

## 11 61 62 - EVENT LIGHTING AND CONTROLS

## PART 1 - GENERAL

## 1.1 SECTION SUMMARY

- A. The purpose of this performance specification is to describe the scope of work for a complete, turn-key design/build, provision, installation, inspection, testing, instruction, and warranties of the intelligent lighting and controls for the West Virginia University Coliseum.
- B. The Contractor shall be responsible for all materials, equipment, transport and labor necessary to provide a complete and working system.
- C. Refer to PDF drawings showing fixture locations included with this document.
- D. Contractor is responsible for all control wire, power, and conduit requirements from the control room to catwalk, center scoreboard, panel locations, and fixtures. Refer to Electrical drawings as provided with this document.

## 1.2 RELATED DOCUMENTS

- A. Theatrical Lighting Controls sketches ("TL" Series), Architectural Drawings ("A" Series), and general provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.

## 1.3 SECTION INCLUDES

- A. Coordination, provision, installation, inspection, commissioning, testing, instruction and warranties of the Intelligent lighting Controls. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and proper System.
- B. Also includes:
  - 1. Required licenses and permits including payment of charges and fees.
  - 2. Verification of dimensions and conditions at the job site.
  - 3. Provision of submissions.
  - 4. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
  - 5. Extension of electrical service, including ground, to equipment locations.
  - 6. Documented tests and adjustments.
  - 7. Provisions of manuals.
  - 8. Maintenance services and warranty.

## 1.4 RELATED WORK

- A. Division 01: General Conditions
- B. Electrical:
  - 1. Power is provided for this work at locations shown on the as-built electrical drawings or other drawings/information. Power will be terminated to a junction box within or near the equipment enclosure. The contractor shall be responsible for any and all electrical power & coordination of the termination required within the electrical junction box.
  - 2. The contractor shall be responsible for connecting ground point to all equipment in accordance with NEC Code, local codes and standards specified herein.

3. Conduit infrastructure system, including wire for AC Power and grounding for the System(s), are to be included in this project. Coordination between different disciplines is required to achieve a proper conduit system installation and power provisions for the System(s). All electrical installation shall be in accordance with overall Division 26 provisions and applicable codes.
- C. Demolition:
  1. All existing lighting fixtures that are being replaced by new LED fixtures are to be removed and disposed.
- D. Mounting: Fixture mounting and submittal drawings requires a West Virginia PE stamp. Refer to details below under 1.9 Submittals section. If requested by Owner or Consultant Contractor is responsible to provide a fixture mounting mock-up for onsite review.

## 1.5 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
  1. American National Safety Institute (ANSI),
  2. American Society of Testing and Materials (ASTM),
  3. Electronics Industries Association (EIA),
  4. Institute of Electrical and Electronic Engineers (IEEE),
  5. National Electrical Manufacturer's Association (NEMA),
  6. National Electrical Code (NEC),
  7. Underwriters Laboratories (UL),
  8. Occupational Safety and Health Administration (OSHA),
  9. Entertainment Services and Technology Association (ESTA)
  10. Professional Lighting and Sound Association (PLASA)
  11. United States Institute of Theater Technology (USITT)

## 1.6 DESCRIPTIONS AND REQUIREMENTS

- A. The following is intended to further describe the items required for the Arena - Intelligent lighting:
  1. Provide a fully functional networked (DMX/EDMX) lighting control system. This shall consist of control console, wiring devices, and lighting instruments.
  2. Provide a lighting control console, LCD control monitors, a wireless control tablet, backup processor and a UPS backup that shall be located at the control position, and as located on the drawings.
  3. Provide lighting control DMX splitters, network switch gear, patch panels and other auxiliary equipment as required.
  4. Provide a control interface, and DMX/EDMX interfaces as required & as located on the drawings.
  5. Provide a control interface with the current houselight and sports lighting system. The Owner requires the ability to control the houselights & sports lighting from the lighting console & the wireless tablet.
  6. Provide control cables and conduit from the floor and control room to Lighting Control Panel (LCP) and fixtures on the catwalks.
- B. Distribution System:
  1. Provide control conduit, junction boxes (JB), and associated hardware for the lighting. Provide all connections, cables, pipe clamps, safety cables as required for installation of the intelligent lighting fixtures. Provide network control cables to parallel the multi-

- conductor cable runs. Verify all electrical circuits and label all circuit numbers as specified.
2. All plugging boxes shall be installed and have all circuits verified and circuit numbers labeled.
  3. Provide recessed wall mounted boxes, verify, and label as specified.
  4. Contractor shall be responsible for installation and termination of DMX/EDMX to all control and fixture locations. It is the contractor's responsibility to verify operation on ground before fixtures are permanently installed. Any required DMX controlled interface shall be provided by the Contractor including equipment parts, labor and installation of equipment.

C. Lighting Fixtures:

1. All lighting fixtures shall be provided with mounting hardware, connectors, safety cables, gel frame holders, c-clamps, and connectors. Other accessories are specifically listed in the specifications. All fixtures are to be labeled as indicated in the specifications and aligned before they are installed for lighting control system testing.
2. Contractor is to include an annual fixture check within the fixture package for the first two (2) years of the installation. This fixture check is to include a full review of each fixture and cleaning of interior components. Coordinate schedule with Owner.
3. Replacement of existing interior & exterior up-lights. Fixture to be replaced with LED RGBW fixtures. Exterior fixtures are required to be minimum IP65 rated. All new power & control wiring is to utilize the existing locations and pathways. It is the contractors responsibility to verify locations, quantity, & power to all architectural fixtures.

D. Miscellaneous Equipment:

1. Extension cables of varying lengths and configurations are provided for circuiting lighting instruments and control modules.
2. Provide haze machine as noted.

## 1.7 RESPONSIBILITY AND RELATED WORK

- A. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Installer is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems. Coordinate the work with the General, Electrical and other related contractors as stated in Part 1.4, and the scheduled work of other trades.
- B. Coordination between different disciplines is required to achieve a proper conduit system installation and power provisions for Theatre Lighting Systems. All electrical installation shall be in accordance with division 26 and the National Electric Code.
- C. Supply accessories and minor equipment items needed for a complete and fully operational system, even if not specifically mentioned in these Specifications or on the associated drawings, without claim for additional payment.
- D. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the system Installer to supply systems in full working order. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires Installer to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- E. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.

- F. Execute all work in accordance with the National Electrical Code, the National Electrical Safety Code, and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
  - 1. No less than 5 years continuous experience in the production of specified type of product.
  - 2. Production shall meet applicable NEMA standards.
- B. Contractor shall attend pre-installation and coordination meetings as needed to coordinate with other trades as required.

## 1.9 SUBMITTALS:

- A. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the installer above 25% of the scheduled value of this work until all submittal information has been approved. Cost for the Owner's consultant to review secondary and re-submittals due to the Installer's failure to include all required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Installer. The cost shall be based on the hourly rates of the architect and his consultants as published in their current professional fees schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).
- B. Project Submittal Part 1:
  - 1. Provide for approval not later than fourteen (14) days after issuance of Notice to Proceed and prior to commencement of Work:
    - a. Section 1: A complete schedule of submittals.
    - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.
- C. Project Submittal Part 2:
  - 1. Provide for approval no later than twenty-one (21) days after issuance of notice to proceed and in accordance with previously submitted submittal schedule.
    - a. Section 1: Complete list of products to be incorporated within the Work (Bill of Materials). With the list of products provide a written description of how the products function as a system.
    - b. Section 2: Manufacturer's data sheets for each product. Provide original manufacturer's data sheets in order as they appear in the specification. Provide data sheets on each type of dimmer, contactor, and relay module specified for use on this project. These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the Work.
    - c. Section 3: Provide a copy of the UL Listing Card for each dimmer, contactor, and relay module specified for use on this project. Provide UL Listing Card for each rack or assembly. Provide UL Listing Card for each wiring device specified for use on this project. Provide UL Listing Card for each type or module of lighting fixture to be provided on this project.

- d. Section 4: Provide architect and/or architect's consultant with samples of wall plate materials and colors as specified in this section.
  - e. Section 5: Submit Material Safety Data Sheets (MSDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the MSDS.
2. Drawings:
- a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system compatible with AutoCAD release 2010 or higher. Electronic files of intelligent lighting contract documents shall not be distributed for use in generating submittal documents with the exception of architectural backgrounds.
  - b. Schematic Drawings. Provide drawings detailing inter- and intra-components or fabricated products, wiring, conduit and cabling diagram depicting cable types, designator and color codes. Give each component a unique designator and use this designator consistently throughout the project. All schematic/riser drawings shall be provided by the lighting control system manufacturer.
  - c. Floorplan and Section Drawings. Provide drawings showing the exact location of all installed equipment on floorplans and sections, including all walls, doors and rooms, showing exact locations of devices and equipment, including, but not limited to, dimmer racks and associated control equipment as coordinated with other electrical equipment.
  - d. Rack Elevations: provide a front elevation and dimmer schedule of each dimmer rack giving the circuit number and location of connected load.
  - e. Installation Drawings. Provide drawings showing special details depicting methods and means specific to each product, assembly and each product manufacturer's recommended installation methods and means.
  - f. Conduit and Electrical Drawings. Provide floor plan drawings, including all walls, doors and rooms, showing exact power requirements and conduit sizing/routing for each system with the location of all junction boxes.
  - g. Equipment Drawings. Provide drawings showing location of equipment in racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
  - h. Custom Enclosures and Millwork Drawings. Provide full fabrication detail drawings indicating size, material, finish and openings for equipment.
  - i. Fabricated Plates and Panels Drawings. Provide complete drawings on custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
  - j. Schedule Drawings. Provide wiring schedule drawings showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting and location.
  - k. Labeling Drawing. Provide representative equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and descriptor and designator schedule.
  - l. General Detail Drawings. Provide detail drawings depicting any unique installation methods specific to each product.
  - m. Template Drawings. Provide detail drawings for master house lighting touch screens stations. Note that some screens may be revised during Owner training to meet the needs of the End User.
  - n. Any other pertinent data generated which is necessary to provide the Work.
- D. Structural rigging and fixture mounting details:

1. Structural rigging and mounting details of all intelligent fixtures suspended from the catwalks or mounted to the building structure. These drawings will identify all types of hardware, fittings and materials to be used. Detail the product manufacturer, part numbers and load capacity of the hardware, fittings and materials selected. All structural rigging and mounting detail drawings shall be signed and sealed by a professional engineer licensed to practice in the State of West Virginia and will include a copy of the design calculations.
2. The signed and sealed drawings noted above to include the following:
  - a. Attachment method to building structure for intelligent fixtures or mounted brackets, and lift assemblies.
  - b. Any secondary steel required for attachment to the building structure.
  - c. All fittings, hardware, materials, and cable used for suspended equipment.
  - d. All custom brackets, mounts, suspension grids or trusses and cabinet frames or brackets not supplied by the manufacturer for the specific equipment to be mounted or suspended.

E. Submittal Format:

1. Provide electronic PDF of each submittal.
2. Provide each submittal with a unique number and be numbered in consecutive order.
3. Provide each submittal binder with a cover and a spine reflecting the project title and submittal number. Submittals shall not be issued with other disciplines.
4. Provide each submittal with a complete table of contents with the following information:
  - a. Project title and number.
  - b. Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
  - c. Date of submission.
  - d. Referenced addendum or change-order number as applicable.
  - e. Referenced specification Section, Part, Article, Paragraph and page number or drawing reference as applicable.
  - f. Index Product Data sheets by manufacturer and model or part number.
5. Separate major grouping with labeled binder tabs.
6. Arrange product data list in alpha-numeric order when applicable followed by unspecified product arrange by manufacturer and model or part number. Follow list by manufacturer's data sheets, arranged in the same order. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
7. Drawings executed at an appropriate scale, not smaller than 1/8"=1'.

F. Submittal Copies:

1. These requirements represent minimum project requirements; a project's general conditions may require additional copies for project distribution.
2. Submit one (1) unbound reproducible drawing set and three (3) bound prints of all drawings.
3. Submit four binders of bound materials (e.g. product submittals).
4. Submit two copies of product or sample finishes as required within this specification.

G. Resubmission Requirements:

1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
2. Indicate any changes that have been made other than those requested.

- H. Approval of Submittals: The submittal information will be reviewed by the general contractor, owner, architects, engineers, and consultant. Each submittal package will be returned, stamped as follows:
1. "No Exceptions Taken" proceed with construction, all job site coordination will be at the direction of the general contractor.
  2. "Make Corrections Noted: No Resubmission Required" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
  3. "Make Corrections Noted: Submit Corrected Copy" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
  4. "REJECTED, Submit Specified Item" a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  5. "REJECTED, Revise and Re-submit" submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  6. "No Review Action Required" all information provided was for information or coordination purposes only. Review is not required.

#### 1.10 PROJECT RECORD MANUAL

- A. Submit three bound original sets (this is a minimum of two for the Owner and one for the Architect's consultant; additional copies may be required by the project's general conditions) after substantial completion and prior to final inspection.
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
1. Operations Manual:
    - a. Product Data: Product actually incorporated within the Work:
      - (1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer's serial numbers.
      - (2) Each products Owner/Instruction Manual.
      - (3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
      - (4) Manufacturer's wiring diagram for each type of product actually incorporated.
      - (5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.
    - b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work. Provide a one (1) full size set of reproducible drawings and one DVD containing all CAD generated drawings prepared in conjunction with this project. Drawing files shall be in AutoCAD Release 2010 DWG format.
    - c. Test Reports: Recorded findings of testing specification of this specification.
    - d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
      - (1) This procedure should describe the operation of all system capabilities.
      - (2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
  2. Service & Maintenance Manual:
    - a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
    - b. Manufacturer's maintenance and care instructions.

- c. Maintenance Instructions: including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
    - 3. Warranty Manual:
      - a. Manufacturer's warranty statements on each product.
      - b. Date of substantial completion and ending dates for warranties for each group of products.
      - c. Software registration and licenses.
  - C. Include any other pertinent data generated during the Project or required for future service.
  - D. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.
- 1.11 DELIVERY, STORAGE, AND HANDLING
- A. Ship product in its original container, to prevent damaging or entrance of foreign matter.
  - B. Handling and shipping in accordance with manufacturer's recommendation.
  - C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.
  - D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.
- 1.12 PROJECT CONDITIONS
- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
  - B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.
- 1.13 ACCEPTANCE TESTING
- A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Owner's Representative.
  - B. Provide two representatives familiar with all aspects of the system to assist the Owner's Representative during acceptance testing.
  - C. The process of acceptance testing the System may necessitate moving and adjusting certain component parts; perform such adjustments without claim for additional payment.
  - D. Testing includes operation of each major system and any other components deemed necessary. Provide required test equipment, tools and materials required to make necessary repairs, corrections or adjustments.
  - E. In the event that the system is not complete for the final testing and equalization of the system the Contractor shall be responsible for the Consultants fee. Cost of this service is \$1,500 and will include one (1) man-days of consultant's time on site and should be included in Contractor's



installation cost. Should additional time on site be required due to incomplete, not properly working, etc., systems, each additional day will be invoiced at \$1,500 per day or partial day on site.

#### 1.14 WARRANTY

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost required to complete this warranty repair is the responsibility of the contractor.
- B. All lighting control network components (i.e. routers, switches, nodes, etc...) will be covered under warranty by the lighting control systems' manufacturer for a minimum of two (2) years following the date of substantial completion. These warranties are in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. During the warranty period, the manufacturer shall provide a toll-free 24-hour-per-day number for telephone technical support and service request. If callback is required, calls shall be answered within thirty (30) minutes.
- D. Within the warranty period, contractor and/or manufacturer shall correct the deficiency within twenty four (24) hours.

#### 1.15 TECHNICAL SYSTEMS SOFTWARE LICENSE

- A. Introduction:
  - 1. All proprietary software provided for the intelligent lighting control system shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
  - 2. Contractor shall agree that 3rd party (e.g. manufacturer's) proprietary software provided with the system shall be subject to this agreement.
  - 3. Contractor and Owner agree that this software license is deemed to be part of, and subject to, the terms and the Agreement applicable to both parties; and shall supersede any standard manufacturer or Contractor's standard license agreement.
  - 4. Proprietary software shall be defined to include, but not limited to, device and system specific software and firmware designed to run on conventional computer based setup, or operate the system or its components.
  - 5. For sake of this agreement, MS Windows® shall not be considered "proprietary" software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.
- B. License Grant and Ownership:
  - 1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the Owner.
  - 2. Except as expressly set forth in this paragraph, Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties or

service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system shall be delivered to Owner for the sole benefit of Owner.

3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.

C. Copies, Modification, and Use:

1. Source code shall be available to Owner for a period of not less than 15 years.
2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of Owner and its representatives.
3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right in Owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.
5. During the life of the system (defined as a period of not less than 10 years and not more than 15 years), the Contractor shall provide software updates in accordance with all necessary support requirements to maintain the system. This shall include a commitment to provide appropriate patches, fixes, and interface updates as necessary to maintain the operability and security of the system at a level commensurate with the original system.
  - a. In the event that computer and or processor hardware refinements and updates are necessary to support software updates 7 years after substantial completion, said hardware will be provided to Owner at the agreed upon terms for change orders of the original contract.
  - b. Labor shall be in accordance with change order rates of the original contract, as adjusted for inflation in accordance with conditions and limitations of the General Contractor or U.S. Bureau of Labor Statistics' Consumer Price Index (CPI).
6. All hardware supplied shall support software updates for a period of not less than 7 years following substantial completion.

D. Warranties and Representations:

1. Contractor represents and warrants to Owner that:
  - a. It has necessary rights and authority to execute and deliver this Software license and perform its obligations hereunder and to grant the rights granted under this Software License to Owner.
  - b. The goods and services provided to Contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners.
  - c. The software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
2. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in

the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.

- E. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose, of merchantability, or warranty of no infringement of third-party intellectual property rights.

## PART 2 - PRODUCTS

### 2.0 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality.
- B. Substitution of specified products with other qualified manufacturers and products will be considered providing:
  - 1. Proper substitution procedures outline under Division 1 is adhered to.
  - 2. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
  - 3. Sufficient data for each product is presented for prior approval including technical data, UL approval, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
  - 4. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- C. If proposed System includes equipment other than specified model numbers, submit a list of major items and their quantities, with a generated one-line schematic diagram for review. Include a list of previously installed projects using proposed substitute equipment that are similar in nature to the specified System.
- D. Providing product not specifically specified without prior written approval by the Owner, Architect and/or Architect's Consultant shall not be accepted.

### 2.1 GENERAL

- A. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.
- B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.
- C. All cable shall be compliant with NEC as applicable, and UL listed or CSA certified. UL listing must be available at the time of bid.

### 2.2 CABLING AND CABLING ACCESSORIES

- A. DMX512 (E-DMX) distribution cable:
  - 1. Provide 23AWG four twisted pair data cable.
  - 2. Pair Color Code Chart:
    - a. 1-White/Blue Stripe & Blue
    - b. 2-White/Orange Stripe & Orange

- c. 3-White/Green Stripe & Green
  - d. 4-White/Brown Stripe & Brown
- 3. Insulation: Polyolefin
- 4. Inner/Outer Jacket Material: PVC - Polyvinyl Chloride
- 5. Nominal Impedance: 100 ohms.
- 6. Nominal Velocity of Prop.: 72%.
- 7. Capacitance between conductors: 15.0 pF/ft.
- 8. Acceptable product:
  - a. Belden 11872A (Category 6).
- B. DMX512 Control Signal Distribution Cable:
  - 1. Provide 24AWG two twisted pair cable.
  - 2. Insulation: Foam polyethylene.
  - 3. Shield: aluminum foil/polyester tape
  - 4. Capacitance between conductors: 12.5 pF/ft.
  - 5. Acceptable product:
    - a. Belden 9729
- C. Remote Focus Control Signal Distribution Cable:
  - 1. Provide 24AWG four twisted pair cable.
  - 2. Insulation: polyethylene.
  - 3. Shield: aluminum foil/polyester.
  - 4. Capacitance between conductors: 23 pF/ft.
  - 5. Acceptable product:
    - a. Belden 9728
- D. Multi-Conductor SO Type Cable:
  - 1. Provide multiconductor cable with black neoprene jacket.
  - 2. Conductivity: not less than 98%.
  - 3. Conductor: soft drawn annealed stranded copper.
  - 4. Minimum Conductor Temperature: 90°.
  - 5. Size: No. 12 AWG minimum.
  - 6. No. of Conductors: As required.
  - 7. Acceptable product:
    - a. Cole Wire & Cable
    - b. Carrol
    - c. Rome.

## 2.3 CONTROL EQUIPMENT

- A. Control Console:
  - 1. Provide control console for control of solid state lighting and entertainment devices.
  - 2. Console will have the following minimum features:
    - a. Hog 4 operating Software.
    - b. Unlimited number of simultaneous crossfades
    - c. One internal 22-inch wide screen touchscreens with 10-point multi touch
    - d. One external monitor or touchscreen supported\*
    - e. 4 encoders for an expanded wheelset
    - f. Twelve User Keys
    - g. Ten playback faders

- h. Four fixed universes of DMX 512 and up to 8 universes of DMX 512 over ArtNet or sACN
  - i. Hog-Net Ethernet connector
  - j. Fixture-Net Ethernet connector
  - k. Internal Solid State Hard disk drive
  - l. Five USB ports for Wholehog wings and external touchscreens
  - m. Desklights, feedback LEDs, and integrated worklight all dimmable
  - n. Auto-ranging mains input (90-250VAC)
  - o. USB interface for software upgrades.
  - p. Numeric, function, and macro keys on console.
  - q. Display of backup function indicators: check panic status, record backup cues.
  - r. Ability to park dimmers, channels or groups at fixed levels.
  - s. Unlimited number of DMX channels via Ethernet DPs
  - t. Unlimited number of Art-Net and E1.3.1 (sACN) universes via Ethernet DPs
  - u. MIDI Input and Output, MIDI Show Control and MIDI Time Code via optional external widget
  - v. Multiple LTC input via optional external widgets
  - w. Connectivity with many visualizers via Ethernet
  - x. Remote Focus capabilities when networked with a tablet PC running Hog 4PC software
  - y. Supports USB Playback and Master Wings
- 3. Provide control network software and cabling as required for a complete system.
  - 4. Provide with backup processor: Rack Hog 4 or equal.
  - 5. Acceptable products:
    - a. High End Road Hog 4 Control with playback wing and DMX 8000
    - b. Grand MA2 ultra-light and MA NPU

B. Ethernet Switch

- 1. Provide Ethernet Switches in the control rack room as noted. The switch shall route DMX-512 control signals. The Switch shall be a fast Ethernet repeater that supports integrated hub stacking ports.
- 2. Network Protocol and Standards Compatibility:
  - a. IEEE 802.3x full duplex on 10Base-T, 100Base-TX, and 1000Base-X ports
  - b. IEEE 802.1D Spanning-Tree Protocol
  - c. IEEE 802.1p CoS prioritization
  - d. IEEE 802.1Q VLAN
  - e. IEEE 802.3u 100Base-TX specification
  - f. IEEE 802.3 10Base-T specification
  - g. IEEE 802.3af Power over Ethernet
- 3. Inline power 48-volt DC power is provided over Category 5e UTP cable up to 100 meters
- 4. 10 and 100 Mbps peak and aggregate throughput for high-performance data transfer.
- 5. 10/100 auto-sensing on each port detects the speed of the attached device to configure the port for 10 or 100 Mbps operation.
- 6. Switch shall be equipped with LED indicators for power status, port status, bandwidth utilization, collision detection, and speed indication.
- 7. Switch shall be equipped with 24-ports with linking available to other switches within the same rack.
- 8. Built-in Web-based management interface provides easy-to-use management through a standard browser such as Netscape Navigator or Microsoft Explorer (provide all required software management tools)
- 9. Provide rack mount kit and required hardware and cables for stacking.

10. Each network location shall have a dedicated input point on the network switch. Patching shall not be required.
11. Provide with redundant power system (Cisco RPS 675).
12. The Ethernet switch shall be provided by the lighting control system manufacturer.
13. Quantity: As required by design.
14. Acceptable product:
  - a. Cisco Catalyst 3750 - 24PS (24-port 10/100 with integrated inline power) or as approved by lighting console manufacturer.

C. DMX Distribution/Configuration Software

1. Provide one (1) license for configuration software for an Owner provided computer that will allow configuration of all Nodes in lighting system.
2. Shall allow for Drag-and-Drop functionality
3. Shall provide primary DMX routing
4. Configuration software shall control all of the following attributes:
  - a. Channel Patch
  - b. Merge
  - c. Priority Switch
  - d. Backup Switch
  - e. Node labeling
  - f. Port labeling
  - g. Backlight control
5. Software will provide a connected system overview
6. Acceptable product:
  - a. Pathway Connect Pathport Manager Software
  - b. Or as approved by lighting console manufacturer.

D. Network Receptacle Station (Net):

1. Provide a remote plug-in station for connection of control console and portable DMX Nodes at control booth and other locations as noted in the drawings.
2. Station shall be provided with a Neutrik RJ 45 jack. Each jack shall be rated for use in harsh commercial conditions.
3. Station will contain the following components:
  - a. RJ 45 jack with punch down block, provide Neutrik EtherCon type receptacle as indicated on drawings.
  - b. Station faceplates shall be .80" aluminum, finished in fine texture, scratch-resistant black powder coat.
  - c. Station back box will be a minimum of 2.5 inches.
  - d. Station shall have silk screened graphics white in color.
  - e. Provide a Lamacoid label that de-notes, using a alpha-numeric labeling convention, the switch location and network port number.
4. These network connections shall also be configured with a back box and mounting hardware for mounting on the FOH lighting galleries or backstage.
5. Each Network jack will route directly to the Ethernet Switch located in the assigned Dimmer Rooms without the need for patching.
6. No daisy chaining between jacks, or splicing of Category 5e and above cable is allowed.
7. Quantity: As depicted in drawings.

E. DMX512 Distribution Box/Network Node (DMX In/Out):

1. Provide a permanently installed wall plug-in box designed for flush, recessed or pipe mounting application.

2. Node shall provide the quantity of universes, as specified, of DMX512 control for intelligent lighting or other DMX512 addressable devices.
3. Power for the node shall be provided over the Category 6 cable, utilizing IEEE 802.3af compliant Power over Ethernet distribution equipment. Power consumption shall not be greater than 5 watts.
4. Ports:
  - a. DMX Ports shall comply with the requirements of the USITT DMX512.
  - b. The two DMX ports shall be software-configurable for either input or output.
  - c. DMX inputs shall be fully opto-isolated from the node electronics and from each other.
  - d. DMX outputs shall be earth-ground referenced.
  - e. DMX Ports shall be capable of withstanding fault voltages of up to 250VAC without damage.
5. Node modules will mount within a standard electrical box or enclosure.
6. Each input shall route directly to the Ethernet Switch located in the assigned Dimmer Rooms without the need for patching.
7. Acceptable product:
  - a. Pathway Two-Port Gateway Node.
  - b. Or as approved by lighting console manufacturer.

F. Portable Network Nodes:

1. In addition to the permanently installed Nodes, provide two (2) spare portable output nodes and two (2) input nodes for pipe mounting at any NET station.
2. Each node shall be equipped with a molded RJ 45 connector on a jacketed cable (see specification for flexible Category 6 cable) for connection to the lighting control network (NET).
3. Node shall provide the quantity of universes, as specified, of DMX512 control for intelligent lighting or other DMX512 addressable devices.
4. Power for the node shall be provided over the Category 6 cable, utilizing IEEE 802.3af compliant Power over Ethernet distribution equipment. Power consumption shall not be greater than 5 watts.
5. Ports:
  - a. DMX Ports shall comply with the requirements of the USITT DMX512.
  - b. The two DMX ports shall be software-configurable for either input or output.
  - c. DMX inputs shall be fully opto-isolated from the node electronics and from each other.
  - d. DMX outputs shall be earth-ground referenced.
  - e. DMX Ports shall be capable of withstanding fault voltages of up to 250VAC without damage.
6. Provide C-clamp for pipe mounting.
7. Acceptable product:
  - a. Or approved equal by Pathway Connectivity or lighting console manufacturer.

G. DMX-512 Distribution

1. Provide DMX512 distribution for connection to wiring devices in the Black Box/Drama Room.
2. Modules shall provide one optically isolated DMX512 signal output capable of driving thirty two (32) receiving devices on a single DMX line.
3. DMX device drivers shall have maintained outputs; however, the ability to program individual outputs as momentary on/off signals through a soft patch shall be built-in.
4. Isolation: input to output signal isolation is provided by an opto-isolator designed for data use.

5. Provide quantity as required by design.
6. Provide product as manufactured by:
  - a. Gray by Pathway Connectivity
  - b. Doug Fleenor Designs Enhanced2 DMX512 Isolated Splitter
  - c. Or approved equal by lighting console manufacturer

H. Control Distribution Racks:

1. Type: Sectional 42" (24 Space) with vented locking front door.
2. Factory installed 11 Ga. 10-32 threaded rack rails.
3. Provide Magnetic Work Light with 18.0' cord and spare 60 watt "rough service bulb."
4. Provide one (1) locking storage drawer and all necessary vent or blank panels.
5. The control distribution rack shall be provided by the lighting control system manufacturer.
6. Quantity: As shown on drawings
7. Acceptable product:
  - a. Mid-Atlantic DWR24-22, WL-60

I. UPS Backup Power / Surge Protection

1. Provide a rack mountable UPS backup to support equipment located in the control distribution racks (provide with one (1) spare batteries).
2. Output Power Capacity: 1400VA/1050W,
3. Input 120V/ Output 120V
4. Interface Port: DB-9 RS-232
5. Extended runtime model
6. Rack Height: 3 Units
7. Filtering: Full time multi-pole noise - filtering: 0.3% IEEE surge let-through: zero clamping response time: meets UL 1449
8. The UPS shall be provided by the lighting control system manufacturer.
9. Quantity: As shown on drawings
10. Provide product as manufactured by:
  - a. APC part# SU1400RMXL3U or as approved by the lighting console manufacturer.

## 2.4 DISTRIBUTION EQUIPMENT

- A. General: All wiring devices are to be provided for the new lighting control system. All new multi-conductor cable is to be installed with Kellem strain relief grips at each end of the cables. All circuits are to be tested and be functioning. All circuits on the connector strips and plug boxes are to be relabeled with 2" yellow on black Brady numbers. All wall mounted boxes are to be provided with new 1" yellow on black Brady numbers. Overall assembly to be UL listed.

B. Junction Box (JB):

1. Provide a junction box designed to mount to the grid structure.
2. Construction: 16-gauge, cold rolled steel with removable covers.
3. Size: minimum 18"W X 6"H X 12"DP with four mounting holes. Box shall be provided to accommodate number of circuits specified on drawings.
4. Finish: fine-texture, scratch resistant, black-powder coating.
5. Termination: barriered, screw clamp type terminal strip(s). Terminals to be sized for the circuit, according to the circuit amperage as required.
6. Grounding: junction box will have grounding lugs.
7. Up to two (2) GIJBs may be required per stage electric; reference circuit count per drawings.
8. Overall assembly UL listed.
9. Provide Kellems grips for each multi-conductor cable entering the junction box.



10. Acceptable product:
  - a. ETC 8700 Series
  - b. SSRC
  - c. Strand

C. Pipe Mounted Box:

1. Provide a plug box designed for pipe mounting.
2. Construction: code gauge steel.
3. Connectors: female 20A grounded pin connectors on the end of each of the pigtails.
4. Pigtails: SO type cable, provide lengths as shown on drawings
5. Circuits: number of circuits as specified on drawings.
6. Rating: pigtails and connectors to be 20 ampere.
7. Labeling: circuits are labeled with yellow letters on black background.
8. Overall assembly UL listed.
9. Acceptable product:
  - a. ETC 8300B series
  - b. SSRC
  - c. Strand

D. DMX512 Distribution Box (DMX):

1. Provide a wall plugging box designed for surface mounting.
1. Construction: code gauge steel.
2. Connectors: Neutrik 5 conductor XLR, flush mounted.
3. Circuits: located as shown on the drawings.
4. Labeling: labeled with yellow letters on black background.
5. Acceptable product:
  - a. ETC
  - b. SSRC

## 2.5 LIGHTING FIXTURES

- A. General: All fixtures will be UL listed. Provide one fixture of each listed below for review by the Owner. All fixtures will be UL listed.

B. Intelligent Lighting Fixtures: high output spot fixture

1. Unit shall be integrally designed, remote controlled motorized spot fixture.
2. Construction: the head, yoke, and enclosure shall be constructed of aluminum alloy and steel for lightweight strength and durability.
3. Movement: unit contains stepper motors for smooth movement. The yoke pans 360 degrees minimum and head tilts 250 degrees minimum. Pan and tilt is monitored by a feedback system that corrects movement against externally introduced errors.
4. Electrical: 208VAC at 60Hz. Short arc lamp.
5. Mechanical: The fixture has a mechanical dimmer to regulate output intensity. Unit shall be equipped with a shutter that can provide instant blackout and strobe effects.
6. Color: A minimum of two (2) color wheels. Provide standard compliment with fixture.
7. Power and control: 3 conductor electrical cable for power, plus XLR receptacle for DMX512 control; provide each fixture with 5-pin XLR converter cable.
8. Provide with all required attachments and safety for mounting.
9. Quantity: 4
10. Acceptable products:
  - a. Vari-Lite VL6000 Spot

b. Or approved equal.

C. Intelligent Lighting Fixtures: LED beam fixture

1. Unit shall be integrally designed, remote controlled motorized spot fixture.
2. Construction: the head, yoke, and enclosure shall be constructed of aluminum alloy and steel for lightweight strength and durability.
3. Movement: unit contains stepper motors for smooth movement. The yoke pans 360 degrees minimum and head tilts 250 degrees minimum. Pan and tilt is monitored by a feedback system that corrects movement against externally introduced errors.
4. Electrical: 120/208VAC at 60Hz.
5. Power and control: 3 conductor electrical cable for power, plus XLR receptacle for DMX512 control; provide each fixture with 5-pin XLR converter cable.
6. Provide with all required attachments and safety for mounting.
7. Quantity: 12
8. Acceptable products:
  - a. High End SOLAHyBeam 3000 LED
  - b. Martin ERA 800 performance LED
  - c. ClayPacky Axcor Profile 900
  - d. Or approved equal.

D. DMX-512 cable - portable

1. Provide DMX-512 cables for connecting lighting consoles, moving lights, or other DMX controlled accessories to the Network Nodes.
1. Connectors shall be Neutrik 5-pin.
2. Provide 24AWG two twisted pair data cable.
3. Insulation: polyethylene.
4. Nominal Impedance: 100 ohms.
5. Nominal Velocity of Prop.: 78%.
6. Capacitance between conductors: 12.5 pF/ft.
7. Provide:
  - a. 100' DMX Cable (quantity: 10)
  - b. 50' DMX Cable (quantity: 10)
  - c. 25' DMX Cable (quantity: 20)
  - d. 10' DMX Cable (quantity: 20)
  - e. 5' DMX Cable (quantity: 20)

## PART 3 - EXECUTION

### 5.0 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.
- C. Permanently installed equipment to be firmly and safely held in place.

### 5.1 INSTALLATION OF CABLE AND WIRING

- A. Coordinate all electrical work with the Electrical Contractor. Provide all necessary equipment including hardware and apparatus for complete connection of power system wiring.

- B. Coordinate installation of power and ground wiring to equipment. Power and ground wiring will terminate inside of equipment and/or junction boxes, and hardwired to ground buss and circuit breaker to ensure uninterrupted operation.
- C. All control wiring will be executed in adherence to USITT standard control systems practices including the following:
  - 1. Isolate cables carrying signals at different levels and separate to restrict interaction.
  - 2. Keep wiring separated into three groups of conduit provided for control circuits, power circuits (up to 50 amps), and feeder circuits (above 50 amps).
  - 3. Isolate all wiring, except for safety ground wiring, from conduit ground.
  - 4. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic interference in other technical systems (such as sound and communications systems) in the facility. Where possible all devices and wiring will be enclosed in a shielded environment. Take care not to use shields (conduits) and grounds as current carrying return paths for lamp and relay coil commons. All ground references are to be made to the building electrical system ground.
  - 5. Label unused wiring provided for spares or future systems and terminate at screw terminal strips.
- D. All joints and connections will be made with resin-core solder or with ratchet jaw crimp type mechanical connectors. Connect all circuits electrically in phase using same wire color code for similar circuits throughout the project.

## 5.2 INSTALLATION OF CONNECTORS, PLATES & PANELS

- A. Install panel mounted connectors rigidly attached to panels, plumb and level.
- B. Custom connector plates are typically stainless steel, unless otherwise noted or specified. However, it is the Installer's responsibility to verify plate finish with the Architect.

## 5.3 INSTALLATION OF EQUIPMENT HOUSING

- A. Prewire and test equipment cabinets before delivery to job site.
- B. Provide adequate ventilation in cabinet mounted equipment to keep temperature in the cabinet below 110° F. Install additional ventilation fans if necessary to attain a temperature below 110° F.
- C. Power to be distributed within dimming and distribution system by Intelligent lighting System Installer.

## 5.4 INSTALLATION OF EQUIPMENT

- A. Take appropriate precautions against electrostatic discharge (ESD) when installing electronic equipment. Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.
- B. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.
- C. Mount equipment plumb and level, firmly, and safely held in place.
- D. All equipment will be installed in compliance with applicable Local and National codes and regulations. Equipment will also be installed in accordance with Manufacturer's recommendations

and specifications. Prior to initial energizing, the system will be inspected by a representative of the Manufacturer as outlined under Contractor Commissioning.

- E. Install lighting fixtures and followspots using standard stage-industry practices. Do not use bare hands when handling lamps; keep lamps free of body oil. All lamps, lenses and reflectors will be installed free of dirt, dust, and finger smudges. Ensure that a safety cable is properly used with each fixture.

## 5.5 LABELING OF EQUIPMENT

- A. Create a lettering template for marking lighting and other instruments that depicts the initials or name of the Owner or facility. Coordinate exact lettering with Owner. Letters to be a minimum of 1" sans-serif text. A properly rated spray paint compliant with applicable codes will be used with template to label equipment. Coordinate color of paint with Owner.
- B. Lighting fixtures will be marked visibly on housing. Coordinate and verify location of lettering with Owner.
- C. Use proper measures to ensure that the lettering is clear and that the surface area of the equipment is free of overspray.
- D. Provide Owner with lettering template upon completion of the project for future use by Owner.

## 5.6 CONTRACTOR COMMISSIONING

- A. Prior to energizing or testing the System ensure the following:
  - 1. Products are installed in proper and safe manner according to manufacturer's instructions.
  - 2. Dust, debris, solder splatter, etc. is removed.
  - 3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  - 4. Labeling has been provided in compliance with specification and/or Owner.
  - 5. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
  - 6. Products are neat, clean and unmarred and parts securely attached.
  - 7. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. The jobsite shall be broom clean.
  - 8. Retain the services of a qualified engineer regularly employed by the System Manufacturer to check the installation and ensure its proper operation. No part of the Intelligent lighting System may be energized before this engineer has checked and approved the System installation. Failure to observe this provision will automatically relieve the manufacturer of any responsibility concerning the proper operation of the system or any part thereof and the replacement of parts which may have been damaged by the premature energizing. The engineer will be promptly available at the job site within (14) days of written notice by the Intelligent lighting Installer to the Manufacturer.
  - 9. All dimmers and associated dimmers are to be tested. Each dimmer shall be tested with a load equal to at least 50% of the capacity of the dimmer.
  - 10. The entire dimmer bank shall be tested with a minimum of 50% capacity of the dimmer bank for not less than thirty minutes operating at full output. A representative of the owner or architect shall be present to observe the dimmer load tests.
  - 11. Contractor shall provide circuit tester with the appropriate type of connector so that circuits can be tested at random.
  - 12. Contractor shall have available three UHF or VHF walk-talkies for use by the consultant during the inspection and testing of the lighting control system.

## 5.7 ACCEPTANCE

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Architect's consultant no earlier than two weeks after receipt of the written results.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary. Installer will assist in this testing and provide any test equipment required specified herein. Installer shall provide at least two (2) technicians available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Installer. Testing process is estimated to take a minimum of 1 day.
- C. Provide the following test gear:
  - 1. Stage Pin Circuit Tester
  - 2. DMX Tester
  - 3. LinkCheck Ethernet Tester
  - 4. Ethernet Length Meter
- D. The process of testing the System may necessitate moving and adjusting certain components such as signal processors.
- E. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- F. The following procedures will be performed on each System:
  - 1. Inspection of the methods and means employed to incorporate the System within the facility.
  - 2. Verification of proper operation, from controlling devices to controlled devices.
  - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
  - 4. Other tests on equipment or systems deemed appropriate.
- G. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.

## 5.8 INSTRUCTION OF OWNER PERSONNEL

- A. Manufacturer's trainers to provide operations and service training on the following major equipment components and subject matter.
- B. Control Console & Fixtures (72 hours):
  - 1. Training shall consist of three types:
    - a. Operational training
    - b. Patching and programming.
    - c. Applications interface for retrieving information from the control console

- d. Upgrades
- 2. Training time shall consist of four (4) hour days in separate sessions separated by some weeks, in accordance with owner's schedule. It is essential that the trainer be able to discuss interfacing to the audio visual and house lighting systems.
- C. Event Attendance includes the following requirements:
  - 1. Be present at three (3) events as assigned by the Owner.
  - 2. During these events, attendance shall begin at the first crew call and conclude when the crew is released. During these events perform such tasks (e.g. assistance with patching, programming, troubleshooting cabling problems, etc.) as requested by user. Tasks shall be strictly assistance, not operation.
  - 3. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance, or as event attendance.
  - 4. Coordinate these schedules with the owner.
- D. Manufacturer training will not be required where the item of equipment is owner furnished, part of an option that is not selected, or an item of equipment that is not actually purchased.
- E. Training Schedules
  - 1. Manufacturer's training should be assumed to take place on the project site, unless agreed to by the Owner.
  - 2. Training should be scheduled to be non-overlapping with other disciplines.
  - 3. Actual training schedule shall be by agreement with Owner. Do not assume that training will occur over eight (8) hour days. It is more likely that training will be scheduled in four (4) hour increments; perhaps over a period of weeks (or even months).
  - 4. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, then the training time shall be extended an equal amount of time.
- F. The following is a general idea of the training "curriculum":
  - 1. A general familiarization of the device(s).
  - 2. An explanation of how the device(s) interfaces to the rest of the lighting control system.
  - 3. General training on operating the device(s).
  - 4. Specific training on device(s) operation.
  - 5. Saving information; backing information up.
  - 6. Basic troubleshooting
  - 7. Specific troubleshooting (this information may be conveyed to personnel other than the device's "operators").
  - 8. How to upgrade software; precautions taken while doing (e.g. backing-up existing software).
- G. Following training occurrence, submit completed training records no later than 5 business days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.

