

MINNESOTA MULTI-PURPOSE STADIUM

MINNEAPOLIS, MINNESOTA

Large Format Video Fascia and Scoring

Exterior Creative Display Systems

Video Production Control Room

December 8, 2014

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MINNEAPOLIS, MINNESOTA

SECTION 27 41 33

DISPLAY SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. THIS SPECIFICATION IS ISSUED FOR REFERENCE ONLY.
- B. All prequalified LED display manufacturers and direct sale representatives are invited to provide a proposal based on specifications prepared by Idibri Consulting. for the Minnesota Sports Facilities Authority.
- C. All requirements in this section of the solicitation as well as in other sections of the solicitation, Referenced Documents or Practices, and any Amendments to the solicitation shall be considered a part of this section (Section III. Scope of Work / Specifications). Each Offeror to the solicitation is responsible for becoming thoroughly familiar with all its contents as to requirements which affect this Section. Contractor is responsible for coordinating all items of this section with the Owner and Project Consultant to insure that all items of this section are furnished in accordance with the Owner's (the Minnesota Sports Facilities Authority) standards.

1.2 REFERENCES

- A. National Fire Protection Association (N.F.P.A.).
- B. American National Safety Institute (A.N.S.I.).
- C. National Electrical Code (N.E.C.).
- D. Underwriters Laboratories (U.L.).
- E. Electronics Industries Association (E.I.A.).
- F. Standard for Electric Signs, UL-48.
- G. Standard for Control Centers for Changing Message Type Signs, UL-1433.
- H. Federal Communications Commission Regulation Part 15.
- I. Project Drawings
- J. Specification for the Project: Structure, Electrical, Structured Cables, Production Control Room, IPTV System, HVAC, pang and coatings.

1.3 DEFINITION OF TERMS AND ABBREVIATIONS

- A. Provide: to supply and install.
- B. Supply: to supply but not install.
- C. Install: to install but not supply.

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- D. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- E. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- F. Future: Equipment that will be provided by owner at a later date. Accommodations shall be provided for future equipment as shown on the drawings.
- G. Contract Documents: This specification and included conceptual display drawings.
- H. Project Consultant: Idibri Consulting

1.4 RESPONSIBILITY AND RELATED WORK

- A. Coordinate scheduling of work with the Owner.
- B. The systems described in this section will be called the "Display Systems" and the installer will be called "The Contractor." The Contractor will provide all labor, materials, equipment, necessary tools, test equipment, hoisting, transportation, supervision and coordination necessary to complete the installation of the "Display Systems" as described in the construction documentation.
- C. The Contract Documents are intended to include or imply all items required for the proper execution and completion of the work.
- D. The Display Systems consist of the materials, equipment and systems described in this specification, related drawing details, and any schedules that are part of the contract documents. This Contract is for equipment, material, installation and training. The work of this section includes complete and operational Display Systems.
- E. The Contractor will provide all accessories, such as connectors, adapters, matching devices and equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.
- F. The Contractor shall provide complete, turnkey Display Systems, fully tested and ready for intended use according to the design intent of the contract documents.
- G. Obtain all insurance, bonding, licenses and permits necessary to complete the work, and for operation by the Owner.
- H. Contractor will comply with all equity and union jurisdiction and prevailing wage requirements for the completion of the project.
- I. If a conflict is identified between the Contract Documents and the appropriate codes and is reported to the Owner and confirmed prior to contract award, the Project Consultant will prepare the necessary clarification or revision. When a conflict is reported after contract award, the Contractor will propose a resolution of the conflict and, upon approval, perform related work.
- J. Coordinate with other Contractors as required and in a timely fashion to convey all information (scheduling, structural, electrical, technical or otherwise) necessary to complete the project.
- K. The Contractor shall be responsible for:

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1. Verification of dimensions and conditions at the project for the display and control equipment locations prior to ordering/manufacturing.
2. Submittal of State registered structural stamped designs and calculations with the shop drawing submittals. This will be for the final design and connection from the provided steel structure to the display only.
3. Provision of all transportation and hoisting.
4. Furnish protective covering during construction/installation to prevent damage or entrance of foreign matter.
5. Replace at no expense to Owner/project, product damaged during delivery, storage or handling.
6. Provision of safe and protected storage. The owner takes no responsibility for damage or theft relating to negligence in failure to secure equipment by The Contractor.
7. Installation in accordance with the Contract Documents, manufacturer's recommendations, and all applicable code requirements.
8. Provision of complete assemblies (sub-structure, enclosure, and finishes) and all necessary attachment hardware, and framing.
9. All required material for a complete water tight enclosure including front border metals to protect and finish out the display systems. (Outdoor displays only). All displays to include a 2" metal framing border or as specified around the entire display.
10. Provision of all panels, branch circuit distribution, and remote on/off contactors are the responsibility of the Display Contractor. Main feeders will be brought to the catwalk level for the main displays. Feeders for the Ribbon Displays will be brought to a nearby electrical room.
11. Provision, termination and testing of all necessary signal cabling and remote operation control cabling.
12. Provision of all transmission, processing, receiver electronics to distribute control signals to the display systems.
13. Provision and integration of an automated data parsing interface for the purpose of accumulating G.I.P. and player information from multiple sources into a database accessible to the project video production and network broadcaster's character generators. The Display Systems Contractor will provide the programming and/or custom device(s) necessary to complete this interface and database for automatic statistics updates from the controller and other sources.
14. Provision of equipment to receive and insert text data from an onsite or remote stenographer.
15. Coordination of any installation of rack mounted devices into equipment racks (provided by others) with other related trades with equipment in the same space.
16. Connecting ground point to all equipment in accordance with NEC code and standards specified. Coordinate with Division 26.
17. UL Certification of all pertinent equipment including control and display systems attached with identification labels. If any equipment requiring certification is not UL Certified, then The Contractor shall arrange onsite inspections and certification at no additional expense to the contract/project.
18. All control equipment to operate the display shall be located in the facilities' control room. Any necessary signal/control conduit and cable raceways for cable runs to and from display components will be provided by others.
19. All submittals detailed within the Contract Documents
20. Initial tests and adjustments
21. Final performance testing, calibration and adjustment prior to first use.
22. Maintenance services contract, warranty for equipment and workmanship.
23. Provision of required shelving and inventory labels for all spare equipment.
24. Provisions of preseason cleaning of the displays within 14 days of the first event held in facility for the first year.

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25. Provide protection for finished areas during the installation. Any damage caused during construction is the full responsibility of the Contractor to repair or replace at no additional cost.
26. Electrical Bonding of equipment and racks as required to the facility ground buss to ensure equipment meets FCC guidelines for RF noise interference.
27. Terminate all unused BNC outputs.

1.5 SYSTEMS DESCRIPTIONS

A. End Zone Display

1. It is understood that The Contractor's manufacturing processes, electronics, enclosure requirements and display module sizes may dictate the final manufacturer's offering. Dimensions indicated are active video area unless otherwise noted.
2. The West Main End Zone Display Systems work includes:
 - a. One (1) 120'W x 68'H. 16mm (physical pixel-to-pixel density), rear serviceable, shall accept high definition 1080p60 (minimum) video inputs and then scale to the displays native resolution, full color LED pixel large screen display system including miscellaneous structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2.
 - b. Two (2) 15'W x 43'H. 16mm (physical pixel-to-pixel density), rear serviceable, shall accept high definition 1080p60 (minimum) video inputs and then scale to the displays native resolution, full color LED pixel large screen display system including miscellaneous structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2.
 - c. Four (4) 15'W x 12'6"H Corner static sponsor signs will be provided by others. Provide engineering and design to coordinate with the alternate vendor a cohesive and uniform display.
3. The East Main End Zone Display Systems work includes:
 - a. One (1) 88'W x 50'H. 16mm (physical pixel-to-pixel density), rear serviceable, shall accept high definition 1080p60 (minimum) video inputs and then scale to the displays native resolution, full color LED pixel large screen display system including miscellaneous structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2.
 - b. Two (2) 15'W x 25'H. 16mm (physical pixel-to-pixel density), rear serviceable, shall accept high definition 1080p60 (minimum) video inputs and then scale to the displays native resolution, full color LED pixel large screen display system including miscellaneous structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2.
 - c. Four (4) 15'W x 12'6"H Corner static sponsor signs will be provided by others. Provide engineering and design to coordinate with the alternate vendor a cohesive and uniform display.

