)
- 9. DC Control Lines:
 - a. low current loads (mute, VCA, LED): AWG #20.
 - b. medium current loads (relays, switch lamps): AWG #18.
- 10. RF: 50 ohm.
 - a. (runs <25') Acceptable: Belden 8240 or approved equal.
 - b. (runs >25'<75') Acceptable: General C1176A or approved equal.
 - c. (runs >75') Acceptable: Belden 8214 or approved equal.
- 11. Digital Remote Control Lines:
 - a. Acceptable: Carol 1130, West Penn 271, or approved equal.
- 12. Loudspeaker lines not in conduit:
 - a. Low Z: AWG #10 equal to WestPenn/CDT HA210 or consultant approved equal by Belden or Liberty.
 - b. High Z: AWG #14 equal to WestPenn/CDT 226 or consultant approved equal by Belden or Liberty.
- 13. Unshielded, Twisted Pair:
 - a. Category 5e
 - 1) Acceptable: Berk-Tek LanMark-350, or approved equal.
 - b. Category 6
 - 1) Acceptable: Berk-Tek LanMark-1000, or approved equal.
- 14. Digital Media Cable
 - a. Copper (DM over one-wire cable requirements)

- 1) Category 5e Shielded Twisted Pair (STP) equal to Crestron DM-CBL-8G-NP cable or manufacturers approved equal
- b. Fiber
 - 1) Crestron CresFiber8G or manufacturers approved equal
- Y. Portable Cables:
 1. Reusable Portable Cable Tie
 - a. Acceptable: Rip-Tie CableWrap no known equal.
 - b. Quantity: 1 per portable cable provided.
- Z. Connectors and Receptacles:
 1. Only metal connector shells and bodies are permitted.
 2. Mic and Line:
 - a. Solder only. No IDC, 1-piece compression or screw terminal versions permitted.
 - b. Input: 3-pin female XLR-type and 1/4" TRS jacks where shown on drawings. Insulate 1/4" jacks from plate, do not ground pin 1 on XLRs.
 - c. Output: 3-pin male XLR-type and 1/4" TRS as above.
 - d. RCA: Only solder style, metal connector shells and bodies are permitted., no "molded assemblies" shall be permitted
 3. Loudspeaker:
 - a. Only Neutrik Speakon devices are acceptable.
 - b. Wire all terminals unless otherwise noted.
 - c. Panel: Neutrik NL4MP or NL2MP as required.
 - d. Cords: NL4FC.
 - e. Cable couplers: Neutrik NL4MM.
 - f. Wooden box mounting: Neutrik NL4MPR.
 - g. All NL4 devices shall be cabled for two channel operation unless otherwise noted.
 4. Video: 75 ohm Coax
 - a. Only 3-piece BNC devices are acceptable.
 - b. No IDC, compression or screw terminal versions permitted.
 - c. Extron BNC's shall not be permitted
 - d. Panel-mount recessed BNC: Neutrik D-Series
 - e. Cable:
 - 1) Canare BCP-C3B for Vx-3C series cables.
 - 2) Canare BCP-C4B for use with RG-59 cables.
 - 3) Canare BCP-C77A for use with LV-77S cables.
 - f. Cable couplers: BNC male/male barrel
 - g. HDMI: Cables shall be Cat-2 certified for 10.2 Gb/s and shall carry the HDMI logo.

5. Control: submit cut sheets.
6. Production Communications: 3-pin and 6-pin male XLR-type as shown on drawings

AA. Receptacle Panels, aluminum:

1. Field-verify panel sizes required for backboxes.
 - a. Oversize flush panels sufficient to trim wall openings but not less than ½"
 - b. Size surface mount panels exactly to backbox yielding no sharp corners and chamfering edges
2. Aluminum panels with labels engraved and back-filled in black
3. Anodized, horizontal brushed finish
4. Submit engraved sample for approval by architects.

BB. DC Power Supplies:

1. 12, 24 volt, capacity as required with 100% extra, UL (or other) listed: Condor linear or approved equal, submit cut sheets.
2. Provide and install in shielded metal chassis with fused LED status indicators.