## PART 6 - ALTERNATES

### 6.0 ALTERNATE A - COSTS FOR PROVIDING INTERIOR UPLIGHTING OF THE DOME

- A. A1 – Equipment
- B. A2 – Labor

6.1 ALTERNATE B - COSTS FOR PROVIDING EXTERIOR UPLIGHTING OF THE DOME

A. B1 – Equipment

B. B2 – Labor

6.2 ALTERNATE C - COSTS FOR PROVIDING INTELLIGENT LIGHTING SYSTEM

END OF SECTION

## SECTION 11 63 10.01 – COLISEUM LED DISPLAY SYSTEMS

## PART 1 - GENERAL

## 1.1 SCOPE OF WORK

- A. This is a design/build project. Work under this Contract includes all labor, materials, tools, transportation services, supervision, coordination, etc., necessary to complete the provision of the LED Display Systems, as described in these specifications and illustrated on the associated drawings. The systems shall be called the “Display System” and the provider the “Display System Provider”.
- B. The Contract Documents are complementary and are intended to include or imply all items required for the proper execution and completion of the work. Any item of work required by the Specifications or other portion of the Contract Documents, but not shown on the drawings, or shown on the drawings but not required in the Specification, shall be provided without extra charge as if shown or mentioned in both.
- C. The work specified herein is performance based. This requires the Installer to provide all final design and engineering (e.g. structural, electrical, etc.), which is not included or indicated within the Contract Documents, to meet the requirements of this Performance Specification. The installer is responsible for providing all components necessary for a complete and operational system. Any system changes or revisions necessary to make the system conform to the structure, building walls, steel, low voltage/signal, electrical services, etc., shall be included at time of proposal and installed without claims for additional compensation.
- D. Drawings should be considered to be conceptual in nature, illustrating the features and appearance of the system. The plans do not show complete and accurate building details. The Installer is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems. It is intended that the installer shall assume full responsibility for final structural engineering, rigging requirements as well as finished project information and coordination required in accordance with the provider's final design of elements being provided under this contract.
- E. The Installer must recognize that the scope of work requires coordination with building events, other trades and installers.
- F. The LED Display Systems include the following major items:
  - 1. Main center hung assembly consisting of
    - a. (4) LED video displays
    - b. (3) LED rings
    - c. (4) Corner wedge LED displays
    - d. (2) Underbelly LED displays
    - e. Control System
    - f. Connection to existing Electrolift hoist system
    - g. Mounting provisions for speakers
    - h. Mounting provisions for intelligent lighting fixtures
    - i. Acoustically transparent scrim within the inside of the assembly as not to interfere with speakers, intelligent lighting and underbelly displays.
  - 2. Two (2) Court level LED ribbon displays
  - 3. (2) LED tables:
    - a. Media



- b. Score
  - 4. Interface to existing:
    - a. Chyron Hego Crossfire and Blaze control system
    - b. Daktronics All-Sport clock and scoring system distribution system (shot clocks, play clocks, time expiration strips, TV truck and video production)
    - c. Daktronics (12) 30"x13' vomitory displays and stanchion displays
  - 5. Supply, installation and termination of all signal cabling (primary and redundant) to each display.
    - a. Use of existing cabling is acceptable provided it is fully warranted.
  - 6. Reconfiguration of existing animations and graphics to work within new size and pixel resolution of new displays.
  - 7. Option Pricing
  - 8. Operations and maintenance training.
- G. The Contract also includes:
  - 1. Removal and disposal of LED, Scoring and advertising displays that include:
    - a. Center hung display assembly
    - b. Event Level LED ribbons
  - 2. Interface to existing Daktronics LED displays above vomitory headers
  - 3. Provision of final engineering, development of final design drawings and submission to the Owner for approval.
  - 4. All structural and electrical engineering for displays.
  - 5. Submission of all information required by public agencies.
  - 6. Patch/repair/paint (as appropriate) any existing architectural finishes damaged due to display removal in areas in public view.
  - 7. Pre-project meetings on site.
  - 8. Verification of dimensions and conditions at the job sites.
  - 9. Coordination with other contractors and trades; especially when working in common areas at the same time.
  - 10. Development of final design drawings. Submission of all information required by public agencies.
  - 11. All necessary permits.
  - 12. State registered Engineers' stamp on all structural, attachment and electrical drawings with any calculations required for stamp.
  - 13. Development of any additional power and signal raceway information with Subcontractors and other responsible trades.
  - 14. Preparation of submittal information.
  - 15. Initial tests and adjustments, written report, and documentation.
  - 16. Instruction of operating personnel; provision of manuals.
  - 17. Maintenance services; warranty.
  - 18. Event attendance as outlined herein.
  - 19. Any required seating bowl and/or floor protection when utilizing cranes or any lift mechanism or other equipment.
    - a. Obtain approval from the University for any heavy equipment proposed to be used on concourses and playing surfaces.
- H. The Owner will consider subjective assessment of image quality, brightness/uniformity and scoring and control/animation software along with user interface as part of the overall evaluation process. The Owner reserves the right to make product selection based on this subjective comparison among vendors providing responsive proposals meeting all technical performance requirements.

## 1.2 WORK PROVIDED IN CONJUNCTION WITH THIS SPECIFICATION

- A. Sound System Upgrade
- B. Sports and Theatrical Lighting Upgrades

## 1.3 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
  - 1. American Iron and Steel Institute (AISI)
  - 2. American National Safety Institute (ANSI)
  - 3. American Society of Mechanical Engineers (ASME)
  - 4. American Society of Testing and Materials (ASTM)
  - 5. National Electrical Manufacturer's Association (NEMA)
  - 6. Occupational Safety and Health Administration (OHSA)
  - 7. Underwriters Laboratories (UL)
  - 8. United States Institute of Theatre Technology (USITT)
  - 9. Entertainment Services and Technology Association (ESTA)
  - 10. Standard for Electric Signs, UL-48, 13th Edition
  - 11. Standard for Control Centers for Changing Message Type Signs, UL-1433, 1st Edition
  - 12. Federal Communications Commission Regulation Part 15
  - 13. National Electric Code (NEC)
  - 14. Building Industry Consulting Service International (BICSI)
  - 15. Telecommunications Industry Association (TIA)
  - 16. Any or all local, government or other applicable codes.
  - 17. University standards for cable, electrical and conduit
  - 18. University standards for network switches.

## 1.4 DESCRIPTION OF WORK

- A. Seating Bowl LED Displays
  - 1. Main Center Hung LED Display assembly work includes, but is not limited to:
    - a. New LED displays to achieve the appearance of the renderings and drawings.
    - b. Structural modifications to accommodate the new assembly as well as reviewed, stamped design.
    - c. Connection to existing power service at catwalk
      - 1) Provide additional primary power if needed for the new systems
    - d. Removal and disposal of existing display assembly and processors.
    - e. Removal and re-installation of time expiration horn.
  - 2. Existing Electro Lift hoist lift capacity is reported to be rated at 60,000 lbs.
    - a. This scope of work to include field inspection and report of existing hoist. Inform Owner of any problems found with hoist. Provide price to correct any problems discovered. The following entities can be contacted to assist in reviewing and designing, if needed:
      - 1) Structural Engineer:
        - a) TBD
      - 2) Hoist Inspection:
        - a) TBD
    - b. Owner allowance items within center hung assembly:
      - 1) Speakers – 1,000 lbs.
      - 2) PTZ camera – 20 lbs.
      - 3) Theatrical lighting – 600 lbs.

- c. Intent is for new center hung assembly, plus owner allowance items to achieve a total weight of not more than 60,000 lbs. In the event that the proposed center hung assembly, with owner allowance items, exceeds the lift capacity of the existing hoist, upgrade or replacement of the existing hoist is to be included in this scope of work or provide an alternate, smaller configuration.
      - 1) Hoist platform and roof structure are existing. Modifications required to accommodate hoisting system, such as openings for lift lines, attachment to building structure, secondary steel, platforms, etc. are the responsibility of the display installer.
  - 3. LED Ribbon Displays
    - a. Connection to existing power service
    - b. Removal and disposal of existing display and processing equipment.
    - c. Coordinate elevation of displays prior to submittals.
  - 4. LED Score and Media Tables
  - 5. All disposed items shall be disposed in a proper manner for the material's in question and an affidavit shall be provided to the University that all materials have been properly disposed.
- B. Within the control room:
  - 1. Provide and install remote on/off power controls, separately for each display in the system including the fascia displays.
  - 2. Signal cabling from scoreboard control room racks to workstations.
  - 3. Interface to existing Chyron Hego Crossfire and Blaze control system.
- C. Common requirements of all base bid and optional displays:
  - 1. Reconfiguration of existing animations and graphics to work within new size and pixel resolution of new displays.
  - 2. Structural provision of signal and power drop cabling for video display modules, module sub-structure and signal cabling. Weight and power consumption in accordance with project requirements.
  - 3. Electrical
    - a. All electrical distribution/load centers, etc., within each display system at each installation point from isolator or disconnect as shown on electrical drawings.
    - b. If available, the design of electrical distribution to allow a portion of center hung display assembly to be on emergency power system.
    - c. Scope includes coordination and installation of existing AC power service including any breakers, step downs, etc. for use with all displays on the assembly (LED, backlit, etc.)
      - a. Power controls to allow any display in the overall system to be turned on/off. Manual switches located at scoreboard are not acceptable.
  - 4. Signal and power conduits provided for display systems existing. Installer is required to provide coordination services in the preparation of Electrical and signal raceway drawings to ensure proper conduit provisions. Installer is responsible for addition of any raceway not shown on the project documents or currently installed that is required for completion of work or to meet code requirements. Extension or addition of conduit from electrical rooms to catwalk platforms or auxiliary/fascia displays is the responsibility of this contractor. Exposed cabling will not be allowed.
  - 5. Operations and maintenance training.
  - 6. Touch up painting of finishes damaged during installation or at rust remediation locations.
  - 7. System to allow input of "open captioning" information generated on or off site by computer, steno and specialized captioning equipment. Control system to allow zoning of any display surface for real time display of this information.

8. Supply all necessary loads, weights, power and other necessary design and coordination for Owner/Owner's Representative to provide adequate mounting structure for displays. This includes state registered structural engineer stamped calculations for all structural elements. Provider to be responsible for all structure required to attach displays to structure. The Owner will supply necessary structural engineering reports on existing vertical elements where available. The provider to submit structural attachment between display assembly, requirements for secondary steel and existing structure for review and approval by project structural engineer.
9. Supply complete assemblies (structure, enclosure, and finish) for Displays, and ad panels included as part of this scope of work as appropriate, including State registered structural engineer stamped calculations. Attachments to base vertical structure to be reviewed and approved by the project Structural Engineer as directed by Owner/Owner's Representative.
10. Colors of all exposed structure, enclosures, close-out panels, etc., to be determined during submittal process. Submit color samples to Owner for written approval.

#### 1.5 RESPONSIBILITY AND RELATED WORK

- A. Coordinate all work so that a complete and functioning scoreboard assembly and related systems (scoreboard, game/locker/shot clocks, etc.) is achieved.
- B. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.
- C. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Scoreboard Provider to supply systems in full working order. Notify the Owner/Owner's Representative of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.
- D. Obtain all permits necessary for the execution of any work pertaining to the provision, or any operation by the Owner.
- E. If a conflict develops between the contract documents and the appropriate codes and is reported to the Owner's representative prior to bid opening, the Owner's representative will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.
- F. Coordinate work with other trades to avoid causing delays in schedule in accordance with Owner's direction.
- G. Coordinate product and materials delivery, offloading, staging, security and transportation with Owner/Owner's Representative.
- H. Fire Alarm Interface. Provide a fire alarm interface to automatically engage emergency evacuation messages on designated displays. Coordinate with Owner and Fire Marshall/Code Authority as to message text.

#### 1.6 ELECTRICAL

- A. Power is provided as shown on electrical as-built documents for displays. It is recommended that this contractor review and note on-site conditions. Conduit from electrical rooms to displays for both signal and power is existing. It is this integrator's responsibility to provide any additional power extension and conduit required if existing infrastructure is insufficient.

- B. The Integrator shall be responsible for distributing electrical power as required, including breakers. This will include necessary distribution boards, conduit and cabling as required for a complete system.
  - 1. Provide individual circuits/breakers for each system display, one for all scoring displays, one for all advertising displays and one for all video displays.
  - 2. Label each breaker as to its function
  - 3. Conceal branch conduit within the assembly and not outside.
  - 4. Hold conduit tight to structure and paint to match existing structure where visible to public.
  - 5. Provide complete power and branch circuit distribution within the enclosure from a demarcation point near displays.
  - 6. Provide independent remote power control in the control room for each of the following elements:
    - a. Each LED display

#### 1.7 DISPLAY SIGNAL CABLING AND CONDUIT

- A. Installation shall include all required and operationally necessary low voltage control and/or fiber optic cabling for all scoring displays from Scoreboard Control location to each display assembly as appropriate.
- B. Provide primary and backup connection cabling (separate overall jacket, not diverse pathways) from each display to control system location and other specified control locations.
  - 1. Patch panels shall be provided at the Control Room and Video Display to facilitate transfer between primary and back-up cables.
- C. Existing cable may be used provided it is fully warranted as new.
- D. All cable whether fiber optic or copper may be run in conduit/cable tray from the Scoreboard Control Room to each display element. This does not relieve this contractor from providing fire stop material, armored cable and/or innerduct if project requires it. If additional conduit is required for a complete system, provide. Cable exposed to public view and through inaccessible areas is to be in conduit. If conduit is required for a complete, code compliant system, provide as part of this scope of work.
- E. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
- F. Do not damage any signal cabling that may be co-located with video and scoring cabling. In the event of damage, bring damage to attention of owner and propose acceptable repair.
- G. Provide any necessary cable management, vertical ladder tray, j-hooks, etc. in areas with pathway.
- H. Provide, under this contract, any D-rings, hooks, etc. required for cable runs above accessible ceilings that cannot be run in raceways. Provide any necessary cable management, vertical ladder tray, etc. in communications closets for vertical risers. Provide appropriate cable management, Wiremold, raceways within scoreboard control areas between base building cable tray and control locations. Fire stopping for cabling penetrating rated partitions as required by code is also included.
- I. Available conduit/raceway/cable tray distribution for display signal/data cabling is shown on Owner's drawings which may be incomplete and not up to date. Site observation will be required to determine full extent of existing raceway and raceway provided by the Owner for this

project. If additional conduit, junction/terminal boxes/enclosures will be required notify Owner/Owner's Representative for coordination at time of proposal otherwise provide any conduit required for a complete, working, turn-key systems provision.

- J. Hold conduit tight to structure
- K. Remove and dispose of cabling that is abandoned as part of the project.

#### 1.8 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: At least 5 years' experience in the production of specified products.
- B. Installer's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
  - 1. At least five years' experience with equipment and systems of the specified types.
  - 2. Experience with at least two comparable scale professional or collegiate sports projects within the last three years.
  - 3. Maintain a fully staffed and equipped service facility.

#### 1.9 REQUIRED PROPOSAL TECHNICAL DOCUMENTATION WITH BID RETURN

- A. With the proposal, the potential Provider shall provide:
  - 1. Form of corporation
  - 2. Proof of adequate plant and equipment to complete the work.
  - 3. Adequate regional service organization to meet warranty.
  - 4. Adequate staff with commensurate technical experience.
  - 5. Suitable financial status to meet the obligations of the work.
  - 6. References from three (3) or more users of stadium similar display and software control systems provided by Installer.
  - 7. List of structural, electrical and other subcontractors intended to do the work.
  - 8. Concept renderings of displays, structures and enclosures with elevations and sections.
  - 9. Completed AIA Contractor's Qualification form
  - 10. Proposed equipment
  - 11. Proposed project schedule
  - 12. Name and relevant experience of the proposed project manager. Also provide the name and qualifications of the site superintendent
  - 13. Completed display form included in Part VII
  - 14. Listing with appropriate explanation regarding the status of Installer's resolved or unresolved legal disputes within the last six calendar years.
  - 15. Listing with appropriate explanation regarding any projects within the last 3 years, where the Installer has failed to meet construction schedules, due Installer's cause.
  - 16. Statement acknowledging that contract includes guaranty of availability of spare parts for not less than 10 years from date of substantial completion

#### 1.10 SUBMITTALS

- A. Submit all shop drawings and submittals in accordance with Project Requirements. Quantities listed herein are the minimum; in all conflicts with the General Conditions, the more stringent requirement shall prevail.
- B. Shop drawings and submittal data shall contain sufficient information to describe the Work to be performed. Drawings shall be executed at an appropriate scale. Submit (3) electronic sets of

drawings and catalog data sheets, in .pdf form and One hard copy. Submit all Shop Drawing information at one time. Information shall include but not necessarily be limited to:

1. LED lamp order inclusive of part numbers
2. Elevation and Sections of all displays.
  - a. Note that sections that span expansion joints, bends/corners in the precast should be studied for any seams and obstructed viewing angles.
3. Naming Rights panel.
4. Color options (with photographs of examples) for all fixed digit and monochrome LED displays. Include white as a color option wherever possible.
5. Finishes of all exposed housings with finish samples.
6. Connection of the provider supplied equipment to the actual project structure at each different condition. Drawings to indicate nature of disassembly for storage.
7. Coordinate with project structural engineer and pre-cast fabricator for all necessary structural accommodations (embeds, attachment locations, structural requirements) for integrated railing fascia display system.
8. Complete structural drawings showing member sizes, connections, etc. Submit design calculations, bearing the state registered structural engineer's stamp for review. Review will be for design intent only and shall not be construed as approving the design analysis.
9. Conduit and Electrical Drawings. If the system incorporates an electrical or electronic system of any type, provide detailed drawings depicting wiring routing, termination, and sizing schematic, conduit routing and sizing, etc. These drawings shall be floor plan drawings, including all walls, doors and rooms, showing exact power requirements and conduit routing for each system with the location of all junction boxes.
  - a. Indicate location of all access panels. All required access panels are part of this scope of work.
10. Equipment Drawings. Provide equipment mounting and location details including necessary physical dimensions, clearances, load limits, etc. These shall be floor plan drawings, including all walls, doors and rooms, showing exact locations of devices and equipment.
11. Structural plan and Section Drawings. Provide drawings showing the exact location of all provided equipment on plans and/or sections. Describe attachment methodology for each component that connects to the building structure.
12. Fabricated Plates, Panels, or Signage Drawings. If plates, panels, or signage is required, provide complete drawings depicting dimensioned locations of components, component types, engraving or printing information, plate material and color, and bill of material
13. Wiring diagrams. Complete, detailed wiring diagrams for all systems, based on the contract documents but including cable types, identification and color codes, and detailed wiring of connections, both at equipment and between equipment racks and wiring in conduit.
14. Equipment. Location of all equipment in racks, consoles, mill work, enclosures or on Owner provided counter top/tables with dimensions; wire routing and cabling within housings; AC power outlets, terminal strip and UPS locations. These shall be floor plan drawings, including all walls, doors and rooms, showing exact locations of devices and equipment.
15. A material list of all equipment to be furnished, arranged in specification order. This list shall be followed by catalog data sheets, arranged in specification order, of all equipment to be furnished. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
16. Viewing angle calculations:
  - a. For horizontal viewing angles submit:
    - 1) Facility seating plan closest to board (in elevation). Plan should include vomitories, radial column lines, and other identifying characteristics (e.g. camera platforms, aisles, steps, etc.).

- 2) Lines radiating from center of display intersecting with rear of facility at 5° increments. 0° reference shall be perpendicular to board. Lines shall be marked at no less than 15° increments.
    - b. For vertical viewing angles submit:
      - 1) Section through board and stadium indicating identifying points on the field.
      - 2) Horizontal measurements from board.
    - c. Lines radiating from center of display intersecting with rear of facility at 5° increments. 0° reference shall be perpendicular to board. Lines shall be marked at no less than 15° increments
  - 17. Proposed cable labeling technique.
  - 18. Samples as required in various specification paragraphs.
  - 19. Power consumption at 50% and 100% illumination levels for each display.
  - 20. QA/QC procedure.
  - 21. Final Inspection Notification Report. Checkout report for each piece of equipment and the entire system shall be prepared and submitted; it shall include:
    - a. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and date re-tested (if failure occurred during any previous tests).
    - b. The final report shall indicate that every device tested successfully.
    - c. A performance test report indicating that the system meets all of the Provider testing requirements of Part III.
- C. Training and Event Attendance Submittals:
- 1. All Operations and Maintenance manuals, as well as as-built drawings must be on site for all sessions of training.
  - 2. Following discussions with Owner, formally submit a Training and Event Attendance submittal 2-4 weeks prior to first training. Submittal shall:
    - a. Include a separate page/entry for every training session.
    - b. Indicate date, time, and approximate length of training session.
    - c. Indicate person(s) conducting training.
    - d. Indicate whether training will be video recorded.
    - e. Intended curriculum and most appropriate attendees (e.g. engineer, operations, IT, etc.)
    - f. Include signature and title lines for
      - 1) Owner acknowledging and accepting training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
      - 2) Countersigning by trainer indicating that training actually occurred.
      - 3) All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
      - 4) Owner's representative attending training at the end of the session shall initial that:
        - a) Training Occurred.
        - b) Training Materials were provided and left with owner
        - c) Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
        - d) Training was generally sufficient for the proposed curriculum.
      - 5) Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.)



- g. Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.
- D. Contract closeout submittals:
- 1. Keep a complete set of drawings on the job, note any changes made during provision, and submit 1 corrected set of hard copy drawings and electronic files in Auto Cad format, showing Work as provided.
  - 2. Provide all as-built, close out and testing information, manuals, drawings, test results, etc. in electronic form acceptable to the owner. Specification required as-built drawings, commissioning reports, manuals and electronic files to be submitted prior to acceptance testing and final payment.
  - 3. Submit the following data for review, prepared as indicated, at least one week prior to acceptance testing (exceptions noted):
    - a. System Reference Manual for the following sections:
      - 1) System Operation and Instructions. Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.
      - 2) A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e. rack/room number). Update following acceptance testing, if changed.
      - 3) Manufacturer's Instruction Manuals for all items of equipment, incorporating or followed by manufacturer's warranty statements. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
      - 4) A list of settings, if applicable, of all semi-fixed controls. This shall include a listing of all software settings required in all operating system areas (e.g. control panel, network, etc.) as well as project specific software programs. Update following acceptance testing. Preferred method of displaying "software" settings is with PC-captured "screen shots".
      - 5) Photographically reproduced schematic wiring diagrams of the scoreboard and advertising display low and high voltage systems, based on the as-built documentation, at a reduced scale easy to handle but fully legible. Blueline (or similar diazo process) prints are not acceptable.
      - 6) Maintenance Instructions, including Provider's maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
      - 7) A legend of acronyms and abbreviations must accompany all documentation.
      - 8) Any other pertinent data generated during the Project or required for future service.
      - 9) Manufacturer's Service Manuals and parts lists for all equipment. Photocopies are not acceptable. For custom circuits or modifications, complete schematics and parts lists.
      - 10) As-built wiring diagrams and system block diagrams showing nominal input and output levels. (Submit within two weeks after Acceptance Testing.)
      - 11) Duplicate copies of reduced-scale wiring diagrams.
    - b. Photographically reproduced as-built wiring diagrams and overall building wiring diagrams, at a reduced scale easy to handle but fully legible. Blueline (or similar

diazo process) prints are not acceptable. Mounted behind clear acetate and located with the equipment racks.

#### 1.11 PROJECT CONDITIONS

- A. Verify all conditions on the jobsite applicable to this work. Notify Architect and Owner's representative in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The bid drawings are intended to show equipment configurations. Provider to attend project design coordination meetings to provide design assist in preparation of infrastructure (conduit, power, etc.) drawings to ensure that Providers work can be completed as intended. References to these drawings and requirements for additional conduit or cable management/raceway over what is shown on drawings prepared with assistance of scoreboard provider are included in this scope of work.
- C. If conditions exist at the job site which make it impossible to provide work as shown, recommend solutions and/or submit drawings to the Owner/Owner's Representative for approval, showing how the work may be provided.

#### 1.12 ACCEPTANCE TESTING

- A. Upon completion of provision and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Owner/Owner's Representative.
- B. Provide one person familiar with all aspects of the system to assist the Owner/Owner's Representative during acceptance testing. One of the available individuals must have specialized knowledge of the computer control system operating software and function of the system.
- C. Final Acceptance shall occur after the displays have functioned without failure for two separate consecutive home stands.
  - 1. Failure shall be defined as a failure of the display, or a portion of the display equal to 10% of that display's square footage, to meet the project performance specifications for a length of time greater than one minute due to electronic, electrical, mechanical, structural, or other failure of the display. Failure due to owner's operators, spectators, or force majeure will not be considered event failure; failure due to provider's operators will be considered a failure.
  - 2. Failure shall be defined as a failure of the display processing and control system.

#### 1.13 VIDEO AND SCORING SYSTEMS SOFTWARE LICENSE

- A. INTRODUCTION
  - 1. All proprietary software provided for the Technical Systems shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
  - 2. Contractor shall agree that 3rd party (e.g. manufacturer's) proprietary software provided with the system shall be subject to this agreement.
  - 3. Contractor and owner agree that this software license is deemed to be part of, and subject to, the terms of the Agreement applicable to both parties; and shall supercede any standard manufacturer or Contractor's standard license agreement.
  - 4. Proprietary software shall be defined to include, but not be limited to, device and system specific software and firmware designed to run on conventional computer based

operating platforms as well as all micro-processor based hardware used to program, setup, or operate the system or its components.

5. For sake of this agreement, MS Windows® shall not be considered “proprietary” software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.

**B. LICENSE GRANT AND OWNERSHIP**

1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the owner.
2. Except as expressly set forth in this paragraph, Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties or service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system shall be delivered to Owner for the sole benefit of owner.
3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.

**C. COPIES, MODIFICATION, AND USE**

1. Source code shall be available to owner for a period of not less than 15 years.
2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of owner and its representatives.
3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right in owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.
5. During the life of the system (defined as a period of not less than 10 years and not more than 15 years), the Contractor shall provide software updates in accordance with all necessary support requirements to maintain the system. This shall include a commitment to provide appropriate patches, fixes, and interface updates as necessary to maintain the operability and security of the system at a level commensurate with the original system.
  - a. In the event that computer and or processor hardware refinements and updates are necessary to support software updates 7 years after substantial completion, said hardware will be provided to owner at the agreed upon terms for change orders of the original contract.
  - b. Labor shall be in accordance with change order rates of the original contract, as adjusted for inflation in accordance with project General Conditions.
6. All hardware supplied shall support software updates for a period of not less than 7 years following substantial completion.

**D. WARRANTIES AND REPRESENTATIONS**

1. Contractor represents and warrants to Owner that:

- a. it has all necessary rights and authority to execute and deliver this Software License and perform its obligations hereunder and to grant the rights granted under this Software License to owner;
  - b. the goods and services provided by contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners; and
  - c. the software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
2. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.
3. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose, of merchantability, or warranty of no infringement of third-party intellectual property rights.

#### 1.14 WARRANTY/MAINTENANCE

- A. Warrant labor and materials for two years following the date of final acceptance or the fourth, trouble-free, regular season game played, whichever is later.
- B. System to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or materials within the Warranty period without charge.
  1. A defect as it applies to:
    - a. Defined as any pixel or module/lighting unit that at any point fails to be able to meet the performance requirements of this specification.
    - b. Animation and control processors fail to be able to meet performance requirements of this specification.
    - c. In the event any display exhibits a total of 2% or more non-functioning LED lamps or pixels during the warranty period, the Owner can choose to either have the display repaired or replaced at Owner's option.
- C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- D. Within the warranty period, answer service calls within 8 hours, and correct the problem within twenty-four hours. Provide local representation with service personnel available upon call within 3 hours prior to an event and throughout the time of the event.
- E. Register all manufacturer's warranties in Owner's name.
- F. Maintain spare parts inventory on-site as listed in this specification from end of initial warranty period through year 5 of display life. Within 72 hours of notification that spare part has been used, that part (excluding bulbs) shall be replaced by the service representative/manufacturer.
- G. Unless otherwise noted the following is the requirement for spares throughout the Scoring and Matrix system:
  1. Provide 2% of LED modules/lighting units and 2% (or one if 2% is less than one) spare parts of power supplies, fans, and elements, including cables, jigs and the like.

2. Provide one (1) spare printed circuit card and transmit/receive interface of each type used in the system.
  3. Provide 25% spares of any air filters—after final acceptance.
  4. Provide extenders where required for service and maintenance of equipment.
  5. Provide a single spare for each transceiver (line driver) type used by the scoring/matrix system.
- H. During the minimal 50,000 hours nominal board lifetime, the Owner may have certified brightness and color temperature measurements made on screen(s) according to the acceptance procedure to verify that the board is operating within specifications. If the board is not capable of meeting specifications, provide price to perform the necessary repair and component replacement to bring the system to operational parameters. This new work shall be warranted for at least 20,000 hours effective from the original Owner acceptance date. Manufacturer warrants that equipment, spare parts and components required to affect any repairs will be available for a period of 10 years after substantial completion.
- I. Preventative inspections and cleaning:
1. Clean or wash displays prior to first use.
  2. Preventative inspections shall occur 30 days before the beginning of the second and third seasons (one of the inspections will be occurring immediately preceding the expiration of the 2-year warranty period).

#### 1.15 EVENT ATTENDANCE

- A. In addition to training and warranty requirements, this installer shall provide event support services to facilitate troubleshooting and effect repair of the specified systems (hardware and software) during critical Four (4) events, as designated by Owner, for the duration of the warranty period. Event support shall begin in a period 24 hours prior to the opening of gates and shall extend to 48 hours for a weekend game.
1. Two days prior to the event; test and review all displays, processors and supporting computers to confirm proper operation; repair and address issues as required.
  2. Be available on call after testing.
  3. Be present on game day from at least 4 hours before gates open, until the time released by the Owner.
- B. Provide sufficient manpower to effect repairs as expeditiously as possible.

#### 1.16 OPTIONS AND UNIT COSTS

- A. As Noted in Part 6

### PART 2 - PRODUCTS

#### 2.1 SPECIFIED PRODUCTS AND MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet all of its published manufacturer's specifications. Verify performance as required. Where two or more acceptable products are listed, the Provider may use either at his option. Invitation to proposed does not necessarily imply that vendor has met all qualification requirements.

- B. Suppliers invited to respond to this RFP are done so with no implication or certification that manufacturer's proposed products meet the technical requirements of this specification.

Suppliers invited to respond to this RFP include:

1. Prime Contractors
  - a. ANC
  - b. Daktronics
  - c. Mitsubishi
  - d. Prismview/Samsung
  - e. South Paw Live
2. Exterior LED Displays:
  - a. Absen
  - b. Daktronics
  - c. Leyard
  - d. Mitsubishi
  - e. Prismview
3. Approved LED Lamp suppliers
  - a. Cree
  - b. Nichia
  - c. Multicolor
  - d. Yaham
  - e. As Approved
4. Control/content management equipment/software
  - a. Existing

## 2.2 GENERAL

- A. All equipment supplied shall be new (unless identified otherwise within this specification) and meet the latest published specifications of that product. In the event that the product is enhanced, or improved, supply the newer product at no additional cost.
1. If product is discontinued or becomes obsolete due to continuing product development, replace it with manufacturers' current equivalent at time of installation at no additional cost.
  2. If product is discontinued or becomes obsolete due to technology change, substitution will be based on fair market value of accepted and proposed products, upon approval of substitution by Owner's Representative.
- B. Manufacturer's name, logo or representation shall not be visible to the public in any fashion.
- C. All materials shall fully comply with Underwriters Laboratories or other acceptable testing agencies acceptable to local authorities with jurisdiction.
- D. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with no less than the specified manufacturer's published specifications.
- E. Provide product not specifically specified commensurate with the quality and standards established by the specified product.
- F. Provide product of given type from one manufacturer.

## 2.3 PHYSICAL DESIGN CRITERIA

- A. General: Engineer systems to the most stringent applicable code.

- B. Seismic Loads: Subject to the Building Official's approval, seismic design shall be under the Building Code in use for this project.
- C. Recommended Minimum thicknesses, gauges and standards:
1. All sheet metal shall have a minimum thickness of 18 gauge.
  2. Structural steel members shall have a minimum flange, web or wall thickness of 1/4 inch. Aluminum must be of size to achieve same structural capabilities.
  3. Where similar connections and members are used in other areas of the arena, every effort shall be made to detail and furnish members in a consistent and uniform manner.
  4. All enclosure surfaces subject to fan abuse shall have a minimum thickness of 16 gauge.
  5. All sheet metal shall have a minimum thickness of 18 gauge
- D. Enclosure and structure.
1. New structure or assemblies as required.
  2. Installer to submit complete drawings showing the connection of the Provider supplied equipment to the structure at each different condition.
  3. Provider to submit design calculations, bearing structural engineer's stamp for review by Owner's structural engineer, if requested. Review will be for design intent only and impact to base building structure and shall not be construed as approving the design analysis.
  4. The internal module structure, supports, attachment and anchoring members, mounting hardware shall be provided in accordance with engineering standards and governing codes. Design to space displays off wall the distance required to allow for proper ventilation.
  5. Exposed steel to be painted. Coatings to be in accordance with project coating specifications
  6. Enclosure.
    - a. Enclosure to be shop fabricated, anodized aluminum, style and color as shown on the Owner's scoreboard concept drawings. Fabrication to comply with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other industry standard practice.
    - b. Form exposed sheet metal work without excessive "oil-canning", buckling and tool marks with exposed edges folded back to form hem.
    - c. Finish to comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations. For components which are assembled or welded in factory, apply finish after completion of fabrication.
    - d. Finishes shall be directed by the Owner during the submittal process. Provide color/finish samples with submittals.
    - e. All welds shall be cleaned, primed and painted.
    - f. Cabinet depth of adjacent scoring, matrix and or video displays shall be within 1" (+/-). Notify Owner when variance is greater.
    - g. The structure, supports, attachments and anchoring members, mounting hardware shall be provided in accordance with engineering standards and governing codes.
    - h. Electrolytic protection shall be provided wherever differing metals come into contact.
    - i. Trim shall be coordinated to be identical in appearance to adjacent advertising panels scoring displays and architectural elements.
    - j. Close out trim panels/bezels are required for all displays to create a unitary appearance to each assembly with no gaps, holes, etc.
- E. Catwalks, Stairs, and Hoist way
1. Are existing.

- F. Patch/repair any existing architectural finishes and or structure damaged due to display provision in areas in public view.
- G. Ventilation
  - 1. Provide natural or forced ventilation as required for operation of all components.
  - 2. Provide all necessary dust and dirt filtration for the ventilation system.
  - 3. Filters shall be easily removable and changeable.
  - 4. NC level attributed to this ventilation shall be no more than NC 40 at nearest seat.
  - 5. Any louvers or other openings in enclosures required for the proper operation of the displays are to be included in this scope of work. This includes coordination of location, type, color or size that are exposed to public view.
- H. Service Requirements
  - 1. All displays to be front service type.
  - 2. All screws and nuts that are required to be removed for access to displays shall incorporate captive screw and nut type designs.
  - 3. A minimum of one of any specialized or custom tool required for maintenance of the display required for maintenance and repair.

## 2.4 LED DISPLAYS

- A. Technical Standards:
  - 4. The LED Display shall incorporate LED direct view technology.
  - 5. Brightness: 16 levels of illumination, including 0%, 25%, 75% and 100%.
  - 6. Brightness shall not fall below (at 100% white generated by external input):
    - a. 2500 nits within first 5,000 hours of operation after acceptance.
    - b. 2000 nits level over 12,000 hours of screen operation after acceptance.
  - 7. Uniformity of brightness:
    - a. Adjacent pixels 2.5%,
    - b. 5% total variation across entire display, brightest to darkest pixel/module.
    - c. Uniformity standards to apply over entire viewing angle specified with no perceptible color shift.
  - 8. 160° minimum horizontal angle (defined as 50% brightness) of viewing and 70° (nominal  $\pm 35^\circ$  with screen vertical) of vertical. Color temperature to remain constant over 50% brightness viewing angle range.
  - 9. Color temperature of display: 7,000-9,300° Kelvin. With a uniformity of 250°K between adjacent pixel with remote set-up and control to adjustment and balance of any pixel/module in display to match overall display color temperature through 10,000 hours of use.
  - 10. Physical Pixel spacing:
    - a. As indicated in Display Schedule and drawings
  - 11. Size:
    - b. As indicated on Display Schedule and drawings
  - 12. Ribbon displays to be top service.
  - 13. Flicker-less display
  - 14. Gaps in ribbon displays shall not be larger than 125% of the pixel spacing of the displays (i.e.; 20 mm, 25 mm maximum gap between adjacent sections). Sections spanning expansion joints to feature "slip joints" attachments to minimize or eliminate gaps.
  - 15. Joints, seams or modules out of plane with the rest of the display, due to mechanical alignment of modules, units, louvers, secondary seals or related artifacts will not be acceptable.
- B. Video/Scoreboard Processor



1. The processor shall be configured to support the following inputs:
  - a. Component Serial Digital input (i.e. ITU-R 601; SMPTE RP-125)
  - b. Digital Television (DTV) Production standards (e.g. 480p; 720p, 1080i).
    - 1) DVI/HDMI
    - 2) With HD/SDI being the primary signal type
  - c. Processor shall be able to support having 3 simultaneous sources on screen, while transitioning to 2 sources and back again without glitch, stutter, shimmer, black frames etc.
2. Provide connections, cabling and appropriate backups from control room to board to support the following connections:
  - a. SMPTE 292, HD-SDI (e.g. 480p; 720p, 1080i).
  - b. SMPTE 424M; 3G-SDI is desirable. If this adds significant cost, please identify removal as a VE.
  - c. Shall be capable of using an input of the type specified (e.g. HD-SDI) as a chroma key.
3. Remote operation.
  - a. Preferred method of operation will be for a processor which responds to the existing Ross Carbonite protocol which allows for effects (in this case processor transitions) to be queued, run, and rewound. Refer to 2.1 G for additional information. Alternate method of operation will require the processor to respond to contact closures from the production switcher to achieve the same effects. (Assume need for 8-12 contact closures to recall specific preset configurations, and then exercise the transition).
4. Processor shall output an HD-SDI signal to video control/video replay system which represents a composite of the same "feed" which is being sent to the video display.
  - a. If these requirements place significant cost burden on the processor, indicate savings achieved with a more limited approach within the VE portion of the proposal form.
  - b. If computers are employed as part of the LED Video display system, they shall meet these specification requirements as well as:
  - c. Provide with a 15 minute UPS (Uninterruptible Power Supply).
  - d. If a computer is used as part of the processor—or used for remote control or any other functions of the video board—provide a complete backup computing system running in a full-time, on-line backup mode with appropriate disk mirroring.

## 2.5 SCORE AND MEDIA TABLES

- A. Table structure to be portable with locking casters and padded vinyl on ends and top.
- B. Provide facility/team logos on pads for each end of display.
- C. Refer to schedule for LED display size and pixel resolution.
- D. Total Media Table to be composed of not less than four sections. Other common requirements of Media and Score Table:
  1. Sections to be configured to allow connections for seamless display image.
  2. Provide electrical and signal connections to "daisy chain" sections together
  3. Sections to physically interlock and be on locking casters and leveling feet.
- E. Overall depth of table assembly (counter plus display) not to exceed 32".
- F. Overall height of display not to exceed 36".
- G. Provide 24 in (minimum) counter depth.

- H. Provide 4 in. x 4 in cable trough along front edge of counter. Trough to have hinged lid.
  - 1. As an alternate to a trough, provide AC power, and data distribution on “back splash” vertical surface at front of counter.
- I. Provide AC power connections and data connections every 36” in along entire length of table and interconnections for service to connect between table sections.
- J. Coordinate location of control computer/workstation and data/power disconnects at floor with Owner.
- K. Power to access display on one location. Provide “snake” of multiple AC power circuits with “fan out” or distribution at power connection end as required. Multiple runs from “wall to display” are not acceptable.

## 2.6 DISPLAY CONTROL COMPONENTS

- A. Provide all applicable control system software updates for a period of 10 years after substantial completion at no additional cost.
- B. Control electronics.
  - 1. Noise level attributed in any operating mode of control/processing/server equipment shall be no more than NC 40 at the nearest operator location.
  - 2. Video screen electronics remote control system to provide complete screen remote control of:
    - a. Brightness level
    - b. Display power on/off (from control computer/console/processor)
    - c. Video signal on/off
    - d. Video Input Selection
      - 1) (including remote activation and deactivation by a contract closure from the video replay system production switcher)
    - e. Image positioning, sizing, and scaling
    - f. Color level
    - g. Hue
    - h. Contrast
    - i. Sharpness
    - j. Color display test, and address location. This pattern shall include a map that corresponds to the address of each unit's physical address as well as a red, green, blue and white color scroll for all inputs over the entire display. Typical pattern:
      - 1) Red – Map, Green – Map, Blue – Map, White – Map
    - k. These controls shall be provided for all inputs to control system processor.
- C. General Configuration
  - 1. Computer based control system hardware shall exhibit sufficient computer processor power and speed to generate images instantly on command without lag, sputter, or stutter during recall, operation, and display. The specific requirements listed below are minimums. All computers in the system to include identical motherboards, CPU and memory configurations.
  - 2. Images must be able to move smoothly through the entire area of the display. Flicker-less display for both static and moving images. Image control and distribution system to allow the display of smoothly moving images with no flicker, jerking, and “stop motion.”
  - 3. Displays to be programmed to show football, soccer, lacrosse, basketball and volleyball game in progress statistics (period, time outs left, possession, score, clock, shots, saves, etc.).