B. Fascia Displays

1. Club Level Fascia Display
 - a. 1475' of 30"H 16mm (physical pixel-to-pixel density) resolution, SMD, top serviceable, full color LED pixel large screen display system including associated structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2.
 - 1) Centered on the north side club level, a 39' section of LED will be used for game in progress information.
 - 2) There is an architectural break in the signage ribbon centered on the south side club level. Provide a 39' break in the fascia LED for a static stadium naming sign provided by others.

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- 3) Below the club level static stadium sign on the south side, provide a 39' x 2'-6" 16mm active LED for dedicated game in progress to match the north side fascia. (This 39' is included in the 1475' estimate)
2. Upper Concourse Level Fascia Display:
 - a. 1550' of 42"H 16mm (physical pixel-to-pixel density) resolution, SMD, top serviceable, full color LED pixel large screen display system including associated structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2.
 - 1) The last 35' of the upper concourse fascia that borders the south side of the west display shall be dedicated to Closed Captioning.
 - 2) The last 35' of the upper concourse fascia that borders the north side of the east display shall be dedicated to Closed Captioning.
 3. Press Level Fascia Display (southeast)
 - a. 225' of 58"H 16mm (physical pixel-to-pixel density) resolution, SMD, top serviceable, full color LED pixel large screen display system including associated structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2.
- C. North Fascia Sponsor LED Video Display (main concourse level)
1. Eight (8) 35'W x 4'H 8mm or less (physical pixel-to-pixel density) resolution, SMD, front and rear serviceable, shall accept DVI computer resolutions to match the native display resolution, full color LED pixel large screen display system including miscellaneous structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2. Maximum depth of these displays to be 8".
- D. West Platform "Skirt" Displays
1. One (1) 64'W x 9'H 16mm (physical pixel-to-pixel density) resolution, SMD, front and rear serviceable, shall accept DVI computer resolutions to match the native display resolution, full color LED pixel large screen display system including miscellaneous structure and all related control and processing systems required to make a "complete operating system" as detailed in Part 2. Maximum depth of these displays to be 8" and all mounted in one continuous sign.
 2. Provide a deduct price to replace a 16'W x 9'H area on the left and right with static backlit advertising signs. The final active LED display would be 32'W x 9'H.
- E. Graphical Animation
1. Provision of animated graphic production sequences custom formatted to fit each display in this specification section. Animations are expected to be a combination of packaged sequences of various durations including, but not limited to the following: One (1) default team lineup layout, one (1) team logo treatment (full screen loopable), and two (2) custom moving background treatments (loopable). Animations are to be approved by the Owner and provided to the owner in the native format of the graphics system.
- F. Hardware Based Scoring and Timing Control System.
1. Provide portable scoring system with connections at the mid-field sideline, home plate, and in the Video Production Booth. Coordinate cabling and connectors with Section 276000.10 (Broadcast Cabling).
 2. Scoring information to be sent to the truck dock for direct insertion into the truck character generator.
 3. Provide standalone remote clock start/stop (Qty: 2)
 4. Provide XML stats feed to the IPTV system
 5. Provide Control Console capable of controlling multiple sports (Qty: 2)

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- G. Delay of Game Clocks
 - 1. Provide football delay of game clocks mounted on the east and west precast wall at field level. These should be controlled from both the mid-field, West sideline and in the Video Production Booth.
 - a. 4'x4' 2-Digit 7-Segment Play Clock (Qty: 2)
 - H. Play/Game Clock
 - 1. Provide a delay of game clock for use in the truck compound.
 - a. 10"H 6-Digit (Qty: 2)
 - 2. Provide a play clock for use in the truck compound.
 - a. 10"H 6-Digit (Qty: 2)
 - 3. Provide game clocks on either endzone for the primary field of play.
 - a. 6'x4' 4-Digit 7-Segment Play Clock (Qty: 2)
 - I. Back of House Game Clocks
 - 1. Provide a game clock in each of the locker rooms, back of house locations, press areas. See planview for exact locations and quantities.
 - a. 10"H 6-Digit Game Clock (Qty: 30)
 - J. Ticket Window Signage (Qty: 18)
 - 1. Provide LED scrolling text display mounted in top of ticket windows.
 - a. Indoor Tri-Color 7mm LED Display
 - b. 26" Wide
 - c. 1 Line of text
 - d. Ethernet capable for control and programming with windows PC
 - e. IR Remote
 - K. Full System Base Warranty, 3 Years.
 - 1. Warranty to include at no cost to the owner:
 - a. Factory repair of failed parts
 - b. Shipping to and from the site.
 - c. Labor to replace failed parts.
 - d. Reconfiguration and recalibration of any display due to a failure.
 - L. Maintenance Plan
 - 1. Provide 2 technicians for the following:
 - a. 3 Days onsite for Pre-Season startup maintenance.
 - b. Event Day coverage including startup and adjustments as required for 10 events.
 - c. 1 Day onsite for End of Season Shut Down.
- 1.6 SUBMITTALS
- A. Bid Submittals
 - 1. Any visible representation of the Manufacturer's name or logo at the facility must be specifically negotiated as part of the contract with the Owner. Only upon approval of the Minnesota Sports Facility Authority Purchasing Department through a change order to the contract will any visible representation of the Manufacturer's name or logo be allowed at the facility.
 - 2. Offeror must have previously installed at least four jobs of similar magnitude to the job described in the solicitation. The jobs of similar magnitude must be completed within the last five years within the USA. In your proposal, submit name, phone number, and current email address of contact person for each representative project reference. Also, in your proposal, identify at least one such completed job available for inspection by the Project Consultant and Owner's Representatives. The Minnesota Sports Facility Authority