CC. UPS Uninterruptible Power Supply

1. Acceptable: APC, TrippLite, Middle Atlantic
 - a. Rack mounted
 - b. Size large enough to power AVPC, RC's, DSP's and Data Switches for 30 minutes minimum.
2. Consultant Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. The following installation requirements shall govern the design, fabrication and installation of the system(s) specified herein. In case of a discrepancy between these overall system standards and the individual equipment item specifications, the latter shall govern:
 - a. The equipment specified shall be installed according to standards of good human engineering practice and the conditions specified herein.
 - b. Workmanship on the installed systems shall be of professional quality, best commercial practice and accomplished by persons experienced in the techniques and standards of the particular industries involved.
 - c. The specifications describe required performance. The specifications with the contract drawings indicate a general design; it is the intention of the

specifications that the Audio-Visual Contractor will supply from his background of experience and knowledge the necessary supporting details; for example, the implementation of specific components into functioning sub-systems.

- d. In general, the drawings show dimensions, positions, and kind of construction. The specifications describe materials, qualities and methods. Any work called for on the drawings and not mentioned in the specifications, or vice versa, shall be performed as though fully set forth in both. In case of differences between the drawings and the specifications, the decision of the Owner's Representative shall govern. Work not particularly detailed, marked or specified, shall be construed to be the same as similar parts or areas that are detailed, marked, or specified.
2. Equipment markings shall present only needed information and be readable from the operator's normal work position. These markings shall be designed to minimize ambiguous interpretation.
3. Control panels shall be designed to reduce chances of human error and controls shall be natural and consonant with normal operator expectations.
4. All control consoles and their panel mountings shall be provided with the necessary controls, indicators and switches, etc., as outlined in the pertinent sections of this specification. The grouping of these facilities shall be in accordance with the associated drawings and shall, in all cases, be arranged to present an orderly, functional appearance. The layout of controls shall be such that priority of accessibility shall be given to those facilities which frequently require attention.
5. The total design of the system shall simplify the operator's task and insure maximum performance and reliability while minimizing possibilities for human error and providing a comfortable environment for the operator during operation.
6. At the operational level (i.e., patch panels, Audio-Visual equipment receptacle boxes, etc.) all receptacles shall be clearly marked by function and number. When there are multiples of the same function for example, a given microphone line may appear at several locations, the same label shall be shown at each location.

B. The Conduit System:

1. The category AV drawings indicate the number, type and location of the receptacle, wire and cable requirements and Equipment Room layouts, which are the responsibility of the Audio-Visual Contractor. The conduit diagrams indicate schematically the functions served by the conduit system. Also, the conduit diagrams may indicate the locations at which functions are served at several locations in the facility. See the general installation notes for additional information and requirements as shown on the category AV drawings.
2. The Electrical Contractor shall provide the conduit system shown on the category AV drawings. If the conduit installation is concurrent with the present contract, the Audio-Visual Contractor shall inspect the work at appropriate times during

construction and report any discrepancies to the Architect and General Contractor in writing. The Audio-Visual Contractor shall coordinate the exact location of intermediate collector boxes behind the equipment rack(s) with the electrical contractor.

3. The Electrical Contractor shall verify continuity of all conduit as described in the category AV drawings with a yellow pull string.
4. The Audio-Visual Contractor shall be responsible for supplying any additional conduit that may be required to complete the system installation in accordance with the drawings.
5. It shall be the responsibility of the Audio-Visual Contractor to obtain the exact location of any pull boxes, "LBs" or other intermediate locations from the Electrical Contractor.
6. The Audio-Visual Contractor shall also verify that conduits are adequate for the wiring and functions specified. If the Audio-Visual System Contractor substitutes the specified wiring the Audio-Video Contractors shall bear the sole responsibility for reengineering the conduit system.
7. The Audio-Visual Contractor shall field verify all back box installation conditions on site and shall size connection panels as described below. Notify the Audio-Visual Consultant of any discrepancies between AV drawings and installation conditions.
 - a. Surface Mounted Back Boxes: Connection panels shall be sized to match the outer edges of the installed back box and shall have smooth edges.
 - b. Recessed Mounted Back Boxes: Connection panels shall be sized to overlap the outer edges of the installed back box by 1" in both horizontal and vertical directions and shall be installed tightly against the wall surface finish.
8. Each conduit shall contain wires or cable of the same signal level or the same type of circuitry only. Each separate service level designation shown on the AV conduit riser shall be run in their respective, separate conduits and all conduit landings in backboxes or equipment racks shall be grouped by service level.
9. Ground power conduits to the power system ground. Do not connect power system conduits to the racks or to the audio system ground.