4. Software packages and control electronics shall provide specified operational features. Game scoring and clock function data to be provided by Scoreboard control system.
  5. All control system software and messages shall be stored in non-volatile (disk) format.
  6. Back-up computing and redundancy.
    - a. Network server and centralized file storage shall incorporate fully on-line, completely redundant processing (or mirror masters), including duplicate storage devices (ie; RAID arrays).
    - b. All computers, processors, and control panels shall be inter-networked.
    - c. Computer system shall be fully redundant with back-up, mirror processors on-line.
  7. Computer System shall be able to import common computer interchange graphic file formats (e.g. AVI, TIFFs, GIFs, DVI, etc.)
  8. All distributed processing computers shall be located in physically accessible spaces (e.g. control room, riser closets). Above ceiling mounting is not acceptable.
  9. Computer and control equipment sound levels at any operator or control position shall not exceed NC 40.
  10. Different configurations which meet these standards are acceptable. All computers in this system to be of same manufacturer with identical specifications and features.
  11. Processor: as required to meet specified operating performance without noticeable delays or productivity impediments.
  12. Rack Mounted
- D. Provide the following workstations in the Control Room:
1. Video display controllers; Primary and back-up
  2. Individual ribbon display controllers on center hung; Primary and back-up
  3. Floor level ribbon display controllers: Primary and back-up
- E. Un-interruptible Power Supply (UPS). Provide UPS on screen processor(s), electronics, etc. that may be disrupted by momentary loss of power. UPS shall be designed to support signal processing path (not display). UPS to have 90-minute capacity for the electronics used to generate and maintain the emergency message, unless that equipment is on generator power, in which case the UPS can be rated for 15 minutes
- F. Hardware Control functions
1. Brightness controls: Provide a minimum of three brightness levels for each matrix display. Brightness levels shall be 50 to 65%, 75% and 100% of full brightness.
  2. Provide separate ON/OFF controls for each display
  3. Clear ("oops") Button: Provide a special clear button in addition to the keyboard control that will immediately clear each matrix board. This will override any display in progress, and allow the operators to immediately remove any messages or animation.
    - a. If this adds significant cost, provide as VE deduct.
  4. Emergency message: Provide a special button or "soft" key on keyboard to initiate a minimum of six different stored emergency text messages of Owner's creation, on all displays capable of text.

## 2.7 LED GRAPHICS AND ANIMATION

- A. Provide service to reconfigure existing animations and graphic images on Chyron Hego Crossfire/Blaze to be displayed on new displays.
1. Chyron Hego COMM OS3
- B. Proofing Process

1. It is anticipated that the development of these animations and graphics will be something of an iterative process, working with the team to arrive at a suitable graphic appearance and look.
  2. Where multiple versions are noted, it is likely that some of the additional versions may be sponsored.
  3. Some animations will require multiple reviews to arrive at finished, playable product.
  4. Video display animations shall be delivered at full 1920x1080 resolution and possibly in at least two codecs based on team preference. Verify preferences for delivery.
  5. Software rights
    - a. Provide each graphic and animation in an editable, layered file format (e.g. Photoshop and After Effects, etc.) so that team can make corrections during the season (e.g. add players as the season progresses).
- C. All animations must be accepted by the Owner.
1. As with all custom animations, it is expected that the review process will be iterative and that 2-3 submittals might be required to arrive at final accepted animations.

## 2.8 GAME IN PROGRESS/STATISTICAL INFORMATION CONTROL

- A. Installer shall provide connectivity and interface to existing Daktronics system

## 2.9 CENTER HUNG ASSEMBLY SCRIM

- A. Designed to cover the internal, visible, rear units of the displays and structure. Take into account the speakers, lighting and underbelly displays that are part of the floor level design requirements.
- B. Coordinate any printed graphic requirements with the Owner.
- C. Acceptable products:
1. Snyder Mfg 1018 PVC Coated Nylon Scrim
  2. Britten Speaker Mesh

## 2.10 GENERAL EQUIPMENT

- A. There is space available in the existing equipment racks. If additional or new is required, these racks are to be frame and panel type constructed of 16-gauge cold-rolled steel. Racks to have locking rear door mounted on the frame (not the rails). Empty mounting panel spaces to be filled with blank or vent panels, in a finish to match rack. Provide end panels and top panels as required. Provide shelving as required for equipment mounting within racks. Provide rack supports as required. Provide seven rack keys of each type. Rack color to be gloss or flat black. Include extra set of mounting rails in each rack for rear support of panels or equipment. Verify exact rack space required.
1. Support Equipment
    - a. Blank Panels
    - b. Rack screws
    - c. Power distribution
    - d. Rack light
    - e. Rack Shelves:
    - f. Horizontal Cable Management
- B. Network Switch
1. Connect to existing. If existing unit is insufficient, replace per University standard of performance.

- C. Keyboard, Video, Mouse Matrix Switcher/extender
  - 1. Connect to existing. If existing unit is insufficient, replace.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. All equipment and materials shall be new. Take care to prevent scratches, dents, chips, etc.
- B. Mount equipment and enclosures plumb and square. Permanently placed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least three. Seismic bracing shall be placed on appropriate equipment where local codes require such installation.
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommets.
- D. Provide event, portable cabling from courtside/field side AV junction boxes to control operating positions for interconnection and operation of scoring systems.
- E. AC Power and Grounding
  - 1. Adhere to all local and national electrical codes and standards.
  - 2. Label power distribution equipment (e.g. breaker panels, disconnects, and load centers) as to what portion of what module is being served by that device (e.g. breaker).
- F. All engraving shall be 1/8" block sans serif characters unless noted otherwise. On dark panels or push buttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored push buttons, letters shall be black.
- G. Equipment and Cable Labeling
  - 1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Mount labels in a neat, plumb and permanent manner. Embossed labels are not acceptable. Equipment labels to have at least three lines of engraving with the first line listing the general name of the device. The second line to include the schematic reference of the device. The bottom line to indicate what other devices or areas this equipment controls.
  - 2. Provide an engraved label over each user-operated control that describes the function or purpose of the control. Label size to be adjusted to fit available space.
  - 3. Engraved labels to have 1/8" high characters minimum. Labels to be black with white characters except where indicated.
  - 4. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.
  - 5. Wiring designations to be an alpha-numeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 3" of the point of termination or connection. For cable runs that have intermediate splice points, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by provider. Add cable designation codes to system schematic drawings included with Project Record Drawings.

6. Label each terminal strip with a unique identification code in addition to a numerical label for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Drawings.
7. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

### 3.2 INSTALLER TESTS AND ADJUSTMENTS

- A. Verify the following before beginning actual tests and adjustments on the system:
  1. Electronic devices are properly grounded.
  2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
  3. Insulation and shrink tubing are present where required.
  4. Dust, debris, solder splatter, etc. is removed.
  5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
- B. Preparation for Acceptance, prior to final inspection:
  1. Temporary facilities and utilities shall be properly disconnected, removed and disposed of off-site.
  2. All systems, equipment and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
  3. All displays shall be cleaned. If project conditions prevent cleaning of displays, clean prior to first event.
  4. All materials shall be neat, clean and unmarred and parts securely attached.
  5. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. shall be replaced or properly repaired, and debris cleaned up and discarded.
  6. All extra materials, portable equipment, and spares shall be delivered and stored at the premises as directed.
  7. Verify each component is working properly
  8. Verify each individual component's performance meets manufacturer's published performance for this unit.
  9. Verify proper operation from controlling devices to controlled devices.
  10. Verify proper adjustment, balance and alignment of equipment for optimum quality and to meet the manufacturer's published specifications
  11. Verify that all communications and networking services are provided and in proper working condition
  12. Establish and mark normal settings for each level control and properly record these settings within the "Systems Operation and Maintenance Manual."
    - a. For software controls, "screen shots" of the relevant menus, pages or dialog boxes shall be made. Additionally, software presets shall be recorded to "disc" permitting full recall.
- C. RGB LED testing requirements
  1. In the event that owner believes that a display does not comply with the performance criteria of the specification, the provider shall contract with a mutually agreed on independent testing agency/consultancy to verify performance of the display or displays. Cost of this testing will be solely born by the provider. At a minimum the following must be tested:
    - a. Overall screen brightness (peak)
    - b. Uniformity testing
      - 1) Separate measurements (brightness and color temperature) shall be made to verify uniformity at:

- a) Peak/maximum brightness (recommended direct sunlight operating brightness).
  - b) Typical operating brightness
  - c) Evening/nighttime operating brightness
- 2) Brightness uniformity
  - a) pixel to pixel
    - (1) intra-module
    - (2) between modules
    - (3) Sampling techniques are acceptable, provided:
      - (a) number of samples is not less than 20% of the total display's pixels.
      - (b) samples are spread throughout the screen
      - (c) Samples run width of screen
  - b) module to module
  - c) best case to worst case
- 3) Color temperature uniformity
  - a) pixel to pixel
    - (1) intra-module
    - (2) between modules
    - (3) Sampling techniques are acceptable, provided:
      - (a) number of samples is not less than 20% of the total display's pixels.
      - (b) sample is spread throughout the screen
  - b) module to module
  - c) best case to worst case
- c. Viewing angles:
  - 1) Horizontal
  - 2) Vertical
  - 3) Defined as 50 percent of peak brightness, or at the point a noticeable color shift occurs.
- d. Tests to be performed in accordance with manufacturer's recommendations on displays provided at the site, with a "normal" video signal that is injected at the control room, or at the board. Tests on display elements or modules prior to provision are not acceptable.
- e. Test report shall include full documentation on test procedure, instruments employed (including model number and serial number) and copy of instrument calibration certification.

### 3.3 TEST EQUIPMENT

- A. Provide test equipment for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, provide a list to the Owner/Owner's Representative of test equipment make and model numbers that will be used.
  - 1. Dual-trace oscilloscope: 100 Mhz bandwidth, 1 mV/cm sensitivity, TV trigger.
  - 2. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A.
  - 3. Television signal generator: Tektronik.

### 3.4 ACCEPTANCE

- A. Upon completion of provision and initial tests and report specified in Part 3, acceptance testing shall be performed by the Owner/Owner's Representative.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary. Provider will assist in this testing and provide any test equipment required

specified herein. Provider shall provide at least 1 technician available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Provider.

- C. The following procedures will be performed on each System:
1. Assessment of all display images.
  2. Provide test pattern on all color matrix and video displays for Owner's Representative to review. Pattern to include:
    - a. A rotation of red, grid, blue, grid, green, grid, white, grid.
    - b. Grids to have letter and/or number or combination of both within each grid box representing module.
    - c. Rotation to be able to be easily accessed and automatic.
  3. Physical inspection of displays
  4. Review of animations
  5. Review of scoring and clock functions.
  6. Review of system operation on redundant cabling.
  7. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
  8. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each adjustable control with small white, adhesive dots, and record these settings, in the "System Operation and Maintenance Manual."
  9. Provided and loose equipment will be inventoried for correct quantity.
  10. Testing to include demonstration of Stenograph and Sports Ticker data input capability. Provision of stenograph equipment and operator as required, is the responsibility of the Provider.
  11. Any other test on any piece of equipment or system deemed appropriate.
- D. In the event the need for further adjustment or work becomes evident during equalization and/or acceptance testing, the Provider will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or provision to meet the requirements of these specifications, the Provider will pay for additional time and expenses of the Owner/Owner's Representative.
- E. The Owner's fees and costs involved in acceptance testing are not the responsibility of the Scoring and Matrix Display System Provider, except as described in Part 3 of this specification.
- F. Final acceptance will follow the successful control system operation all first season pre-season games and first two regular season games. Should play at the arena begin mid-season this period shall be a minimum of four games.
- G. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance, or as event attendance.

### 3.5 DEMONSTRATIONS

- A. Provide 16 hours instruction to Owner/Owner's Representative designated personnel/facility staff on the use and operation of the base bid system, scheduled as a minimum of five separate sessions, by an instructor fully knowledgeable and qualified in system operation.
- B. The System Reference Manuals should be complete and on site at the time of this instruction. Coordinate schedule of demonstration with Owner/Owner's Representative.



- C. Training Schedules
  - 1. Training should be assumed to take place on the project site, unless agreed to by the Owner.
  - 2. Training should be scheduled to be non-overlapping, unless agreed to by the Owner.
  - 3. Actual training schedule shall be by agreement with Owner. Do not assume that training will occur over 8 hour days. It is more likely that training will be scheduled in 4 to 6 hour increments; perhaps over a period of weeks (or even months).
- D. The following is a general idea of the training “curriculum”:
  - 1. A general familiarization of the Owner’s Representative of the device.
  - 2. An explanation of how the device interfaces to the rest of the system (including data connections; timing requirements and the like).
  - 3. General training on operating the device.
  - 4. Specific training on device operation (e.g. entering statistics; how to access data retrieval sources; how to create repeatable formats and layouts, changing fonts, loading new fonts).
  - 5. Saving information; backing information up (including a review of the proper procedures for backing up).
  - 6. Basic troubleshooting
  - 7. Specific troubleshooting (this information may be conveyed to personnel other than the device’s “operators”).
  - 8. How to upgrade software; precautions taken while doing (e.g. backing-up existing software, don’t be the first one to try the new software on game day).
- E. Any time spent troubleshooting shall not count towards fulfilling this requirement and shall be extended an equal amount of time.

#### PART 4 - DEFINITIONS AND TERMS FOR SCHEDULE OF DISPLAYS

##### 4.1 DISPLAY LEGEND

- A. Unique Identification
  - 1. LOC—Location of Display
  - 2. QTY—Quantity of units
- B. Dimensions
  - 1. HT—Height of Active Display area (excluding, trim, etc.), in inches.
  - 2. WD—Width of Active Display area (excluding, trim, etc.), in feet.
  - 3. TOL—Tolerance, expressed as a percentage of Height or Width. Allowable variation to base size.
  - 4. MAX HT—Maximum height of display, including all cabinet, trim, etc. (inches unless otherwise noted). This dimension is generally set by sight lines and cannot be exceeded within base proposal.
- C. TYPE—Technology Type
  - 1. LAMP—Full color, bulb, through hole light emitting diode (LED)
  - 2. SMD—Full color, surface mount, light emitting diode (LED)
  - 3. MONO—Monochrome, light emitting diode (LED)
  - 4. FD—Fixed digit, light emitting diode (LED)
  - 5. BL—Back lit panel
  - 6. FL – Front Lit panel
  - 7. STAT – Static Display

- D. TARGET RES—Absolute Minimum Physical Pixel Resolution expressed in mm (higher resolution products are implicitly allowed; within the available power limitations).
- E. USE—Purpose of display
- F. MIN PIXELS – minimum horizontal and vertical resolution
- G. Notes—

## PART 5 - SCHEDULE OF DISPLAYS

LOC	Q T Y	HT X WD	TOL	MAX HT	TYPE	RES	USE	TARGET PIXELS	NOTES
CH	4	17' x 26'	2%	17.6'	RGB	6mm	Video, Animation, advertising crowd prompts, information		Main Video
CH	4	17' x 6'	2%	17.6'	RGB	10mm	Advertising information		Corner Wedges
CH	2	8' x 10.6'	2%	8'	RGB	6mm	Video, Animation, advertising, crowd prompts, information		Underbelly
CH	1	5' x 140'	2%	5.6'	RGB	10mm	Advertising , crowd prompts, game information		LED Ring Above Video
CH	1	3' x 128'	2%	3'1"	RGB	10mm	Advertising , crowd prompts,		Top LED Ring
CH	1	3' x 128'	2%	3.1'	RGB	10mm	Advertising , Crowd Prompts, Information		Bottom Ring
CH	1				STAT		Scrim	Within enclosure	Not to cover lights or underbelly displays
EVENT	2	28" x 70'	2%	28"	RGB	10mm	Advertising , Game in Progress, Crowd Prompts, Information		Fascia Ribbon
EVENT	1	3' x 40'	2%	3'	RGB	10mm	Advertising , Game in Progress, Crowd Prompts, Information		Score Table

LOC	Q T Y	HT X WD	TOL	MAX HT	TYPE	RES	USE	TARGET PIXELS	NOTES
EVENT	1	3' x 10'	2%	3'	RGB	10mm	Advertising , Game in Progress, Crowd Prompts, Information		Media Table

## PART 6 - ALTERNATES TO BASE BID

- A. Alternate A – Increase resolution of all displays in center hung assembly to 6mm
- B. Alternate B - Provide black package on main center hung video displays.
- C. Alternate C – Increase resolution of scorer and media tables to 6mm
- D. Alternate D – Increase size of court level ribbon boards to 32" x 70'
- E. Alternate E – Remove animation re-creation requirement.
- F. Alternate F – Remove network switch requirement.
- G. Alternate G - Service Contract for parts and labor for Years 3 through 10 for the scope of work covered under in 11 63 10. Since this is a phased project, warranty periods shall begin with each venue's completion date. Pricing shall remain in effect until the end of the warranty period or until the Owner accepts or declines this service contract whichever occurs first.
  - 1. Requirements of service contract.
    - a. All costs for US factory parts repair or replacement shall be included.
    - b. Following expiration of warranty period, owner will remove failed components from display (scoring or video) and ship, at owner's expense, to US repair depot.
    - c. Provider (or Provider's Supplier) shall repair or replace components and ship to owner, at Provider's expense using next-day delivery for Tuesday to Saturday deliveries (in Morgantown, WV). Provider shall ship repair parts, within 24 hours of request of owner, prior to their receipt of failed part.
    - d. Repair and return shipment shall be in a timely fashion to maintain display operation.
    - e. In the event of parts failure of more than 5% of the display(s), the Provider shall dispatch to the site, at provider's cost, factory technicians to assess cause, and means of returning to operation. Site visit timing shall be coordinated with owner, and in the event that adequate notice is provided (36-48 hours), shall be provided prior to stadium events where more than 50% of the facilities seating capacity is expected.
  - 2. Individual Costs of years 3 through 10.
    - a. G1 - Year 3 costs.
    - b. G2 - Year 4 costs.
    - c. G3 - Year 5 costs.
    - d. G4 - Year 6 costs.
    - e. G5 - Year 7 costs.
    - f. G6 - Year 8 costs.
    - g. G7 - Year 9 costs.
    - h. G8 - Year 10 costs.
    - i. G9 - Provide sum of years 3-10 and indicate if discount is given for selecting all years.
      - 1) Note if Options increase or decrease these values, indicate savings (or additional cost)
- H. Option H – Cost to provide annual pre-season "health check" for display systems for years 3 through 10 for the scope of work covered under 11 63 10. The intent, to the extent possible, is to bring the system up to as new operating condition and performance. Pricing shall remain in effect until the end of the warranty period or until the Owner accepts or declines this service contract whichever occurs first.
  - 1. Requirements of the contract:

- a. Inspection and preventative maintenance on all components in the system.
  - b. Washing or cleaning of displays (if required)
  - c. Updating system software
  - d. Verification of all control and display equipment
  - e. Repair (from Owner's spare inventory) all displays and control equipment.
    - 1) Individual Costs for years 3 through 10.
      - a) H1 - Year 3 costs.
      - b) H2 - Year 4 costs.
      - c) H3 - Year 5 costs.
      - d) H4 - Year 6 costs.
      - e) H5 - Year 7 costs.
      - f) H6 - Year 8 costs.
      - g) H7 - Year 9 costs.
      - h) H8 - Year 10 costs.
- I. Option I – Value Engineering, Voluntary Alternates, Voluntary Savings
- 1. This is an area where a vendor may suggest alternate resolutions, sizes, value engineering opportunities or deviate from technical specifications. Attach a separate description and enumeration of items.

## PART 7 - PERFORMANCE STANDARDS – LIST FOR EACH DISPLAY TYPE

## 7.1 RGB LED BOARD DETAILS

Option Number: \_\_\_\_\_

Location: \_\_\_\_\_

LED Manufacturer and bin #: \_\_\_\_\_

Model: \_\_\_\_\_

Fractional Units (e.g. 18.5')

**Overall** Display Size (measured from  
pixel to pixel; not including cabinet)

Vertical \_\_\_\_\_ feet

Horizontal \_\_\_\_\_ feet

**PHYSICAL** Pixel Pitch

Vertical/Vertical \_\_\_\_\_ mm

Horizontal/Horizontal \_\_\_\_\_ mm

TOTAL NUMBER OF **PHYSICAL** LEDsLEDs/each display  
\_\_\_\_\_TOTAL NUMBER OF **PHYSICAL** PIXELSPixels/each display  
\_\_\_\_\_Manufacturer/Supplier of 3-in-1 LEDs  
\_\_\_\_\_

Brightness

Nits  
\_\_\_\_\_Brightness Level adjustment  
\_\_\_\_\_

Color Temperature

°K  
\_\_\_\_\_

Viewing Angle

Vertical \_\_\_\_\_ degrees V

Horizontal \_\_\_\_\_ Degrees H

Power Consumption

Average (each video display) \_\_\_\_\_

Maximum (each video display) \_\_\_\_\_

Normal Power requirements(Voltage, Service, Ø)  
Include any air conditioning requirements for entire Display \_\_\_\_\_**Entire Display Weight** (Includes internal structure;  
and secondary structural steel attachments) \_\_\_\_\_

END OF SECTION

## SECTION 11 63 10.02 – STADIUM LED DISPLAY SYSTEMS

## PART 1 - GENERAL

## 1.1 SCOPE OF WORK

- A. This is a design/build project. Work under this Contract includes all labor, materials, tools, transportation services, supervision, coordination, etc., necessary to complete the provision of the LED Display Systems, as described in these specifications and illustrated on the associated drawings. The systems shall be called the “Display System” and the provider the “Display System Provider”.
- B. The Contract Documents are complementary and are intended to include or imply all items required for the proper execution and completion of the work. Any item of work required by the Specifications or other portion of the Contract Documents, but not shown on the drawings, or shown on the drawings but not required in the Specification, shall be provided without extra charge as if shown or mentioned in both.
- C. The work specified herein is performance based. This requires the Installer to provide all final design and engineering (e.g. structural, electrical, etc.), which is not included or indicated within the Contract Documents, to meet the requirements of this Performance Specification. The installer is responsible for providing all components necessary for a complete and operational system. Any system changes or revisions necessary to make the system conform to the structure, building walls, steel, low voltage/signal, electrical services, etc., shall be included at time of proposal and installed without claims for additional compensation.
- D. Drawings should be considered to be conceptual in nature, illustrating the features and appearance of the system. The plans do not show complete and accurate building details. The Installer is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems. It is intended that the installer shall assume full responsibility for final structural engineering, rigging requirements as well as finished project information and coordination required in accordance with the provider's final design of elements being provided under this contract.
- E. The Installer must recognize that the scope of work requires coordination with building events, other trades and installers.
- F. The LED Display Systems include the following major items:
  - 1. Main South End Zone Assembly
    - a. LED Display
    - b. Backlit and Static Signage
    - c. Coordination with new speaker system in the assembly
    - d. Structural modifications to hold new displays and speakers
      - 1) Refer to report from Thornton Thomasetti
  - 2. Fascia/Ribbon LED Displays at East and West sides
  - 3. Connect to and interface with existing display control systems
    - a. Chyron Hego Crossfire and Blaze control system
    - b. Daktronics All-Sport clock and score system
  - 4. Interface with existing displays
    - a. Field Level Panasonic Lighthouse displays
    - b. North end zone Daktronics displays
    - c. Ensure these displays still function as original when finished.



5. Supply, installation and termination of all signal cabling (primary and redundant) to each display.
  - a. Use of existing cabling is acceptable provided it is fully warranted.
6. Reconfiguration of existing animations and graphics to work within new size and pixel resolution of new displays.
7. Option Pricing
8. Operations and maintenance training.
9. Review and installation of safety fall restraint system as required by code at exterior scoreboard enclosure per OSHA regulations for installation and maintenance.

G. The Contract also includes:

1. South End Zone
  - a. Removal and disposal of existing LED displays and signage components
  - b. Coordination of removal and re-installation of existing components that might include:
    - 1) Security cameras
    - 2) WiFi APs
    - 3) DAS Antennae
2. West and East ribbon displays
  - a. Removal and disposal of existing LED displays
3. Provision of final engineering, development of final design drawings and submission to the Owner for approval.
4. All structural and electrical engineering for displays.
5. Submission of all information required by public agencies.
6. All necessary permits.
7. Registered Engineers' stamp on all structural, attachment and electrical drawings, with any calculations, where required, for stamp or for review by Owner's engineer.
8. Verification of dimensions and conditions at the job site.
9. Coordination with other contractors and trades; especially where working in common areas.
10. Preparation of submittal information.
11. Installation and all anchorages and attachments in accordance with the contract documents, manufacturer's recommendations, and all applicable code requirements.
12. Initial tests and adjustments, written report, and documentation.
13. Instruction of operating personnel; provision of manuals.
14. Maintenance services; warranty.
15. Attendance at project meetings as required for coordination of efforts.
16. Event attendance as outlined herein.
17. Field and floor protection when utilizing cranes and/or any other lift mechanism allowed by the project.
  - a. Coordination is required to establish weight load capacity on concourses and field for heavy equipment proposed to be used by installer.

- H. The Owner will consider subjective assessment of image quality, brightness/uniformity and scoring and control/animation software along with user interface as part of the overall evaluation process. The Owner reserves the right to make product selection based on this subjective comparison among vendors providing responsive proposals meeting all technical performance requirements.

1.2 WORK PROVIDED IN CONJUNCTION WITH THIS SPECIFICATION

- A. Sound Reinforcement System

1.3 REFERENCES

- A. American Iron and Steel Institute (AISI)

- B. American National Safety Institute (ANSI)
- C. American Society of Mechanical Engineers (ASME)
- D. American Society of Testing and Materials (ASTM)
- E. National Electrical Manufacturer's Association (NEMA)
- F. Occupational Safety and Health Administration (OHSA) 1910
- G. Underwriters Laboratories (UL)
- H. United States Institute of Theatre Technology (USITT)
- I. Entertainment Services and Technology Association (ESTA)
- J. Standard for Electric Signs, UL-48, 13th Edition
- K. Standard for Control Centers for Changing Message Type Signs, UL-1433, 1st Edition
- L. Federal Communications Commission Regulation Part 15
- M. National Electric Code (NEC)
- N. Building Industry Consulting Service International (BICSI)
- O. Telecommunications Industry Association (TIA)
- P. Any and all local, government or other applicable codes
- Q. University standards for cable, electrical, conduit and network switches.

#### 1.4 DESCRIPTION OF WORK

- A. Seating Bowl LED Displays
  - 1. Main South LED Video Display work includes, but is not limited to:
    - a. New LED Video board, backlit and static ad panels to achieve the appearance of the renderings and drawings.
    - b. Structural modifications to accommodate the new displays and sound system.
      - 1) Refer to Thornton Thomasetti report
    - c. Secondary structure, catwalks and railing to attach displays and speakers to modified primary structure.
    - d. Reconfiguration and re-routing of existing power service and cable/conduit extensions from the building below.
      - 1) 800A service for displays
      - 2) 200KvA service for emergency power
    - e. Review and installation of safety fall restraint system as required by code, at scoreboard interiors per OSHA regulations for installation and maintenance.
    - f. Removal and disposal of existing display and sign elements.
    - g. Removal and disposal of existing display processing equipment.
  - 3. All disposed items shall be disposed in a proper manner for the material's in question and an affidavit shall be provided to the University that all materials have been properly disposed.
  - 2. LED Ribbon Displays on the east and west.
    - a. Extension of electrical service with outdoor/rough service as required by code.

- b. Top service access system required for all fascia/ribbon displays.
  - c. Coordinate elevation of displays prior to submittals.
- B. Within the control room:
  - 1. Provide and install remote on/off power controls, separately for each display in the system including the fascia displays.
  - 2. Signal cabling from scoreboard control room racks to workstations.
  - 3. Interface to existing Chyron Hego Crossfire and Blaze control system.
- C. Common Requirements for all base and optional displays
  - 1. Reconfiguration of existing animations and graphics to work within new size and pixel resolution of new displays.
  - 2. Electrical
    - a. All electrical distribution/load centers, etc., within each display system at each installation point from isolator or disconnect as shown on electrical drawings.
    - b. Design of electrical distribution to allow a portion of the main south LED display to be on the existing 200KvA emergency power system.
    - c. Scope includes coordination and extension of existing 800A AC power service including any breakers, step downs, etc. for use with all displays on the assembly (LED, backlit, etc.)
  - 3. All electrical distribution/load centers, etc., within each system at each installation point from isolator or disconnect. Power is provided as noted on electrical drawings.
  - 4. Installation of all signal cabling. Provide a redundant cable (separate overall jacket) to each display. A separate pathway for redundant cabling is not required.
  - 5. Any required signal conduit for a complete, turn-key installation is included in this scope.
    - a. Any additional conduit or raceway required for a complete, code and specification compliant system is to be included in the Display Installer's scope of work. Exposed cabling is not allowed.
    - b. Paint all exposed conduit/raceway installed under this contract as directed by Architect or Owner.
  - 6. Provision of structural support/framing for LED modules, intermediate steel, attachments, etc., required to attach display to primary structure is to be provided under this contract.
  - 7. Painting of all new steel, welded steel and the like provided under this contract.
  - 8. Painting of all structure exposed to public view.
  - 9. Remediation of all rust and corrosion within video/scoreboard displays, structure or skin/enclosure where displays attach to primary steel.
  - 10. Touch up painting of finishes damaged during installation or at rust remediation locations.
- D. Supply complete dimensions, clearance requirements, mounting locations and requirements, and total and point load structural loading data. Submit structural design and all requested information to Owner's structural engineer for review of attachments to base building structure. Cost of this review to be included in this scope of work.
- E. Provide all ventilation and climate control equipment, including shop drawings, showing louvers, openings dimensions, clearance requirements, condensate drain requirements, unit weights and noise data.
- F. Supply complete assemblies (structure, any required enclosure, and finish) for the displays as appropriate, including registered in the jurisdiction of the project structural engineer stamped calculations., all structure, catwalks, ladders, etc., not shown on the drawing be are required for service, installation of operation, are to be part of this scope of work. "Enclosures" refers to enclosures for the LED display modules and equipment.
- G. Scoring and Video Control
  - 1. All control equipment to operate LED displays shall be located in:

- a. Control Room B210 on the Press Level
  - b. Space is available in the Electronics Room 209 equipment racks for all LED display control and processing equipment. Coordinate all control room equipment installation with the Owner
  - c. Connections between displays and control equipment and any physically separate control position locations shall be included in this installer's scope of work.
  - d. Connection to existing game in progress and data output, compatible with standard Network (i.e.; ESPN) interface with outputs mounted in a rack panel.
2. All Displays provided under this contract to be able to be independently turned on/off from the scoreboard control room.
  3. Time of Day and Temperature Sensor/Display Capability.
  4. Automated statistic update capability from in-house and third-party services along with automatic statistical updates during game from game scoring controller.
  5. Data (player/game statistics and game-in-progress information) output compatible with video character generator for use by broadcasters and stadium TV/video systems.
  6. Ability to receive and display on any LED display surface in the project, electronic text data from standard stenography (captioning) equipment, caption decoders, and data from multiple electronic services such as Sports Ticker, and Stat Crew, etc. (subscription and captioning services costs are not included as part of this scope).
- H. Coordination and connect to to the existing in-house video production system. System to take an HD/SDI input.
- I. Coordinate with Owner's Testing and Inspection Agency to provide access for testing of welds and attachments in accordance with the project General Conditions and overall project requirements and specifications. All testing criteria shall be as indicated in the project General Conditions and overall project requirements and specifications.

#### 1.5 RESPONSIBILITY AND RELATED WORK

- A. Coordinate all work so that a complete and functioning scoreboard assembly and related systems is achieved.
- B. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.
- C. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Display System Installer to supply systems in full working order. Notify the Owner's representative of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.
- D. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner.
- E. If a conflict develops between the contract documents and the appropriate codes and is reported to the Owner's representative prior to bid opening, the Owner's representative will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.
- F. Coordinate work with other trades to avoid causing delays in construction schedule.
- G. Contractor is responsible for coordinating and providing areaway, grass and field protection when utilizing a crane or any other lift mechanism during installation at all locations.

- H. Fire Alarm Interface. If not already connected and functioning, provide a fire alarm interface to automatically engage emergency evacuation messages on designated displays. Coordinate with Owner and Fire Marshall/Code Authority as to message text.
- I. Coordinate product and materials delivery, offloading, staging, security and transportation with Owner.

#### 1.6 ELECTRICAL

- A. Power is provided as noted on the existing electrical drawings. The Installer shall be responsible for termination and distribution of electrical power from the demarcation point shown on the electrical drawings to the displays. All distribution equipment as required (including load center, breakers, step down transformers, etc.) is to be included in the display installer's scope. This will include necessary distribution boards, conduit and cabling as required for a complete installation.
- B. A ground point will be provided. The Installer shall be responsible for connecting ground point to all equipment in accordance with NEC code, local codes and standards specified herein.
- C. Connect each LED assembly to the building's grounding/lightning protection network, if present.
- D. Provide convenience outlets and task lighting within the scoreboard enclosure.
- E. Refer to electrical single line diagrams for minimum short ratings of all required equipment.
- F. Provide complete power and branch circuit distribution within the display/enclosure from the existing demarcation point provided by Owner as shown on electrical drawings.
  - 1. Power Distribution: All panel boards or load centers provided with lighting units for power distribution to displays loads shall incorporate main breakers.
  - 2. Provide utility power distribution in all rear service enclosures.
  - 3. Label each breaker as to its function within the scoreboard assembly (i.e. backlit panel #1, etc.)
- G. Conceal all distribution equipment, transformers, panels, etc., and conduit within enclosures.
- H. Provide lockable load center, breaker panels, and disconnects. Provide minimum of 8 keys per lock.
- I. All materials shall fully comply with Underwriters' Laboratories or other acceptable testing agencies acceptable to local authorities with jurisdiction.
- J. Provide remote power on/off for all displays provided herein.
- K. A portion of the main South LED display will be connected to the existing 200KvA of emergency power located at the base of the assembly.

#### 1.7 DISPLAY SIGNAL CABLING AND CONDUIT

- A. Install signal in conduit, raceway and cable tray. If additional conduit is required, provide as part of this installation scope. Cabling exposed to public view or the elements is not allowed.
- B. Do not damage any signal cabling that may be co-located with video and scoring cabling. In the event of damage, bring damage to attention of Owner and propose acceptable repair.

- C. Installation shall include all required and operationally necessary low voltage control and/or fiber optic cabling for all scoring displays from Scoreboard Control location to each display assembly as appropriate.
- D. Provide primary and backup connection cabling (separate overall jacket, not diverse pathways) from each display to control system location and other specified control locations.
- E. All cable whether fiber optic or copper will be run in conduit/cable tray from the Scoreboard Control Room to each scoring/matrix element. This does not relieve this contractor from providing fire stop material, armored cable and/or innerduct if project requires it. If additional conduit is required for a complete system, provide.
- F. Patch panels shall be provided at the Control Room and Video Display to facilitate transfer between primary and back-up cables.
- G. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
- H. Any timing or clock data signal cable located in cable tray with any audio cable shall have appropriate separation between services and appropriate jacket.
- I. Provide any necessary cable management, vertical ladder tray, j-hooks, etc. in areas without pathway.
- J. Provide, under this contract, any D-rings, hooks, etc. required for cable runs above accessible ceilings that cannot be run in raceways provided. Provide any necessary cable management, vertical ladder tray, etc. in communications closets for vertical risers. Provide appropriate cable management, Wiremold, raceways within scoreboard control areas between base building cable tray and control locations.
- K. Available conduit/raceway/cable tray distribution for display signal/data cabling is shown on RFP documents which may be incomplete and not up to date. Site observation will be required to determine full extent of existing raceway and raceway installed by the Owner for this project. If additional conduit, junction/terminal boxes/enclosures will be required notify Owner/Owner's Representative for coordination at time of proposal otherwise provide any conduit required for a complete, working, turn-key systems installation.
- L. Hold conduit tight to structure and conceal behind structure away from public view.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: At least 5 years' experience in the production of specified products.
- B. Installer's Qualifications information to be provided with Bid Response. Firm experienced in the installation of systems similar in complexity to those required for this project; and meet the following criteria. Owner may choose to waive or enforce these items at the Owner's sole discretion:
  - 1. At least five years of experience with equipment and systems of the specified types.
  - 2. Experience with at least two comparable (capacity or display size) NCAA Div. I stadiums new construction or renovation projects within the last three years, unless requirement is waived or modified by Owner.
  - 3. Maintain a fully staffed and equipped U.S. service facility.

**1.9 REQUIRED PROPOSAL TECHNICAL DOCUMENTATION WITH BID RETURN**

- A. With the bid return, the potential Installer shall provide:
1. Form of corporation
  2. Proof of adequate plant and equipment to complete the work.
  3. Adequate regional service organization to meet warranty.
  4. Adequate staff with commensurate technical experience.
  5. Suitable financial status to meet the obligations of the work.
  6. References from three (3) or more users of stadium similar display and software control systems provided by Installer.
  7. List of structural, electrical and other subcontractors intended to do the work.
  8. Concept renderings of displays, structures and enclosures with elevations and sections.
  9. Completed AIA Contractor's Qualification form
  10. Proposed equipment
  11. Proposed project schedule
  12. Name and relevant experience of the proposed project manager. Also provide the name and qualifications of the site superintendent
  13. Completed display form included in Part VII
  14. Listing with appropriate explanation regarding the status of Installer's resolved or unresolved legal disputes within the last six calendar years.
  15. Listing with appropriate explanation regarding any projects within the last 3 years, where the Installer has failed to meet construction schedules, due Installer's cause.
  16. Statement acknowledging that contract includes guaranty of availability of spare parts for not less than 10 years from date of substantial completion

**1.10 SUBMITTALS**

- A. Submit all shop drawings and submittals in accordance with project requirements. Quantities listed herein are the minimum required of this contractor.
- B. Shop drawings and submittal data shall contain sufficient information to describe the Work to be performed. Drawings shall be executed at an appropriate scale. Submit electronic PDF files and one bond sets of drawings; submit electronic PDF files of product data/manuals. Submit all Shop Drawing information at one time. Information shall include but not necessarily be limited to:
1. LED lamp order inclusive of part numbers
  2. Elevation and sections of all displays along with enclosure/structure fabrication drawings.
    - a. Note that display sections that span expansion joints, bends/corners should be studied for any large seams between modules and obstructed viewing angles.
  3. Color options for all fixed digit and monochrome LED displays. Include white as a color option wherever possible.
  4. Finishes of all exposed housings.
  5. Ad panels
  6. Complete, detailed wiring diagrams for all systems, based on the contract documents but including cable types, identification and color codes, and detailed wiring of connections, both at equipment and between equipment racks and wiring in conduit.
  7. Provide drawing indicating location and size of any access/egress panels in relationship to stadium gangways and pitch access for review by building/safety authorities.
  8. Location of all equipment in racks, consoles, mill work, enclosures or on Owner provided countertop/tables with dimensions; wire routing and cabling within housings; AC power outlets, terminal strip and UPS locations.
  9. Schematic drawings of any custom circuitry or equipment modifications, including connector pin-outs and component lists.
  10. A material list of all equipment to be furnished, arranged in specification order. This list shall be followed by catalog data sheets, arranged in specification order, of all equipment to be furnished. Where a data sheet shows more than one product, indicate the model

- being proposed with an arrow or other appropriate symbol. This submittal must be submitted in its entirety.
11. Floor Plan drawings, including all walls, doors and rooms, showing exact locations of devices and equipment.
  12. Floor Plan drawings, including all walls, doors and rooms, showing exact power requirements and conduit routing for each system with the location of all junction boxes.
  13. MEP
    - b. Full MEP coordination drawings reflecting all mechanical, electrical and plumbing work.
    - c. The Owner and Owner's representative shall approve exhaust fan, louver and piping locations.
    - d. All electrical drawings to be stamped by a licensed engineer, registered in the State of the project location.
    - e. Note locations (in plan and/or section) of areas that will be on emergency power.
  14. Structural
    - f. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories. Indicate welded connections using standard AWS welding symbols.
    - g. Submit a letter of certification prepared by a professional Structural Engineer(s) (registered in the State of the project location) employed by the fabricator certifying the following:
      - 1) The aforementioned Engineer is fully experienced in the design of structural steel, signage, catwalks and railings.
      - 2) All shop drawings (including all supports, connections and components) shall be prepared under the direction of the aforementioned engineer(s), in compliance with the Contract Document requirements and applicable building codes. His seal and signature shall appear on all shop drawings. The aforementioned shop drawings shall include sufficient information to enable the Owner to confirm that design loads, support points and tie backs are in compliance with the Owner's design criteria.
      - 3) This certification letter must be received by the Owner prior to the submission of the Shop Drawings for the metal stairs and railings, and shall bear the seal and signature of the aforementioned engineer.
    - h. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, design loads, support points and tie backs.
    - i. The design shall be in accordance with the aesthetic design intent of the project with the Owner having final authority in reference to aesthetic matters.
    - j. The aforementioned engineer shall submit a letter to the Owner stating that the fabrication and installation of all work associated with this Contract has been performed in accordance with his design. This letter shall be signed and sealed by the aforementioned engineer as part of "Project Closeout".
    - k. All design calculations (which shall bear the seal and signature of the aforementioned engineer), indicating compliance with the requirements of the design criteria and appropriate codes shall be provided to the Owner prior to fabrication for record purposes.
    - l. The calculations provided to the Owner at project completion shall be forwarded to the Owner as part of "Project Closeout".
  15. Proposed cable labeling technique.
  16. Samples as required in various specification paragraphs.
  17. Power consumption at 50%, 75% and 100% illumination levels (all lighting elements energized) for each display.
  18. Viewing angle calculations:
    - m. For horizontal viewing angles submit:



- 1) Facility seating plan closest to board (in elevation). Plan should include vomitories, radial column lines, and other identifying characteristics (e.g. camera platforms, aisles, steps, etc.).
      - 2) Lines radiating from center of display intersecting with rear of facility at 5° increments. 0° reference shall be perpendicular to board. Lines shall be marked at no less than 15° increments.
    - n. For vertical viewing angles submit:
      - 1) Section through board and stadium indicating identifying points on the field.
      - 2) Horizontal measurements from board.
      - 3) Lines radiating from center of display intersecting with rear of facility at 5° increments. 0° reference shall be perpendicular to board. Lines shall be marked at no less than 15° increments.
  19. Drawings of initial proposal for pre-programmed displays
- C. Training and Event Attendance Submittals:
1. All Operations and Maintenance manuals, as well as as-built drawings must be on site for all sessions of training.
  2. Following discussions with Owner, formally submit a Training and Event Attendance submittal 2-4 weeks prior to first training. Submittal shall:
    - a. Include a separate page/entry for every training session.
    - b. Indicate date, time, and approximate length of training session.
    - c. Indicate person(s) conducting training.
    - d. Indicate whether training will be video recorded.
    - e. Intended curriculum and most appropriate attendees (e.g. engineer, operations, IT, etc.)
    - f. Include signature and title lines for
      - 1) Owner acknowledging and accepting training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
      - 2) Countersigning by trainer indicating that training actually occurred.
      - 3) All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
      - 4) Owner's representative attending training at the end of the session shall initial that:
        - 5) Training Occurred.
        - 6) Training Materials were provided and left with Owner
        - 7) Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
      - 8) Training was generally sufficient for the proposed curriculum.
    - g. Include Notes Section for Owner and Contractor to note any issues during training (areas requiring further development, etc.)
  3. Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.
- D. Final Inspection Notification Report. Neatly prepared checkout report for each piece of equipment and the entire system shall be prepared and submitted; it shall include:
1. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and date re-tested (if failure occurred during any previous tests).
  2. The final report shall indicate that every device tested successfully.