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reserves the right to inspect offeror's completed job with the permission of the project owner prior to awarding contract from the solicitation.

3. In its proposal, Offeror will confirm in writing that it has at least five years of experience with equipment and systems of the types specified in the solicitation, that it maintains a fully staffed and equipped service facility in the region of the United States that includes Minneapolis Minnesota, and that it is franchised dealer and authorized service facility for any equipment used on the contract project not manufactured by the offeror, and that the offeror is properly licensed to work in the project home state (Minnesota).
4. In its proposal, Offeror will confirm in writing that any Sub-contractor it uses in performance to contract has five years of experience with the primary contractor's / offeror's equipment and systems and that the subcontractor's company is properly licensed to work in the project home state (Minnesota). In its proposal, Offeror will identify all Subcontractors on the Proposal Response team and provide a detailed scope of work for each Subcontractor it plans to use in performance to contract.
5. In its proposal, Offeror will include resumes of its project manager, lead engineer and lead installers that will be working on the contract project. This will include key team members of any Sub Contractor that the offeror plans to use in performance to contract. Resumes must be submitted with offeror's proposal response.
6. In its proposal, Offeror will submit preliminary power requirements for its proposed display at 100%, 50%, and 5%.
7. In its proposal, Offeror will submit horizontal and vertical viewable dimensions for each display and any voluntary alternates.
8. In its proposal, Offeror will submit horizontal/vertical physical pixel count of its proposed display and any voluntary alternates.
9. In its proposal, Offeror will submit preliminary total weight and structural calculations for its proposed display and any voluntary alternates.
10. In its proposal, Offeror will submit a schedule to indicate durations for shop drawing submittal, procurement, and fabrication, shipping requirements, installation timelines for each major system and test and commissioning sessions. Coordinate these milestone dates in the schedule with project schedule and intended completion dates for the contract project in the solicitation.
11. In its Cost Proposal, Offeror will submit Schedule of Values for each item listed in Sub-Part 1.5 Systems Description of the solicitation. Breakout display, processing and any additional costs for each display system. Breakout system cabling cost and provide a per foot unit cost for additional cable that may be required once construction starts.

B. Project Submittals:

1. Product Data Submittal: Contractor shall submit manufacturer's product data sheets for each item of equipment to be used for the contract project in electronic form via email as PDF electronic files.
2. Shop Drawings Submittal: Contractor shall indicate complete details and dimensions of work to be performed and indicate types and locations of equipment, fabricated equipment, and other details to completely describe work to be performed.
3. Contractor shall submit the above information via email and memory device as PDF electronic files for review and distribution to the Owner's Representative. There shall be no contract work authorized on site without the prior submittal of a complete set of shop drawings. Any exceptions to this contractual requirement must be in writing and approved by the Owner's Representative.
4. Shop Drawing Details to include the following:
 - a. Plan, Elevation and Section Views of the displays.
 - b. Drawings showing the connection of contractor supplied equipment to the structure at each different condition.