C. Equipment Room(s) Arrangement:

1. The general layout for these rooms is indicated in the drawings. The Audio-Visual Contractor shall prepare and submit a detailed layout for approval by the Owner's Representative. This drawing shall include, but not be limited to, the equipment racks, the operator's console and monitoring station, the lighting system and the fire suppression/extinguishing system.
2. Maintain accessibility to the rear of the equipment racks. In the event that the equipment room is not large enough to maintain minimum rear access clearance as mandated by National Electric Code, local code requirements and herein, the

equipment racks shall be mounted on 3" casters or use an extension system. If casters are used the Audio-Visual Contractor shall engineer a locking mechanism and submit it for approval by the Owner's Representative. See specification section 3.01D5 for minimum clearance information.

D. Equipment Rack Assemblies:

1. General:

- a. Equipment rack(s) shall be completely assembled, tested and programmed in the Audio-Visual Contractor's shop. No rack assembly shall be performed at the project site. After the equipment racks are tested the Audio-Visual Contractor shall notify the Owner's Representative in writing that the equipment rack assemblies are ready for observation and approval. Allow adequate time for any modifications necessary to satisfy the contract drawings and specifications.
- b. Use rear and mid rails for intermediate terminations. Maintain accessibility to the rear of the equipment.
- c. Mid rails must be used to support equipment weighing more than 50 pounds.

2. Wiring Harnesses:

- a. Equipment rack wiring shall be "Harness" style. "Point to Point" rack wiring is not acceptable. The individual wiring harnesses shall be located at the front of the equipment rack and individual pairs of cable shall be broken out around the side of the equipment to the rear where the connectors are located.
- b. Electrical service levels shall not be mixed in an individual harness. It is the intent that there will be a separate harness for each electrical service level.
- c. Great care shall be exercised to keep low level signal harnesses separated from the AC power lines and high level signal harnesses.
- d. When 3 or more equipment racks are used, interconnection between equipment racks shall be performed with multi channel cable and multi-pin connector assemblies. It is the intent that each rack shall be a complete stand-alone assembly allowing the system to be completely tested in the Audio-Visual Contractor's shop.

3. Equipment Labels:

- a. Rack-mounted equipment shall be labeled on front and back, as to function using engraved black/white laminated plastic blocks. For example: LEFT HI-FREQ AMPLIFIER or CENTER EQUALIZER
- b. Use permanent professional quality labels such as "Lamacoid" or approved equal. Stick-on strip labels such as those from Dyno, Brother or Kroy are not acceptable.
- c. The labels shall directly relate to the device names indicated on the as-built drawings.

4. Internal A/C Receptacles:

- a. Maintain grounding as shown on contract drawings and described in the herein.
- b. In general, locate all internal AC receptacles on the left side of the rack and all harnesses on the right side of the rack. In the event that there are 2 equipment racks side by side locate the A/C receptacles in the middle of the equipment racks and the wiring harnesses to the outer sides.
- c. Furnish each equipment rack with a full height AC plug strip with receptacles sufficient for powering all equipment contained with plus 20% for future expansion.
- d. The use of "Waber" strip style plug strips, commercial or consumer grade is strictly prohibited.
- e. All "wall-wart" style power supplies shall be firmly secured to the plug strip using 3M Dual-Lock™ recloseable fastener strips or single Ty-wraps, joined or linked ty-wraps are not permitted.
- f. Provide 1- 40 Watt lamp and pull-chain in top rear of the rack, for each equipment rack.

5. Installation:

- a. No equipment may be installed prior to the following:
 - 1) The Consultant has performed the A/V Equipment Rack Observation in the A/V Contractor's Shop.
 - 2) Any and all punch list items described as 'minimum to enable rack delivery to site' have been addressed, proof has been submitted to Consultant, and Consultant has approved rack delivery to site.
 - 3) Notice has been filed with the General Contractor, the Architect, and the Consultant that a 'dust-free' environment has been achieved in the project in all areas where audiovisual system equipment is to be installed. Dust-free shall be defined as follows: all floor, wall, ceiling construction, millwork, finishes (including paint), carpet, hardware, electrical, and HVAC is absolutely complete (and tested and fully operational in the case of electrical and HVAC systems) before A/V equipment racks may be delivered to the site.
- b. The equipment rack(s) shall be installed in the Equipment Room(s) in the configuration shown in the drawings. The plan shall allow for an absolute minimum of 36 inches, preferably 42 inches, of clear space measured from the front of the rack(s) and from the rear of the equipment rack(s) to any installed equipment or walls.
- c. All stationary equipment rack(s) shall be secured to the building structure to meet seismic and code requirements.
- d. Interconnecting multi-channel cabling shall be led laterally from equipment rack to the vertical rack member, opposite from the AC power and then run vertically, remaining as exposed and accessible as possible. Wherever corners in multi-channel cabling occur strain relief spiral covering shall be

used. All cable clamps shall be non-conducting or have soft insulating covers.