3. A performance test report indicating that the system meets all of the Installer testing requirements of Part III.
- E. Contract closeout submittals:
1. Keep a complete set of drawings on the job, note any changes made during installation, and submit electronic sets of drawings showing work as installed.
  2. Submit the following data for review, prepared as indicated, at least one week prior to acceptance testing (exceptions noted) in electronic form:
    - a. System Reference Manual:
    - b. Provide tabular dividers with legends for the following sections:
      - 1) System Operation and Instructions. Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.
      - 2) A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e.; rack/room number). Update following acceptance testing, if changed.
      - 3) Manufacturer's Instruction Manuals for all items of equipment, incorporating or followed by manufacturer's warranty statements.
      - 4) Where manufacturer registration is required, register warranty in Owner's name, and at an address determined by Owner. Provide copy of registration.
      - 5) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
      - 6) A list of settings, if applicable, of all semi-fixed controls. Update following acceptance testing.
      - 7) Photographically reproduced schematic wiring diagrams of the scoreboard and advertising display low and high voltage systems, based on the as-built documentation, at a reduced scale easy to handle but fully legible. Blueline (or similar diazo process) prints are not acceptable.
      - 8) Maintenance Instructions, including Installer's maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products. Instructions shall include recommendations for products and cleaning, washing and painting of all matrix, auxiliary, and advertising boards for a period of 10 years as deemed necessary by the Owner or tenant.
      - 9) A legend of acronyms and abbreviations must accompany all documentation.
      - 10) Any other pertinent data generated during the Project or required for future service.
      - 11) Manufacturer's Service Manuals and parts lists for all equipment. Photocopies are not acceptable. For custom circuits or modifications, complete schematics and parts lists.
      - 12) As-built wiring diagrams and system block diagrams showing nominal input and output levels. (Submit within two weeks after Acceptance Testing.)
      - 13) Duplicate copies of reduced-scale wiring diagrams.
    - c. Photographically reproduced as-built wiring diagrams and overall wiring diagrams, at a reduced scale easy to handle but fully legible. Blueline (or similar diazo process) prints are not acceptable. Mounted behind clear acetate and located with the equipment racks.
- F. Submittal format:
1. Provide a unique control number in consecutive order (e.g. 11 63 10-001)

2. Provide a complete table of contents with the following information:
  - a. Project title and number
  - b. Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in cumulative order.
3. Date of submission.
4. Referenced addendum or change order number as applicable.
5. Referenced specification section, Part, Article, Paragraph and page number or drawing reference as applicable.
6. Index by manufacturer and model or part number unless specified otherwise herein.
7. Each submission page stamped with Contractor's certification stamp, initialed or signed certifying:
  - c. Review, approval and acceptance of submission.
  - d. Certification of product compliance to specification.
  - e. Verification product may be incorporated within the work.
8. Arrange product data list in specification order when applicable followed by unspecified product arrange by manufacturer and model or part number. Follow list by manufacturer's data sheets, arranged in the same order. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
9. Drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'-0". Provide one reproducible transparency and two bound blue-line prints of which the processed transparency will be returned to Contractor, additional prints will not be reviewed or returned.

G. Resubmission Requirements:

1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
2. Indicate any changes that have been made other than those requested.

1.11 PROJECT CONDITIONS

- A. Verify all conditions on the jobsite applicable to this work. Notify Architect and Owner's representative in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The drawings diagrammatically show cables, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist at the job site which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Owner's representative for approval, showing how the work may be installed.
- C. This installer is responsible for all additional electrical (high and low voltage), structural, mechanical and plumbing work for completed systems.

1.12 ACCEPTANCE TESTING

- A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Owner's representative or Owner's Consultant.
- B. Provide one person familiar with all aspects of the system to assist the Owner's representative or Owner during acceptance testing. The individual must have specialized knowledge of the computer control system operating software and function of the system.
- C. Final Acceptance shall occur after the displays have functioned without failure for two home games.
  1. Failure shall be defined as a failure of the display, or a portion of the display equal to 10% of that display's square footage, to meet the project performance specifications for a length of time greater than one minute due to electronic, electrical, mechanical, structural,

or other failure of the display. Failure due to Owner's Owners, spectators, or force majeure will not be considered event failure; failure due to installer's Owners will be considered a failure.

2. Failure shall be defined as a failure of the display processing and control system.

#### 1.13 VIDEO AND SCORING SYSTEMS SOFTWARE LICENSE

##### A. INTRODUCTION

1. All proprietary software provided for the Technical Systems shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
2. Contractor shall agree that 3rd party (e.g. manufacturer's) proprietary software provided with the system shall be subject to this agreement.
3. Contractor and owner agree that this software license is deemed to be part of, and subject to, the terms of the Agreement applicable to both parties; and shall supercede any standard manufacturer or Contractor's standard license agreement.
4. Proprietary software shall be defined to include, but not be limited to, device and system specific software and firmware designed to run on conventional computer based operating platforms as well as all micro-processor based hardware used to program, setup, or operate the system or its components.
5. For sake of this agreement, MS Windows® shall not be considered "proprietary" software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.

##### B. LICENSE GRANT AND OWNERSHIP

1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the owner.
2. Except as expressly set forth in this paragraph, Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties or service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system shall be delivered to Owner for the sole benefit of owner.
3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.

##### C. COPIES, MODIFICATION, AND USE

1. Source code shall be available to owner for a period of not less than 15 years.
2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of owner and its representatives.
3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right in owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.

5. During the life of the system (defined as a period of not less than 10 years and not more than 15 years), the Contractor shall provide software updates in accordance with all necessary support requirements to maintain the system. This shall include a commitment to provide appropriate patches, fixes, and interface updates as necessary to maintain the operability and security of the system at a level commensurate with the original system.
  - a. In the event that computer and or processor hardware refinements and updates are necessary to support software updates 7 years after substantial completion, said hardware will be provided to owner at the agreed upon terms for change orders of the original contract.
  - b. Labor shall be in accordance with change order rates of the original contract, as adjusted for inflation in accordance with project General Conditions.
6. All hardware supplied shall support software updates for a period of not less than 7 years following substantial completion.

D. WARRANTIES AND REPRESENTATIONS

1. Contractor represents and warrants to Owner that:
  - a. It has all necessary rights and authority to execute and deliver this Software License and perform its obligations hereunder and to grant the rights granted under this Software License to owner;
2. The goods and services provided by contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners; and
  - b. The software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
  - c. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.
  - d. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose, of merchantability, or warranty of no infringement of third party intellectual property rights.

1.14 WARRANTY/MAINTENANCE

- A. Warrant labor and materials for two years following the date of the first trouble free completion of a game, or Final Acceptance by Owner, whichever is later.
- B. System to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or materials within the Warranty period without charge.
  1. A defect as it applies to:
    - a. Defined as any pixel or module/lighting unit that at any point fails to be able to meet the performance requirements of this specification.
    - b. Animation and control processors fail to be able to meet performance requirements of this specification.
    - c. In the event any display exhibits a total of 2% or more non-functioning LED lamps or pixels during the warranty period, the Owner can choose to either have the display repaired or replaced at Owner's option.
- C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

- D. Within the warranty period, answer service calls within 8 hours, and correct the problem within twenty-four hours. Provide local representation with service personnel available upon call within 3 hours prior to an event and throughout the time of the event.
- E. Register all manufacturer's warranties (e.g. software, computers, etc.) in Owner's name.
- F. Maintain spare parts inventory on-site as listed in this specification from end of initial warranty period through year 5 of display life. Within 72 hours of notification that spare part has been used, that part shall be replaced by the service representative/manufacturer.
  - 1. For End Zone display, maintain spares inside lockable storage cabinet inside the assembly, cabinet provided as part of this contract.
- G. Unless otherwise noted the following is the requirement for spares throughout the Display system:
  - 1. Provide 2% of LED modules/lighting units and 2% (or one if 2% is less than one) spare parts of power supplies, fans, and elements, including cables, jigs and the like.
  - 2. Provide one (2) spare printed circuit card and transmit/receive interface of each type used in the system.
  - 3. Provide 25% spares of any air filters—after final acceptance.
  - 4. Provide extenders where required for service and maintenance of equipment.
  - 5. Provide a single spare for each transceiver (line driver) type used by the scoring/matrix system.
- H. During the 50,000-hour nominal board lifetime, the Owner may have certified brightness and color temperature measurements made on screen(s) according to the acceptance procedure to verify that the board is operating within specifications. If the board is not capable of meeting specifications, provide price to perform the necessary repair and component replacement to bring the system to operational parameters. This new work shall be warranted for 20,000 hours effective from the original Owner acceptance date. Manufacturer warrants that equipment, spare parts and components required to affect any repairs will be available for a period of 10 years after substantial completion.
- I. Preventative inspections and cleaning:
  - 1. Preventative inspections shall occur 30 days before the beginning of the second and third football seasons (one of the inspections will be occurring immediately preceding the expiration of the 2-year warranty period).
  - 2. As part of the initial installation commissioning and subsequent warranty inspections, clean or wash all LED displays installed under this scope, if required.

#### 1.15 EVENT ATTENDANCE

- A. In addition to training and warranty requirements, this installer shall provide event support services to facilitate troubleshooting and effect repair of the specified systems (hardware and software) during critical Four (4) events, as designated by Owner, for the duration of the warranty period. Event support shall begin in a period 24 hours prior to the opening of gates and shall extend to 48 hours for a weekend game.
  - 1. Two days prior to the event; test and review all displays, processors and supporting computers to confirm proper operation; repair and address issues as required.
  - 2. Be available on call after testing.
  - 3. Be present on game day from at least 4 hours before gates open, until the time released by the Owner.
- B. Provide sufficient manpower to effect repairs as expeditiously as possible.

## 1.16 OPTIONS AND UNIT COSTS

- A. See Part 6

## PART 2 - PRODUCTS

## 2.1 SPECIFIED PRODUCTS AND MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet all of its published manufacturer's specifications. Verify performance as required. Where two or more acceptable products are listed, the Installer may use either at his option. Invitation to bid does not necessary imply that vendor has met all qualification requirements.
- B. Suppliers invited to bid are done so with no implication or certification that their proposed products meet the technical requirements of this specification. Potential vendors are invited to prepare prices for more than one display type meeting these specifications (i.e. different pixel spacing). Suppliers invited to bid include:
1. Prime Contractors
    - a. ANC
    - b. Daktronics
    - c. Mitsubishi
    - d. Prismview/Samsung
    - e. South Paw Live
  2. Exterior LED Displays:
    - a. Absen
    - b. Daktronics
    - c. Leyard
    - d. Mitsubishi
    - e. Prismview
  3. Approved LED Lamp suppliers
    - a. Cree
    - b. Nichia
    - c. Multicolor
    - d. Yaham
    - e. As Approved
  4. Control/content management equipment/software
    - a. Existing

## 2.2 GENERAL

- A. All equipment supplied shall be new (unless identified otherwise within this specification) and meet the latest published specifications of that product. In the event that the product is enhanced, or improved, supply the newer product at no additional cost.
1. If product is discontinued or becomes obsolete due to continuing product development, replace it with manufacturers' current equivalent at time of installation at no additional cost.
  2. If product is discontinued or becomes obsolete due to technology change, substitution will be based on fair market value of accepted and proposed products, upon approval of substitution by Owner's Representative.
- B. Manufacturer's name, logo or representation shall not be visible to the public in any fashion.
- C. All materials shall fully comply with Underwriters Laboratories or other acceptable testing agencies acceptable to local authorities with jurisdiction.

- D. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with no less than the specified manufacturer's published specifications.
- E. Provide product not specifically specified commensurate with the quality and standards established by the specified product.
- F. Provide product of given type from one manufacturer.

## 2.3 PHYSICAL DESIGN CRITERIA

- A. General: Engineer systems to the most stringent applicable code.
- B. Wind Loads: A minimum design pressure as dictated by IBC code (positive or negative) shall be applied to all signage and display surfaces. This also applies to the entire Scoreboard Enclosure. Corner pressures and attachment loads shall be as determined through local Building Code and by applying the project specific criteria. (All attachments, connections and members shall also be capable of withstanding all seismic forces in accordance with the local Building Code.)
- C. Seismic Loads: Subject to the Building Official's approval, seismic design shall be under the Building Code in use at the time of the original construction of the scoreboard structure.
- D. Minimum thicknesses, gauges and standards:
  - 1. All enclosure surfaces subject to fan abuse shall have a minimum thickness of 16 gauge.
  - 2. All sheet metal shall have a minimum thickness of 18 gauge.
  - 3. Structural steel members shall have a minimum flange, web or wall thickness of 1/4 inch.
  - 4. All welds exposed to weather shall be 1/4 inch minimum, and shall be continuous for the entire surface of the connection.
  - 5. All steel grating shall be serrated and powder coated.
  - 6. Where similar connections and members are used in other areas of the stadium, every effort shall be made to detail and furnish members in a consistent and uniform manner.
- E. Enclosure and structure.
  - 1. The structure that is available is noted shown on the architectural and structural drawings. All additional enclosure, sheet metal/advertising panel material for front and back lit advertising panels, all additional structure, matching close out panels around displays, lighting, power distribution, convenience outlets, and other items for installation, operation, maintenance, and repair is this contractor's responsibility.
  - 2. Installer to submit complete drawings showing the connection of the Installer supplied equipment to the structure at each different condition.
  - 3. Installer to submit design calculations, bearing structural engineer's stamp for review. Review will be for design intent only and shall not be construed as approving the design analysis.
  - 4. The internal module structure, supports, attachment and anchoring members, mounting hardware shall be provided in accordance with engineering standards and governing codes.
  - 5. In areas where low clearance is present, provide caution tape or warning on cross member.
  - 6. All floor grating shall continue to each vertical member without any visible gaps or openings in the floor.
  - 7. Enclosure.
    - a. Construction to comply with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other industry standard practice.
    - b. Form exposed sheet metal work without excessive "oil-canning", buckling and tool marks with exposed edges folded back to form hem.



- c. Finish to comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations. For components which are assembled or welded in factory, apply finish after completion of fabrication.
- d. The structure, supports, attachments and anchoring members, mounting hardware shall be provided in accordance with engineering standards and governing codes.
- e. Electrolytic protection shall be provided wherever differing metals come into contact.
- f. Trim shall be coordinated to be identical in appearance to adjacent advertising or architectural panels (whether provided herein, or by others).
- g. Finishes shall match adjacent elements, unless otherwise indicated.
- h. All welds shall be cleaned, primed and painted.
- i. Cabinet depth of adjacent displays shall be within 1" (+/-). Notify Architect when variance is greater.
- j. Close out trim panels/bezels are required for all displays to create a unitary appearance to each assembly with no gaps, holes, etc.

F. Handrails and Railings:

- 1. It is this contractor's responsibility to review the structural and architectural drawings for any additional required handrails and railings. If additional work is required, install the following:
  - a. Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors and connections:
  - b. Provide handrails and railings complying with ASTM E985 for structural performance; tested in accordance with ASTM E894 and ASTM E935.
  - c. Provide handrails and railings that allow for thermal movements in air and material surfaces due to both solar heat gain and nighttime sky heat loss. Range: air 120 degrees F; material 180 degrees F.
  - d. Form changes in railing members:
    - 1) Flush radius bends
    - 2) Mitering elbow bends
    - 3) Prefabricated flush elbows
    - 4) Any method above to change in direction involved.
  - e. Provide inserts and other anchorage devices for connecting handrails and railings to any concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchors with supporting substrate.
  - f. Provide weep holes to drain entrapped water in hollow sections exposed to exterior moisture, condensation, or other sources.
  - g. Finishes:
    - 1) Galvanized
    - 2) Hot-dip handrails and railings to comply with ASTM A123 and hardware to ASTM A 153.
    - 3) Fill vent and drain holes not required for weep holes with zinc solder and file off smooth.
    - 4) All fittings, attachments, and ferrous components to be galvanized.
    - 5) After galvanizing, thoroughly clean of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
    - 6) Cleaning: clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

G. Catwalks and Stairs

- 1. It is this contractor's responsibility to review the structural and architectural drawings for any additional required catwalks and stairs. If additional work is required, install the following:

- a. Provide catwalks and platform assemblies capable of withstanding the following structural loads without exceeding allowable design working stresses of materials, members and connections:
    - 1) A minimum uniform design load as dictated by the IBC shall be used for all catwalks, platforms and access ways.
    - 2) Catwalks shall be provided the full width of all rear-service electronic and advertising displays.
    - 3) Internal circulation between catwalks shall be by ships ladders or stairs; vertical ladders are generally not acceptable.
    - 4) Ladders shall extend beyond each catwalk level.
    - 5) Provide self-closing access gate for openings in railing.
  2. Provide any required additions to hoist way, a hoist attachment point, hoist arm, davit, etc., and access through enclosure/railing, etc. shown on structural drawings, to allow materials to be lifted to display from accessible area below (i.e.; roof top/seating/concourse) utilizing hoisting equipment provided by others. Structural capacity of any additional structural provisions for hoist to be of sufficient size to raise and lower all service items required for servicing the display, up to and including removal and replacement of air conditioning units, with a minimum of 500 lbs. Hoist may rise through catwalks, in which case, hinged catwalk openings with safety railings shall Contractor is responsible for touch up and repair of welds, paint and finishes where work attaches to existing structure. Coordinate with Owner to maintain all product warranties where attaching to other trades such as Paint, Roofing, Expansion Joints, etc. Provide complete painting of the Scoreboard Steel at the top and sides of the scoreboard.
- H. Ventilation
1. Provide natural or forced ventilation as required for operation of all components.
  2. Provide all necessary dust and dirt filtration for the ventilation system.
  3. Filters shall be easily removable and changeable.
  4. NC level attributed to this ventilation shall be no more than NC 45 at nearest fixed seat or occupied location.
  5. Louvers or other openings in enclosures are to be included in this scope of work as required for proper operation of the displays are to be included in this scope of work, including coordination of location, type and color of any equipment or openings that are exposed to public view.
- I. Service Requirements
1. Where primary scoreboard structure might impede access to the LED displays, the rear of the cabinet to include access panel that is removed by unlatching, sliding up and out or to the side and out in lieu of a hinged, swinging door. Show locations in the submittal process where this type of cabinet might be required.
    - a. Cabinets to have enough signal and power cable slack to remain connected when removed.
  2. All screws and nuts that are required to be removed for access to displays shall incorporate captive screw and nut type designs.
  3. A minimum of one of any specialized or custom tool required for maintenance of the display; including any specialized/custom ladder, bosun's chair, or scaffolding required to service auxiliary displays for maintenance and repair.
- J. Lightning Protection
1. Tie into the building's system, if present.
- K. Fall Protection.
1. Scoreboard enclosures to be upgraded to meet the fall protection requirements set forth in the following:
    - a. OSHA 1910

- b. OSHA 1926 Subpart M
- c. ANSI-Z359
- 2. At a minimum all working surfaces with a fall potential of 4ft or greater shall have guardrails, travel restraint systems, or fall-arrest systems installed. These systems shall meet the more restrictive requirement of the standards listed above. Additionally, a comprehensive managed fall protection plan should be developed and included for the owner to incorporate into their overall facility plan.

## 2.4 EXTERIOR LED VIDEO DISPLAY

### A. Technical Standards:

- 1. The Video Display shall incorporate direct view technology; currently recognized technologies:
  - a. "Full Color" Light Emitting Diode (LED)
- 2. Brightness: not less than 7500 nits with 16 levels of illumination, including 0%, 25%, 75% and 100%.
  - b. These illumination levels shall be able to be preset to simultaneously switch brightness and gamma correction to accommodate the following common game conditions:
    - 1) Direct Daylight
    - 2) Indirect daylight/overcast days
    - 3) Afternoon/evening
    - 4) Night (with field lighting)
    - 5) Night (without field lighting)
  - c. A method of accommodating automatic brightness control based on sunlight shall be supported.
  - d. Brightness shall not fall below (at 100% white generated at external input):
    - 1) 7500 nits within first 20,000 hours of operation after acceptance.
  - e. Uniformity of brightness:
    - 1) Adjacent pixels 2.25%,
    - 2) 7% total variation across entire display, brightest to darkest pixel/module.
    - 3) Uniformity standards to apply over entire viewing angle specified with no perceptible color shift.
- 3. 140° minimum horizontal angle (defined as 50% brightness) of viewing and 50° (nominal +10/-40° with screen vertical) of vertical. Color temperature to remain constant over 50% brightness viewing angle range.
- 4. Color temperature of display: 7,000-9,300° Kelvin. With a uniformity of 250°K between adjacent pixel with remote set-up and control to adjustment and balance of any pixel/module in display to match overall display color temperature through 20,000 hours of use.
- 5. Joints, seams or modules out of plane with the rest of the display, due to mechanical alignment of modules, units, louvers, secondary seals or artifacts will not be acceptable.
- 6. IP rating of not less than 64 front and back.
- 7. Fill ratio: 4% minimum of LEDs (illuminated) area to non-illuminated area.
- 8. Physical Pixel spacing (resolution): refer to Schedule of Displays.
- 9. Size: refer to Schedule of Displays.
- 10. Display must be able to be completely serviced from rear of screen (module replacement occurs from rear of screen)
- 11. Display shall be flicker less, and free of all image processing artifacts such as image stuttering, frame dropping or skipping of any portion of the image display.
- 12. Compliance
  - a. Entirety of LED displays (not just individual module) must comply with FCC regulations.

### B. Video/Scoreboard Processor

- 1. The processor shall be configured to support the following inputs:

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## STADIUM LED DISPLAY SYSTEMS

- a. HD/SDI input supporting Digital Television (DTV) Production standards (e.g. 480p; 720p, 1080i).
  - b. HDMI/ DVI.
  - c. HD-SDI being preferred
2. Provide connections, cabling and appropriate backups from control room (field level, Video Control) to board to support switching between the following connections (simultaneous display is not a requirement):
  - a. SMPTE 292, HD-SDI (e.g. 480p; 720p, 1080i).
  - b. SMPTE 424M; 3G-SDI is desirable. If this adds significant cost, please identify removal as a VE.
3. Remote operation will be for a processor which responds to the VDCP protocol common in production switchers which allows for effects (in this case processor transitions) to be queued, run, and rewound. Note: VDCP over Ethernet has been supported/operated to date and is preferred implementation.
4. Processor shall output an HD-SDI signal to video control/video replay system which represents a composite of the same "feed" which is being sent to the video display.
  - a. If these requirements place significant cost burden on the processor, indicate savings achieved with a more limited approach within the VE portion of the proposal form.
  - b. If computers are employed as part of the LED Video display system, they shall meet these specification requirements as well as:
5. Un-interruptible Power Supply (UPS). Provide UPS on screen processor(s), electronics, etc. that may be disrupted by momentary loss of power. UPS shall be designed to support signal processing path (not display) for 180 seconds.
  - a. If a computer is used as part of the processor—or used for remote control or any other functions of the video board—provide a complete backup computing system running in a full-time, on-line backup mode with appropriate disk mirroring.

## 2.5 RGB LED MATRIX DISPLAYS (FASCIA/RIBBON)

### A. RGB LED Matrix Display

1. Technical Standards:
  - a. The RGB Matrix Display shall incorporate LED direct view technology.
  - b. Brightness: Not less than 7500 nit with 16 levels of illumination, including 0%, 25%, 75% and 100%.
  - c. Brightness shall not fall below (at 100% white generated by external input):
    - 1) Outdoors
      - a) 5,000 nits within first 20,000 hours of operation after acceptance.
  - d. Uniformity of brightness:
    - 1) Adjacent pixels 2%,
    - 2) 8% total variation across entire display, brightest to darkest pixel/module.
    - 3) Uniformity standards to apply over entire viewing angle specified with no perceptible color shift.
  - e. 120° minimum horizontal angle (defined as 50% brightness) of viewing and 60° (nominal  $\pm 30^\circ$  with screen vertical) vertical. Color temperature to remain constant over 50% brightness viewing angle range.
  - f. Color temperature of display: 7,000-9,300 Kelvin. With a uniformity of 250 K between adjacent pixel with remote set-up and control to adjustment and balance of any pixel/module in display to match overall display color temperature through 10,000 hours of use.
  - g. Fill ratio: 4% minimum of LEDs (illuminated) area to non-illuminated area.
  - h. Pixel spacing: refer to Schedule of Displays
  - i. Size: refer to Schedule of Displays
2. Displays to be top service.

3. Gaps in fascia displays shall not be larger than 125% of the pixel spacing of the displays (i.e.; 20 mm, 25 mm maximum gap between adjacent sections). Sections spanning expansion joints to feature "slip joints" attachments to minimize or eliminate gaps.
4. Joints, seams or modules out of plane with the rest of the display, due to mechanical alignment of modules, units, louvers, secondary seals or related artifacts will not be acceptable.
5. Un-interruptible Power Supply (UPS). Provide UPS on screen processor(s), electronics, etc. that may be disrupted by momentary loss of power. UPS shall be designed to support signal processing path (not display) for 180 seconds.
6. Enclosure.
  - a. Provide attachments and enclosure for fascia displays.
  - b. Enclosure dimensions, shape and finish to be coordinated to ensure that all fascia mounted enclosures match in appearance and are approved by Owner's Representative
  - c. Provide end caps, close out bezels or covers for sides and bottom of displays
  - d. Verify that sightlines to field are not obstructed
7. Provide any required other items for installations, operation, maintenance, and repair of RGB Matrix Display.
8. The internal module structure, supports, attachment and anchoring members, mounting hardware shall be provided in accordance with engineering standards and governing codes.

## 2.6 DISPLAY CONTROL COMPONENTS

- A. Provide all applicable control system software updates for a period of 10 years after substantial completion at no additional cost.
- B. Control electronics.
  1. Noise level attributed in any operating mode of control/processing/server equipment shall be no more than NC 35 at the nearest operator location.
  2. Video screen electronics remote control system to provide complete screen remote control of:
    - a. Brightness level
    - b. Display power on/off (from control computer/console/processor)
    - c. Video signal on/off
    - d. Video Input Selection
      - 1) Includes remote activation and deactivation by a contract closure from the video replay system production switcher
    - e. Image positioning, sizing, and scaling
    - f. Color level
    - g. Hue
    - h. Contrast
    - i. Sharpness
    - j. Color display test, and address location. This pattern shall include a map that corresponds to the address of each unit's physical address as well as a red, green, blue and white color scroll for all inputs over the entire display. Typical pattern:
      - 1) Red – Map, Green – Map, Blue – Map, White – Map
    - k. These controls shall be provided for all inputs to control system processor.
- C. General Configuration
  1. Computer based control system hardware shall exhibit sufficient computer processor power and speed to generate images instantly on command without lag, sputter, or stutter during recall, operation, and display. The specific requirements listed below are minimums. All computers in the system to include identical motherboards, CPU and memory configurations.

2. Images must be able to move smoothly through the entire area of the display. Flicker-less display for both static and moving images. Image control and distribution system to allow the display of smoothly moving images with no flicker, jerking, and "stop motion."
  3. Displays to be programmed to show game in progress statistics.
  4. Software packages and control electronics shall provide specified operational features. Game scoring and clock function data is existing.
  5. All control system software and messages shall be stored in non-volatile (disk) format.
  6. Back-up computing and redundancy.
    - a. Network server and centralized file storage shall incorporate fully on-line, completely redundant processing (or mirror masters), including duplicate storage devices (ie; RAID arrays).
    - b. All computers, processors, and control panels shall be inter-networked.
    - c. Computer system shall be fully redundant with back-up, mirror processors on-line.
  7. Computer System shall be able to import common computer interchange graphic file formats (e.g. AVI, TIFFs, GIFs, DVI, etc.)
  8. All distributed processing computers shall be located in physically accessible spaces (e.g. control room, riser closets). Above ceiling mounting is not acceptable.
  9. Computer and control equipment sound levels at any operator or control position shall not exceed NC 40.
  10. Minimum Workstation specifications:
  11. Different configurations which meet these standards are acceptable. All computers in this system to be of same manufacturer with identical specifications and features.
  12. Processor: as required to meet specified operating performance without noticeable delays or productivity impediments.
  13. Rack Mounted
- D. Un-interruptible Power Supply (UPS). Provide UPS on screen processor(s), electronics, etc. that may be disrupted by momentary loss of power. UPS shall be designed to support signal processing path (not display). UPS to have 90-minute capacity for the electronics used to generate and maintain the emergency message, unless that equipment is on generator power, in which case the UPS can be rated for 15 minutes
- E. Provide the following workstations in the Electronics Room 206 area of Press Level:
1. Video display Controllers; Primary and back-up
  2. Fascia display Controllers: Primary and back-up

## 2.7 BACKLIT SIGNAGE

- A. Illumination
1. White, high brightness LED.
  2. Lighting coverage to be evenly distributed throughout display without visible dark spots.
- B. Face
1. Depth: dependent on layout with aluminum returns and backs of a sufficient thickness to prevent buckling, oil-canning or visible warping.
  2. Height: as shown on schedule and renderings
  3. Front Face to be as dictated by Owner
  4. Transformers mounted either inside assembly or on catwalks.
  5. UL connectors and toggle disconnects with neoprene boot - Outdoor
  6. Supporting Structure—to match depth and appearance of entire assembly.
  7. Controls: from scoreboard/PA room.

## 2.8 LED GRAPHICS AND ANIMATION

- A. Provide service to reconfigure existing animations and graphic images on Chyron Hego Crossfire/Blaze to be displayed on new displays.

## 1. Chyron Hego COMM OS3

## B. Proofing Process

1. It is anticipated that the development of these animations and graphics will be something of an iterative process, working with the team to arrive at a suitable graphic appearance and look.
2. Where multiple versions are noted, it is likely that some of the additional versions may be sponsored.
3. Some animations will require multiple reviews to arrive at finished, playable product.
4. Video display animations shall be delivered at full 1920x1080 resolution and possibly in at least two codecs based on team preference. Verify preferences for delivery.
5. Software rights
  - a. Provide each graphic and animation in an editable, layered file format (e.g. Photoshop and After Effects, etc.) so that team can make corrections during the season (e.g. add players as the season progresses).

## C. All animations must be accepted by the owner or owner's authorized marketing agent.

1. As with all custom animations, it is expected that the review process will be iterative and that 2-3 submittals might be required to arrive at final accepted animations.

## 2.9 GENERAL DISPLAY SYSTEM SUPPORT EQUIPMENT

## A. There is space available in the existing equipment racks. If additional or new is required, these racks are to be frame and panel type constructed of 16-gauge cold-rolled steel. Racks to have locking rear door mounted on the frame (not the rails). Empty mounting panel spaces to be filled with blank or vent panels, in a finish to match rack. Provide end panels and top panels as required. Provide shelving as required for equipment mounting within racks. Provide rack supports as required. Provide seven rack keys of each type. Rack color to be gloss or flat black. Include extra set of mounting rails in each rack for rear support of panels or equipment. Verify exact rack space required.

1. Support Equipment
  - a. Blank Panels
  - b. Rack screws
  - c. Power distribution
  - d. Rack light
  - e. Rack Shelves:
  - f. Horizontal Cable Management

## B. Network Switch

1. Connect to existing. If existing unit is insufficient, replace per University standard

## C. Keyboard, Video, Mouse Matrix Switcher/extender

1. Connect to existing. If existing unit is insufficient, replace.

## 2.10 FIBER OPTIC CABLING AND TERMINATIONS

## A. Fiber Optic Termination Panels

1. Optical Fiber Rack Mount Patch Panel
  - a. 2U Panel, 24 – 48 Port
2. Fiber Pigtails Single
3. Termination Panel Inserts
  - a. Single Density, Loaded with 3-SC single mode
  - b. Double Density, Loaded with 6-SC single mode
  - c. Blank Strip

## B. Fiber Optic Connectors

1. Single Mode Pigtails
  - a. ST Pigtail (12 Fiber Strands)
  - b. SC Pigtail (12 Fiber Strands)
  - c. SC Angle Polish (APC)
2. Single Mode fiber optic patch cords
  - a. Simplex single mode patch cords
    - 1) SC Patch Cord
    - 2) ST Patch Cord
  - b. Angle Polished (APC) SC single mode Patch Cord

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. All equipment and materials shall be new. Take care during installation to prevent scratches, dents, chips, etc.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least three. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommets.
- D. AC Power and Grounding
  1. Adhere to all local and national electrical codes and standards.
  2. Label power distribution equipment (e.g. breaker panels, disconnects, and load centers) as to that portion of what module is being served by that device (e.g. breaker).
- E. All engraving shall be 1/8" block sans serif characters unless noted otherwise. On dark panels or push buttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored push buttons, letters shall be black.
- F. Equipment and Cable Labeling
  1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Mount labels in a neat, plumb and permanent manner. Embossed labels are not acceptable. Equipment labels to have at least three lines of engraving with the first line listing the general name of the device. The second line to include the schematic reference of the device. The bottom line to indicate what other devices or areas this equipment controls.
  2. Provide an engraved label over each user-operated control that describes the function or purpose of the control. Label size to be adjusted to fit available space.
  3. Engraved labels to have 1/8" high characters minimum. Labels to be black with white characters except where indicated.
  4. Cables, and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.
  5. Wiring designations to be an alphanumeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 3" of the point of termination or connection. For cable runs that have intermediate splice points, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Installer.



- Add cable designation codes to system schematic drawings included with Project Record Drawings.
6. Label each terminal strip with a unique identification code in addition to a numerical label for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Drawings.
  7. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

- G. No Unistrut or Kindorf allowed in any location visible to the public.

### 3.2 INSTALLER TESTS AND ADJUSTMENTS

- A. Verify the following before beginning actual tests and adjustments on the system:
1. Electronic devices are properly grounded.
  2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly
  3. Insulation and shrink tubing are present where required.
  4. Dust, debris, solder splatter, etc. is removed.
  5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
- B. If requested by Owner, Installer shall contract with independent testing agency/consultancy to verify LED display performance as part of this scope of work, to determine:
1. Overall screen brightness (peak)
  2. Uniformity testing
    - a. Separate measurements (brightness and color temperature) shall be made to verify uniformity at:
      - b. Peak/maximum brightness (recommended direct sunlight operating brightness).
      - c. Typical operating brightness
      - d. Evening/nighttime operating brightness
    - e. Brightness uniformity (pixel to pixel and module to module)
      - 1) Intra-module
      - 2) Between modules
      - 3) Sampling techniques are acceptable, provided:
      - 4) Number of samples is not less than 20% of the total display's pixels.
      - 5) Samples are spread throughout the screen
      - 6) Samples run width of screen
      - 7) Best case to worst case
    - f. Color temperature uniformity (pixel to pixel and module to module)
      - 1) Intra-module
      - 2) Between modules
      - 3) Sampling techniques are acceptable, provided:
      - 4) Number of samples is not less than 20% of the total display's pixels.
      - 5) Sample is spread throughout the screen
      - 6) Best case to worst case
  3. Viewing angles:
    - a. Horizontal
    - b. Vertical
    - c. Defined as 50% of peak brightness, or at the point a noticeable color shift occurs.
  4. Meets FCC compliancy. Testing might be required, if requested by Owner, adjacent property owner or government agency.
  5. Tests to be performed in accordance with manufacturer's installation and service manual on displays when physically installed at the site, with a "normal" video signal that is injected at the control room, or at the board. Tests on display elements or modules prior to installation are not acceptable.

6. Test report shall include full documentation on test procedure, instruments employed (including model number and serial number) and copy of instrument calibration certification.
- C. Color temperature of all displays to be adjusted to be within a maximum range of 10%, while maintaining absolute values stipulated in this specification.
- D. Preparation for Acceptance, prior to final inspection:
  1. Temporary facilities and utilities shall be properly disconnected, removed and disposed of off-site.
  2. All systems, equipment and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
  3. All materials shall be neat, clean and unmarred and parts securely attached.
  4. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. shall be replaced or properly repaired, and debris cleaned up and discarded.
  5. All extra materials, portable equipment, and spares shall be delivered and stored at the premises as directed.
  6. All as built documentation, record drawings, operations and maintenance manuals, and test data must be presented prior to or during acceptance as determined by Owner's representative.
  7. Verify each component is working properly
  8. Verify each individual component's performance meets manufacturer's published performance for this unit.
  9. Verify proper operation from controlling devices to controlled devices.
  10. Verify proper adjustment, balance and alignment of equipment for optimum quality and to meet the manufacturer's published specifications
  11. Verify that all communications and networking services are provided and in proper working condition
  12. Establish and mark normal settings for each level control and properly record these settings within the "Systems Operation and Maintenance Manual."
    - a. For software controls, "screen shots" of the relevant menus, pages or dialog boxes shall be made. Additionally, software presets shall be recorded to "disc" permitting full recall.

### 3.3 TEST EQUIPMENT

- A. Provide test equipment for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, provide a list to the Owner/Owner's Representative of test equipment make and model numbers that will be used.
  1. Dual-trace oscilloscope: 100 Mhz bandwidth, 1 mV/cm sensitivity, TV trigger.
  2. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A.
  3. Television signal generator: Tektronik.

### 3.4 ACCEPTANCE

- A. Upon completion of installation and initial tests and report specified in Part 3, acceptance testing shall be performed by the Owner's Consultant.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary. Installer will assist in this testing and provide any test equipment required specified herein. Installer shall provide at least 2 technicians available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Installer. Testing process is estimated to take a minimum of 3 days. Testing to include

demonstration of Stenograph and Sports Ticker/other outside service, data input capability. Provision of stenograph equipment and Owner as required, is the responsibility of the Installer.

- C. The following procedures will be performed on each System:
1. Assessment of all display images.
  2. Provide test pattern on all new displays for Owner's Representative to review. Pattern to include:
    - a. A rotation of red, grid, blue, grid, green, grid, white, grid.
    - b. Grids to have letter and/or number or combination of both within each grid box representing module.
    - c. Rotation to be able to be easily accessed and automatic.
  3. Physical inspection of displays
  4. Review of animations
  5. Review of scoring and clock functions.
  6. Review of system operation on redundant cabling.
  7. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
  8. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each adjustable control with small white, adhesive dots, and record these settings, in the "System Operation and Maintenance Manual."
  9. Provided and loose equipment will be inventoried for correct quantity.
  10. Testing to include demonstration of Stenograph and Sports Ticker data input capability. Provision of stenograph equipment and operator as required, is the responsibility of the Installer.
  11. Any other test on any piece of equipment or system deemed appropriate.
- D. In the event the need for further adjustment or work becomes evident during setup and/or acceptance testing, the Installer will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Installer will pay for additional time and expenses of the Owner's Representative.
- E. The Owner's Consultant's fees and costs involved in acceptance testing are not the responsibility of the Display System Installer, except as described in Part 3 of this specification.
- F. Final acceptance will follow the successful control system operation at the completion of the team's first two home games.

### 3.5 DEMONSTRATIONS

- A. Provide 12 hours instruction to Owner designated personnel on the use and operation of the System, scheduled as a minimum of 3 separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction. Coordinate schedule of demonstration with Owner's Representative and Owner. At direction of Owner or tenant, a portion of training time may be deferred to end of, or at any point during the first regular season as follow-up sessions to enhance Owner's ability to maximize performance of system.
- B. Training Schedules
1. Training should be assumed to take place on the project site, unless agreed to by the Owner.
  2. Training should be scheduled to be non-overlapping, unless agreed to by the Owner.
  3. Actual training schedule shall be by agreement with Owner. Do not assume that training will occur over 8-hour days. It is more likely that training will be scheduled in 3 to 6-hour increments; perhaps over a period of weeks (or even months).

4. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, then the training time shall be extended an equal amount of time.
- C. The following is a general idea of the training “curriculum”:
  1. A general familiarization of the Owner's representative(s) of the device.
  2. An explanation of how the device interfaces to the rest of the system (including data connections; timing requirements and the like).
  3. General training on operating the device.
  4. Specific training on device operation (e.g. entering statistics; how to access data retrieval sources; how to create repeatable formats and layouts, changing fonts, loading new fonts).
  5. Saving information; backing information up (including a review of the proper procedures for backing up).
  6. Basic troubleshooting
  7. Specific troubleshooting (this information may be conveyed to personnel other than the device's “Owners”).
  8. How to upgrade software; precautions taken while doing (e.g. backing-up existing software, don't be the first one to try the new software on game day).
- D. In addition to training noted above, the software/template trainer shall be present at four MLS games and two other events as designated by the Owner.
- E. In the event that the LED Display system is used prior to final acceptance, attendance in support of said usage shall not be construed as acceptance, or as event attendance.