- e. Great care shall be exercised to keep low level signal lines separated from the AC power lines and high-level signal lines.
- f. All audio field lines entering the Equipment Racks must be connected with an intermediate terminal block. Video field lines may be connected directly to the switcher or patch bays. In the event that a patch bay with an E3 or E90 connectors is used, the patch bay may serve as the terminal block. This will also facilitate the testing of the systems in the Audio-Visual Contractor's shop.
- g. All connections of lines at terminal blocks, as well as at signal receptacles, shall be mechanically secured and then soldered. No unsoldered connections shall be permitted. Where lines approach the racks and terminal blocks they shall also be mechanically anchored at the rack, and provided with sufficient slack length to avoid strain, abrasion or wear.

E. Wiring and Cabling:

1. General:

- a. Extreme care must be taken to physically segregate and separate all high level lines from lower level lines.
- b. Control cables and power distribution wiring shall not be installed adjacent to signal cables. Power distribution cabling shall be on the opposite side from signal wiring in equipment enclosures and shall be uniformly located throughout an installation.
- c. A wall location near the racks shall be chosen and suitable suspension "fingers" provided so that all patch cords of a given type can be grouped and suspended.
- d. All wire and cable utilized in systems interconnection shall be of the flame-retardant type (FR-1 flame test).
- e. All cabling or system interconnection which passes through or into acoustically isolated areas, such as sound locks and studios, shall be suitably sealed after cable has been installed.

2. Wire Labels:

- a. During installation both ends of all wires or cables shall be clearly labeled with approved wire labels.
- b. The wire labels shall be numbered consecutively with respect to the patch bay with a leading service level designation. If there are no patch bays utilized in the system the wire labels shall be numbered consecutively with a leading service level designation.
- c. The wire labels shall not be more than 8 inches or less than 4 inches from the connector or termination at each end of the cable.
- d. Wire labels shall utilize plastic shrink-wrap, protecting the text and ensuring they remain affixed to the wiring. Approved: Thomas and Betts or approved equal, submit sample to the Owner's Representative.

3. Documentation:
 - a. Maintain a careful running log of route and terminations for each cable.
 - b. A detailed wiring diagram shall be furnished with wire numbers shown as part of the as-built documentation. All spare cable shall be shown on the as-built documentation.
4. Cable Management:
 - a. Cabling and wiring within the Equipment Room(s), that are semi-permanent (i.e., those leading from rack to rack, rack to conduit terminus or rack to equipment locations) shall be carried not within conduit, but rather within ducts, troughs or cable trays mounted along walls or below the ceiling.
 - b. Appropriate hooks along the wall or on the ceiling will aid in running occasional or frequently changed extension cables to use position.
 - c. Cables shall be grouped and bundled by type and routed from source to termination in a uniform manner throughout all equipment housings. Care shall be taken not to break the insulation or deform the cable by harness supports. Cables shall not change relative position in a cable group throughout a cable route.
 - d. Cable support bars shall be installed to support cables in areas of dense harness breakouts such as behind patch panels, distribution amplifiers and other multiple input/output devices.
 - e. Edge protection material ("cat track") or grommets shall be installed on the edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edges.
5. Terminations:
 - a. The Audio-Visual Contractor shall employ the latest industry-standard termination practices and materials.
 - b. Signal and control cable ends shall be neatly formed, and shrinkable tubing shall be applied where necessary to secure the insulation against fraying or raveling.
 - c. Internal rack terminations and field terminations shall be made with Wago style modular terminal blocks. All wires shall be fitted with ferrules prior to insertion.
 - d. Punch block terminations are not acceptable and shall not be allowed except in the case of Category style data terminations.
 - e. Coaxial connectors shall be three-piece crimp-on style. Audio and control wires shall be terminated with crimp-on Thomas and Betts® style lugs.
 - f. All bare wire shall be tinned prior to termination unless the connector manufacturer recommends otherwise.
 - g. Unused line level shields shall be individually insulated using shrinkable tubing and attached to the cable using an additional piece of shrinkable tubing.
 - h. Pre-made, molded cable assemblies, the sorts of which are typically supplied with consumer grade electronics are not permitted for use on this project. Only custom made and commercial grade, factory certified

assemblies shall be accepted. The Consultant shall be the final judge on the acceptability of any given cable assembly.

- i. All cable pin out and connector conversions shall be performed utilizing factory terminated, certified cable assemblies. Adapters, gender changers, format converters shall not be permitted unless indicated on the contract documents or otherwise specifically authorized by the AV consultant.
- j. All panel mount connectors shall be secured with Kep® style lock nuts having integral external tooth lock washers and treated with LocTite® 242-Blue thread locking compound.

F. System Grounding:

1. The "spider" concept, as indicated in the grounding diagram, is designed to avoid ground loops and inductive coupling.
2. The systems shall be hum free, stable and free of oscillation with the earth ground temporarily disconnected.
3. The earth ground shall be made at only one point in the system as indicated and shall be in accordance with National Electric Code 2002 paragraphs 250.146(D), 406.2(D) and 480.20 Exception.
4. The grounding method shall insure that the system is free of the following problems under any mode of operation:
 - a. RF oscillation, pickup and interference.
 - b. Distortion.
 - c. Crosstalk.
 - d. Signal Leakage.
 - e. Very high frequency feedback.
 - f. Audio Hum.
5. Major wiring ducts or trays in the Equipment Room(s) shall be grounded to the conduit system.
6. The equipment racks shall be isolated from, and not electrically bonded to, the building conduit system. This means that the conduit system shall not be electrically connected to the equipment racks and that the equipment racks shall be installed so that they are electrically isolated from the building structural steel. The racks shall be electrically bonded at only one point to the isolated grounding system as shown on the category AV drawings.

G. Seismic Restraints:

1. All hanging or free-standing equipment and cabinets furnished including but not limited to racks, loudspeakers, projection screens, and TV monitors shall be secured to substantial building structures. The equipment described shall resist seismic acceleration in any direction up to a limit of the greater of 1.0 G or the limit prescribed by the local governing codes.
2. Maintain electrical isolation between the equipment racks and building steel.

3. Loudspeaker hanging details, rack bracing, and other seismic restraints are not shown on the contract drawings; it shall be the Audio-Visual Contractor responsibility to develop these drawings.
4. Submit mounting (rigging) drawings for all suspended equipment to the AV Consultant for review after they have been stamped and signed by a licensed structural engineer engaged in regular practice in the Project's State.

H. Audio System Processing Adjustments:

1. The AV Contractor shall program the DSP system to include filters adjusted such that the loudspeaker zone(s) effected by same are measured to exhibit uniform (flat) frequency response (less than +/- 3 dB) at the listening location for the frequencies the transducer is designed/intended to address. Measurements utilized for determining filter adjustments shall be made on axis with respect to a single transducer (representative of the zone) in its intended field of coverage. Loudspeaker cross-over filters shall be provided first for all actively crossed transducers per loudspeaker manufacturer's instructions. Additional filters will still be required to achieve uniform frequency response measured at the various listening locations. For loudspeaker zones of small transducers, utilize high-pass filters first and foremost and then utilize parametric EQ filters to flatten the measured response. For loudspeaker zones of large transducers, where other transducers in the system will address higher frequencies, utilize low-pass filters first and foremost and then utilize parametric EQ filters to flatten the measured response.
2. The AV Contractor shall program the DSP system to include delay settings adjusted so that the direct sound from the main loudspeaker clusters and the delay zone transducers in question arrives simultaneously at the listening plane served by the delay zone transducers. The Audio-Visual Consultant may add additional delay to address 'imaging / Haas effect preferences' as appropriate.
3. The Audio-Visual Consultant may add additional filters and delay (as required) to address 'tuning preferences', but such 'tuning preferences' shall not be considered as part of the base line requirements for determining substantial completion of the audio system. Flat frequency response and time alignment of the direct sound from the loudspeakers will be considered a base line requirement for determining substantial completion of the audio system.

I. Loudspeaker Installation:

1. Verify all loudspeaker aiming and positioning with Owner's Representative.
2. Submit loudspeaker mounting (rigging) drawings to the Architect for review after they have been approved and signed by a certified structural engineer engaged in regular practice in the Project's State.
3. All loudspeaker backcans must be secured to the building structure by qualified personnel in accordance with safe installations practices. Use suspension materials, connection fixturing and methods that are appropriate for the building

structure and installation conditions. Employ a minimum 5:1 safety factor for each suspension point or greater as may be required by local code.