#### PART 4 - DEFINITIONS AND TERMS FOR SCHEDULE OF DISPLAYS

##### 4.1 DISPLAY LEGEND

- A. Unique Identification
  1. LOC—Location of Display
  2. QTY—Quantity of units
- B. Dimensions
  1. HT—Height of Active Display area (excluding, trim, etc.), in inches.
  2. WD—Width of Active Display area (excluding, trim, etc.), in feet.
  3. TOL—Tolerance, expressed as a percentage of Height or Width. Allowable variation to base size.
  4. MAX HT—Maximum height of display, including all cabinet, trim, etc. (inches unless otherwise noted). This dimension is generally set by sight lines and cannot be exceeded within base proposal.
- C. TYPE—Technology Type
  1. LAMP—Full color, bulb, through hole light emitting diode (LED)
  2. SMD—Full color, surface mount, light emitting diode (LED)
  3. MONO—Monochrome, light emitting diode (LED)
  4. FD—Fixed digit, light emitting diode (LED)
  5. BL—Back lit panel
  6. FL – Front Lit panel
  7. STAT – Static non-illuminated panel
- D. TARGET RES—Absolute Desired Pixel Resolution expressed in mm (higher resolution products are implicitly allowed; within the available power limitations).
- E. USE – Purpose of Display

- F. MIN PIXELS – minimum horizontal and vertical resolution
- G. Notes--

## PART 5 - SCHEDULE OF DISPLAYS

LOC	Q T Y	HT X WD	TOL	MAX HT	TYPE	RES	USE	TARGET PIXELS	NOTES
Main South	1	44' x 134'	2%	44'	LAMP	16mm	Video, Animation, ads, crowd prompts, info	823 x 2538	Video
Main South	2	22' x 44'	2%	22'	BL		Advertising		Sides
Main South	1	3' x 178'	2%	3'	STAT		Advertising		Below
Ribbon	1	2.6' x 300'	2%	3'	LAMP	16mm	Game in Progress, Advertising, Crowd Prompts	46 x 5750	East
Ribbon	1	2.6' x 300'	2%	3'	LAMP	16mm	Game in Progress, Advertising, Crowd Prompts	46 x 5750	West

## PART 6 - ALTERNATES TO BASE BID

- A. Alternate A - Cost to change base bid Main South LED video display properties:
1. A-1: 15mm interleaved pixel technology
  2. A-2: 12mm discrete lamp
  3. A-3: 13 mm interleaved pixel technology
  4. A-4: 12mm SMD
  5. A-5: 9,000 nit product
- B. Alternate B – Cost to change base bid east and west LED ribbon/fascia properties:
1. B-1: 15mm interleaved pixel technology
  2. B-2: 13 mm interleaved pixel technology
  3. B-3: Replace base bid with 3' x 485' at 16mm
  4. B-4: Replace base bid with 3' x 485' at 15mm interleaved pixel technology
  5. B-5: Replace base bid with 3' x 485' at 13 mm interleave pixel technology
- C. Alternate C – Remove animation re-creation requirement.
- D. Alternate D – Remove network switch requirement.
- E. Alternate E - Service Contract for parts and labor for Years 3 through 10 for the scope of work covered under 11 63 10. Pricing shall remain in effect until the end of the warranty period or until the Owner accepts or declines this service contract whichever occurs first.
1. Requirements of service contract.
    - a. All costs for US factory parts repair or replacement shall be included.
    - b. Following expiration of warranty period, owner will remove failed components from display (scoring or video) and ship, at owner's expense, to US repair depot.
    - c. Installer (or installer's Supplier) shall repair or replace components and ship to owner, at installer's expense using next-day delivery for Tuesday to Saturday deliveries (in Morgantown, WV). Installer shall ship repair parts, within 24 hours of request of owner, prior to their receipt of failed part.
    - d. Repair and return shipment shall be in a timely fashion to maintain display operation.
    - e. In the event of parts failure of more than 5% of any component of the display(s), the installer shall dispatch to the site, at installer's cost, factory technicians to assess cause, and means of returning to operation. Site visit timing shall be coordinated with owner, and in the event that adequate notice is provided (36-48 hours), shall be provided prior to stadium events where more than 50% of the facilities seating capacity is expected.
  2. Individual Costs of years 3 through 10.
    - a. E1 - Year 3 costs.
    - b. E2 - Year 4 costs.
    - c. E3 - Year 5 costs.
    - d. E4 - Year 6 costs.
    - e. E5 - Year 7 costs.
    - f. E6 - Year 8 costs.
    - g. E7 - Year 9 costs.
    - h. E8 - Year 10 costs.
    - i. E9 - Provide sum of years 3-10 and indicate if discount is given for selecting all years.
      - 1) Note if Options increase or decrease these values, indicate savings (or additional cost)
- F. Option F – Cost to provide annual pre-season “health check” for display systems for years 3 through 10 for the scope of work covered under 11 63 10. The intent, to the extent possible, is

to bring the system up to as new operating condition and performance. Pricing shall remain in effect until the end of the warranty period of until the Owner accepts or declines this service contract whichever occurs first.

1. Requirements of the contract:
  - a. Inspection and preventative maintenance on all components in the system.
  - b. Washing or cleaning of displays (if required)
  - c. Updating system software
  - d. Verification of all control and display equipment
  - e. Repair (from Owner's spare inventory) all displays and control equipment.
    - 1) Individual Costs for years 3 through 10.
    - 2) F1 - Year 3 costs.
    - 3) F2 - Year 4 costs.
    - 4) F3 - Year 5 costs.
    - 5) F4 - Year 6 costs.
    - 6) F5 - Year 7 costs.
    - 7) F6 - Year 8 costs.
    - 8) F7 - Year 9 costs.
    - 9) F8 - Year 10 costs.

G. Option G – Value Engineering and Voluntary Alternates

1. G-1: Cost for vendor proposed alternate displays. Include entire scope, as a list of displays and equipment with proposal.
2. G-2: Cost to delete a requirement of the specification that can save the Owner significant cost. Describe alternate and consequences, if any, for functionality, reliability and/or performance.



## PART 7 - PERFORMANCE STANDARDS – LIST FOR EACH DISPLAY TYPE

## 7.1 RGB LED BOARD DETAILS

Option Number: \_\_\_\_\_ Location: \_\_\_\_\_

LED Manufacturer and Bin #: \_\_\_\_\_ Model: \_\_\_\_\_

Product being manufactured and its package/assembly location \_\_\_\_\_

**Overall** Display Size (measured from pixel  
to pixel; not including cabinet) in fractional  
units (e.g. 18'5')

Vertical \_\_\_\_\_ feet

Horizontal \_\_\_\_\_ feet

**TOTAL PHYSICAL** Pixel Lines

Vertical \_\_\_\_\_ mm

Horizontal \_\_\_\_\_ mm

TOTAL NUMBER OF **PHYSICAL** LEDsLEDs/each display  
\_\_\_\_\_TOTAL NUMBER OF **PHYSICAL** PIXELSPixels/each display  
\_\_\_\_\_Manufacturer/Supplier of 3-in-1 or discrete/thru hole LEDs  
\_\_\_\_\_**Brightness**Nits  
\_\_\_\_\_

Brightness Level adjustment \_\_\_\_\_

Color Temperature \_\_\_\_\_ °K

**Viewing Angle**

Vertical \_\_\_\_\_ degrees V Up/Down

Horizontal \_\_\_\_\_ Degrees H

**Power Consumption**

Average (each video display) \_\_\_\_\_

Maximum (each video display) \_\_\_\_\_

**Display Weight**

Total per display \_\_\_\_\_

Total per cabinet/section \_\_\_\_\_

END OF SECTION

## 26 51 13 - SPORTS LIGHTING SYSTEMS

## PART 1 - GENERAL

## 1.1 SECTION SUMMARY

- A. This performance specification is intended to convey guidelines for the design and build of a turn-key system of sports lighting and controls for the West Virginia University Coliseum.
- B. The Contractor shall provide design and engineering, to meet the requirements of this performance-based specification. The Contractor shall be responsible for making the field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of this system.
- C. The Contractor shall be responsible for all materials, equipment, transport and labor necessary to provide a complete and working system.

## 1.2 RELATED DOCUMENTS

- A. Drawings
  - 1. Theatrical Lighting (TL-series)
  - 2. Architectural (A-series)
- B. Related Work Specified Elsewhere:
  - 1. Section 11 61 62: Event Lighting and Controls
- C. General provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.

## 1.3 SECTION INCLUDES

- A. Coordination, provision, installation, inspection, commissioning, testing, instruction and warranties of the Sports Lighting System. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and proper System.
- B. Wiring, Cabling and Accessories
  - 1. Network and eDMX cabling
  - 2. DMX and/or 0-10V cabling
  - 3. Architectural control cabling
  - 4. Multi-conductor flat cabling
- C. Control Equipment
  - 1. Architectural lighting control processors
  - 2. Architectural control devices
  - 3. Network Control equipment
  - 4. Control equipment racks and rack components
  - 5. DMX control and/or 0-10V control equipment
- D. LED sports lighting fixtures
  - 1. New LED sports lighting fixtures to replace existing on a one to one basis
  - 2. Any mounting adjustments as required on the existing catwalks
  - 3. Provide an additional line item to replace 15% fewer fixture with LED

## E. Also includes:

1. Required licenses and permits including payment of charges and fees.
2. Verification of dimensions and conditions at the job site.
3. Provision of submittal documents.
4. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
5. Extension of electrical service, including ground, to equipment locations.
6. Documented tests and adjustments.
7. Provisions of manuals.
8. Maintenance services and warranty.

## F. Electrical:

1. Power is provided for this work at locations shown on the as-built electrical drawings or other drawings/information. Power will be terminated to a junction box within or near the equipment enclosure. The contractor shall be responsible for any and all electrical power & coordination of the termination required within the electrical junction box.
2. The contractor shall be responsible for connecting ground point to all equipment in accordance with NEC Code, local codes and standards specified herein.
3. Conduit infrastructure system, including wire for AC Power and grounding for the System(s), are to be included in this project. Coordination between different disciplines is required to achieve a proper conduit system installation and power provisions for the System(s). All electrical installation shall be in accordance with overall Division 26 provisions and applicable codes.

## G. Demolition:

1. All existing sports lighting fixtures that are being replaced by new LED fixtures are to be removed and disposed.

## 1.4 REFERENCES

## A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:

1. American National Safety Institute (ANSI),
2. American Society of Testing and Materials (ASTM),
3. Electronics Industries Association (EIA),
4. Institute of Electrical and Electronic Engineers (IEEE),
5. National Electrical Manufacturer's Association (NEMA),
6. National Electrical Code (NEC),
7. National Fire Protection Agency (NFPA),
8. Underwriters Laboratories (UL),
9. Occupational Safety and Health Administration (OSHA),
10. Professional Lighting and Sound Association (PLASA),
11. Entertainment Services and Technology Association (ESTA)
12. United States Institute of Theater Technology (USITT)

## 1.5 DEFINITIONS

## A. In addition to Division 1 definitions the following list of terms as used in the Section shall be defined as follows:

1. Owner – West Virginia University
2. Project - Coliseum
3. Consultant – The Owner's Technical Representative for this Section
4. Architect – N/A
5. End User – West Virginia University
6. Contractor - The designer, engineer and provider of all systems in this section.

7. Furnish - To purchase, procure, acquire, and deliver complete with related accessories.
8. Install - To set in place, join, attach, link, set up or otherwise connect together and test until complete before turning over to the Owner, all parts, items, or equipment supplied by Contractor.
9. Provide - To furnish and install

## 1.6 DESCRIPTIONS AND REQUIREMENTS

- A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the Sports Lighting System. Refer to the documents notes in paragraph 1.2 above for further information relating to this Section.
- B. General: Main Court/Arena
  1. Propose an LED fixture selection and develop a layout to meet the requirements as laid out in this Section. Fixture selection and layouts to be based on coordination layouts shown on the AV sheets. Existing fixture to be replaced on a one to one basis.
  2. All sports lighting fixtures in the Main Court shall mount at the lighting catwalk level as shown on the drawings. Fixtures shall utilize the upper railing of the catwalk system in existing locations, leaving the lower railing free for Owner/user installation of specialty event lighting and accessories.
  3. All fixtures shall circuit to existing lighting panel-boards as shown on the as-built E-series drawings. Contractor shall coordinate electrical load requirements associated with the system. Field verify all conditions.
  4. All fixtures shall be individually dimmable via DMX-512 and/or 0-10V. Dimming capability shall be continuous within the range of 1%-100% of the fixture's rated output.
- C. Arena - Lighting Control System:
  1. The existing Payne Sparkman control system is to be reused & upgraded with interface as required. Refer to the example retrofit page at the end of the specification.
  2. If required for a complete system provide a networked lighting control system for the arena. This may include:
    - a. Portable and fixed control stations.
    - b. Wireless and fixed controlled LCD touchscreens.
    - c. Architectural control processors, related network equipment, enclosures, cabling and accessories.
    - d. Integrated emergency-bypass detection and override devices.
  3. Provide a robust DMX/eDMX (i.e. DMX over Ethernet) and/or 0-10V lighting control network. This shall include:
    - a. DMX and eDMX control receptacle stations.
    - b. DMX/eDMX splitters, network gateways and nodes.
    - c. Network switch gear, patch panels, cabling, and other auxiliary equipment as required.
    - d. Provide additional network switches, hubs, or fiber-optic network links as required to achieve a properly operating system as appropriate to cabling distance limitations and the intended use of the facility.
- D. Distribution System:
  1. Provide DMX and 0-10V controlled panel-boards to serve the sports lighting loads as described on the drawings.
  2. Provide junction boxes distributed throughout the arena catwalks for the lighting loads as required.
  3. Verify all electrical circuits and label all circuit numbers as specified
- E. Distribution System:
  1. Provide DMX and/or 0-10V controlled panel-board in an enclosure with control electronics to serve sports and architectural lighting fixtures as shown on the drawings.

2. Verify all electrical circuits and label all circuit numbers as specified
- F. Primary Performance Requirements: Main Court
1. Fixture selection and layout shall meet the following minimum NCAA National Broadcast basketball lighting levels as follows:
    - a. Horizontal Illumination: 150fc
    - b. Horizontal Uniformity (Max/Min): 1.7:1
    - c. Main Center Camera Vertical Illumination: 100fc
    - d. Max/Min Uniformity Ratio (Main Center Camera): 1.7:1
    - e. End Camera Vertical Illumination 60fc
    - f. Max/Min Uniformity Ratio (End Camera): 2.5:1
  2. Minimum CRI: 75
  3. Nominal color temperature: 5000K; Contractor shall verify color temperature with the Owner and Design team.
  4. Contractor shall provide the Owner with documentation of (1) all intended engineering-phase lighting levels intended by the design, and (2) field measurements representing the completed and installed work. These shall be formatted as required for use by the Owner, the NCAA, and all broadcast partners.
- G. Secondary Performance Requirements: Main Court
1. Provide selection, layout and aiming so that controllable minimum lighting levels are maintained off of the playing surface toward the seating areas as follows:
    - a. 70% of primary lighting levels within 10ft of court boundary
    - b. 50% of primary lighting levels within 30ft of court boundary
    - c. Levels may be achieved in conjunction/coordination with the architectural lighting fixtures.
  2. Contractor shall make all effort to minimize glare
    - a. at players' line of sight to basketball goals; no fixture shall be located within the baseline zone at an angle of less than 10-degrees from each sideline.
    - b. to seated patrons at the event floor level.
- H. Control System Integration
1. Control of the architectural and sports lighting fixtures within the arena bowl shall interface with the Event Lighting Control System (11 6163) scope of work. The intent is for both systems to communicate and have the ability to work independently or to combine functions and presets as required by the Owner.
  2. Sports lighting system Contractor shall:
    - a. Provide sample fixtures to the Owner and control system manufacturer. These shall be used to verify and demonstrate DMX and 0-10V control capability prior to shipping and installation of the completed product.
    - b. Develop the light level/preset requirements for the following facility uses:
      - 1) general cleaning and maintenance
      - 2) event set-up
      - 3) athletic practice
      - 4) sports events
      - 5) concert events
      - 6) meeting, convocation, and convention events
      - 7) as directed by the Owner.
    - c. Coordinate designation of fixtures intended for use on the emergency lighting riser so that minimum safe lighting levels are maintained per the general requirements of the project and all applicable local codes. Verify operation of DMX control network bypass.
    - d. Verify all lighting levels noted above for the Owner at commissioning.
    - e. Interface shall be RS-232 or Ethernet based as required by the third-party controls.

- f. Emergency lighting detection and bypass to ensure that architectural and sports fixtures designated to operate from the facility's standby power riser shall operate as required by the general requirements of the project and all applicable local codes.
3. Control system installation, product selection, and programming shall provide for redundant/backup control operations of all architectural control processors such that failure of any single unit in the system shall not prevent continuous and proper operation of the system as a whole.
- I. Additional Control System Provisions
  1. Contractor shall be responsible for communicating and coordinating all installation and termination requirements related to the DMX and 0-10V control network prior to installation.
  2. It is the Contractor's responsibility to verify proper operation on the ground before fixtures are permanently installed in inaccessible spaces.
  3. Provide any additional architectural lighting control interfaces that may be required based on the final architectural lighting fixture selection for the facility. This may include DMX, 0-10V, DALI, etc.

#### 1.7 RESPONSIBILITY AND RELATED WORK

- A. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Contractor is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems. Coordinate the work with the General, Electrical, AV and other related contractors as stated in the paragraphs above, and the scheduled work of other trades.
- B. Coordination between different disciplines is required to achieve a proper conduit system and power provisions for installation of the Sports Lighting Systems. All electrical installation shall be in accordance with Division 26 and the National Electric Code.
- C. Supply accessories and minor equipment items needed for a complete and fully operational system, even if not specifically mentioned in this Specification or on the associated drawings, without claim for additional payment.
- D. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Sports Lighting System Contractor to provide systems in full working order. Notify the University of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires Sports Lighting System Contractor to supply items and quantities according to the intent of the Specification and associated Drawings without claim for additional payment.
- E. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.
- F. Execute all work in accordance with the National Electrical Code, the National Electrical Safety Code, and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the University prior to bid opening, the University will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

#### 1.8 QUALITY ASSURANCE

- A. Contractor's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:

1. No less than five years' experience with equipment and systems of the specified types.
  2. Experience with at least five comparable scale projects within the last two years.
  3. Be a franchised dealer and service facility for the manufacturer's products furnished.
  4. Maintain a fully staffed and equipped service facility.
  5. At the request of the design consultant, demonstrate that:
    - a. Adequate plant and equipment is available to complete the work.
    - b. Adequate staff with commensurate technical experience is available.
- B. Manufacturer's Qualifications:
1. No less than 5 years continuous experience in the production of specified type of product.
  2. Production shall meet applicable NEMA standards.
- C. Contractor shall attend pre-installation and coordination meetings as needed to coordinate with other trades as required.
- 1.9 SUBMITTALS:
- A. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the Contractor above 25% of the scheduled value of this work until all submittal information has been approved. Cost for the Owner's consultant to review secondary and re-submittals due to the Contractor's failure to include all required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Contractor. The cost shall be based on the hourly rates of the consultants as published in their current professional fees schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).
- B. Project Submittal Part 1:
1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
    - a. Section 1: A complete schedule of submittals.
    - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.
- C. Project Submittal Part 2:
1. Provide for approval no later than sixty (60) days after issuance of Notice to Proceed and in accordance with previously submitted submittal schedule.
    - a. Section 1: Complete list of products to be incorporated within the Work (Bill of Materials). With the list of products provide a written description of how the products function as a system.
    - b. Section 2: Manufacturer's data sheets for each product. Provide original manufacturer's data sheets in order as they appear in the specification. Provide data sheets on each component type specified for use on this project. These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the Work.
    - c. Section 3: Provide a copy of the UL Listing Card for each component type specified for use on this project. Provide UL Listing Card for each rack or assembly. Provide UL Listing Card for each wiring device specified for use on this project. Provide UL Listing Card for each type or module of lighting fixture to be provided on this project.
    - d. Section 4: Provide Owner and/or Owner's consultant with samples of wall plate materials and colors as specified in this section.
    - e. Section 5: Submit Material Safety Data Sheets (MSDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the MSDS.

## 2. Drawings:

- a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system compatible with AutoCAD release 2010 or higher. Electronic files of Lighting Control contract documents shall not be distributed for use in generating submittal documents with the exception of architectural backgrounds.
- b. Schematic Drawings. Provide drawings detailing inter- and intra-components or fabricated products, wiring, conduit and cabling diagram depicting cable types, designator and color codes. Give each component a unique designator and use this designator consistently throughout the project. All schematic/riser drawings shall be provided by the lighting control system manufacturer.
- c. Floor-plan and Section Drawings. Provide drawings showing the exact location of all installed equipment on floor-plans and sections, including all walls, doors and rooms, showing exact locations of devices and equipment, including, but not limited to, racks and associated control equipment as coordinated with other electrical equipment.
- d. Relay Panel Elevations: provide a front elevation and schedule of each relay panel giving the circuit number and location of connected load.
- e. Installation Drawings. Provide drawings showing special details depicting methods and means specific to each product, assembly and each product manufacturer's recommended installation methods and means.
- f. Conduit and Electrical Drawings. Provide floor plan drawings, including all walls, doors and rooms, showing exact power requirements and conduit sizing/routing for each system with the location of all junction boxes.
- g. Equipment Drawings. Provide drawings showing location of equipment in racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
- h. Custom Enclosures and Millwork Drawings. Provide full fabrication detail drawings indicating size, material, finish and openings for equipment.
- i. Fabricated Plates and Panels Drawings. Provide complete drawings on custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
- j. Schedule Drawings. Provide wiring schedule drawings showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting and location.
- k. Labeling Drawing. Provide representative equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and descriptor and designator schedule.
- l. General Detail Drawings. Provide detail drawings depicting any unique installation methods specific to each product.
- m. Template Drawings. Provide detail drawings for master house lighting touch screens stations. Note that some screens may be revised during Owner training to meet the needs of the End User.
- n. Any other pertinent data generated which is necessary to provide the Work.

## D. Samples

1. Provide sample fixtures to the Owner and control system manufacturer. These shall be used to verify and demonstrate DMX control and/or 0-10V capability prior to shipping and installation of the completed product.
2. Schedule of demonstration for Owner and control system Contractor with the General Contractor.

## E. Submittal Format:

1. Electronic submittals in PDF format are encouraged.



2. Each submittal shall be bound in a three-ring D style binder sized for 150% of the material with a maximum size being a three inch spine. Use multiple volumes if necessary.
  3. Provide each submittal with a unique number and be numbered in consecutive order.
  4. Provide each submittal binder with a cover and a spine reflecting the project title and submittal number. Submittals shall not be issued with other disciplines.
  5. Provide each submittal with a complete table of contents with the following information:
    - a. Project title and number.
    - b. Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
    - c. Date of submission.
    - d. Referenced addendum or change-order number as applicable.
    - e. Referenced specification Section, Part, Article, Paragraph and page number or drawing reference as applicable.
    - f. Index Product Data sheets by manufacturer and model or part number.
  6. Separate major grouping with labeled binder tabs.
  7. Arrange product data list in alpha-numeric order when applicable followed by unspecified product arrange by manufacturer and model or part number. Follow list by manufacturer's data sheets, arranged in the same order. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
  8. Drawings executed at an appropriate scale, not smaller than  $\frac{1}{8}" = 1'-0"$ .
- F. Submittal Copies:
1. These requirements represent minimum project requirements; a project's general conditions may require additional copies for project distribution.
  2. Submit one (1) unbound reproducible drawing set and three (3) bound prints of all drawings.
  3. Submit four binders of bound materials (e.g. product submittals).
  4. Submit two copies of product or sample finishes as required within this specification.
- G. Resubmission Requirements:
1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
  2. Indicate any changes that have been made other than those requested.
- H. Approval of Submittals: The submittal information will be reviewed by the general contractor, owner, architects, engineers, and consultant. Each submittal package will be returned, stamped as follows:
1. "No Exceptions Taken" proceed with construction, all job site coordination will be at the direction of the general contractor.
  2. "Make Corrections Noted: No Resubmission Required" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
  3. "Make Corrections Noted: Submit Corrected Copy" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
  4. "REJECTED, Submit Specified Item" a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  5. "REJECTED, Revise and Re-submit" submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  6. "No Review Action Required" all information provided was for information or coordination purposes only. Review is not required.

## 1.10 PROJECT RECORD MANUAL

- A. Submit three bound original sets (this is a minimum of two for the Owner and one for the consultant; additional copies may be required by the project's general conditions) after substantial completion and prior to final inspection.
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
  - 1. Operations Manual:
    - a. Product Data: Product actually incorporated within the Work:
      - 1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer's serial numbers.
      - 2) Each products Owner/Instruction Manual.
      - 3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
      - 4) Manufacturer's wiring diagram for each type of product actually incorporated.
      - 5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.
    - b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work. Provide a one (1) full size set of reproducible drawings and one (1) CD-ROM containing all CAD generated drawings prepared in conjunction with this project. Drawing files shall be in AutoCAD Release 2010 DWG format.
    - c. Test Reports: Recorded findings of testing specification of this specification.
    - d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
      - 1) This procedure should describe the operation of all system capabilities.
      - 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
  - 2. Service & Maintenance Manual:
    - a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
    - b. Manufacturer's maintenance and care instructions.
    - c. Provided certification of fluorescent lamp "burn-in" with dates and times clearly detailed. Provide information on faulty lamps and/or fixtures noted during "burn-in."
    - d. Maintenance Instructions: including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
  - 3. Warranty Manual:
    - a. Manufacturer's warranty statements on each product.
    - b. Date of substantial completion and ending dates for warranties for each group of products.
    - c. Software registration and licenses.
- C. Include any other pertinent data generated during the Project or required for future service.
- D. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

## 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Ship product in its original container, to prevent damaging or entrance of foreign matter.
- B. Handling and shipping in accordance with manufacturer's recommendation.

- C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.
- D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

#### 1.12 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Owner in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Owner for approval, showing how the work may be installed.

#### 1.13 ACCEPTANCE TESTING

- A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Owner's Representative.
- B. Provide two representatives familiar with all aspects of the system to assist the Owner's Representative during acceptance testing.
- C. The process of acceptance testing the System may necessitate moving and adjusting certain component parts; perform such adjustments without claim for additional payment.
- D. Testing includes operation of each major system and any other components deemed necessary. Provide required test equipment, tools and materials required to make necessary repairs, corrections or adjustments.

#### 1.14 WARRANTY

- A. Warrant labor and product for five (5) years following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost required to complete this warranty repair is the responsibility of the contractor.
- B. During the warranty period, the manufacturer shall provide a toll-free 24-hour-per-day number for telephone technical support and service request. If callback is required, calls shall be answered within thirty (30) minutes.
- C. Within the warranty period, contractor and/or manufacturer shall correct the deficiency within twenty-four (24) hours.

#### 1.15 TECHNICAL SYSTEMS SOFTWARE LICENSE

- A. Introduction:
  - 1. All proprietary software provided for the Lighting Control system shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
  - 2. Contractor shall agree that 3rd party (e.g. manufacturer's) proprietary software provided with the system shall be subject to this agreement.

3. Contractor and Owner agree that this software license is deemed to be part of, and subject to, the terms and the Agreement applicable to both parties; and shall supersede any standard manufacturer or Contractor's standard license agreement.
  4. Proprietary software shall be defined to include, but not limited to, device and system specific software and firmware designed to run on conventional computer based setup, or operate the system or its components.
  5. For sake of this agreement, MS Windows® shall not be considered "proprietary" software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.
- B. License Grant and Ownership:
1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the Owner.
  2. Except as expressly set forth in this paragraph, Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties or service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system shall be delivered to Owner for the sole benefit of Owner.
  3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.
- C. Copies, Modification, and Use:
1. Source code shall be available to Owner for a period of not less than 15 years.
  2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of Owner and its representatives.
  3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right in Owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
  4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.
  5. During the life of the system (defined as a period of not less than 10 years and not more than 15 years), the Contractor shall provide software updates in accordance with all necessary support requirements to maintain the system. This shall include a commitment to provide appropriate patches, fixes, and interface updates as necessary to maintain the operability and security of the system at a level commensurate with the original system.
    - a. In the event that computer and or processor hardware refinements and updates are necessary to support software updates 7 years after substantial completion, said hardware will be provided to Owner at the agreed upon terms for change orders of the original contract.
    - b. Labor shall be in accordance with change order rates of the original contract, as adjusted for inflation in accordance with conditions and limitations of the General Contractor or U.S. Bureau of Labor Statistics' Consumer Price Index (CPI).
  6. All hardware supplied shall support software updates for a period of not less than 7 years following substantial completion.

D. Warranties and Representations:

1. Contractor represents and warrants to Owner that:
  - a. It has necessary rights and authority to execute and deliver this Software license and perform its obligations hereunder and to grant the rights granted under this Software License to Owner.
  - b. The goods and services provided to Contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners.
  - c. The software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
2. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.

- E. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose, of merchantability, or warranty of no infringement of third party intellectual property rights.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality.
- B. Substitution of specified products with other qualified manufacturers and products will be considered providing:
  1. Proper substitution procedures outline under Division 1 is adhered to.
  2. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
  3. Sufficient data for each product is presented for prior approval including technical data, UL approval, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
  4. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- C. If proposed System includes equipment other than specified model numbers, submit a list of major items and their quantities, with a generated one-line schematic diagram for review. Include a list of previously installed projects using proposed substitute equipment that are similar in nature to the specified System.
- D. Providing product not specifically specified without prior written approval by the Owner's Consultant shall not be accepted.

2.2 GENERAL

- A. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.
- B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

- C. All cable shall be compliant with NEC as applicable, and UL listed or CSA certified. UL listing must be available at the time of bid.

## 2.3 CABLING AND CABLING ACCESSORIES

- A. DMX512 (E-DMX) distribution cable:
  - 1. Provide 23AWG four twisted pair data cable.
  - 2. Pair Color Code Chart:
    - a. 1-White/Blue Stripe & Blue
    - b. 2-White/Orange Stripe & Orange
    - c. 3-White/Green Stripe & Green
    - d. 4-White/Brown Stripe & Brown
  - 3. Insulation: Polyolefin
  - 4. Inner/Outer Jacket Material: PVC - Polyvinyl Chloride
  - 5. Nominal Impedance: 100 ohms.
  - 6. Nominal Velocity of Prop.: 72%.
  - 7. Capacitance between conductors: 15.0 pF/ft.
  - 8. Acceptable product:
    - e. Belden 11872A (Category 6).
- B. DMX512 Control Signal Distribution Cable:
  - 1. Provide 24AWG two twisted pair cable.
  - 2. Insulation: Foam polyethylene.
  - 3. Shield: aluminum foil/polyester tape
  - 4. Capacitance between conductors: 12.5 pF/ft.
  - 5. Acceptable product:
    - a. Belden 9729
- C. Architectural lighting Control Signal Distribution Cable:
  - 1. Provide 16AWG single twisted pair cable.
  - 2. Insulation: PVC-polyvinyl chloride
  - 3. Shield: unshielded
  - 4. Capacitance between conductors: 33 pF/ft.
  - 5. Acceptable product:
    - a. Belden 8471

## 2.4 SPORTS LIGHTING FIXTURES

- A. Provide an LED based sports lighting fixture with all required accessories. Fixture & layout must meet NCAA requirements.
- B. Lamp/light color: white.
- C. Finish: White as approved by Owner.
- D. Photometric characteristics
  - 1. Nominal color temperature: 5000K
  - 2. Minimum CRI: 75+
  - 3. Minimum useful life: 100,000hr.
- E. Electrical
  - 1. Multi-input supply up to 480Vac
  - 2. 0-10V dimmable driver (5-100%)
  - 3. 10 kv surge protection
- F. Physical

1. Minimum IP20
2. Provide with hanging yoke/bracket and all accessories for pipe and wall mounting.
3. Provide lens kits if/as required to accommodate the design.
4. Provide shutters, louvers, etc. As required to meet the design requirements.

G. Product basis of design:

1. Leader Light LL Sport LED Series
2. Musco LED Sports Cluster LED Series
3. Ephesus Lumadapt Sports LED Series
4. Schreder OMNIstar LED Series
5. Or approved equal.

## 2.5 CONTROL EQUIPMENT

A. Architectural Lighting Control System:

1. Provide rack mounted control processing units located in the control distribution racks.
2. The processing rack shall receive distribution output data from a lighting control console and/or architectural control stations, process the information it receives and distribute the information to the relay rack's electronics modules.
3. Processing Racks shall be designed to support the following wire terminations:
  - a. AC (single phase)
  - b. Echelon link power
  - c. 24Vdc
  - d. DMX512 In
  - e. DMX512 Out
  - f. RS232 Serial In/Out
  - g. Unshielded Twisted Pair (UTP) or ST fiber optic
4. Master station shall be located at the Lighting control position as noted on the drawings. Master station shall be able to lock out preset stations located in the facility. Master station shall have local control for each architectural light, sports light, and other settings as required by the Owner. Portable master stations shall have 25' connection cables. Unit shall utilize a clam type cover to protect the LCD touch screen display.
5. Provide preset stations as described on the drawings.
6. Provide keyed on/off switches for the work lights. For maintenance on/off switches, the key switch shall initiate the pre-programmed preset. This shall be a single action, not requiring keyed take control then initiating a preset.
7. Coordinate integration of lighting system with the Event Lighting, AV control interface and architectural lighting system.
8. All audience exposed switches shall be provided with locking covers and shall be labeled and painted a custom color as determined by the Owner.
9. Quantity: As depicted in drawings; control units should be as shown on the drawings.
10. Provide supplemental control link power supplies and network extenders as required to create a fully operational system.
11. Acceptable product: Electronic Theatre Controls Paradigm System, or approved equal. Product associated with the system shall include:
  - a. Paradigm ACP
  - b. Unison Heritage 5-button preset stations
  - c. Unison wall-mounted LCD stations
  - d. Paradigm Central Control Server
  - e. Paradigm 18" Touchscreen – wall mount.

B. DMX Emergency Bypass Control

1. Provide a bypass means to trigger special-purpose lighting presets and bypass normal lighting controls during emergency or panic situations; a DMX Emergency Bypass Controller (DEBC) as manufactured by Electronic Theatre Controls, Inc., or equal.

2. The DMX Emergency Bypass Controller shall be capable of overriding a single universe of ANSI E1.11–2008, USITT DMX512-A control signals from “Normal” to “Bypass” when a trigger signal is detected via a two-pin trigger input.
3. The DMX Emergency Bypass Controller shall poll the bypass trigger input after a power loss and react upon start up.
4. The default or recorded sequence shall be recalled immediately on restart if the trigger is also applied at restart.
5. The DMX Emergency Bypass Controller shall be capable of recording a single DMX preset (snapshot) of 512 channels for recall during “Bypass” mode.
6. The DMX Emergency Bypass Controller (DEBC) enclosure shall be a surface mounted, constructed of 16-gauge, formed steel panels with a removable front cover.
7. The DMX Emergency Bypass Controller (DEBC) enclosure shall provide discrete high and low voltage wiring compartments with voltage barrier.
8. DEBC shall support labeled, socketed termination connections for DMX Input and DMX Output wiring.
9. Terminations shall support Belden 9729 cable or equivalent.
10. DEBC shall support labeled, socketed termination for the bypass contact input.
11. Termination shall support two, 30-12 AWG low-voltage wires
12. The DMX Emergency Bypass Controller (DEBC) shall have a single bi-color LED indicator visible from the exterior of the enclosure.
13. DMX Emergency Bypass Controllers (DEBC) shall support 100 to 277-volt input power, 50/60 Hz, 150mA maximum current.
14. The DMX Emergency Bypass Controller shall support a single bypass input using two input modes:
15. The DMX Emergency Bypass Controller bypass input shall be configurable for two functions using maintained dipswitches:
16. Maintained Normally Open (N.O.), or
17. Maintained Normally Closed (N.C.).
18. The DMX Emergency Bypass Controller (DEBC) shall support one Universe (512 channels) of Digital Multiplexing (DMX) in accordance with ANSI E1.11–2008, USITT DMX512-A.
19. Controllers that do not support E1.11–2008 compliant DMX communication shall not be acceptable
20. The DMX Emergency Bypass Controller shall be UL and cUL Section 924 Listed for interaction with similarly listed products.

C. Emergency Bypass Detection Kit

1. Provide a bypass means to trigger special-purpose lighting presets and bypass normal lighting controls during emergency or panic situations; a DMX Emergency Bypass Controller (DEBC) as manufactured by Electronic Theatre Controls, Inc., or equal.
2. The DMX Emergency Bypass Controller shall be capable of overriding a single universe of ANSI E1.11–2008, USITT DMX512-A control signals from “Normal” to “Bypass” when a trigger signal is detected via a two-pin trigger input.
  - a. The DMX Emergency Bypass Controller shall poll the bypass trigger input after a power loss and react upon start up.
  - b. The default or recorded sequence shall be recalled immediately on restart if the trigger is also applied at restart.
3. The DMX Emergency Bypass Controller shall be capable of recording a single DMX preset (snapshot) of 512 channels for recall during “Bypass” mode.
4. The bypass detection kit shall be the Emergency Bypass Detection Kit as manufactured by Electronic Theatre Controls, Inc., or equal.
5. The Enclosure shall be a surface mounted, constructed of 16-gauge formed steel panels removable front cover finished in fine textured, scratch-resistant, powder coat paint
6. Accessories for installation, including tap kits and manual reset switch kits shall be available from a single manufacturer.
7. Emergency Bypass Detection enclosures shall support 100 to 277 volt configurations



8. EBDK enclosures shall be field configurable for single-phase, bi-phase, and three-phase operation without the need for additional components.
9. The Emergency Bypass Detection Kit shall be completely pre-wired by the manufacturer. The contractor shall provide input feed and control wiring.
10. All control wire connections shall be terminated via factory provided connectors.
11. The Bypass Detection Kit shall be UL and cUL Section 924 Listed for interaction with similarly listed dimming and switching panels.

D. Ethernet Switch

1. Provide Ethernet Switches in the control distribution rack as shown on the drawings. The switch shall route DMX-512 control signals. The Switch shall be a fast Ethernet repeater that supports integrated hub stacking ports.
2. Network Protocol and Standards Compatibility:
  - a. IEEE 802.3x full duplex on 10Base-T, 100Base-TX, and 1000Base-X ports
  - b. IEEE 802.1D Spanning-Tree Protocol
  - c. IEEE 802.1p CoS prioritization
  - d. IEEE 802.1Q VLAN
  - e. IEEE 802.3u 100Base-TX specification
  - f. IEEE 802.3 10Base-T specification
  - g. IEEE 802.3af Power over Ethernet
3. Inline power 48-volt DC power is provided over Category 5e UTP cable up to 100 meters
4. 10 and 100 Mbps peak and aggregate throughput for high-performance data transfer.
5. 10/100 auto-sensing on each port detects the speed of the attached device to configure the port for 10 or 100 Mbps operation.
6. Switch shall be equipped with LED indicators for power status, port status, bandwidth utilization, collision detection, and speed indication.
7. Switch shall be equipped with 24-ports with linking available to other switches within the same rack.
8. Built-in Web-based management interface provides easy-to-use management through a standard browser such as Netscape Navigator or Microsoft Explorer (provide all required software management tools)
9. Provide rack mount kit and required hardware and cables for stacking.
10. Each network location shall have a dedicated input point on the network switch. Patching shall not be required.
11. Provide with redundant power system (Cisco RPS 675).
12. The Ethernet switch shall be provided by the lighting control system manufacturer.
13. Quantity: As required by design.
14. Acceptable product:
  - a. Cisco Catalyst 3750 - 24PS (24-port 10/100 with integrated inline power)

E. DMX Distribution/Configuration Software

1. Provide one (1) license for configuration software for an Owner provided computer that will allow configuration of all Nodes in lighting system.
2. Shall allow for Drag-and-Drop functionality
3. Shall provide primary DMX routing
4. Configuration software shall control all of the following attributes:
  - a. Channel Patch
  - b. Merge
  - c. Priority Switch
  - d. Backup Switch
  - e. Node labeling
  - f. Port labeling
  - g. Backlight control
5. Compatible with Windows 7 or later.
6. Software will provide a connected system overview
7. Acceptable product:

- a. Pathway Connect Pathport Manager Software
  - b. ETC Network Configuration Editor
  - c. Or as provided by approved equipment manufacturer.
- F. DMX512 Distribution Box/Network Node (DMX In/Out):
  - 1. Provide a permanently installed plug-in box designed for rack mounting application.
  - 2. Node shall provide the quantity of universes, as specified, of DMX512 control for Lighting Control or other DMX512 addressable devices.
  - 3. Ports:
    - a. DMX Ports shall comply with the requirements of the USITT DMX512.
    - b. The two DMX ports shall be software-configurable for either input or output.
    - c. DMX inputs shall be fully opto-isolated from the node electronics and from each other.
    - d. DMX outputs shall be earth-ground referenced.
    - e. DMX Ports shall be capable of withstanding fault voltages of up to 250VAC without damage.
  - 4. Each input shall route directly to the Ethernet Switch located in the assigned Control distribution rack Rooms without the need for patching.
  - 5. Acceptable product:
    - a. Pathway Connectivity Octo
- G. DMX-512 Distribution
  - 1. Provide DMX512 distribution for connection to wiring devices in the arena bowl.
  - 2. Modules shall provide one optically isolated DMX512 signal output capable of driving thirty two (32) receiving devices on a single DMX line.
  - 3. DMX device drivers shall have maintained outputs; however, the ability to program individual outputs as momentary on/off signals through a soft patch shall be built-in.
  - 4. Isolation: input to output signal isolation is provided by an opto-isolator designed for data use.
  - 5. Provide quantity as required by design.
  - 6. Provide product as manufactured by:
    - a. eDIN by Pathway Connectivity
- H. Control Distribution Racks:
  - 1. Type: Sectional 61.25" (35 Space) with vented locking front door.
  - 2. Factory installed 11 Ga. 10-32 threaded rack rails.
  - 3. Provide Magnetic Work Light with 18.0' cord and spare 60 watt "rough service bulb."
  - 4. Provide one (1) locking storage drawer and all necessary vent or blank panels.
  - 5. The control distribution rack shall be provided by the lighting control system manufacturer.
  - 6. Quantity: As shown on drawings
  - 7. Acceptable product:
    - a. Mid-Atlantic DWR35-26, WL-60
- I. UPS Backup Power / Surge Protection
  - 1. Provide a rack mountable UPS backup to support equipment located in the control distribution racks (provide with one (1) spare batteries).
  - 2. Output Power Capacity: 1400VA/1050W,
  - 3. Input 120V/ Output 120V
  - 4. Interface Port: DB-9 RS-232
  - 5. Extended runtime model
  - 6. Rack Height: 3 Units
  - 7. Filtering: Full time multi-pole noise - filtering: 0.3% IEEE surge let-through: zero clamping response time: meets UL 1449
  - 8. The UPS shall be provided by the lighting control system manufacturer.

9. Quantity: As shown on drawings
10. Provide product as manufactured by:
  - a. APC part# SU1400RMXL3U

## 2.6 DISTRIBUTION EQUIPMENT

- A. General: All wiring devices are to be provided for the lighting control system. All circuits are to be tested and be functioning. All circuits on the connector strips and plug boxes are to be relabeled with 2" yellow on black Brady numbers. All floor pockets and wall mounted boxes are to be provided with new 1" yellow on black Brady numbers. Overall assembly to be UL listed.
- B. DMX Controlled A.C. Panelboard (RP-PC, RP- S1 & RP-S2)
  1. Supplemental A.C. power for the lighting system shall be supplied from DMX controlled sources capable of being remote controlled via the DMX 512 network.
  2. Controlled circuits shall be controlled by a branch circuit breaker with an integral motor control.
  3. The DMX Breaker Control system shall have brownout protection; monitoring the line voltage and disabling DMX command execution if the line voltage drops below 95 volts for more than 2 seconds.
  4. The DMX Breaker Control system shall have EDO (Emergency DMX Override) capability triggered by external contacts. An external EDO contract closure shall override all DMX commands and recall a stored Emergency on/off scene.
  5. Un-controlled circuits, as required, shall be supplied from the same A.C. source so that a single lever main circuit breaker may control all.
  6. Three phase panelboards shall have 200% neutrals.
  7. All branch circuit breakers shall be bolt-on.
  8. Panel shall be able to accommodate a sense feed for normal and emergency power.
  9. Panel shall be UL924 compliant.
  10. Acceptable Product:
    - a. LynTec LCP 341-xx series DMX Controlled Panelboard.
    - b. ETC Echo Relay Panel 277/480V, or approved equal.
- C. Arena Catwalk Pipe Mounted Box (PB):
  1. Provide a plug box designed for pipe mounting.
  2. Construction: code gauge steel.
  3. Connectors:
  4. Circuits: number of circuits as specified on drawings.
  5. Rating: each circuit at 20A.
  6. Labeling: circuits are labeled with yellow letters on black background.
  7. Overall assembly UL listed.
  8. Acceptable product:
    - a. ETC 8300B series
    - b. SSRC
    - c. Strand
    - d. Rigging Innovators
- D. DMX512 Distribution Box (DMX):
  1. Provide a wall plugging box designed for surface mounting.
  2. Construction: code gauge steel.
  3. Connectors: Neutrik 5 conductor XLR, flush mounted.
  4. Circuits: located as shown on the drawings.
  5. Labeling: labeled with yellow letters on black background.
  6. Acceptable product:
    - a. ETC
    - b. SSRC
    - c. Strand

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PART 3 - EXECUTION

## 3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.
- C. Permanently installed equipment to be firmly and safely held in place.