J. Video Projector Installation:

1. The video projector shall be converged, registered and color balanced. Obtain from the owner all scan rates and resolutions that are to be used and properly converge the projector for all possible inputs. In addition, the Audio-Visual Contractor shall optimize the projector for the following standard scan rates and resolutions:
 - a. NTSC
 - b. HDTV, 720i, 720p, 1080i, 1080p
 - c. 640x480, 60Hz.
 - d. 800 x 600, 60Hz and 72Hz.
 - e. 1024 x 768, 60Hz, 70Hz, 72Hz and 75Hz.
 - f. 1152 x 870, 75Hz.
 - g. 1280 x 1024, 60Hz, 70Hz, 72Hz and 75Hz.
 - h. 1400 x 1050, 60Hz, 70Hz, 72Hz and 75Hz.
 - i. 1600 x 1200, 60Hz, 70Hz, 72Hz and 75Hz.

K. Satellite Receiving Equipment Installation (as appropriate):

1. Installers must hold current Level 2 certification through the (SBCA) Satellite Broadcasting & Communications Association.
2. Follow all local & national codes governing dish installation and grounding.

3.2 SYSTEM PERFORMANCE TESTS:

A. General:

1. The Audio-Visual Contractor shall pre-assemble and test all systems and sub-systems in his own facility before completed assemblies are delivery to the project site.
2. Tests shall include but are not limited to those listed below in order to verify that the system meets all design requirements.
3. The Audio-Visual Contractor shall perform the initial system testing and adjustment prior to scheduling the final system acceptance tests.
4. The Consultant shall provide forms in electronic form for the documentation of all test results. All tests shall be fully documented and a neat copy presented for review by the Owner's Representative and inclusion in the system manual.

B. Performance Tests on Individual Components:

1. Perform in Audio-Visual Contractor's facility.
2. Verify that the manufacturer's specifications are met.
3. Measure and record the impedance on each driver, and verify the acoustical output and freedom from rattles and distortion of all loudspeakers.

C. Performance Tests on Completed Component Sub-assemblies:

1. Perform in Audio-Visual Contractor's facilities.
2. Before delivery of the equipment to the project site, the specialty Audio-Visual Contractor shall demonstrate to Owner's Representatives at the Audio-Visual Contractor's facilities that all sub-assemblies are operating as specified.
3. Verify the achievement of the specifications for each electronic component in situ, i.e., as assembled in its console, rack or other enclosure, powered by the system power supply and with all other components also activated, i.e., powered and interconnected. The magnitude and character of the threshold noise shall be observed for appearance of hum in excess of that present with individual activation, or the appearance of high frequency oscillation.
4. Projection equipment shall be tested to verify that the manufacturer's specifications are met after it has been incorporated into a complete subassembly.
5. Video equipment shall be tested to verify that its operation meets the manufacturer's specifications and EIA RS-170A after assembly into complete subsystems.

D. Performance Tests on the Complete System:

1. Verify that all wiring is correctly and completely installed. Verify that there are no short circuits between conductors within any cable, or from cable to cable. Verify the integrity of each conductor, i.e., that the conductor is not open circuited. In addition, the correct polarity of each connector, including those in patch panels, shall be verified and the color-coding scheme shall be recorded and included in the documentation provided to the Owner's Representative.
2. Verify that the entire system performance is in accordance with the design requirements. Specific attention is directed to the following for each system:
 - a. Projection Equipment.
 - b. Video Transports.
 - c. Video Matrix Switchers.
 - d. Remote Control Components.
 - e. Video Distribution Amplifiers.
 - f. Audio Amplifiers.
3. The threshold noise output of the system, measured at the output of the power amplifier, must equal the input when its gain control is full on, and of the line or booster amplifier input when all channel controls are off. No hum shall be audible in the system within the noise signal, or with the inputs terminated in microphone impedance and all controls full on. No high frequency oscillation shall be observed at the system output. No audible radio signal shall be detectable in the system at any control setting. Depending upon the proximity of a local radio station, or upon the cable configuration of the system, RF oscillation or leakage may be a problem and the Audio-Visual Contractor shall be prepared to install a RF low pass filter appropriately in the system as a final remedy.