## 3.2 FIELD MEASUREMENT TESTING

- A. Provide Owner with documentation of light levels as noted in Part 1.
- B. Measurements shall be taken from the center of a grid overlaid on the court at a spacing of 10ftx10ft. Measurements shall be taken at 36" AFF.
- C. Provide measurements in foot-candles.
- D. Report light levels (horizontal and vertical) at each grid location. Calculate average values across all grids. Calculate uniformity ratio by dividing highest reading by lowest reading.
- E. Provide model and calibration certification for metering equipment used.

## 3.3 INSTALLATION OF CABLE AND WIRING

- A. Coordinate all electrical work with the Electrical Contractor. Provide all necessary equipment including hardware and apparatus for complete connection of power system wiring.
- B. Coordinate installation of power and ground wiring to equipment. Power and ground wiring will terminate inside of equipment and/or junction boxes and hardwired to ground buss and circuit breaker to ensure uninterrupted operation.
- C. All control wiring will be executed in adherence to ANSI standard control systems practices including the following:
  - 1. Isolate cables carrying signals at different levels and separate to restrict interaction.
  - 2. Keep wiring separated into three groups of conduit provided for control circuits, power circuits (up to 50 amps), and feeder circuits (above 50 amps).
  - 3. Isolate all wiring, except for safety ground wiring, from conduit ground.
  - 4. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic interference in other technical systems (such as sound and communications systems) in the facility. Where possible all devices and wiring will be enclosed in a shielded environment. Take care not to use shields (conduits) and grounds as current carrying return paths for lamp and relay coil commons. All ground references are to be made to the building electrical system ground.
  - 5. Label unused wiring provided for spares or future systems and terminate at screw terminal strips.
- D. All joints and connections will be made with resin-core solder or with ratchet jaw crimp type mechanical connectors. Connect all circuits electrically in phase using same wire color code for similar circuits throughout the project.

### 3.4 INSTALLATION OF EQUIPMENT

- A. Take appropriate precautions against electrostatic discharge (ESD) when installing/connecting electronic equipment. Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.
- B. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.
- C. Mount equipment plumb and level, firmly, and safely held in place.
- D. All equipment will be installed in compliance with applicable Local and National codes and regulations. Equipment will also be installed in accordance with Manufacturer's recommendations and specifications. Prior to initial energizing, the system will be inspected by a representative of the Manufacturer as outlined under Contractor Commissioning.
- E. Contractor shall document location of each type of distribution device and circuiting and place plot on gator foam board. Provide three copies: two (2) copies to client and one (1) copy to theatrical consultant.

### 3.5 CONTRACTOR COMMISSIONING

- A. Prior to energizing or testing the System, ensure that:
  - 1. Products are installed in proper and safe manner according to manufacturer's instructions.
  - 2. Dust, debris, solder splatter, etc. is removed.
  - 3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  - 4. Labeling has been provided in compliance with specification and/or Owner.
  - 5. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
  - 6. Products are neat, clean and unmarred and parts securely attached.
  - 7. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. The jobsite shall be broom clean.

### 3.6 ACCEPTANCE

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Owner's consultant no earlier than two weeks after receipt of the written results.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and provide any test equipment required. Contractor shall provide at least two (2) technicians available for the entire testing to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Contractor. Testing process is estimated to take a minimum of 1/2 day.
- C. The process of testing the System may necessitate moving and adjusting certain components such as signal processors.
- D. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:

1. Inspection of the methods and means employed to incorporate the System within the facility.
  2. Verification of proper operation, from controlling devices to controlled devices.
  3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
  4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.

### 3.7 INSTRUCTION OF OWNER PERSONNEL

- A. Manufacturer's trainers to provide operations and service training on the following major equipment components and subject matter.
- B. Racks, sports lighting, and controls (12 hours)
1. Basic testing and control
  2. Normal operations
  3. Programming memory
  4. Software configurations and upgrades
  5. Training time shall consist of two (4) hour days in separate sessions separated by some weeks, in accordance with owner's schedule.
  6. Provide integration and programming of existing work lights, new houselights, and new lecture lighting. Take note that time will need to be allotted for final programming with the Owner and Consultant.
- C. Manufacturer training will not be required where the item of equipment is owner furnished, part of an option that is not selected, or an item of equipment that is not actually purchased.
- D. Training Schedules
1. Manufacturer's training should be assumed to take place on the project site, unless agreed to by the Owner.
  2. Training should be scheduled to be non-overlapping with other disciplines.
  3. Actual training schedule shall be by agreement with Owner. Do not assume that training will occur over eight (8) hour days. It is more likely that training will be scheduled in four (4) hour increments; perhaps over a period of weeks (or even months).
  4. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, then the training time shall be extended an equal amount of time.
- E. The following is a general idea of the training "curriculum":
1. A general familiarization of the device(s).
  2. An explanation of how the device(s) interfaces to the rest of the lighting control system.
  3. General training on operating the device(s).
  4. Specific training on device(s) operation.
  5. Saving information; backing information up.
  6. Basic troubleshooting
  7. Specific troubleshooting (this information may be conveyed to personnel other than the device's "operators").
  8. How to upgrade software; precautions taken while doing (e.g. backing-up existing software).

- F. Submit an outline of the course with sample instructional aides for approval thirty (30) days prior to scheduled instruction sessions to Owner and Owner's consultant.
- G. Lighting system installer shall attend events of the facility.
  - 1. Event Attendance includes the following requirements:
    - a. Be present at the first event.
    - b. During these events, attendance shall begin at the first crew call and conclude when the crew is released. During these events perform such tasks (e.g. assistance with patching, programming, troubleshooting cabling problems, etc.) as requested by user. Tasks shall be strictly assistance, not operation.
    - c. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance, or as event attendance.
  - 2. Coordinate these schedules with the Owner.
- H. Following discussions with Owner, formally submit a Training and Event Attendance submittal 2-4 weeks prior to first training. Submittal shall:
  - 1. Include a separate page/entry for every training session.
  - 2. Indicate date, time, and approximate length of training session.
  - 3. Indicate person(s) conducting training.
  - 4. Indicate whether training will be videotaped.
  - 5. Intended curriculum and most appropriate attendees (e.g. engineer, operations, IT, etc.)
  - 6. Include signature and title lines for
    - a. Owner acknowledging and accepting training schedule. Include both an accepted and rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
    - b. Countersigning by trainer indicating that training actually occurred.
    - c. All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
    - d. Owner's representative attending training at the end of the session shall initial that:
      - 1) Training Occurred.
      - 2) Training Materials were provided and left with Owner
      - 3) Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
      - 4) Training was generally sufficient for the proposed curriculum.
  - 7. Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.)
- I. Following completion of training, submit completed training records no later than 5 business days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.

#### PART 4 - ALTERNATES

- 4.1 COSTS FOR PROVIDING 15% FEWER FIXTURES THAN BASE BID REQUIREMENT.
  - A. A1 – Equipment
  - B. A2 – Labor

END OF SECTION

## SECTION 27 41 16.63 – STADIUM SOUND SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Stadium seating bowl sound system design-build performance specification

## 1.2 SECTION INCLUDES:

- A. Coordination, engineering, provision, installation, inspection, test, instruction and warranties of a complete speaker system serving the stadium seating bowl.
- B. Custom hardware and structure for speaker system rigging and necessary structural modifications to existing scoreboard structure as a turn-key design build element of the project
- C. Necessary materials, equipment, transport, and labor to have a complete and working AV system
- D. Required licenses and permits, including payment of charges and fees
- E. Verification of dimensions and conditions at the job site
- F. Provision of submittal information
- G. Installation in accordance with the contract documents, manufacturer's recommendations, applicable codes, and authority having jurisdiction
- H. Instruction of operating personnel
- I. Provision of manuals
- J. Maintenance service and warranty

## 1.3 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
  - 1. American National Safety Institute (ANSI)
  - 2. Electronics Industries Association (EIA)
  - 3. Federal Communications Commission (FCC)
  - 4. National Electrical Manufacturer's Association (NEMA)
  - 5. National Electrical Code (NEC)
  - 6. Underwriters Laboratories (UL)
  - 7. Occupational Safety and Health Administration (OSHA)
  - 8. Building Industry Consulting Service International (BICSI)



**1.4 RESPONSIBILITY**

- A. All engineering, materials, equipment, transportation, and labor necessary to achieve a complete and functionally working system as shown or inferred on the Drawings and in the Specifications. Supply accessories and minor equipment items (such as, but not limited to: power strips, adapters, connectors, mounting hardware, etc.) needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- B. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Contractor to supply a full working, tested, and calibrated system. Notify the Owner of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.
- C. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Owner for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the Owner.
- D. Execute all work in accordance with the National Electrical Code (NEC), the National Electrical Safety Code, the Occupational Safety and Health Act (OSHA) and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract documents and the appropriate codes and is reported to the Owner prior to bid opening, the Owner will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform Work

**1.5 SEATING BOWL SOUND SYSTEM DESCRIPTION AND REQUIREMENTS**

- A. The following is intended to provide an overview of the required work details, system features, and design concepts as shown on the project drawings. The contractor is to provide all parts and work necessary for completely functioning systems as described in project documents.
  - 1. The pre-existing loudspeaker system located within the endzone scoreboard structure is removed and disposed of.
  - 2. New loudspeaker system is provided at the endzone scoreboard.
  - 3. Fill speakers are located within the top level of the scoreboard behind acoustical scrim.
  - 4. Custom designed speaker frames and attachments to existing scoreboard structure designed by P.E. licensed in state of the install.
  - 5. Digital Signal Processing (DSP) system and network is provided to take feeds from the existing control room PA equipment and transport processed audio over fiber-optic cabling to the new loudspeaker system and provides the necessary signal processing for the loudspeaker system components.
  - 6. The computer controlling DSP and Amplifier system is in control room.
  - 7. The scrim material at the scoreboard speaker enclosure is replaced with new material and attachments to match existing.
  - 8. Pre-existing fill speakers serving the under-balcony area on the west side are maintained and re-used.

9. New DSP and digital audio network equipment is provided at control room and scoreboard speaker equipment rack. The control room racks are pre-existing. The equipment racks at the Scoreboard are provided new.
  10. New Mixing console and wireless microphone system provided provided.
  11. The new DSP will include dedicated outputs for driving the pre-existing under balcony fill speaker systems and provide PA feed to back of house systems.
  12. Analog and fiber-optic cable pulls are added between the west press box control room and the new equipment in the south.
- B. The seating bowl speaker system is a an endzone point source type system with the main speakers at the south scoreboard serving the fixed spectator seating areas in the stadium. Vertical speaker arrays on east and west sides of the south camera booth atop the scoreboard and provide primary sound coverage to the Seating Bowl, high power, high-directivity loudspeakers are co-located with the arrays to provide supplemental sound to the near side upper decks and areas shadowed from the main arrays..
- C. Seating Bowl Loudspeaker Design Criteria (all values are as measured from spectator seats)
1. Maximum continuous loudness of not less than 103dBA
  2. Minimum frequency response range of 60 Hz to 8,500 Hz
  3. Uniformity of Loudness of  $\pm 3$  dBA
  4. Ratio of first/direct arrival sound to reverberant or indirect sound of +6 dBA
- D. Amplifiers for the stadium sound system are to be housed in the existing amplifier closet at the base of the scoreboard.
- 1.6 QUALITY ASSURANCE
- A. The Contractor shall be experienced in the provision of systems similar in complexity to those required for the project and meet the following requirements:
1. The Primary business of contractor shall be the installation of sound and video systems.
  2. No less than three years of experience with equipment and systems of the specified types.
  3. Experience with a least two projects of this type and comparable scale within the last three years involving large-scale reinforcement speakers.
  4. Be a franchised dealer and service facility for the major products furnished.
  5. Maintain a fully staffed and equipped service facility with full time field technicians. It is recommended that one or more members of the installation team have a NICET level II certification.
  6. At the request of the Owner, the Contractor shall demonstrate that he has adequate plant and equipment to complete the work, as well as adequate staff with commensurate technical experience.

- B. Work shall follow the applicable standards listed above and all governing codes and regulations of the authorities having jurisdiction and the Contract Documents.
  - 1. Drawings and specification requirements shall govern where they exceed Code and Regulation requirements.
  - 2. Where requirements between governing Codes and Regulations vary, the more restrictive provision shall apply.
  - 3. Nothing in the Contract Documents shall be construed as authority or permission to disregard or violate legal requirements.
- C. Coordinated exact location and installation of equipment, power, conduit, and raceway systems with the Owner in submittal phase.

#### 1.7 SUBMITTALS

- A. General: Provide submittals in accordance with General Conditions.
- B. Supplementary submittal requirements:
  - 1. Complete schedule of submittals.
  - 2. Chronological schedule of work in bar chart form.
  - 3. Provide a list of manufacturer's data sheet on product to be incorporated within the Work. Organize data sheets in specification order.
  - 4. Functional diagrams and description of all parts of the system installation.
- C. Shop Drawings
  - 1. Schematic: Submit detailed wiring diagrams showing interconnection of components and products, wiring, and cabling diagrams depicting cable types and designators, and device designators. Provide connector designations and terminal strips identification, along with color codes for cables connecting to these devices. Give each component a unique designator and use the designator consistently throughout the project.
  - 2. Coordination: Submit drawings showing major element, components, and devices of the sound system in relationship with other building components. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all equipment. Indicate locations where space is limited, and where sequencing and coordination of installation is of importance to the efficient flow of the work including but not necessarily limited to the following:
    - a. Equipment housings
    - b. Ceiling and wall mounted devices
    - c. Raceways
    - d. Cablings
    - e. Equipment: Location of equipment in racks, consoles, or on tables with dimensions, wire routing and cabling within housings, AC power outlet, and terminal strip locations.
    - f. Patch panel layouts and labeling strips, including color schemes.
    - g. Full fabrication details of custom enclosure and millwork indicated size, material, finish, and openings for equipment.

- h. Speaker mounting details: Including hardware types, material and load capacity. Structural information shall include design calculations and copy of engineer's seal.
- i. Fabricated Plate and Panels: Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensions locations of components, component types, engraving information, plate material and color, and bill of materials.
- j. Labeling: Equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and designator schedule.
- k. Schedules: Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting, and location. Include this information with remainder of wiring diagrams.
- l. Suspended loudspeaker rigging design with Engineer's seal.

D. Submittal format:

- 1. Detail drawings executed at an appropriate scale, not less than 3/8 inches = 1 foot.
- 2. Separate major grouping with label binder tabs.
- 3. Bind contents in titled three ring D-style binders sized for 150 percent of the material. Maximum three inch spine. Use multiple volumes if necessary.

1.8 PROJECT CLOSEOUT

A. Supplementary Project Closeout Procedures in addition to the terms and conditions as defined by the general contractor construction manager for systems commissioning and turnover.

- 1. Product Data: Product actually incorporated within the Work:
- 2. Manufacturer's data for each type of product conforming to the submission format specified herein. Include manufacturer's serial numbers within the list of products.
- 3. For custom circuits or modifications, a description of purpose, capabilities, and operations of each item.
- 4. Each product's Owner/Instruction Manual. Provide high quality copies where necessary, with all text legible and illustrations of equal resolution and sharpness as the original manual. Faxed copies or copies with portions of the information missing or smeared are not acceptable.
- 5. Manufacturer's maintenance and care instructions.
- 6. Separately bound list by manufacture and model or part number of product incorporated within the Work arranged in alphanumeric order. When applicable bind Manufacturer's warranty statement separately.

B. Record drawings: Final rendition of Shop Drawings depicting what is actually incorporate within the Work delivered as electronic files and three copies of full size bond prints.

C. Test Reports: Recorded findings of Contractor's Commissioning.

D. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.

1. Describe the operation of system capabilities.
2. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.

E. Service & Maintenance Manual:

1. Provide an original manufacture's copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. On equipment where there is no service manual, provide statement from company indicating manual if not available. Arrange manuals in the same order as the operations manual.
2. Manufacture's maintenance and care instructions.
3. Maintenance instructions, including maintenance phone numbers and hours, maintenance schedule, description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.

F. Any other pertinent data generated during the Project or required for future service.

G. Segregate documents into separate bindings containing data relevant to operational, maintenance, and warranty issues. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

1.9 DELIVERY, STORAGE AND HANDLING

- A. To prevent damage or entrance of foreign matter, ship product in its original container.
- B. Ship in accordance with manufacturer's recommendations.
- C. Provide protective covering during construction.
- D. At no expense to Owner, replace product damaged during storage or handling.

1.10 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Owner's Representative in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings show cables, conduit, wiring, and arrangement of equipment fitting the space available without interference. If conditions exist at the job site which make it impossible to install work as shown, recommend solutions and submit drawings to the owner for approval, showing how the work may be installed.

1.11 FINAL INSPECTION AND TESTING

- A. Upon completion of installation and contractor commissioning as specified in Part 3, inspection and testing shall be performed by the Owner.
- B. To assist the Owner, provide a minimum of one person for inspection and two persons for testing who are familiar with all aspects of the system. The process of testing the System may necessitate moving and adjusting certain components such as speaker aiming or transformer taps.
- C. Testing includes operation of each major system and any other components deemed necessary. Provide required test equipment, tools and materials required to make necessary repairs, corrections or adjustments.

- D. The following procedures are performed on each System by the University's representative:
  - 1. Inspection of the methods provided to incorporate the System within the facility.
  - 2. Verification of proper operation of all devices.
  - 3. Verification that the equipment has been properly adjusted, balanced, and aligned for optimum quality and meets the manufacturer's published specifications.
- E. In the event further adjustment or work becomes evident during testing, the Contractor shall continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Contractor shall pay for additional time and expenses of the Owner or his representative at the standard rate in effect at that time.
- F. Testing is estimated to take three days.

#### 1.12 WARRANTY

- A. Installer shall warrant equipment to be free of defects in materials and workmanship for one year following the date of the first regular season football game, trouble free operation, or substantial completion, whichever is later
- B. System to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics; repair or replace defects occurring in labor or materials within the Warranty period without charge.
- C. Within the Warranty period, answer service calls within eight hours, and correct the problem within twenty-four hours.
- D. This warranty shall not void specific warranties issued by manufacturers for greater periods of time, nor shall it void any rights guaranteed to the Owner by law.
- E. Contractor to provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Record Drawings.
- F. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment or transducers discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment. Coordinate inspection visit with the Owner.
- G. Outdoor mounted speakers shall be warranted by the manufacturer or installer to withstand the rigors of the environment and perform to the published specifications for at least one year after date of first football game.

#### 1.13 RELATED WORK

- A. Electrical
  - 1. Field verification and coordination with the owner is required. The contractor shall be responsible for circuit breakers, termination and distribution of electrical power from the panel to the equipment enclosure distribution as required. Each circuit extended from the panel is to have separate neutral and ground conductors. In the event of a power failure, power servicing this equipment to be provided from the emergency power system in order to support emergency messaging.

2. The contractor shall be responsible for connecting ground point to all equipment in accordance with NEC Code, local codes and standards specified herein. Isolated ground system is not required for this work.
3. The contractor shall be responsible for all conduit and raceway required for the installation of the system. All conduits and raceway to be installed in accordance with NEC, local codes and standards specified herein.
4. The contractor shall be responsible for fire-stopping building penetrations associated with this Work. Fire-stopping to be installed in accordance with NEC, local codes and standards.
5. A State licensed professional engineer stamp is required for all electrical submittals as-built drawings

B. Structural

1. The contractor shall be responsible for design and structural engineering for all loudspeaker brackets attaching the loudspeakers to the building structure at position shown within the drawings.
2. A State licensed professional engineer stamp is required for all structural submittals as-built drawings

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Products listed are provided for reference and standard of quality. Design proposals are to meet or exceed performance of this reference.

2.2 GENERAL

- A. Provide all equipment as part of "turn-key" system delivery.
- B. Product quantity is as required. If a quantity is given, the contractor shall provide at least the given amount. Some products listed under this section may not be required to fulfill the obligations of the work.
- C. Equipment and materials shall be new and conform to applicable UL or ANSI provisions. Precautions must be taken during installation to prevent scratches, dents, chips, etc.
- D. Regardless of length or completeness of the descriptive paragraph herein, each device shall meet published manufacturer's specification.
- E. Remove all manufacturers' names, logos, or other symbols from speakers or other objects placed in view of the public.
- F. Paint ceiling, wall mounted speaker grilles, enclosures and conduit to match the surrounding ceiling or wall color as directed by the Owner.

2.3 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of function, performance, and quality. Alternate product to be considered in place of the basis of design product, provide the following:

- B. Documentation demonstrating that the proposed product meets, or exceeds, basis of design product description attributes
- C. Loudspeaker substitutions will require:
- D. A working EASE model (or equivalent CATT Acoustic) demonstrating the proposed loudspeaker system providing performance that meets or exceeds the reference design.

## 2.4 LOUDSPEAKERS

- A. Loudspeakers are provided with custom mounting hardware. Wall mounted and surface mounted speakers are not to use manufacturers' typical bracket. Provide custom brackets where required to hold speakers tight to structure. All loudspeakers are to be designed and approved for outdoor use by manufacturer.

- B. Type 1 Array

- 1. 3-way full-range vertical line array (Qty 12 each array)
- 2. Horn-loaded mid-high section with 8" midrange drivers, 3" coil HF compression drivers
- 3. Frequency Range: 42 Hz – 15 kHz (-10 dB)
- 4. Frequency Response: 58 Hz – 12 kHz ( $\pm$  3dB)
- 5. Horizontal Coverage: 60/90°
- 6. Maximum LF SPL: 132 dB SPL continuous average
- 7. Maximum MF SPL: 137 dB SPL continuous average
- 8. Maximum HF SPL: 141 dB SPL continuous average
- 9. Sensitivity (1 w @ 1m): 100 dB SPL
- 10. Enclosure: 16 mm (5/8) exterior grade 12-ply birch plywood. Provide highest level of weather protection.
- 11. Grille: Powder coated 14-gauge perforated steel, zinc-phosphate dipped, acoustically transparent foam backing
- 12. Provide custom rigging and hardware system to suspend speakers for safe stable operation
- 13. Acceptable Product:
  - a. JBL VLA601WRX
  - b. JBL VLA901WRX

- C. Side Fill Speakers

- 1. Frequency Range: 150 Hz – 17 kHz (-10 dB)
- 2. Frequency Response: 200 Hz – 15 kHz ( $\pm$  3dB)
- 3. Coverage Angle: 40° x 30°



4. Maximum MF SPL: 139 dB SPL continuous average
5. Maximum HF SPL: 140 dB SPL continuous average
6. MF Sensitivity: 111 dB, 1 W @ 1
7. HF: Sensitivity: 118 dB, 1 W @ 1 m
8. Grille: Powder coated 14-gauge perforated steel, zinc-phosphate dipped, acoustically transparent foam backing
9. Provide custom rigging and hardware to suspend speakers for safe stable operation.
10. Provide fully weatherized "WRX" options
11. Acceptable Product:
  - a. JBL PD743WRX
  - b. JBL PD764WRX

## 2.5 MIX CONSOLE

- A. Control Booth Mixing Console (MIX Type 1)
- B. Inputs: Capability of up to 32 mono inputs and 8 stereo inputs from analog mic/line inputs, AES/EBU, and DANTE sources
- C. Local I/O: 16 in, 8 out
- D. Frequency response: +.5/-1.5dB, 20 Hz to 20 kHz with less than 0.05% THD at +4 dBm out
- E. Maximum output level: at least +24 dBu
- F. Input Module: 150 Ohm microphone or 600 Ohm line balanced input
- G. Input attenuator to provide attenuation allowing signal levels from -60 to +10 dBm without overload or distortion.
- H. Input Channel: high pass filter, insert point, gain, parametric EQ, compressor, limiter, and delay.
- I. System latency: less than 2.5ms
- J. Wireless remote control via iPad
- K. Acceptable Product to include the following:
  1. Yamaha QL1 Digital Mixing Console
  2. Yamaha RIO3224-D2
  3. Gooseneck console lamps for all lamp ports
  4. Fitted nylon console dust cover
  5. Current iPad model

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2.6 MICROPHONES AND ACCESSORIES

- A. Headset Microphone
  - 1. Acceptable Product
    - a. Crown CM311a (Quantity: 1)
- B. Desktop Microphone and desk stand
  - 1. Acceptable Product
    - a. Electro-Voice RE20 with 309a shock mount (Quantity: 1)
  - 2. Acceptable Product (Quantity: 1)
    - b. On-Stage DS7200B
    - c. Proline PLDRB1B
- C. Announcer Control Station
  - 1. Acceptable Product
    - a. Studio Technologies 230 (Quantity: 1)
- D. Wireless Microphone System
  - 1. Provide equipment for six channels of handheld microphones
  - 2. Acceptable Product
    - a. Shure Axient AXT400 Dual Channel Receiver
    - b. Shure Axient UA870USTV Directional Antenna
    - c. Shure Wireless Workbench 6 Software Package
    - d. Shure Axient AXT200 Handheld Transmitter (Quantity: 2)
    - e. Shure RPW118 Wireless SM58 Cartridge (Quantity: 2)
    - f. Shure AXT920 Lithium-ion Rechargeable Battery (Quantity: 4)
    - g. Shure Axient AXT900 Charging Station
- E. Wireless In-Ear Monitor System
  - 1. Shure 900 Series. Provide complete turn-key system including rack, rack drawers, power distribution, and stands for Antennas.
  - 2. Wireless Transmitter
    - a. Acceptable Product
      - 1) Shure P9T (Quantity: 2)
  - 3. Dual Rack Mount Kit
    - b. Acceptable Product
      - 1) Shure RPW504
  - 4. Directional Antenna
    - c. Acceptable Product
      - 1) Shure PA805SWB (Quantity: 2)
  - 5. Wireless Bodypack Receiver
    - d. Acceptable Product
      - 1) Shure P9RA (Quantity: 2)
  - 6. Rechargeable Batteries
    - e. Acceptable Product
      - 1) Shure SB900A (Quantity: 4)
  - 7. Battery Charger
    - f. Acceptable Product
      - 1) Shure SBC200
  - 8. Earphones
    - g. Acceptable Product
      - 1) Shure SE215-K (Quantity: 4)
      - 2) Provide pricing for additional units
  - 9. Earphone Replacement Sleeves

- h. Acceptable Product
  - 1) Shure EABKF1-10L (Quantity: 4)
  - 2) Shure EABKF1-10M (Quantity: 4)
  - 3) Shure EABKF1-10S (Quantity: 4)
  - 4) Provide pricing for additional units

## 2.7 PROCESSORS

### A. Digital Signal Processing System (DSP)

1. Stand-alone, single rack space units
2. 16 Configurable analogue input/analogue output card slots in banks of 4
3. No dedicated/on-line computer system required
4. 24-Bit A/D, D/A conversion
5. Dynamic Range: 105dB w/THD <0.01%
6. Dante Compatible
7. Digital audio bus capable of transferring 256 channels of audio (at 48kHz sample rate, 128 channels at 96kHz)
8. Control Software to provide audio processing to include: Crossovers, Compressors, Gates, Duckers, Expanders, Limiters, Gain blocks, Graphic Equalizers, Stereo Graphic Equalizers, Parametric Equalizers, Stereo Parametric Equalizers, Filters, Metering points, Delays, Mixers, Matrix Routers, Matrix Mixers, Source Matrices, Tone Generators, and Source Selectors
9. TCP/IP and RS-232 Controllable
10. Acceptable Products:
  - a. BSS Soundweb London BLU-806
  - b. BSS Soundweb London BLU-BIB
  - c. BSS Soundweb London BLU-BOB
  - d. BSS Soundweb London BLU-120

## 2.8 AMPLIFIERS

### A. Networked Power Amplifiers:

1. The power amplifiers shall be a four-channel digital network-processing amplifier with DSP to optimize loudspeaker performance
2. Amplifiers to approved and recommended for use by loudspeaker manufacturer.
3. Provide protection of circuit components in the event of input over-drive, output overload, or short circuits.
4. Frequency response:  $\pm 1$  dB, 20 Hz to 20 kHz with less than 1 per cent THD at rated output.
5. Input impedance: 10kohm balanced.
6. Output regulation: 2 dB from no load to full load conditions.

7. Noise generation: at least 85 dB below rated output with input shorted.
8. Provide software, hardware, and cabling to allow remote monitoring and control of amplifiers.
9. Provide site specific programming to optimize speaker systems and provide recallable presets for three typical scenarios.
10. Software to be Windows compatible and provided on a rack mounted computer with keyboard, monitor, and mouse/trackball.
11. Acceptable products:
  - a. Type 1 Amp – 4000Watts into each of 4 channels at 4 ohms
  - b. Crown iTech 4x3500HD

## 2.9 AMPLIFIER CONTROL SYSTEM

### A. Control System Makeup

1. All new loudspeakers for the seating bowl shall be under computer control.
2. All amplifiers shall be under computer control.
3. Control System shall use a Windows Professional® based software system.
4. Graphical displays and menu screens to maintain a consistent user interface.
5. Screen selections shall be implemented by mouse pointer or keyboard.
6. System shall be implemented from control computer described above.
7. Control System shall communicate with other components via non-proprietary communication protocol. Provide all necessary repeaters, signal conditioners, format converters, etc. needed to connect the control room with the amplifier rooms. Data cable not to be run with audio cables.
8. Control System software shall include password protection for multiple user levels.

### B. Control System Setup Functions

1. Amplifier setup and adjustment
2. Each amplifier shall be individually adjustable from control screen on computer.
3. Controls shall include volume up/down in 1 dB increments, mute on/off, power, and signal polarity.
4. System shall permit both channels to be linked for common operation or separated for individual adjustment.
5. Provide ability to include user provided amplifier labels for identifying which unit is being controlled.
6. When used in groups, amplifiers shall maintain their own relative gain levels.

7. System shall sequentially power on and power down the amplifiers.
8. Amplifier control screens shall include graphical indications of input and output levels, power status, reserve headroom and thermal conditions of amplifier.
9. System shall have quick access to pre-set amplifier configurations.
10. Each amplifier to be able to retain its current gain settings in the event of power outage or loss of communication with the control computer.

C. Other system Capabilities

1. Amplifier diagnostics
2. Control system shall monitor operating parameters of each amplifier.
3. System shall alert operator when an amplifier or group of amplifiers is clipping or overheating.
4. System to indicate the relative impedance of the speaker line and alert the operator when the load on the amplifier has changed significantly.
5. Provide user adjustability for amplifier alert by permitting operator to set degree of clipping or overheating before generating an alert.
6. Provide user selection on how alerts are indicated, including any combination of: log file, printer, visual indicator, or audible indicator.
7. Visual system monitoring
8. Provide for multiple bar graph displays of amplifier outputs on system monitor.
9. Size of graph and quantity displayed to be determined by operator.
10. Each graph shall indicate amplifier level in dB and include user provided label for describing amplifier function.
11. Graph shall also include information on amplifier clipping, reserve headroom, polarity, and mute status.
12. Control system to provide visual indication of amplifier power and standby status to security office.
13. Seating Bowl Muting
14. Provide a series of graphical screens depicting the seating areas of the stadium with on-screen buttons to mute the appropriate area.
15. Actual graphical layout, color scheme, number of mute zones and individual screen configuration to be submitted for review. Assume the review process will require up to 60 days due to the iterative nature of graphical screen development.
16. System shall remain fully operable if one or more amplifiers ceases operation or goes offline.

17. System shall remain fully operable if the control system goes offline.

D. Acceptable product:

1. Harman Audio Architect.

## 2.10 AUDIO CONTROL COMPUTERS

A. The DSP system and control software shall be operational 30 days prior to the first use of the installed system.

B. Signal processing shall be performed by computer based system. The DSP control platform is to incorporate amplifier and loudspeaker control, monitoring and configurable DSP.

C. The system shall have the following minimum capabilities:

1. Solid State Hard Drive
2. Operating System: Most current OS as supported by the DSP and Amplifier control software.
3. Enclosure/Case: Rack Mountable.
4. Memory: 16 GB, DDR3 1600MHz.
5. Internal Hard Disk 1: 500 GB. 7200RPM, SATA.
6. Networking: Provide two Network Interface Cards
7. Video: Dual Intel HD Graphics with DVI outputs.
8. USB 2.0 connectivity
9. License all software to the client
10. Warranty: Three-Year Onsite Warranty with 24/7 Phone and Next Business Day Service.
11. Computer system shall be completely tested by manufacturer prior to delivery.
12. Acceptable product:
  - a. Super Logics
  - b. Hewlett Packard
  - c. Dell

D. Control Monitor:

1. Viewable Size: 19-inches diagonal.
2. Touchscreen type: Projected capacitive.
3. Touchscreen interface: USB.
4. Contrast ratio: 800:1.
5. Viewing angle: 160° H and 160° V.

6. Display type: LCD Active Matrix TFT.
7. Display resolution: 1280 x 1024.
8. Aspect ratio: 4:3.
9. Mount: 100 VESA.
10. Video Input: DVI and D-Sub 15-pin.
11. Provide USB extensions as required for touchscreen interface to main audio control CPU.
12. Provide with rack mount.
13. Acceptable product to include all of the following:
  - a. Planar PT1985P 19" Touch Screen Monitor.
  - b. Middle Atlantic RM-LCD-MK LCD Rackmount.
  - c. Covid Plenum USB Extender P-USBA-AF-49ACT.

## 2.11 POWER CONDITIONING

### A. Power Protection (SURGE):

1. Provide surge protection device to maintain clean power to the following equipment:
2. DSP analog to digital converters.
3. Fiber Transport system components.
4. Low level (microphone or line) processing equipment with internal microprocessor or DSP chips.
5. Uninterruptible power supplies.
6. Provide product package most suitable for installation method required by equipment and its location.
7. Acceptable products:
  - a. Eaton.
  - b. SurgeX
  - c. Approved Alternate

### B. Backup Power (UPS):

1. Provide UPS systems to maintain power to all DSP, Network switches, computer CPU's and associated video monitors.
2. UPS's shall be on-line style with sufficient battery reserve to operate for 15 minutes. Size each UPS unit for 25% additional capacity.
3. Rack mountable.
4. Acceptable product:
  - a. Eaton 5PX3000VA RT2U

## C. Rack Lighting and Power Strip (POWER LIGHT):

1. 20 Amp/2400 Watt rating.
2. Front panel AC voltmeter.
3. Dual front panel pullout dimmable lights.
4. Spike and surge suppression with over-voltage shutdown
5. 1-U Rack Mountable.
6. Acceptable product:
  - a. Eaton.
  - b. SurgeX
  - c. Approved Alternate

## D. Rack Power Strip (POWER DIST):

1. 20 Amp/2400 Watt rating.
2. Front panel AC voltmeter.
3. Spike and surge suppression with over-voltage shutdown
4. 1-U Rack Mountable.
5. Acceptable product:
  - a. Eaton.

## 2.12 EQUIPMENT HOUSING AND ACCESSORIES (IF REQUIRED)

## A. Existing racks are available for re-use should the components fit.

## B. Equipment Rack (gang-able)

1. Type: frame and panel with locking rear door
2. Size: 32 inches deep with 45 units of vertical space
3. Construction: factory assembled 16-gauge cold-rolled steel frames with all corners welded
4. Black enameled finish
5. Provide with ventilated, locking front door
6. Provide all necessary side panels, trim pieces, tops, fans, temperature sensors and blank panels
7. Provide all necessary Cable support bars, saddles
8. Acceptable Product to include:
  - a. Middle Atlantic Products WRK-44-32

## C. Equipment Rack (free-standing)



1. Type: frame and panel with locking rear door
  2. Size: 32 inches deep with 45 units of vertical space
  3. Construction: factory assembled 16-gauge cold-rolled steel frames with all corners welded
  4. Black enameled finish
  5. Provide with ventilated, locking front door
  6. Provide all necessary side panels, trim pieces, tops, fans, temperature sensors and blank panels
  7. Provide all necessary Cable support bars, saddles
  8. Acceptable Product to include:
    - a. Middle Atlantic Products WRK-44-32
- D. Rack Drawers (DRAWER):
1. Spring loaded latch
  2. Black powder coat finish
  3. Acceptable Product:
    - a. Middle Atlantic D-series
- E. Low Profile Keyboard Shelf:
1. Sliding black laminate shelf
  2. Single rack space
  3. Full Extension
  4. Acceptable Product:
    - a. Middle Atlantic SS
- F. Blank Rack Panels (BLANK):
1. Flanged construction
  2. 16 Gauge steel
  3. Black powder coat finish
  4. Acceptable Product:
    - a. Middle Atlantic SB series
- G. Vent Rack Panels (VENT):
1. Flanged construction
  2. 16 Gauge steel

3. Black powder coat finish
4. Acceptable Product:
  - a. Middle Atlantic VTF series
- H. Fan (FAN):
  1. Acceptable Product:
    - a. Middle Atlantic QFAN with guard
- I. Rack Fan:
  1. Provide 10" fan with guard and thermostat.
  2. Located in all equipment racks over 36 RU's high
  3. Acceptable Product:
    - a. Middle Atlantic FAN-10/GUARD-10/FC-2-215-1C
- J. Fan Thermostat Control:
  1. Switched 15A duplex outlet
  2. Temperature Range: 50 – 90 Degrees
  3. On and Stand-by LED indicators
  4. Integral mounting ears
  5. Provide for each rack fan assembly
  6. Acceptable Product:
    - a. Middle Atlantic FC-4-1C
- K. Rack Light:
  1. Provide gooseneck LED light
  2. Located in all equipment racks over 36 RU's high
  3. Acceptable Product:
    - a. Middle Atlantic LT-GN series
    - b. Middle Atlantic LT-GN-WL
- L. Equipment Rack Screws:
  1. Install rack mounted equipment with black 10-32 star post security screws with flat nylon washers
  2. Quantity as required
  3. Acceptable Product:
    - a. Middle Atlantic HP
- M. Wire Duct:

1. Purpose: signal wire routing in rack
2. Acceptable Product:
  - a. Panduit Type E Slotted

#### 2.13 PLATES AND PANELS

- A. Provide plates and panels and as described in Drawings. Engrave as shown on Drawings. Other Plates and Panels may be required to satisfy the requirements of the Work.
- B. Custom panels shall be 1/8-inch thick aluminum, standard EIA sizes, brushed black anodized finish unless otherwise noted. Brush in direction of aluminum grain only.
- C. Plate finish shall be stainless steel unless noted otherwise. Plastic plates are not acceptable.
- D. Panel, plate and label engraving shall be 1/8-inch block sans serif characters unless noted otherwise. On dark panels or pushbuttons, letters shall be white; on stainless steel, letters shall be black.
- E. Custom and/or Engraved Panels:
  1. Custom panels constructed of 1/8 inch brushed aluminum
  2. Finish: Brushed stainless
  3. Acceptable Product:
    - a. Panel Crafters
    - b. ProCo

#### 2.14 CABLES & WIRING

- A. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.)
- B. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
- C. Where cables are routed through cable tray, provide tray rated cable of equal specification.
- D. Where speaker cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
- E. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
- F. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. If field conditions or actual cable pathway requires tray or plenum cable, provide version of cable that meets required rating. Cables from Liberty, Commscope, Gepco, and West Penn are also acceptable provided they meet the performance specifications of the approved listed cables.
- G. Loudspeaker Cables - 70.7 Volt:
  1. Homerun to Amp: 14 gauge twisted pair, jacketed. Belden 5100UP
  2. Volume Control to Speaker: 14 gauge twisted pair, jacketed. Belden 5100UP

3. Speaker to Speaker: 14 gauge twisted pair, jacketed. Belden 5100UP
  4. Acceptable Manufacturer:
    - a. Belden (Model number listed above)
- H. Loudspeaker Cable - Main Arrays and Fill Speakers
1. Provide 12 AWG cable
  2. Cable to be CL3R or CL2P rated
  3. Jacket color: gray
  4. Acceptable Product:
    - a. Belden 5000UE
- I. Loudspeaker Cable – Subwoofer Array
1. Provide 10 AWG cable
  2. Cable to be CL3R or CL2P rated
  3. Jacket color: gray
  4. Acceptable Product:
    - a. Belden 5T00UP
- J. Multi-pair Audio Cable:
1. 24 AWG, individually shielded, individually jacketed with overall jacket.
  2. Can be used in lieu of Belden 9451 where multiple cable runs to the same location are required.
  3. Acceptable Product:
    - a. Belden 15##C Series
- K. Microphone/Line Level Wire:
1. Provide shielded 22 AWG cable.
  2. Cable to be PVC jacketed.
  3. Jacket color: black.
  4. Acceptable Product:
    - a. Belden 9451
    - b. Liberty 22-1P-EZ
    - c. Belden 88761 (where required)
    - d. Liberty 22-2C-PSH-WHT (where required)
- L. Speaker Level Wire:
1. Provide 14 AWG cable

2. Cable to be CL3R or CL2P rated
3. Jacket color: gray
4. Acceptable Product:
  - a. West Penn 226
  - b. West Penn 25226 (where required)

M. Other Misc. Cables:

1. Acceptable Product:
  - a. As per manufacturer specifications

2.15 CONNECTORS

A. XLR Panel mount Connectors:

1. Provide panel mount XLR connectors with unified metal shell
2. RF-Protector connectors
3. Shell Color: Black
4. Contacts: Silver
5. Terminations: Solder
6. Acceptable Product:
  - a. Male Connectors: Neutrik NC\*MD-L-1-BAG Series
  - b. Female Connectors: Neutrik NC\*FD-L-1-BAG Series

B. XLR Cable Connectors:

1. Provide XLR cable connectors with die cast shell
2. No-screw type assembly
3. Chuck-type strain relief
4. Shell Color: Black
5. Contacts: Silver
6. Terminations: Solder
7. Acceptable Product:
  - a. Male Connectors: Neutrik NC\*MX-BAG Series
  - b. Female Connectors: Neutrik NC\*FX-BAG Series.

C. Other Connectors:

1. As per manufacturers specifications

PART 3 - EXECUTION

### 3.1 GENERAL

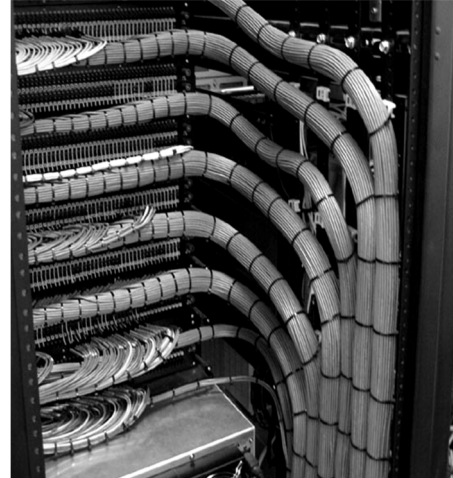
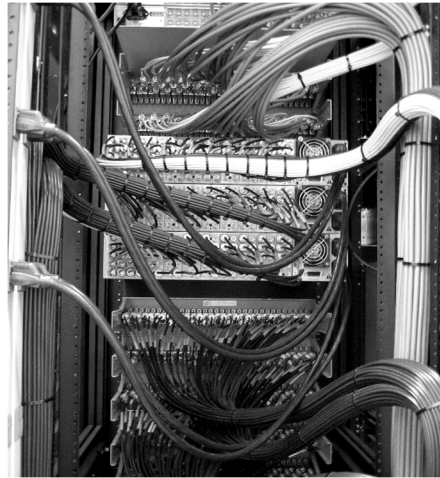
- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final Products.
- B. The installation recommendations contained within ASDI and Telecommunications Distribution Methods Manual are mandatory minimum standards and requirements.
- C. Mount equipment and enclosures plumb and level.
- D. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.
- E. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.
- F. Outdoor mounted junction boxes to meet NEMA 3 or better.

### 3.2 INSTALLATION

- A. Installation of cable and wiring
  - 1. Cabling and Wiring:
  - 2. Install cable in a manner to adhere to manufacturer's specifications for maximum cable pulling tension, minimum bend radius, and restrictions.
  - 3. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
  - 4. If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch (1.2 meter) intervals. At no point shall the cables rest on light fixtures, acoustic ceiling grids, panels, conduits, sprinkler pipe, water pipe and/or HVAC system ducting.
  - 5. Horizontal distribution cables shall be bundled in groups of no more than 50 cables when being supported by J-Hook or trapeze systems. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance. An exception to this rule is when cable is installed in cable tray systems.
  - 6. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices
  - 7. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
  - 8. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced prior to final acceptance at no cost to the Owner.
  - 9. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall

be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

10. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
11. Provide splice free wiring and cabling from origination to destination. Cables shall be installed in continuous lengths from origin to destination (no splices). Properly designed transition points, or consolidation points are not considered 'splice' points.
12. Make joints and connections with rosin-core 60/40 solder or with mechanical connectors specifically intended for the type and class of cable being used. Where spade lugs are used, crimp properly with ratchet type tool.
13. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at one end. Shield not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.
14. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.
15. Connect cable to active components through XLR connections whenever multiple formats are available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.
16. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommets.
17. Execute wiring in strict adherence to:
  - a. Phillip Giddings. Audio System Design and Installation. Indianapolis: Howard W. Sams & Co., 1990.
  - b. Don Davis and Carolyn Davis. Appendix II, Recommended Wiring Practices. Sound System Engineering, 2nd Edition. Indianapolis: Howard W. Sams & Co., 1989.
  - c. AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm, 2015
18. Equipment Housing Cabling and Wiring:
  - a. Lace, tie, or harness wire or cable as required herein, and in accordance with accepted professional practice. Dress, lace or harness all wire or cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Reference photos below for standard of quality.



- c. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.
- d. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
- e. Provide plastic cable ties or Velcro straps to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
- f. Install with connections completely visible and labeled.
- g. Provide termination resistors, if required, of 5 per cent tolerance; fully visible and not concealed.

B. Installation of connectors, plates & panels:

- 1. Install panel mounted connectors rigidly attached to panels, plumb and level.
- 2. Custom rack panels shall be 1/8 inch thick aluminum or steel, standard EIA sizes, brushed black anodized finish (brushed in direction of aluminum grain only), unless otherwise noted.
- 3. Custom connector plates (speaker, microphone, etc) are typically stainless steel, unless otherwise noted or specified. However, verify plate finish with the Owner.
- 4. Install XLR type connectors in accordance with IEC-268 standard, with a wiring scheme of pin 2 hot (high), pin 3 (low), and pin 1 screen (shield).
- 5. Other Plates and Panels may be required to satisfy the requirements of the Work.

C. Installation power and grounding:

- 1. Coordinate final connection of power and ground wiring to housings.
- 2. Hardwire power wiring directly to internal AC receptacles to ensure uninterrupted operation.
- 3. Provide 3-conductor, isolated ground, 120 VAC outlets as required within each housing. Provide a minimum of two spare outlets in each rack.
- 4. Provide a copper ground buss top to bottom in each housing, insulated from the housing. Ground equipment chassis not having a three wire power cord to these busses using 6/32 nuts, bolts and lock-washers with No. 12 wire. Connect green ground wire from each AC outlet in housing to this buss bar.



5. Replace manufacturers supplied 18 gauge IEC power cords with UL listed 18 gauge pre-molded 6", 12", 18", or 24". Use minimum length required. No looped or cable tied IEC power cords are permitted within the equipment rack.
6. Replace manufacturers supplied 14 gauge IEC power cords with UL listed 14 gauge pre-molded 18" or 36" for all equipment IEC capable. Use minimum length required and minimize looped or cable tied IEC power cords present in the equipment rack.

D. Installation of electronic equipment:

1. Take appropriate precautions against electrostatic discharge (ESD). Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.
2. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.
3. Mount trim potentiometers, custom circuit cards, relays, and transformers (except large 70V units) in shielded enclosures, and mark their function and connections with engraved lamicaid labels.
4. Mount equipment plumb and level, firmly and safely held in place.

E. Installation of equipment housing:

1. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner in writing that racks are fabricated on site and the reasons for the change.
2. Provide rear support for housing mounted equipment greater than 15 inches deep.
3. Provide blank panels to fill unused panel space within the equipment housing.
4. If Key door locks are required, key each housing type alike.
5. Looking at the rack from the rear, locate AC power and speaker wiring on the left; line level audio, video, and RF wiring on the right.
6. Provide shaft locks or security covers on non-user operated equipment having front panel controls. These panels are to be installed at the conclusion of testing.
7. If forced air active thermal management is used, provide ventilation blocking material on the front, sides, and rear of the equipment rack as needed. Reference Middle Atlantic Products "Controlling the Temperature Inside Equipment Racks".
8. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.

F. Installation of loudspeakers:

1. Loudspeakers shall be mounted at the operating position in a safe, secure and permanent manner.
2. Rigging, mounting and support systems for loudspeakers shall be reviewed and certified by a registered Professional Engineer (PE) licensed to practice in the State in which the

project is located. Documentation shall be included as a submittal item. Once the systems are installed, the PE shall physically inspect the methods and means used to verify compliance with the original design.

3. Paint speakers, supports and related hardware color as directed by Owner.
4. The aiming direction of all loudspeakers shall be adjustable by  $\pm 5$  degrees vertically.
5. Structural support members to have a safety factor of at least five. Mounting hardware and wire rope to have a safety factor of eight. All fasteners to be graded and certified for use in the intended applications. Overhead suspension hardware shall comply with ASME B30.20 standards and all applicable local building and safety codes. Overhead suspension hardware must be of a type that includes product traceability controls.
6. Provide safety cable on all bracket mounted loudspeakers.
7. All loudspeakers located in ceiling tiles shall be located in the center of the tile unless noted otherwise.

### 3.3 LABELING OF EQUIPMENT

- A. Provide each terminal strip with a unique descriptor and a numerical designator for each terminal. Show terminal strip descriptor and designator on system schematic drawing.
- B. Provide logical and legible cable and wiring label permanently affixed for easy identification.
  1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.
  2. Wiring designator to be an alpha-numeric code unique for each cable. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings.
  3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection. Provide cable designator on circuits with intermediate splice points with an additional suffix to indicate each segment.

### 3.4 ENGRAVING

- A. Text font: 1/8 inch block sans serif characters unless noted otherwise.
- B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.
- C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., AMP-1.
- D. Equipment label: black with white characters except where indicated.

### 3.5 COMMISSIONING

- A. Prior to energizing or testing the system, ensure the following:
  1. All products are installed in proper and safe manner according to manufacturer's instructions.

2. Insulation and shrink tubing are present were required.
  3. Dusts, debris, packing materials, etc. is removed.
  4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  5. Labeling has been provided.
  6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
  7. Products are neat, clean and unmarred and parts securely attached.
  8. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
- B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards.
1. Electronic devices are properly grounded.
  2. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
  3. Verify each individual component is operating properly.
  4. Verify each individual component's performance meets the manufacturer's published performance for this unit.
  5. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
- C. Speaker Circuit Verification Test
1. Measure the impedance of each speaker line leaving the equipment racks.
  2. For constant voltage systems measure the impedance at 100 (or 250) Hz, 1 KHz and 8 (or 10) KHz of each line leaving the equipment rack with the line disconnected from the driving source. For band limited devices, use a frequency appropriate for the operating range of the transducer.
  3. When documenting the results of these tests, include the calculated impedance based on number of units on a line and the size and distance of the run. Correct any field readings that differ more than 20% from the calculated impedance.
  4. Include the results of the tests in the Project Record Manual.
- D. Speaker Polarity Verification Test
1. Use an electronic polarity checker, or two-channel FFT type measurement system to test each loudspeaker. All speakers should have the same relative polarity.
  2. Follow manufacturer's recommendations in conducting the tests.
  3. Include the results of the tests in the Project Record Manual.

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**E. Audio Signal Paths**

1. Verify operation from each source device through all switching, amplification and distribution devices.

**F. System Gain Adjustment**

1. Adjust each active device to have proper gain structure from the mixer output to the input of the amplifier.
2. With all amplifiers turned off, connect a sine wave or pink noise generator to the input of the mixer. Using a RMS AC voltmeter with a dB scale, adjust the mixer to an output between -10 and 0 dBu. Once the level has been established, it should remain unchanged throughout the test. All equalizers should be set flat for this test.
3. Follow the signal flow from the mixer to each subsequent component. Measure the input level and output level of each device at the point of connection to the device. The input level reading should differ no more than 0.25 dB from the level recorded for the preceding device. Diagnose and correct the wiring or equipment when any readings exceed this range.
4. Adjust the output of each component to achieve the proper output level.
5. Record the output levels of each device in the Project Record Manual.

**G. Signal Delay Adjustment**

1. Adjust the delay to each subsystem to ensure proper synchronization between the main speakers and delayed speakers.
2. Using a industry standard two-channel FFT measurement system such as Smaart or EASERA Systune, measure the arrival time of the distant signal and then measure the arrival of the local signal.
3. Based on the arrival times measured, adjust the delay applied to the local speakers to synchronize them with the distant speakers. Repeat the test to verify the delay has been set to within 1ms of the arrival of the distant signal. Once the precise delay time has been determined, provide an additional 10ms of Haas effect delay to maintain directional orientation toward the original sound source.
4. Continue to test and adjust each separate subsystem with a dedicated delay channel.
5. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.

**H. Remote Input Verification Test**

1. Using a microphone or portable signal generator, connect to each microphone/line level receptacle throughout the facility.
2. Verify that the receptacle under test appears at the correct input and is operating properly.
3. In a similar manner, check all remote tielines and media related lines for correct wiring and labeling.

## I. System Equalization

1. Using a Systune, Meyer SIM, or SMAART, equalize all loudspeaker systems to provide a suitable frequency response as follows:
2. Speech Reinforcement Systems: flat response from 125 Hz to 2.5 KHz, with 2 dB roll off above.
3. Program Reproduction Systems: flat response from 65 Hz to 8 KHz, with 2 dB roll off above.
4. Verify system gain and amplifier levels.
5. Provide program levels of at least 85 dB and speech reinforcement levels of at least 70 dB in the seating area without objectionable distortion, buzzes, or rattles.
6. Provide hard copy printouts of the spectral response with the test data.

## J. RFI and Parasitic Oscillation

1. With systems operating check to ensure that all systems are free from spurious oscillation and radio frequency interference in the absence of audio signal.

## K. Buzzes, Rattles and other Distortions

1. Adjust the system for normal operating level in the space. Apply a slow sine wave sweep from 60 Hz to 3 KHz and listen carefully for buzzes, rattles and other objectionable distortions.
2. Correct the cause of the defect. If the cause is not from the system. Bring the cause to the attention of the GC, indicating cause and suggestive corrective actions.

## L. Video Systems Test

1. Projected images and screen must be plumb with respect to ceiling line.
2. Video System Tests. Verify performance of all video equipment, components and systems, as specified herein.
3. Video (signal):
4. S/N (peak to RMS), un-weighted DC to 4.2 MHz: 55 dB minimum.
5. Crosstalk, un-weighted DC to 4.2 MHz: 45 dB minimum.
6. Frequency Response: Within plus to minus 0.5 dB to 4.2 MHz.
7. Line and Field Tilt: 2% maximum.
8. Differential Gain: 2% maximum.
9. Differential Phase: 2 degrees maximum.
10. Frequency Response: DC to 4.2 MHz within plus or minus 0.5 dB.

## M. Video Signal Paths

1. Verify operation from each source device through all switching, amplification and distribution devices.

N. Control Systems

1. Verify operational functions of the control system and all interfaced devices.
2. Verify operational functionality of any wireless user devices.

3.6 FINAL OBSERVATION & TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final observation and test will be performed by the Owner or Owner's representative no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
  1. Observation of the methods and means employed to incorporate the System within the facility.
  2. Verification of proper operation, from controlling devices to controlled devices.
  3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
  4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

3.7 TEST EQUIPMENT

- A. Thirty days prior to start of testing, provide a list to the Owner of test equipment make, model numbers and calibration dates that will be used.
- B. The following equipment shall be available on site for the entire test period through final system testing.
  1. Sound Level Meter : ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.

2. Pink Noise Source - Equal energy per octave bandwidth 20 Hz to 20,000 Hz,  $\pm 1$  dB (long-term average) at 0 dBm output. Stability:  $\pm 2$  dB per day.
  3. Dual-trace oscilloscope - 100 MHz bandwidth, 1 mV/cm sensitivity.
  4. Impedance Meter - Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 5k Hz. Measurement Range: 1 ohm to 100 kohms.
  5. Audio Oscillator: bandwidth 20 Hz to 20k Hz  $\pm 5$  dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level over the range from  $-30$  dBu to  $+10$  dBu.
  6. Multimeter - Measurement range, DC to 20k Hz, 100 mV to 300 V, 10 ma to 10 A, dB.
  7. Ladders and scaffolding necessary to inspect elevated equipment, junction boxes, etc.
- C. Provide three portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project. Include rechargeable batteries and recharger along with holster for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

### 3.8 INSTRUCTION OF OWNER PERSONNEL

- A. Provide 12 hours instruction to Owner designated personnel focusing on the use, operation and maintenance of the systems, scheduled as a minimum of two separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction. Coordinate schedule of demonstration with Owner's Representative.
- B. Video record all training sessions and compile a training video to be provided to the Owner on DVD.
- C. Provide sign in sheet to document the attendee's presence.
- D. If Contractor is not properly equipped to conduct Owner training on particular equipment, arrange for factory representatives of the equipment to be present to provide training at no additional cost to the Owner.

### 3.9 GAME DAY SUPPORT

- A. Provide two qualified technicians who are familiar with the project and its sound system installation for two regular season games.

### 3.10 CLEANUP AND REPAIR

- A. Upon completion of the work, remove refuse and rubbish from and about the premises. Leave areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation of systems at no cost to the Owner.

END OF SECTION

## SECTION 27 41 16.64 – COLISEUM SOUND SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Arena seating bowl sound system design-build performance specification

## 1.2 RELATED DOCUMENTS

- A. General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections (whether attached or not) apply to this section.
- B. AV series drawings
- C. Arena Rigging Systems specification Section 11 61 33

## 1.3 SECTION INCLUDES

- A. Sound System performance requirement
- B. Project instruction for the Contractor
- C. Sound System Product – Design reference product specification
- D. Project completion instruction for the Contractor

## 1.4 RESPONSIBILITY

- A. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Contractor to supply all engineering, materials, equipment, transportation, and labor necessary to provide a fully working, tested, and calibrated system. Supply accessories and minor equipment items (such as, but not limited to: power strips, adapters, connectors, mounting hardware, etc.) needed for a complete system, even if not specifically mentioned in these Specifications.
- B. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Owner for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the Owner.
- C. Execute all work in accordance with the National Electrical Code (NEC), the National Electrical Safety Code, the Occupational Safety and Health Act (OSHA) and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform Work.
- D. Required licenses, insurance, and permits including payment of charges and fees.
- E. Verification of dimensions and conditions at the job site.
- F. Preparation of submittal information.
- G. Pick-up of Owner Furnished Equipment (OFE) and incorporation into project if applicable.



- H. Development and implementation of AV control system software code and control panel layouts.
  - I. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction (AHJ).
  - J. Final tests and adjustments, written report, and documentation.
  - K. Instruction of operating personnel.
  - L. Provision of manuals.
  - M. Maintenance services and warranty.
  - N. Electrical
    - 1. The Contractor shall be responsible for breaker panel and distribution of electrical power from the panel to the equipment as required.
    - 2. A ground point will be provided in each equipment room or enclosure electrical panel. The contractor shall be responsible for connecting ground point to all equipment in accordance with NEC Code, local codes, and standards specified herein.
    - 3. Conduit infrastructure system, including wire for AC Power and grounding for the Audio System(s), are provided by the contractor. Coordination between different disciplines is required to achieve a proper conduit system installation and power provisions for the Audio System(s). All electrical installation shall be in accordance with Division 26 and the National Electric Code.
  - O. Conduit and Cable Management
    - 1. Install signal cabling in conduit or approved communications cabling pathway.
    - 2. Cabling exposed to public view is to be in conduit. Exterior junction boxes, conduit/raceway, terminations, etc. and those within enclosures where enclosures are exposed to outdoor conditions are to meet NEMA ratings for outdoor electrical applications.
  - P. Structural
    - 1. The contractor shall be responsible for design and structural engineering for all loudspeaker brackets attaching the loudspeakers (and/or loudspeaker hoisting system) to the building structure at position shown within the drawings. Coordinate loudspeaker weight loads with the Owner's Structural Engineer.
  - Q. Demolition
    - 1. Remove existing Bowl system sound system equipment and cabling not scheduled for re-use with the new sound system.
    - 2. Palletize all removed equipment.
    - 3. Coordinate disposal with Owner.
- 1.5 REFERENCES
- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
    - 1. American National Safety Institute (ANSI)
    - 2. American Society of Testing and Materials (ASTM)
    - 3. Electronics Industries Association (EIA)
    - 4. Federal Communications Commission (FCC)
    - 5. National Electrical Manufacturer's Association (NEMA)
    - 6. National Electrical Code (NEC)

7. Underwriters Laboratories (UL)
8. Occupational Safety and Health Administration (OSHA)
9. Society of Motion Picture and Television Engineers (SMPTE)
10. Building Industry Consulting Service International (BICSI)
11. Davis and Davis, Sound System Engineering (3rd Edition) (SSE), Howard W. Sams, 2006
12. Giddings, Audio System Design and Installation (ASDI), Howard W. Sams, 2013
13. AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm (AVIH), 2009
14. Middle Atlantic – Thermal Management White Paper

## 1.6 DEFINITIONS

- A. In addition to those Definitions of Division 1, the following list of terms as used in this specification shall be defined as follows:
1. Furnish: To purchase, procure, acquire, and deliver complete with related accessories.
  2. Install: To set in place, join, attach, link, set up, or otherwise connect and test until complete before turning over to the Owner. All parts, items, or equipment supplied by Contractor.
  3. Provide: To furnish and install.

## 1.7 SYSTEMS DESCRIPTIONS AND REQUIREMENTS

- A. The following is intended to provide an overview of the required work details, system features, and design concepts for the Work as shown on the project drawings and is not intended to be an exhaustive description of the systems.
- B. The Work includes provision of a complete and working Sound System, providing sound to spectator seating in the Coliseum seating bowl.
- C. The seating bowl speaker system design goals are to provide sound loudness levels of at least 105 dBA (continuous) with a uniformity of coverage of no more than +/- 2.5 dBA at any fixed seating position, with clear and intelligible sound. Measured STI-PA of at least 0.55 at not less than 95% of the fixed seating.
- D. Program and Source material serving the Main Seating Bowl originate in the Audio Control area and is distributed to the Sound System Amplifiers and DSP in equipment racks located on the press level or catwalk platform.
- E. As an aid to the fire alarm system, the main seating bowl will receive warning signals and announcements from the main fire command center. Tie-lines to interface these systems will be the responsibility of the contractor, along with the fire alarm components to implement the connections. The audio signal for this emergency override condition will insert into the DSP system and will be automatically priority routed when engaged. A contact closure from the fire alarm system will instigate the switch over to the fire alarm signal in the audio processing system at the Audio Control area.
- F. Sound system processing and controls are in the control room. The system renovation will update the connections from the control room to the audio processors using standard digital audio over Ethernet protocols such as DANTE or AES67. The system's digital audio network will allow the mix position to be relocated to the floor and connected over IT cabling for specialty events or to location in the seating bowl so that it can be operated from "in the seats" which is highly recommended. The house audio not only provides sound to the seating bowl speakers but also supports ties to the house video production and broadcast cabling system.
1. The new control computers, rack mounted monitor/keyboards, KVM system, network switch, and DSP are to be in the Audio Control racks. Provide a new rack as necessary

- to house this additional equipment, matching the existing racks to the extent possible. Provide a keyboard, mouse, touchscreen monitor, and KVM switch at the mix position that connects to the KVM system located in the Audio Control racks.
- G. Provide a connection from the new DSP located in the Audio Control area to the existing systems serving the suites, Back of House (BOH), concourse, and any ancillary systems. Coordinate sources to be sent with Owner.
- H. Ensure the existing Assisted Listening system is reconnected and in good working order.
- I. The main Arena seating is served by a variety of loudspeaker systems:
1. Type 1 Loudspeaker – line array system, flown in conjunction with a Type 3 subwoofer speaker array, serving the longer sides of the venue.
  2. Type 2 Loudspeaker – line array system, serving the ends of the venue.
  3. Type 3 Loudspeaker – cardioid subwoofer system, flown in conjunction with a Type 1 Loudspeaker, serving the entire venue.
  4. Type 4 Loudspeaker – point-source type loudspeaker, used as a delay loudspeaker system, serving the upper portion of the upper deck.
  5. Type 5 Loudspeaker – point-source High-Frequency only loudspeaker, used as a delay loudspeaker to cover the area behind dasher glass in the venue's hockey configuration. Not used with the venue's basketball configuration.
  6. Type 6 loudspeaker – point-source full-range loudspeaker, mounted underneath the scoreboard to fill the areas on, and around, the basketball court.
- J. Control System Interface:
1. Create Presets to accommodate the following:
    - a. NCAA Basketball
      - 1) Type 1, Type 2, and Type 3 loudspeakers are the primary sound sources
      - 2) Type 4 and Type 6 loudspeakers are time-aligned to Type 1, Type 2, and Type 3 loudspeakers.
      - 3) Ensure that each Type 6 loudspeaker maintains independent amplifier and DSP control to optimize sound levels on the basketball court and maximize system Gain-before-Feedback with the announcer microphone.
    - b. Ancillary Uses
      - 1) Create DSP presets as necessary to accommodate other venue uses at the instruction of the Owner.
    - c. Fire Alarm over-ride
      - 1) Mute all bowl system signals to the DSP, allowing the fire alarm panel to send any messaging. Coordinate this work with the Fire Alarm Contractor, and the local Authority Having Jurisdiction (AHJ).
    - d. Auxiliary Fed Subwoofers
      - 1) Create Presets that allow the user to choose whether the Subwoofer system signal originates from the console's Main Left/Right, or from an Auxiliary feed.
  2. Create a base control screen scene, active at all times, to include:
    - a. Sound System Power ON/OFF
    - b. Mode Indicator – Hockey, Basketball, or other Ancillary mode(s). These should be active buttons that allow the User to toggle between modes. The active mode should be highlighted in some fashion. Changing between modes should include a double-check from the User.
    - c. System Mute – this button should be Red when active. Muting the sound system should include a double-check from the User.
    - d. System in Fire Alarm over-ride. This should be a bold indicator that only appears when the system is in Fire Alarm over-ride.

- e. Subwoofer signal source – Main Left/Right, or Auxiliary fed. Create a two button graphic that allows the User to toggle between the signal for the Subwoofer system to be fed from the Main Left/Right outputs from the console, or from an Auxiliary output from the console.
- f. System Health. Use a green colored button to indicate “good” and a red colored button to indicate “fault”. This is intended to be system wide fault detector programmed to include:
  - 1) Amplifier Fault or Failure
  - 2) Amplifier Open/Shorted Load
  - 3) Amplifier Online/Offline
  - 4) Network Fault or Failure
  - 5) DSP On Line/Off Line
  - 6) DSP Fault or Failure
- 3. Create a Technician Level control screen scene, to include:
  - g. Access only with Password or Code
  - h. Full access to DSP and Amplifiers
- K. Type 1, Type 2, and Type 3 loudspeakers are to be flown in a manner that allows them to lift into storage location or lowered within reach of the floor for service. The motorized lift system is to be programmed with stops at floor level, performance trim height level, and at high point for storage during events/productions that do not require the arena installed sound system. Dead-hang points are to be provided for the storage position.

#### 1.8 SUBMITTALS

- A. Provide submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section, unless otherwise indicated.
- B. Supplementary submittal requirements:
  - 1. Bid Proposals to include:
    - a. Listing of major products and material provided under this specification
    - b. Statement of conformance to confirm the proposed systems meet or exceed the design requirements as defined in the project documents
    - c. Provide breakout pricing for motorized soft-limit motorized lift system.
  - 2. Upon Notice to Proceed (NTP) and prior to commencement of Work:
    - a. Complete schedule of submittals.
      - 1) Project title.
      - 2) Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix “R” immediately followed by a unique number and be numbered in consecutive order.
      - 3) Date of submission.
    - b. Chronological schedule of Work in bar chart form.
    - c. Product Data Submittal (PD):
      - 1) Provide product data submittal in a single PDF file.
      - 2) Provide an indexed list of products and corresponding manufacturer’s data sheets to be incorporated within the Work.
      - 3) In the index, provide clickable hyperlinks that lead to the page of the submittal for the item.
      - 4) Organize index and data sheets in specification order.
      - 5) Provide references to the specification for each product, i.e.; Type 1 Loudspeaker.
      - 6) When multiple products are shown on a data sheet, indicate which product(s) are to be provided with an arrow, highlight, or note.
      - 7) Submittal shall not include user/operating manuals, service manuals, or marketing brochures.

- 8) For items that will be installed in public areas, indicate what color the product is to be.
- 9) Submissions that do not follow the format and configuration described above will be returned without review.
- d. Shop Drawing Submittal (SD):
  - 1) Functional Diagrams/Schematics:
    - a) Detailed, redrawn wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and designators/label, as well as device designators for each system. Provide connector type and terminal strip identification, along with color codes for cables connecting to these devices. Give each component a unique designator and use this designator consistently throughout the project.
- e. Coordination Drawings:
  - 1) Prepare and submit a set of coordination drawings showing major elements, components, and devices of the audio and video system in relationship with other building components. Prepare drawings to an accurate scale of 1/8"=1'-0" or larger on suitable sized media.
  - 2) Prepare floor plans, reflected ceiling plans, elevations, sections, and details, to conclusively coordinate and integrate all equipment. Indicate locations where space is limited, and where sequencing and coordination of installations is of importance to the efficient flow of the Work including, but not necessarily limited to the following:
    - a) Equipment housings
    - b) Ceiling and wall mounted devices
    - c) Raceways
    - d) Cabling
- f. Equipment: Location of equipment within racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
- g. Patch panel(s): Layouts and designation (labeling) strips, including color schemes.
- h. Full fabrication details of any custom enclosures and millwork indicating size, material, finish and openings for equipment.
- i. Projector, loudspeaker, camera mounting details, include hardware types and load capacity.
- j. Fabricated Plates and Panels: Provide complete drawings of custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
- k. Labeling: Equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and designator schedule.
- l. Schedules: Wiring schedule showing source and destination of wiring, indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting, and location. Include this information with remainder of wiring diagrams.
- m. Consultant's project documents in electronic format will not be supplied to the Contractor for their use as part of submittals.
- n. Detail drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'-0".
- o. Submissions that do not follow the format and configuration described above will be returned without review.
- p. Any other pertinent data which is necessary to provide the Work.
- q. Submittal Format:
  - 1) Provide all document submittals in PDF.
  - 2) Provide each submittal with a unique number, numbered in consecutive order.

- 3) Provide each submittal with a complete table of contents with the following information:
  - a) Project title and number.
  - b) Submittal number. In the case of a re-submittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
  - c) Date of submission.
  - d) Referenced addendum or change-order number as applicable.
  - e) Referenced specification Section, Part, Article, Paragraph and page number or drawing reference as applicable.
- 4) Drawings executed at an appropriate scale, not smaller than  $\frac{1}{8}" = 1'-0"$  for conduit/floor plans,  $\frac{1}{4}" = 1'-0"$  for equipment layouts, and  $\frac{1}{2}" = 1'-0"$  for mounting details and plate/panel details.
- r. Resubmission requirements:
  - 1) Make all requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
  - 2) Indicate all changes that have been made other than those requested.
3. Control System Software:
  - s. Provide electronic copies of proposed control system user interfaces within sixty (60) days of issuance of Notice to Proceed (NTP).
- C. Approval of Submittals: The submittal information will be reviewed by the general contractor, owner, Architects, engineers, and consultants. Each submittal package will be returned, stamped as follows:
  3. "No Exceptions Taken" proceed with construction, all job site coordination will be at the direction of the general contractor.
  3. "Make Corrections Noted: No Resubmission Required" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
  3. "Make Corrections Noted: Submit Corrected Copy" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
  3. "REJECTED, Submit Specified Item" a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  3. "REJECTED, Revise and Re-submit" submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  3. "No Review Action Required" all information provided was for information or coordination purposes only. Review is not required.

#### 1.9 CONTRACT CLOSE-OUT DOCUMENTS:

- A. Provide submittals in accordance with Conditions of the Contract and Division 1, Submittal Procedures section unless otherwise indicated, after substantial completion but prior to final observation:
- B. Supplementary submittal requirements:
  1. Provide the following in one electronic submission for review.
  2. Equipment Manuals:
    - a. Manufacturer's owner/instruction manual for each type of Product by manufacturer and model or part number unless specified otherwise herein
    - b. Supply manufacturer's serial numbers for each Product
    - c. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item

- d. Separately bind list by manufacturer and model or part number of Products incorporated within the Work, arranged in alpha numeric order. When applicable, bind Manufacturer's warranty statements separately.
3. Test Reports: Recorded findings of Commissioning.
4. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
  - a. This procedure should describe the operation of system capabilities.
  - b. Assume the intended reader of the manual to be technically inexperienced but unfamiliar with the components and the facility.
5. Service Information, including service phone number(s) and hours; service schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
6. Any other pertinent data generated during the Project or required for future service.
7. Within three weeks of final observation, submit the following in one electronic submission for review. Upon Owners and/or Consultant's request, provide hard copy files of the following:
  - a. Record drawings: Final rendition of Shop Drawings depicting what is actually incorporated within the Work.
  - b. Record drawings in AutoCAD editable DWG format and Adobe PDF format. Resolution to be sufficient to permit Owner's technicians to be able to clearly read all notes and text on screen.
  - c. One set of signed proof-of-training documents.
8. Submittal Format:
  - a. Record Drawings: Drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'-0".
  - b. Segregate documents into separate folders containing data relevant to operational, maintenance, and warranty issues. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g.; operational data in a maintenance folder.
  - c. Project Record Manual
    - 1) Provide product data submittal in a single PDF file.
    - 2) Provide an indexed list of major groupings.
    - 3) In the index, provide clickable hyperlinks that lead to the page of that major grouping.
    - 4) Organize index and major groupings in logical signal-flow order.
9. Resubmission requirements:
  - a. Make all requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
  - b. Indicate all changes that have been made other than those requested.

#### 1.10 CUSTOM SOFTWARE

##### A. Introduction:

1. Proprietary software provided for the Technical Systems shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
2. Contractor shall agree that 3rd party proprietary software provided with the system shall be subject to this agreement.
3. Contractor and Owner agree that this software license is deemed to be part of, and subject to, the terms of the Agreement applicable to both parties; and shall supersede any standard manufacturer or Contractor's standard license agreement.
4. Proprietary software shall be defined to include, but not be limited to, device and system specific software and firmware designed to run on conventional computer based operating platforms as well as all micro-processor based hardware used to program, setup, or operate the system or its components.

5. For sake of this agreement, MS Windows® shall not be considered “proprietary” software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.
- B. License Grant and Ownership:
1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the Owner.
  2. Except as expressly set forth in this agreement, Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties or service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system shall be delivered to Owner for the sole benefit of Owner.
  3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.
- C. Copies, Modifications, and Use:
1. Source code shall be available to Owner for a period of not less than 10 years.
  2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of Owner and its representatives.
  3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right for Owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
  4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.
- D. Warranties and Representations:
1. Contractor represents and warrants to Owner that:
    - a. It has all necessary rights and authority to execute and deliver this Software License and perform its obligations hereunder and to grant the rights granted under this Software License to Owner;
    - b. The goods and services provided by contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners; and
    - c. The software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
  2. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.
  3. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular



purpose, of merchantability, or warranty of no infringement of third party intellectual property rights.

#### 1.11 QUALITY ASSURANCE

- A. Qualifications: Contractor to be experienced in the provision of systems similar in complexity to those required for this project, and meet the requirements listed below. Provide documentation at the time of bid to support these qualifications:
1. Form of corporation.
  2. No less than three years' experience with equipment and systems of the specified types.
  3. Experience with at least three comparable scale projects within the last three years.
  4. Be a franchised dealer and service facility for the manufacturer's products furnished.
  5. Maintain a fully staffed and equipped service facility with full-time field technicians.
  6. Have at least one supervisory on-site employee who has completed and has been certified CTS-I by Infocomm.
  7. Adequate plant capacity and equipment to complete the Work.
  8. Adequate staff with commensurate technical experience.
  9. Suitable financial status (i.e.; bonding and materials purchase capacity) to meet the obligations of the Work.
  10. Adequate regional service organization to meet warranty response requirements of the Project.
  11. Provide listing with appropriate explanation regarding the status of Contractor's resolved or unresolved legal disputes within the last six calendar years.
  12. Provide listing with appropriate explanation regarding any projects within the last 3 years where the Contractor has failed to meet construction schedules due to Contractor's cause.
  13. Completed current version of the AIA Contractor's Qualification Form.
- B. Subcontractors: at the time of bid, the Contractor shall provide a list of structural, electrical, sound, or any other subcontractors intended to do the Work, or are being retained as local service providers throughout the warranty period. Subcontractors shall be appropriately state licensed in their specialty and must provide the same qualification documents as the Contractor.
- C. Work: Perform Work in compliance with the applicable standards listed herein and governing codes and regulations of the authorities having jurisdiction and the Contract Documents.
1. Drawings and specification requirements govern where they exceed Code and Regulation requirements.
  2. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
  3. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.
- D. Coordinate exact location and installation of equipment, power, grounding, and raceway requirements with the Owner.

#### 1.12 DELIVERY, STORAGE & HANDLING

- A. Ship Products in its original container, to prevent damaging or entrance of foreign matter.
- B. Handling and shipping in accordance with Manufacturer's recommendation.
- C. Provide protective covering during construction of all installed devices, to prevent damaging or entrance of foreign matter.
- D. Replace, at no expense to Owner, Products damaged during storage, handling, or through the course of construction.

**1.13 PROJECT CONDITIONS**

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

**1.14 WARRANTY**

- A. Warrant labor and equipment for one year following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or equipment within the Warranty period without charge.
- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within twenty-four (24) hours during normal working hours and correct the deficiency within forty-eight (48) hours.
- D. Provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Closeout Documents.
- E. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment (OFE). Coordinate observation visit with the Owner.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Products listed are provided for reference and standard of quality. Design proposals are to meet or exceed performance of this reference.
- B. Products quantity is as required. If a quantity is given, provide at least the given amount. Some product listed may not be required to fulfill the obligations of the Work.
- C. Equipment and materials shall be new and conform to applicable UL or ANSI provisions.
- D. Regardless of the length or completeness of the descriptive paragraph herein, provide Products complying with the specified manufacturer's published specifications.
- E. Remove or blank out all manufacturers' names, logos, or other symbols from loudspeakers or other objects placed in view of the public unless a sponsorship agreement has been coordinated with the client. If logos are removable, remove and repaint to the color of the adjacent surface and reattach.
- F. Take care during installation to prevent scratches, dents, chips, etc.
- G. Paint all loudspeakers to match surroundings. Confirm color selection with Owner during the submittal phase.

## 2.2 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of function, performance, and quality. Alternate product to be considered in place of the basis of design product, provide the following:
  - 1. Documentation demonstrating that the proposed product meets, or exceeds, basis of design product description attributes
  - 2. Loudspeaker substitutions will require:
    - a. EASE loudspeaker data, preferably in. gll format
    - b. A working EASE model showing the proposed loudspeaker providing performance that meets or exceeds the basis of design.
- B. Provide all equipment as part of “turn-key” system delivery.