4. Cross talk between channels shall be measured with signal equivalent to 1.0 Volts output into one channel with its gain off and the gain of each other channel varied over their full range. Maximum signal leakage at the system output must be equivalent to -70 dB re 1.0 Volt at the pre-amp output at 1 kHz, increasing to -52 dB at 8 kHz.
 5. The general performance of each loudspeaker unit in situ shall be verified by applying pink noise signal at 10.0 Volt level and verifying the specified output SPL at a distance of 1 foot. Normal undistorted sound quality shall be verified by headphone listening at the output of the calibrated system. Each loudspeaker shall also be fed with an oscillator signal at 10.0 Volt level within its intended frequency range, verifying absence or abnormal distortion of rattles due to installation.
 6. The audio system shall be adjusted as specified above in paragraph entitled "Audio System Processing Adjustments" where minimum requirements for establishing readiness for the substantial completion observation of an audio system are specified.
 7. The complete video system shall be tested in the following manner: All video outputs of the system shall conform to EIA RS-170A when typical inputs to the system are fed with a "known good signal" from a video signal generator.
- E. All optical projection system performance shall be in accordance with the following:
1. Projected images shall properly fill their respective screens to full size without "cropping" or overshoot.
 2. Projection lenses shall provide distortion free images without color fringing or aberration.
 3. Screen brightness and screen brightness ratio shall reasonably approach the theoretical value based on the projector's specified light output value with the necessary light loss corrections.
- F. Test procedures for the optical projection systems shall conform with the following basic guidelines:
1. All equipment items shall be 100% tested for correct functional operation.
- G. Test procedures for video systems shall conform to the following basic guidelines:
1. All equipment and video signal chains shall operate according to manufacturer's specifications and/or to the EIA RS-170A standard.
 2. All video monitors shall be setup and adjusted following the manufacturer's guidelines including the following (with or without blue gun only):
 - a. Black level (using the brightness control).
 - b. White level (using the contrast control).
 - c. Correct Hue.

3. All video cameras shall be setup and adjusted for the following:
 - a. Black balance.
 - b. White balance.
 - c. Range of zoom and iris function.
- H. The contractor shall conduct performance testing and conduct commissioning on the digital video transport systems as recommended by the manufacturer. All such testing and commissioning shall be performed by an individual, factory certified to perform such work. In addition to built-in system testing, the following tests shall be performed on all digital video connections utilizing a Quantum Data 780 or equal (as approved by the Consultant) HDMI test system.
 1. Conduct cable performance tests on all critical path copper.
 2. Conduct Sink (downstream) Tests on projector including:
 - a. Verify hot plug detect
 - b. Verify HDMI +5V
 - c. Verify EDID compliance
 - 1) Header
 - 2) Checksum
 - 3) Test EDID video at 1080p, 1080i, 720p
 - d. Perform HDCP test
 - e. Perform video test at optimum EDID timing and HDCP enabled
 - f. Perform deep color parameters test
 - g. Perform port switching test with HDCP re-authentication
 3. Conduct Source (upstream) Tests on BD players, Tuner including:
 - a. Perform max. HDCP keys test
 - b. Verify incoming video at multiple timings
 - c. Verify video timing parameters
 4. Conduct Repeater Tests on Switchers, Scaler, DAs and Audio Proc. including:
 - a. Verify hot plug detect
 - b. Verify HDMI +5V
 - c. Verify EDID compliance
 - 1) Header
 - 2) Checksum
 - 3) Test EDID video at 1080p, 1080i, 720p
 - d. Verify video timing pass-through
 - e. Verify HDCP authentication
 - f. Perform port switching test with HDCP re-authentication

5. Conduct Link Tests at critical signal chain locations including:
 - a. Verify hot plug detect
 - b. Verify HDMI +5V
 - c. Verify EDID compliance
 - 1) Header
 - 2) Checksum
 - 3) Test EDID video at 1080p, 1080i, 720p
 - d. Verify HDCP authentication from both source and sink
 - e. Perform video test at optimum EDID timing and HDCP enabled
 - f. Perform port switching test with HDCP re-authentication
 - g. Perform max. HDCP keys test
 - h. Verify incoming video at multiple timings
 - i. Verify video timing parameters
- I. All these tests, and any others that the Audio-Visual Contractor may wish for his own satisfaction, shall have been performed and successfully achieved before observation requested. Submit a report of the results of these tests and commissioning exercises to the consultant for review a minimum of one (1) week prior to requesting substantial completion observation visit. The Owner's Representative may request repetition and demonstration during observation of certain of these tests or other critical tests if problems become apparent. If specifications are not met, further observations will be at the Audio-Visual Contractor's expense.