## 2.3 SEATING BOWL LOUDSPEAKERS

- A. Type 1 Loudspeaker
  - 1. Acceptable Product
    - a. D&B Audiotechnik Vi12
- B. Type 2 Loudspeaker
  - 1. Acceptable Product
    - a. Type 2a
      - 1) D&B Audiotechnik Vi12
    - b. Type 2b
      - 1) D&B Audiotechnik Vi8
- C. Type 3 Loudspeaker
  - 1. Acceptable Product
    - a. D&B Audiotechnik J-Sub
- D. Type 4 Loudspeaker
  - 1. Acceptable Product
    - a. D&B Audiotechnik Vi7P
- E. Type 1 Amplifier
  - 1. Acceptable Product
    - a. D&B Audiotechnik D80
- F. Type 2 Amplifier
  - 1. Acceptable Product
    - a. D&B Audiotechnik 30D
- G. Audio Network Bridge
  - 1. Acceptable Product
    - a. D&B Audiotechnik DS10

## 2.4 CATWALK AND UNDER-SCOREBOARD FILL

- A. Type 5 Loudspeaker
  - 1. Dual element, HF only
  - 2. Large waveguide for increased directivity control
  - 3. Frequency response: 500Hz – 17kHz
  - 4. Acceptable Product
    - a. Fulcrum Acoustics AH463 HF-only section
- B. Type 6 Loudspeaker

1. 12" coaxial
2. Compact enclosure
3. Vertically oriented trapezoidal shape
4. Passive operation
5. Frequency response: 69Hz – 20kHz
6. Sensitivity: 98dB 1W/1M
7. Impedance: 8 Ohms
8. Acceptable Product
  - a. Fulcrum Acoustics CX1265

## 2.5 AUDIO SIGNAL PROCESSING

### A. Digital Signal Processor

1. Configuration: Self-contained single chassis processor
2. Operation: Native gigabit Ethernet employing DiffServ quality of service, IEEE 1588 time reference, UDP/IP data transport and floating point audio data representation
3. Latency: analog through-put not to exceed 2.5ms
4. Analog to digital conversion: 24-bit delta sigma at either 48 or 96 kHz
5. Digital to analog conversion: 24-bit delta sigma at either 48 or 96 kHz
6. DANTE capable
7. Audio Architect control software
8. Acceptable Product
  - a. BSS BLU-806DA
  - b. BSS BLU Analog Input Card
  - c. BSS BLU Analog Output Card

### B. I/O Expander

1. Acceptable Product
  - a. BSS BLU-326DA
  - b. BSS BLU Analog Input Card
  - c. BSS BLU Analog Output Card

## 2.6 AUDIO CONTROL COMPUTERS

### A. The system shall have the following capabilities:

1. CPU: 3.3 GHz Intel® Pentium Dual Core
2. Operating System: Microsoft Windows 10 Professional, 64-bit.
3. Enclosure/Case: 2-RU Rack Mountable.
4. Power supply: 350 watt.
5. Memory: 16 GB, DDR4 2400MHz RAM
6. Internal Hard Drive: 1.0TB SATA 6Gb/s 7200RPM
7. Server grade NIC: Intel Gigabit CT PCI-E Network Adaptor EXPI9301CTBLK
8. Networking: Dual 10/100/1000 Mbps.
9. Video: DVI-D, HDMI, and DisplayPort outputs.
10. Software to be included:
  - a. License all software to the client.
  - b. Norton Antivirus.
11. Warranty: Three-Year Onsite Warranty with 24/7 Phone and Next Business Day Service.
12. Computer system shall be completely tested by manufacturer prior to delivery.
13. Acceptable product:
  - c. Super Logics SL-2U-WS-PD-C236SAE-DB (Quantity: 2)

### B. Rack Mount Keyboard and Monitor

1. 1RU integrated Keyboard and Monitor on slides
2. 105 key USB keyboard with integrated keypad
3. 17.3" diagonal LCD display with 1920 x 1080 resolution

4. Acceptable Product:
    - a. Middle Atlantic RM-KB-LCD17HD (Quantity: 2)
  - C. Audio Control Monitor:
    1. Viewable Size: 24-inch diagonal
    2. Touchscreen type: Optical
    3. Touchscreen interface: USB.
    4. Contrast ratio: 1000:1
    5. Display resolution: 1920 x 1080
    6. Aspect ratio: 16:9
    7. Video Input: DVI, HDMI, VGA
    8. Provide USB extensions as required for touchscreen interface to main audio control CPU
    9. Acceptable product
      - a. Planar PXL2430MW
  - D. Keyboard and Mouse:
    1. Normal Keys: 104.
    2. Function Keys: 5.
    3. Mouse Tracking: Optical.
    4. Connection: USB.
    5. Acceptable product
      - a. Microsoft Wired Desktop 600 #APB-00001
      - b. Data Pro AX2M-100 USB to PS2 adaptors, as needed for use with KVM system
- 2.7 SYSTEMS CONTROL SOFTWARE
- A. DSP and Under Scoreboard Common Systems
    1. Acceptable Product
      - a. HiQnet Audio Architect
  - B. Main and Delay Ring Systems
    1. Acceptable Product
      - a. Manufacturer Specific Control and Monitoring Software
- 2.8 KEYBOARD VIDEO MOUSE (KVM) SYSTEM
- A. Locate in the Audio Control Area
  - B. Matrix system to allow user control and viewing of both Control Computers
  - C. Provide the following Guntermann & Drunck Products:
    1. Acceptable Products
      - a. CCC-16C (Quantity: 1)
      - b. DVI-U-CPU (Quantity: 2)
      - c. DVI-U-CON (Quantity: 3)
      - d. MultiPower 12 (Quantity: 1)
      - e. A7000019 3RU Rack Frame (Quantity: 1)
      - f. A7000020 Mounting Hardware (Quantity: 4)
      - g. TS Function (TDS) Firmware (Quantity: 1)
- 2.9 POWER CONDITIONING
- A. Power Protection
    1. Provide UPS systems to maintain power to the following equipment:
      - a. All computer CPU's and associated video monitors
      - b. All Audio System Network equipment

- c. All low level (mic or line) processing equipment with internal microprocessor or DSP chips.
  - d. Mixing Console(s)
- B. UPS's shall be on-line style with enough battery reserve to operate for 15 minutes. Size each UPS unit for 25% additional capacity.
  - 1. Compliant with building or campus standards
  - 2. Acceptable product:
    - a. APC SMT2200RM2U

## 2.10 NETWORK EQUIPMENT

- A. Ethernet Switch
  - 1. Compatible and approved by DSP and amplifier system manufacturer
  - 2. Compliant with campus IT Standards
  - 3. Acceptable product:
    - a. Extreme Networks X460-G2-48p-10ge4
    - b. Fiber Optic Cable adaptors as required

## 2.11 MICROPHONES AND ACCESSORIES

- A. Headset Microphone
  - 1. Acceptable Product
    - a. Crown CM311a (Quantity: 1)
- B. Desktop Microphone and desk stand
  - 1. Acceptable Product
    - a. Electro-Voice RE20 with 309a shock mount (Quantity: 1)
  - 2. Acceptable Product (Quantity: 1)
    - b. On-Stage DS7200B
    - c. Proline PLDRB1B
- C. Announcer Control Station
  - 1. Acceptable Product
    - a. Studio Technologies 230 (Quantity: 1)
- D. Wireless Microphone System
  - 1. Provide equipment for six channels of handheld microphones
  - 2. Acceptable Product
    - a. Shure Axient AXT400 Dual Channel Receiver
    - b. Shure Axient UA870USTV Directional Antenna
    - c. Shure Wireless Workbench 6 Software Package
    - d. Shure Axient AXT200 Handheld Transmitter (Quantity: 2)
    - e. Shure RPW118 Wireless SM58 Cartridge (Quantity: 2)
    - f. Shure AXT920 Lithium-ion Rechargeable Battery (Quantity: 4)
    - g. Shure Axient AXT900 Charging Station
- E. Wireless In-Ear Monitor System
  - 1. Shure 900 Series. Provide complete turn-key system including rack, rack drawers, power distribution, and stands for Antennas.
  - 2. Wireless Transmitter
    - a. Acceptable Product
      - 1) Shure P9T (Quantity: 2)
  - 3. Dual Rack Mount Kit
    - b. Acceptable Product

- 1) Shure RPW504
4. Directional Antenna
  - c. Acceptable Product
    - 1) Shure PA805SWB (Quantity: 2)
5. Wireless Bodypack Receiver
  - d. Acceptable Product
    - 1) Shure P9RA (Quantity: 2)
6. Rechargeable Batteries
  - e. Acceptable Product
    - 1) Shure SB900A (Quantity: 4)
7. Battery Charger
  - f. Acceptable Product
    - 1) Shure SBC200
8. Earphones
  - g. Acceptable Product
    - 1) Shure SE215-K (Quantity: 4)
    - 2) Provide pricing for additional units
9. Earphone Replacement Sleeves
  - h. Acceptable Product
    - 1) Shure EABKF1-10L (Quantity: 4)
    - 2) Shure EABKF1-10M (Quantity: 4)
    - 3) Shure EABKF1-10S (Quantity: 4)
    - 4) Provide pricing for additional units

## 2.12 EQUIPMENT HOUSING & ACCESSORIES

- A. Audio Equipment Racks:
  1. Type: Frame and panel with locking rear door.
  2. Size: 32-inches deep with 44 units of vertical space.
  3. Construction: Factory assembled 16-gauge cold-rolled steel frames with all corners welded.
  4. Black enameled finish.
  5. Provide all necessary side panels, trim pieces, tops, and blank panels.
  6. Provide Middle Atlantic VBK-W27-W32 Vent Blocker kit(s) and configure for proper airflow and cooling of rack.
  7. Acceptable product:
    - a. Middle Atlantic Products WRK series
- B. Rack Drawer:
  1. Spring loaded latch
  2. Black textured finish
  3. Acceptable Product:
    - a. Middle Atlantic TD series
- C. Low Profile Keyboard Shelf:
  1. Sliding black laminate shelf
  2. Single rack space
  3. Acceptable Product:
    - a. Middle Atlantic SSL
- D. Computer Shelf:
  1. Flanged construction
  2. 16 Gauge steel
  3. Black powder coat finish
  4. Acceptable Product:
    - a. Middle Atlantic U4

- E. Universal Rack Shelf:
  - 1. Black textured powder coat finish
  - 2. Acceptable Product:
    - a. Middle Atlantic RSU-129
- F. Universal Mounting Trays:
  - 1. Multiple Devices
  - 2. Acceptable Product:
    - a. Extron RSU 126
  - 3. Single Device
  - 4. Acceptable Product:
    - b. Extron RSB 126
- G. Blank Rack Panels:
  - 1. Flanged construction
  - 2. 16 Gauge steel
  - 3. Black powder coat finish
  - 4. Acceptable Product:
    - a. Middle Atlantic SB series
- H. Vent Rack Panels:
  - 1. Flanged construction
  - 2. 16 Gauge steel
  - 3. Black powder coat finish
  - 4. Acceptable Product:
    - a. Middle Atlantic VTF series
- I. Rack Fan:
  - 1. 10" or 4.5"(x4), 115V
  - 2. Include cord and hardware.
  - 3. Acceptable Product:
    - a. Middle Atlantic FAN10 with GUARD-10
    - b. Middle Atlantic FAN with GUARD
- J. Fan Thermostat Control:
  - 1. Switched 15A duplex outlet
  - 2. Temperature Range: 50 – 90 Degrees
  - 3. On and Stand-by LED indicators
  - 4. Integral mounting ears
  - 5. Provide for each rack fan assembly
  - 6. Acceptable Product:
    - a. Middle Atlantic FC-4-1C
- K. Rack Temperature Display:
  - 1. Provide one display in top front panel space of each rack.
  - 2. Decora mount in 1-RU rack panel.
  - 3. Digital readout in Fahrenheit
  - 4. Connect to DAP GPIO for high temperature alarm to the audio control room.
  - 5. Acceptable products:
    - a. Middle Atlantic TEMP-DEC with DECP-1X1 Panel.
- L. Rack Light:
  - 1. Provide 60W incandescent or 13W fluorescent work light
  - 2. Located in all equipment racks over 36 RU's high
  - 3. Acceptable Product:



- a. Middle Atlantic WL-60
  - b. Lowell RL-1
- M. Equipment Rack Screws:
  - 1. Install rack mounted equipment with black 10-32 star post security screws with flat nylon washers
  - 2. Provide one spare bit located in a clear plastic bag attached to the inside of each equipment rack in plain view
  - 3. Acceptable Product:
    - a. Middle Atlantic HTX
    - b. Raxxess PNTX
- N. Wire Duct:
  - 1. Purpose: signal wire routing in rack
  - 2. Acceptable Product:
    - a. Panduit Type E Slotted
- O. Surface Mount Wire Duct
  - 1. Signal level cabling, loudspeaker level cabling, electrical
  - 2. Acceptable Product:
    - a. Wiremold 4000 Series
- 2.13 PLATES AND PANELS
  - A. Provide plates and panels and as described in Drawings. Engrave as shown on Drawings. Other Plates and Panels may be required to satisfy the requirements of the Work.
  - B. Custom panels shall be flanged standard EIA sizes, brushed black anodized finish unless otherwise noted.
  - C. Plate finish shall be coordinated with the Architect. Plastic plates are not acceptable.
  - D. Panel, plate and label engraving shall be 1/8-inch block sans serif characters unless noted otherwise. On dark panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum pushbuttons, letters shall be black.
  - E. Custom and/or Engraved Panels:
    - 1. Custom panels constructed of 1/8 inch brushed aluminum
    - 2. Finish: black anodize
    - 3. Acceptable Product:
      - a. RCI Custom
      - b. ProCo
  - F. Patch Panels for Audio/Video plate tie lines:
    - 1. Flat all-metal Shielded modular patch panels
    - 2. Mounts to standard cabinets and EIA 19" Racks
    - 3. 16-ports per 1U panel
    - 4. Strain relief bar includes cable tie slots for managing and supporting cables
    - 5. Label area to correspond to unique ID number of AV, AVC, FB plates (Labels to be printed, not hand-written)
    - 6. Utilizes Mini-Com Shielded snap-in modules
    - 7. Acceptable Product to include:
      - a. Panduit #CP16WSBLY
      - b. Panduit TX6 10Gig Shielded Modules
      - c. Mounting screws as needed

**2.14 CABLES & WIRING**

- A. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.)
- B. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
- C. Where cables are routed through cable tray, provide tray rated cable of equal specification.
- D. Where speaker cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
- E. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
- F. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. If field conditions or actual cable pathway requires tray or plenum cable, provide version of cable that meets required rating. Cables from Liberty, Commscope, Gepco, and West Penn are also acceptable provided they meet the performance specifications of the approved listed cables.
- G. Seating Bowl Loudspeaker Cables:
  - 1. Amplifier to Rack Room Terminals: Belden 5000UP - 12 gauge twisted pair, jacketed. Distance not to exceed 25 feet.
  - 2. Rack Room Terminals to Junction Box Terminals near loudspeaker, non-plenum: Belden 5T00UP - 10 gauge twisted pair, jacketed.
  - 3. Rack Room Terminals to Junction Box Terminals near loudspeaker, plenum: Belden 6T00UP - 10 gauge twisted pair, jacketed.
  - 4. Drop cable from Junction Box Terminals to Loudspeaker Array – General Cable-Carrol Brand 09008 (eight conductor), 10 gauge, SOOW rubber jacketed, twisted.
  - 5. Junction Box Terminals to Loudspeaker: General Cable-Carrol Brand 02724 (two-conductor), 02726 (four-conductor) or 09208 (eight conductor), 12 gauge, SOOW rubber jacketed, twisted. Distance not to exceed 15 feet.
  - 6. 70V Zones: Belden 5000UP - 12 gauge twisted pair, jacketed. Provide Belden 6000UE in plenum spaces.
- H. Microphone and Line Level Cable: Belden 1696A - Single Pair twisted, 22 gauge, shielded, jacketed, 110 Ohm cable. Conductor to conductor cable capacitance to be less than 13 pF/ft.
- I. Wireless Antenna Cable: Belden 9258 - RG8/X, 16 gauge stranded center conductor, 95% braided shield.
- J. Ethernet Cable: Belden 2412 - 4 pair, enhanced Category 6 non-bonded pairs.
- K. Digital Audio Fiber Optic Cable: Belden B9W241 Single-mode, 12 strand.

**2.15 CONNECTORS**

- A. XLR Panel mount Connectors:
  - 1. Provide panel mount XLR connectors with unified metal shell
  - 2. RF-Protector connectors
  - 3. Shell Color: Black
  - 4. Contacts: Silver
  - 5. Terminations: Solder
  - 6. Acceptable Product:
    - a. Male Connectors: Neutrik NC\*MD-L-1-BAG Series

- b. Female Connectors: Neutrik NC\*FD-L-1-BAG Series
- B. XLR Cable Connectors:
  - 1. Provide XLR cable connectors with die cast shell
  - 2. No-screw type assembly
  - 3. Chuck-type strain relief
  - 4. Shell Color: Black
  - 5. Contacts: Silver
  - 6. Terminations: Solder
  - 7. Acceptable Product:
    - a. Male Connectors: Neutrik NC\*MX-BAG Series
    - b. Female Connectors: Neutrik NC\*FX-BAG Series.
- C. 1/4" Panel mount Connectors:
  - 1. Provide panel mount 1/4" connectors with unified metal shell
  - 2. Shell Color: Black
  - 3. Contacts: Silver
  - 4. Terminations: Solder
  - 5. Acceptable Product:
    - a. Female Connectors: Neutrik NJ3FP6C-BAG Series
- D. 1/4" Cable Connectors:
  - 1. Provide 1/4" cable connectors with die cast shell
  - 2. No-screw type assembly
  - 3. Chuck-type strain relief
  - 4. Shell Color: Black
  - 5. Contacts: Nickel
  - 6. Terminations: Solder
  - 7. Acceptable Product:
    - a. Male Connectors: Neutrik NP3C-BAG Series
- E. BNC Cable Connectors:
  - 1. Provide cable mount BNC connectors
  - 2. Contacts: Brass or copper
  - 3. Terminations: Crimp
  - 4. Acceptable Product:
    - a. Kings
    - b. Amp
    - c. Amphenol
    - d. Canare
    - e. Liberty
- F. RCA Male Cable Connectors:
  - 1. Provide RCA cable connectors with die cast shell
  - 2. Shell Color: Silver
  - 3. Contacts: Silver
  - 4. Terminations: Solder
  - 5. Acceptable Product:
    - a. Switchcraft 3502 Series
    - b. Liberty
- G. F Connector:
  - 1. Provide commercial style gold plated connector with integral sleeve for F6 Series, F11 Series, and F59 Headend cable
  - 2. Provide seal ring in all moisture intensive environments.

3. Install with manufacturer recommended compression tool
4. Provide weatherized boots and seal covers for all antenna connections.
5. Verify connector cable type, size and construction with manufacturer
6. Acceptable Product:
  - a. Gilbert Engineering GF-US-6Q series, GF-US-11Q, and GF-US-59Q series respectively
  - b. Gilbert Engineering Seal ring: G-SR-1/2

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final Product.
- B. The installation recommendations contained within ASDI and Telecommunications Distribution Methods Manual are mandatory minimum standards and requirements.
- C. Mount equipment and enclosures plumb and level.
- D. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.
- E. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

#### 3.2 INSTALLATION

- A. Installation of cable and wiring
  1. Cabling and Wiring:
    - a. Install cable in a manner to adhere to manufacturer's specifications for maximum cable pulling tension, minimum bend radius, and any other restrictions.
    - b. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
    - c. If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch (1.2 meter) intervals. At no point shall the cables rest on light fixtures, acoustic ceiling grids, panels, conduits, sprinkler pipe, water pipe and/or HVAC system ducting.
    - d. Horizontal distribution cables shall be bundled in groups of no more than 50 cables when being supported by J-Hook or trapeze systems. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance. An exception to this rule is when cable is installed in cable tray systems.
    - e. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
    - f. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
    - g. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced prior to final acceptance at no cost to the Owner.
    - h. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

- i. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
  - j. Provide splice free wiring and cabling from origination to destination. Cables shall be installed in continuous lengths from origin to destination (no splices). Properly designed transition points, or consolidation points are not considered 'splice' points.
  - k. Make joints and connections with rosin-core 60/40 solder or with mechanical connectors specifically intended for the type and class of cable being used. Where spade lugs are used, crimp properly with ratchet type tool.
  - l. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at one end. Shield(s) that are not connected are to be folded back over the cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.
  - m. Isolate cables and wires of different signals or different levels are to be separated, organized, and routed in order to restrict channel crosstalk, or create feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.
  - n. Connect cable to active components through XLR connections whenever multiple formats are available. Make connections to speaker transformers with properly sized closed-end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.
  - o. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
  - p. Execute wiring in strict adherence to:
    - 1) Phillip Giddings. Audio System Design and Installation. Indianapolis: Howard W. Sams & Co., 1990.
    - 2) Don Davis and Carolyn Davis. Appendix II, Recommended Wiring Practices. Sound System Engineering, 2nd Edition. Indianapolis: Howard W. Sams & Co., 1989.
    - 3) AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm, 2009
2. Equipment Housing Cabling and Wiring:
- a. Lace, tie, or harness wire or cable as required herein, and in accordance with accepted professional practice. Dress, lace, or harness all wire or cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag.
  - b. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out to their locked position without straining cable.
  - c. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
  - d. Provide plastic cable ties or Velcro straps to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
  - e. Install with connections completely visible and labeled.
  - f. Provide termination resistors, if required, of 5 percent tolerance. Mount the termination resistors fully visible.
- B. Installation of connectors, plates & panels:
- 1. Install panel mounted connectors rigidly attached to panels, plumb and level.
  - 2. Custom rack panels shall be flanged standard EIA sizes, brushed black anodized finish unless otherwise noted.

3. Custom connector plates (loudspeaker, microphone, etc) are typically stainless steel, unless otherwise noted or specified. However, verify plate finish with the Owner.
  4. Install XLR type connectors in accordance with IEC-268 standard, with a wiring scheme of pin 2 hot (high), pin 3 (low), and pin 1 screen (shield).
  5. Other Plates and Panels may be required to satisfy the requirements of the Work.
- C. Installation power and grounding:
1. Coordinate final connection of power and ground wiring to housings.
  2. Hardwire power wiring directly to internal AC receptacles to ensure uninterrupted operation.
  3. Provide 3-conductor, isolated ground, 120 VAC outlets as required within each housing. Provide a minimum of two spare outlets in each rack.
  4. Provide a copper ground buss top to bottom in each housing, insulated from the housing. Ground equipment chassis not having a three wire power cord to these busses using 6/32 nuts, bolts and lock-washers with No. 12 wire. Connect green ground wire from each AC outlet in housing to this buss bar.
  5. Replace manufacturers supplied 18 gauge IEC power cords with UL listed 18 gauge pre-molded 6", 12", 18", or 24". Use minimum length required. No looped or cable tied IEC power cords will be permitted within the equipment rack.
  6. Replace manufacturers supplied 14 gauge IEC power cords with UL listed 14 gauge pre-molded 18" or 36" for all equipment IEC capable. Use minimum length required and minimize looped or cable tied IEC power cords present in the equipment rack.
- D. Installation of electronic equipment:
1. Take appropriate precautions against electrostatic discharge (ESD). Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.
  2. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.
  3. Mount trim potentiometers, custom circuit cards, relays, and transformers (except large 70V units) in shielded enclosures, and mark their function and connections with engraved lamicaid labels.
  4. Mount equipment plumb and level, firmly and safely held in place.
- E. Installation of equipment housing:
1. Mount equipment in racks or other project specific equipment housing apparatus. Fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner in writing that racks will be fabricated on site and the reasons for the change.
  2. Provide rear support for housing mounted equipment greater than 15 inches deep.
  3. Provide blank panels to fill unused panel space within the equipment housing.
  4. If Key door locks are required, key each housing type alike.
  5. Looking at the rack from the rear, locate AC power and speaker wiring on the left; line level audio, video, and RF wiring on the right.
  6. Provide shaft locks or security covers on non-user operated equipment having front panel controls. These panels are to be installed at the conclusion of testing.
  7. If forced-air active thermal management is used, provide ventilation blocking material on the front, sides, and rear of the equipment rack as needed. Reference Middle Atlantic Products "Controlling the Temperature Inside Equipment Racks".
  8. Panels, or equipment mounted on the rear rack rails, shall not block access to any front mounted components.
  9. If equipment rack is not equipped with casters, provide two inch high wood base to isolate equipment rack from floor. Wood base should be capable of supporting the load.
- F. Installation of loudspeakers:

1. Loudspeakers shall be mounted at the operating position in a safe, secure, and permanent manner.
  2. Rigging, mounting, and support systems for loudspeakers shall be reviewed and certified by a registered Professional Engineer (PE) licensed to practice in the State in which the project is located. Documentation shall be included as a submittal item. Once the systems are installed, the PE shall physically inspect the methods and means used to verify compliance with the original design.
  3. Paint loudspeakers, supports, and related hardware color as directed by the Owner.
  4. The aiming direction of all loudspeakers shall be adjustable by  $\pm 5$  degrees vertically.
  5. Structural support members to have a safety factor of at least five. Mounting hardware and wire rope to have a safety factor of eight. All fasteners are to be graded, and certified for use in the intended applications. Overhead suspension hardware shall comply with ASME B30.20 standards and all applicable local building and safety codes. Overhead suspension hardware must be of a type that includes product traceability controls.
  6. Provide safety cable on all bracket mounted loudspeakers.
  7. All loudspeakers located in ceiling tiles shall be located in the center of the tile unless noted otherwise.
- G. Installation of projectors:
1. Confirm distance of specified projection lens before mounting projector.
  2. Projectors shall be mounted plumb and level at the operating position in a safe, secure, and permanent manner.
  3. All hardware required to locate the mount and projector at the required location shall be provided.
  4. Projectors shall be mounted using tamper proof secure hardware.
  5. Contractor may be required to adjust projection screen, projection screen upper and lower limit switches, and lifts specified elsewhere not installed as part of this Contract.
- H. Installation of flat panel monitors:
1. Confirm location before mounting.
  2. Monitors shall be mounted plumb and level at the operating position in a safe, secure, and permanent manner.
  3. All hardware required to locate the mount and monitor at the required position shall be provided.
  4. Locate monitor on the center line of the room unless noted otherwise.
- I. Outdoor mounting of equipment
1. Objects mounted outdoors and within the building bowl structure shall be properly treated for exposure to moisture and temperature extremes.
  2. Mounting hardware shall be non-corrosive or be coated with a corrosion inhibiting layer.
  3. Structural supports for loudspeakers, or other equipment, shall have inherent corrosion resistance, or be covered with a corrosion inhibiting layer.
  4. Speaker components mounted in exterior environments shall be rigidly connected to the structure to prevent movement caused by wind gusts.
  5. Speaker and microphone enclosures to include grille capable of breaking up direct water sprays or rain.
  6. Seal all exposed electrical connections on speaker enclosure with waterproof silicone sealant.
  7. Treat paper cones of outdoor speakers with silicone based moisture repellent if not factory treated.
  8. Provide screened cover over all openings in horn type speakers to keep out birds, insects, or small animals. Screened covering to be stretched with no visible wrinkles.

### 3.3 FIRESTOP

- A. A fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure, and the materials and assembly of the materials used to seal the penetrated structure. Fire-stop systems comprise an effective block for fire, smoke, heat, vapor, and pressurized water stream.
- B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire-stopped.
- C. Fire-stop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed.
- D. A drawing showing the proposed fire-stop system, stamped/embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the fire-stop system(s).
- E. All fire-stop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for observation by the local authorities prior to cable system acceptance.

### 3.4 CONTROL SYSTEM PROGRAMMING

- A. Transport Control
  - 1. Provide standard Stop, Play, Pause, Fast Forward, and Rewind for each playback device and menu control for DVD players. Buttons should be arranged in a conventional fashion that will be familiar to the normal user.
  - 2. The selected control function should be displayed by showing the appropriate button "pressed". It should remain this way until another function is selected.
  - 3. For devices that will go into a standby mode after a period of time, the control system shall sense this mode and restore normal operating mode once a transport function has been selected. This may require the use of current sensors to determine the state of the unit. No direct user action should be required at the playback device to restore the normal operating mode.
- B. Screen/Shade Control
  - 1. In addition to up-down functions, provide a Stop function to allow the movement to be halted. Once movement has been stopped, the up or down buttons should resume travel in the selected direction.
  - 2. Control system shall not prevent screen/shade wall controls from being used as well.
  - 3. Touch panel controls should be readily accessible to the user to permit direct control of shades or screen with having to navigate through multiple control pages.
- C. Room Combining
  - 1. Combining of adjacent areas shall be done through a graphical representation of the physical areas to be combined. Use of a floor plan metaphor is recommended with the graphic oriented correctly with respect to control panel location.
  - 2. Use buttons or other appropriate objects placed along the common wall to enable the combining function.
  - 3. When spaces are combined, the graphic appearance of those areas shall change to reflect this configuration. Once an area is separated from a combination, the color of its area should revert to the normal room color.



4. Common control functions between combined rooms shall be linked, allowing control of the combined area from any one of the touch panels. Examples of common functions include:
    - a. Background music selection,
    - b. Background music volume
    - c. Background music muting
    - d. Lighting preset recall
    - e. Master volume (not individual channel volume)
  5. When combining adjacent rooms, the control system shall force the common functions to a predetermined default configuration so all rooms have the same configuration.
  6. To avoid unintentional changes, a control panel will not be able to operate a function in a remote location without also operating that same function in the room where the panel is located.
- D. Level Control
1. Objects requiring level adjustment such as volume or tone controls shall be through Up/Down buttons with a graphical representation of the actual level.
  2. Increment of level change to be adjusted for reasonable range without the need to push the Up or Down buttons needlessly.
- E. Volume Mute
1. Where the ability to mute the sound is needed, the button shall use the label "Vol On" and "VOL OFF" instead of Mute and Unmute. When in a "VOL OFF" mode, pushing the "VOL UP" button shall restore the sound and bring the system out of the muted mode.
  2. VOL ON/OFF buttons shall change color to indicate the status of the button.
- F. Standard Colors
1. Control functions shall be color coded to add clarity and show relationships between different groups of controls.
  2. The color Red shall be reserved to indicate a fault or abnormal condition.
  3. Green may be used to indicate normal operation, but may be used for standard control colors as well.
  4. Similar controls should maintain the same color scheme across all control pages.
  5. When a function is selected, the graphical depiction of that button should appear to be pressed and its color change to a darker shade of the regular button color.
  6. Color schemes used for background and foreground objects should be selected to be complimentary and provide a consistent theme throughout the control pages.
- G. Minimum Button Size and Placement
1. Minimum visual size of a button is 3/8" wide by 1/4" high.
  2. Spacing between buttons should be no less than 1/16".
  3. Where buttons are immediately adjacent, the active selection area of the button should be reduced to 80% of the visual area of the button.
- H. Button Actions
1. When a function on a control page is selected, that button or visual object associated with that function should change to reflect what has been chosen.
  2. For functions that are momentary selections (i.e. VOL UP), the change of state is visible for as long as the button is being pressed.
  3. For function that are maintained selections (i.e. PLAY), the change of state remains visible until another function is selected and resets the previous function..
  4. The state change of a button or visible object should depict real-world objects as much as possible including the appearance of the button be pressed inward, change in shade of the original color, but not a change in hue.
- I. Labels

1. Use of simple words or titles are preferred to indicate functionality, navigation and system status.
  2. Use of stylish symbols should be avoided unless their identity is commonly recognized by the general public. Standard symbols for transport functions are acceptable.
  3. Labels should be presented in a clear, sans serif type face that will remain legible on lower resolution touch panels.
  4. Where physical buttons are present along the side of a touch panel, these buttons should be engraved and filled with a contrasting color.
- J. Power On/Off
1. For panels requiring an ON/OFF control, these functions should be linked through current sensors or other methods for the control system to detect the power on condition of the component being controlled.
  2. Powering off a system should not interfere with the ability of a projector to complete its cool down cycle.
- K. Look & Feel
1. Control pages should utilize a clean, elegant but stylish appearance.
  2. Use a common graphical template across all control pages for a consistent look.
  3. The touch screen layout should utilize graphical elements such as drop shadows, gradient fills and transparency to provide a pleasing overall appearance.
  4. Utilize graphical representations of floor plans to convey location information.
  5. Include company logos, icons or watermarks to portray the corporate identity.
  6. Provide clear navigation tools for moving between control pages.
  7. Each sub-page should have a "BACK" button to return to the previous page. This button should appear in the same location on each page.
  8. Provide a "HELP" button or icon on each user page to provide clear, non-technical instructions on how to use the functions available to regular users.
- L. Security
1. Provide password access to control pages not intended to be accessed by the general public.
  2. Unless otherwise noted, provide a minimum of three levels of access
    - a. General User
    - b. Non-Technical Employee
    - c. AV Technician
  3. Segregate the control functions to only allow authorized individuals access to more sophisticated control pages.
  4. Provide a timeout feature to automatically return the control panel back to the default opening screen after 30 seconds of inactivity. After this reset, passwords must be reentered to return to a previous control page.
- M. Presets
1. For systems that have different operating modes or configurations, provide the ability to store and recall preset combinations of system settings.
  2. Provide a "Preset" page that permits a minimum of five presets to be recalled. Each button to include a label describing the function or configuration associated with that button.
  3. Provide the ability for new presets to be stored over previous settings. New preset to be able to change the label to reflect the new or revised configuration.
  4. When a preset has been recalled, the control page should indicate the active configuration.

### 3.5 LABELING OF EQUIPMENT

- A. Provide each terminal strip with a unique descriptor and a numerical designator for each terminal. Show terminal strip descriptor and designator on system schematic drawing.
- B. Provide logical and legible cable and wiring label permanently affixed for easy identification.
  - 1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.
  - 2. Wiring designator to be an alpha-numeric code unique for each cable. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings.
  - 3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection. Provide cable designator on circuits with intermediate splice points with an additional suffix to indicate each segment.

### 3.6 ENGRAVING

- A. Text font: 1/8 inch block sans serif characters unless noted otherwise.
- B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.
- C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., AMP-1.
- D. Equipment label: black with white characters except where indicated.

### 3.7 COMMISSIONING

- A. Prior to energizing or testing the system, ensure the following:
  - 1. All products are installed in proper and safe manner according to manufacturer's instructions.
  - 2. Insulation and heat shrink tubing are present where required.
  - 3. Dust, debris, solder splatter, etc. is removed.
  - 4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  - 5. Labeling has been provided.
  - 6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
  - 7. Products are neat, clean, and unmarred. Parts securely attached.
  - 8. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired. All debris has been cleaned up and discarded.
- B. Prior to energizing the System, verify and perform the following tests and adjustments in compliance with applicable EIA standards.
  - 1. Electronic devices are properly grounded.
  - 2. Test each AC power receptacle with a circuit checker for proper hot, neutral, and ground connections.
  - 3. Verify each individual component is operating properly.
  - 4. Verify each individual component's performance meets the manufacturer's published performance for this unit.
  - 5. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
- C. Loudspeaker Circuit Verification Test
  - 1. Measure the impedance of each loudspeaker line leaving the equipment racks.

2. For constant voltage systems measure the impedance at 100 (or 250) Hz, 1 KHz and 8 (or 10) KHz of each line leaving the equipment rack with the line disconnected from the driving source. For band limited devices, use a frequency appropriate for the operating range of the transducer.
  3. When documenting the results of these tests, include the calculated impedance based on number of units on a line and the size and distance of the run. Correct any field readings that differ more than 20% from the calculated impedance.
  4. Include the results of the tests in the Project Record Manual.
- D. Loudspeaker Polarity Verification Test
1. Use an electronic polarity checker, TEF 20, SYSID, SysTune, SMAART, or other two-channel FFT measurement system to test each loudspeaker. All loudspeakers should have the same relative polarity.
  2. Follow manufacturer's recommendations in conducting the tests.
  3. Include the results of the tests in the Project Record Manual.
- E. Audio Signal Paths
1. Verify operation from each source device through all switching, amplification, and distribution devices.
- F. System Gain Adjustment
1. Adjust each active device to have proper gain structure from the mixer output to the input of the amplifier.
  2. With all amplifiers turned off, connect a sine wave or pink noise generator to the input of the mixer. Using a RMS AC voltmeter with a dB scale, adjust the mixer to an output between -10 and 0 dBu. Once the level has been established, it should remain unchanged throughout the test. All equalizers should be set flat for this test.
  3. Follow the signal flow from the mixer to each subsequent component. Measure the input level and output level of each device at the point of connection to the device. The input level reading should differ no more than 0.25 dB from the level recorded for the preceding device. Diagnose and correct the wiring or equipment when any readings exceed this range.
  4. Adjust the output of each component to achieve the proper output level.
  5. Record the output levels of each device in the Project Record Manual.
- G. Signal Delay Adjustment
1. Adjust the delay to each subsystem to ensure proper synchronization between the main speakers and delayed speakers.
  2. Using a TEF 20, SYSID, SysTune, SMAART, or other two-channel FFT measurement system, measure the arrival time of the distant signal and then measure the arrival of the local signal.
  3. Based on the arrival times measured, adjust the delay applied to the local speakers to synchronize them with the distant speakers. Repeat the test to verify the delay has been set to within 1 ms of the arrival of the distant signal. Once the precise delay time has been determined, provide an additional 10 ms of Haas effect delay to maintain directional orientation toward the original sound source.
  4. Continue to test and adjust each separate subsystem with a dedicated delay channel.
  5. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.
- H. Remote Input Verification Test
1. Using a microphone or portable signal generator, connect to each microphone/line level receptacle throughout the facility.

2. Verify that the receptacle under test appears at the correct input and is operating properly.
  3. In a similar manner, check all remote tielines and media related lines for correct wiring and labeling.
- I. System Equalization
1. Using a TEF 20, SYSID, SysTune, SMAART, or other two-channel FFT measurement system, equalize all loudspeaker systems to provide a suitable frequency response as follows:
    - a. Speech Reinforcement Systems: flat response from 125 Hz to 2.5 KHz, with 2 dB roll off above.
    - b. Program Reproduction Systems: flat response from 65 Hz to 8 KHz, with 2 dB roll off above.
  2. Verify system gain and amplifier levels.
  3. Provide program levels of at least 85 dB and speech reinforcement levels of at least 70 dB in the seating area without objectionable distortion, buzzes, or rattles.
  4. Provide hard copy printouts of the spectral response with the test data.
- J. RFI and Parasitic Oscillation
1. With systems operating check to ensure that all systems are free from spurious oscillation and radio frequency interference in the absence of audio signal.
- K. Buzzes, Rattles, and other Distortions
1. Adjust the system for normal operating level in the space. Apply a slow sine wave sweep from 60 Hz to 3 KHz and listen carefully for buzzes, rattles, and other objectionable distortions.
  2. Correct the cause of the defect. If the cause is not from the system, bring the cause to the attention of the Owner, indicating cause and suggestive corrective actions.
- L. Video Systems Test
1. Projected images and screen must be plumb with respect to ceiling line.
- M. Video System Tests. Verify performance of all video equipment, components and systems, as specified herein.
1. Video (signal):
    - a. S/N (peak to RMS), unweighted DC to 4.2 MHz: 55 dB minimum.
    - b. Crosstalk, unweighted DC to 4.2 MHz: 45 dB minimum.
    - c. Frequency Response: Within plus to minus 0.5 dB to 4.2 MHz.
    - d. Line and Field Tilt: 2% maximum.
    - e. Differential Gain: 2% maximum.
    - f. Differential Phase: 2 degrees maximum.
    - g. Frequency Response: DC to 4.2 MHz within plus or minus 0.5 dB.
- N. Video Signal Paths
1. Verify operation from each source device through all switching, amplification and distribution devices.
- O. Video Test Report shall include the following:
1. Test Failures and Notices
    - a. Sink Device EDID Test – Open items or failures shall not be accepted.
    - b. Cable Length Test – Open items or failures shall not be accepted.
    - c. HDCP KSV Limitations – Limitations shall not be accepted.
    - d. Cable Limitations - Limitations shall not be accepted.
    - e. EDID Limitations - Limitations shall not be accepted.
    - f. Cable Length Limits exceeded – Failing cables shall not be accepted.

2. Device Model Number, Serial Number, and Firmware Version for main chassis and each input and output card.
3. Device Model Number, Serial Number, and Firmware Version for connected transmitter and receiver devices.
4. EDID – Input Resolution and 3D support status for each input.
5. EDID – Supported Output Resolution and 3D support status for devices connected to each output.
6. EDID – Supported Audio formats for each input.
7. EDID – Supported Audio formats for devices connected to each output.

P. Control Systems

1. Verify operational functions of the control system and all interfaced devices.
2. Verify operational functionality of any wireless user devices.

### 3.8 CAT5E/CAT6 CABLE CERTIFICATION

A. General Field Test Requirements

1. All CAT5E/CAT6 cabling links installed as part of this scope shall be tested for the following, in accordance with the field test specifications defines in ANSI/TIA-568-C.2 “Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard.” This document will be referred to as the “Category 5e Standard”:
  - a. Wire Map
  - b. Length
  - c. Insertion Loss
  - d. NEXT loss
  - e. PS NEXT Loss
  - f. ACR-F Loss
  - g. PS ACR-F Loss
  - h. Return Loss
  - i. Propagation Loss
  - j. Delay Skew
2. The installed twisted-pair horizontal links shall be tested from terminated end point to terminated end point for compliance with the “Permanent Link” performance specification as defined in the Category 5e Standard.
3. One hundred percent of the installed cabling links must pass the requirements of the Category 5e standard mentioned above and as further detailed in Section B below. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section C below.
4. The test equipment (tester) shall comply with the accuracy requirements for level IIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 2 of ANSI/TIA-1152 (Table 2 in this TIA document also specifies the accuracy requirements for the channel configuration).
5. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. To ensure that normal handling on

the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

8. The Pass or Fail condition of the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass.
9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specifies test limits for that parameter.

B. Performance Test Parameters

1. The test parameters are defined by the Category 5e Standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 100 MHz) must meet or exceed the limit value determined in the above mentioned standard.
2. Wire Map - Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct.
3. Length – The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.
4. Insertion Loss (Attenuation) – Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 100 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk Ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results of the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which the worst case value occurs, and the test limit value at this frequency.
5. NEXT Loss – Pair-to-pair near end crosstalk loss (abbreviated as NEXT loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 100 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT loss measurements shall not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Table 1 – Maximum frequency step size as defined in ANSI/TIA-1152

Frequency Range (MHz)	Maximum Step Size (MHz)
1-31.25	0.15
31.26-100	0.25

6. NEXT Loss – Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 100

- MHz and the step size may not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Maximum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS next. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
7. ACR-F Loss, pair to pair – Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured 1 through 100 MHz and the maximum step size for FEXT loss measurements shall not exceed the maximum step size defined as the standard as in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst value for ACR-F. There wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
  8. PS ACR-F Loss – Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs of the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
  9. Return Loss – Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst value of Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
  10. Propagation Delay – Propagation delay is the time required for the signal to travel from one of the links to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst propagation delay. The report shall include the propagation delay value measured as well as the test limit value.
  11. Delay Skew – [as defined in the Category 5e Standard; Section 6.2.19] This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

C. Test Result Documentation

1. The test results/measurements shall be transferred into a Windows based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.



2. The database for the completed job shall be stored and delivered electronically, including the software tools required to view, inspect, and print any selection of test reports.
3. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
  - a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
  - b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
  - c. The date and time the test results were saved in the memory of the tester.
4. General information to be provided in the electronic data base with the test results information for each link:
  - a. The identification of the customer site as specified by the end-user.
  - b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
  - c. The overall Pass/Fail evaluation of the link-under-test
  - d. The name of the test limit selected to execute the stored test results
  - e. The cable type and value of NVP used for length calculations
  - f. The date and time the test results were saved in the memory of the tester
  - g. The brand name, model, and serial number of the tester.
  - h. The identification of the tester interface
  - i. The revision of the tester software and the revision of the test limits database in the tester
  - j. The test results information must contain information on each of the required test parameters that are listed in Section B and as further detailed below under paragraph C5.
5. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
6. The detailed test results data to be provided in the electronic database must contain the following information:
  - a. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m330 and test limit value.
  - b. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
  - c. Delay Skew: Identify the pair with the largest value for delay skew, the value measured in nanoseconds (ns) and the test limit value.
  - d. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair.
  - e. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
  - f. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.
  - g. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.

### 3.9 FINAL OBSERVATION & TESTING

- A. Upon completion of installation, initial adjustments, tests, and measurements specified in Part 3, and submission and review of the results, a final observation and test will be performed by the Owner or Owner's representative no earlier than two weeks after receipt of the written results.

- B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
  - 1. Observation of the methods and means employed to incorporate the System within the facility.
  - 2. Verification of proper operation, from controlling devices to controlled devices.
  - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
  - 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

### 3.10 TEST EQUIPMENT

- A. Thirty days prior to start of testing, provide a list to the Owner of test equipment make, model numbers and calibration dates that will be used.
- B. The following equipment shall be available on site for the entire test period through final system testing.
  - 1. Sound Level Meter : ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
  - 2. Pink Noise Source - Equal energy per octave bandwidth 20 Hz to 20,000 Hz,  $\pm 1$  dB (long-term average) at 0 dBm output. Stability:  $\pm 2$  dB per day.
  - 3. Dual-trace oscilloscope - 100 MHz bandwidth, 1 mV/cm sensitivity.
  - 4. Impedance Meter - Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 5k Hz. Measurement Range: 1 ohm to 100 kohms.
  - 5. Audio Oscillator: bandwidth 20 Hz to 20k Hz  $\pm 5$  dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level over the range from  $-30$  dBu to  $+10$  dBu.
  - 6. Multimeter - Measurement range, DC to 20k Hz, 100 mV to 300 V, 10 ma to 10 A, dB.
  - 7. NTSC Test generator
  - 8. Real time analyzer with LED or CRT display. The unit shall meet the filter requirements of ANSI S1.11 Class III for one third octave filters.
  - 9. Video (analog) test generator capable of generating signal up to 1920 x 1200 with audio.
  - 10. Video (digital) test generator capable of generating signal up to 1920 x 1200 with audio.
  - 11. Ladders and scaffolding necessary to inspect elevated equipment, junction boxes, etc.
- C. Provide three portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project. Include rechargeable batteries and recharger along with holster for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

**3.11 INSTRUCTION OF OWNER PERSONNEL**

- A. Provide 8 hours instruction to Owner designated personnel focusing on the use, operation, and maintenance of the systems, scheduled as a minimum of two separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction. Coordinate schedule of demonstration with Owner's Representative.
- B. Video record all training sessions and compile a training video to be provided to the Owner electronically.
- C. Provide sign in sheet to document the attendee's presence.
- D. If Contractor is not properly equipped to conduct Owner training on particular equipment, arrange for factory representatives of the equipment to be present to provide training at no additional cost to the Owner.
- E. Provide on-site event support for 4 events, chosen at the discretion of the Owner, by a technician fully knowledgeable and qualified in sound system operation, programming, and troubleshooting.

**3.12 CLEANUP AND REPAIR**

- A. Upon completion of the work, remove refuse and rubbish from and about the premises. Leave areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation of systems at no cost to the Owner.

END OF SECTION