3.3 DEMONSTRATION AND ACCEPTANCE TESTING

A. Substantial Completion Observation:

1. The Audio-Visual Contractor shall file a written notice with the General Contractor when all of the aids to use described in paragraph above entitled "Submittals", above, have been submitted for approval, all tests described in paragraph above entitled "System Performance Tests", are complete and the test reports have been submitted for review and approval and the systems and sub-systems are ready for the Substantial Completion Observation.
2. The Consultant shall provide a checklist in electronic form for the AVC to fill out, certifying that they have completed all requisite tests and checks and have performed remedial corrections. These forms must be completed and submitted for review along with the written notice of readiness indicated above.
3. The Audio-Visual Contractor shall be prepared to demonstrate the overall system performance including but not limited to functionality, control system programming, operation, optics performance and DSP software control (where applicable). The Audio-Visual Contractor shall be prepared to demonstrate proper gain structure and that base line EQ (uniform frequency response) settings and delay filters (time alignment) have been set. In addition the Substantial Completion Observation of the systems may include repetition or demonstration of any or all of the tests described in paragraph above entitled "System

Performance Tests” above or other critical tests if problems become apparent and the specifications are not met. After the Substantial Completion Observation, written notice noting whether the systems meet the criteria set forth in the General Conditions for Substantial Completion, along with a list of items for the Audio-Visual Contractor to correct shall be provided to the Audio-Visual Contractor.

4. In the event that the systems are found not to be Substantially Complete, all of the costs including fees, travel and living expenses in connection with subsequent observations or corrective work shall be borne solely by the Audio-Visual Contractor. This includes new problems that arise during the course of the subsequent observations.

B. Acceptance Observation:

1. After the systems have been certified as Substantially Complete, and the Audio-Visual Contractor has filed written notice with the General Contractor that the corrections ordered, have been completed, a Final Acceptance Observation shall be scheduled.
2. During the Final Acceptance Observation of the systems repetition or demonstration of any of the tests described in paragraph above entitled “System Performance Tests”, above, or other critical tests if problems become apparent and the specifications are not met, may be requested.
3. Assist in performing final system adjustments and acceptance tests. Provide all labor, materials and tools necessary for these tests and adjustments. Provide all necessary test equipment to complete the tests.
4. Budget 24 working hours for the performance of these tests and adjustments. If final acceptance is delayed beyond this period because the installation is not in proper working order or is incomplete, the Audio-Visual Contractor shall pay for all additional time and expenses for any resultant extension or re-scheduling of the acceptance testing period.
5. Any measurements of frequency response, distortion, noise or other characteristics and any adjustments deemed necessary may be performed on any item or group of items, including re-orientation of loudspeakers, to insure optimum performance of the system.
6. In the event that the corrections have not been completed to the satisfaction of the Owner's Representative, or new problems arise at the time of the Acceptance Observation, all costs including consulting fees, travel and living expenses in connection with subsequent observations or corrective work shall be borne solely by the Audio-Visual System Contractor.

C. Acceptance:

1. After observations and tests indicate that the entire Audio-Visual system and sub systems as specified herein and indicated on the drawings are in total compliance with the drawings and specifications, a letter indicating said compliance shall be issued.

2. Acceptance of the system shall be accomplished as described in the General Conditions.
3. Final acceptance of the installation will be granted when it is clear to the Owner's Representative and the Architect that the following conditions have been met:
 - a. All fixed equipment has been furnished and installed according to the drawings and specifications.
 - b. All portable equipment has been turned over to the Owner.
 - c. All equipment and installation have been tested and shown to perform as specified.
 - d. All instruction manuals, software source code and as-built documentation have been completed and delivered to the Owner's Representative.
 - e. All wall-mounted or laminated (at the Owner's discretion) system diagrams are furnished to the satisfaction of the Owner's representative.
 - f. When the initial installments of system user operational and staff maintenance training has been conducted.
4. The Warrantee period will begin only when all of the above listed items have been performed to the satisfaction of the Architect, Owner and Owner's Representative.

3.4 TRAINING

- A. Submit all training materials to the owner's representative for approval prior to scheduling training sessions.
- B. Provide 16 hours of hands on training practical operation of the system to the Owner's Representative. Address in the training, the general configuration of the system, basic functionality, correct operation procedures, routine maintenance and upkeep.
- C. Provide 4 hours of follow-up training within 3 months of the initial training to review aspects of the original training and provide instruction on specific troubleshooting issues the Owner's Representative raises during the training.
- D. Video tape all training sessions and provide 3 copies to the Owner on DVD-R format.

END OF SECTION 27 41 16