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- c. Wiring diagrams. Complete, detailed wiring diagrams for all systems including cable types, identification and color codes, and detailed wiring of connections, both at equipment and between equipment racks and wiring in conduit.
- d. Location of all equipment in racks, consoles, millwork, and enclosures. Provide dimensions; wire routing and cabling within housings; AC power outlets, terminal strip and UPS locations.
- e. Conduit riser diagrams for all systems.
- f. Schematic drawings of any custom circuitry or equipment modifications, including connector pinouts and component lists.
- g. Equipment rack elevations for front and rear mounted equipment.
- h. Schedule of terminations for all systems.
- i. Coordinate rack AC Power Schedule and circuiting information with the Owner.
- j. Terminal strip layouts for all proposed terminal strips to be used in junction boxes or in the equipment racks.
- k. Power consumption at 100%, 50% and 5% illumination levels for each display.

C. Contract Closeout Submittals

1. Contractor shall keep a single complete set of approved shop drawings on the project site for the full duration of the project until after the final system commissioning. Non-approved shop drawings will not be allowed on the job site. Contractor shall note any changes made during installation on these single set of drawings. Contractor shall submit three corrected sets of reproducible drawings showing work as installed. All "as-built" drawings are to be submitted both in electronic form (PDF and ACAD 2014 or later) and in hard copy (42"x30").
2. Owner Reference Manual: Before owner training commences, Contractor shall submit the following as Adobe .pdf files on 3 CD's and as hard-copy in a single 3 ring binder with project title. Contractor shall submit individual sub-directories/tabular dividers with the following headings:
 - a. A legend with acronyms and abbreviations.
 - b. A catalog of all equipment, organized by manufacturer, model, serial number, including the room and rack number where the device is located.
 - c. System Operation Instructions: Narrative verbiage with photographs and diagrams detailing operational procedures for all equipment as a system.
 - d. Manufacturer's User Manuals for all equipment.
 - e. Warranty Information for all equipment. Include warranty period and service department contact information.
 - f. System Maintenance Instructions: Narrative verbiage with photographs and diagrams detailing owner's responsibilities for preventative maintenance to include schedules and any specific products, procedures or specialized/custom tools required for maintenance of the display system.
 - g. Battery Replacement Schedule: Schedule of dates/intervals for replacement of all batteries. This is to include UPS and control systems.
 - h. As-Built Drawings fully legible at C size (24"x18") bond folded appropriately for binder.
 - i. A list of all test results performed on the systems as outlined in Section 3.4 proving the systems to be in full compliance.
3. As-Built Drawings are to be fully legible at C size (24"x18") bond. Each page to be individually laminated. Set is to be loosely bound using a minimum of two binder rings.
4. Contractor shall submit a complete list of spares in inventory to include quantity, manufacturer, model number, and serial number.

1.7 CODE COMPLIANCE

- A. All work performed by the Contractor and materials used by the Contractor in performance to the contract shall comply with all applicable codes and regulations to meet or exceed Federal, State,

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City, and Local Building Codes and Regulations (including seismic). Contractor shall advise the General Contractor if anything in the Drawings or Specifications is out of compliance with codes and/or laws prior to proposal submission.

- B. The governing building code shall be the 2007 Minnesota State Building Code, including any local city Amendment's.

1.8 PROJECT CONDITIONS

- A. Contractor shall notify the Owner in writing of any issues on the job site negatively affecting the contractor's pursuance of work under their scope. Contractor shall submit recommendations for resolution and assist in coordinating solutions with other trades.
- B. Contractor shall verify position and elevation of structure and its layout for display equipment. Contractor shall verify dimensions by field measurements.
- C. Contractor shall verify mounting structure is capable of supporting the display system weight and seismic loads in addition to any required attachment and structural support metals.

1.9 GUARANTEES

- A. Contractor shall warrant labor and materials on the display systems for three (3) years following the date of Substantial Completion as a base offering. This warranty will include components whose manufacturer warranty is less than the 3 year window.
- B. Within the warranty period, Contractor shall:
 - 1. Make available an exchange program to supply replacement parts for components that fail during the coverage period. To minimize downtime, the exchange parts will be shipped on the same day the order is received or on the following day. The manufacturer will also enclose an air bill for return of the defective components.
 - 2. Make available a 24/7 help desk with a toll-free number fully staffed by experience technicians and coordinators who are thoroughly familiar with the display products and available for technical support. This contractor help desk staff must be available at no additional cost to the customer and provide an "on-call" service during weekends.
 - 3. Make available a access to a local factory representative or factory authorized service company that can repair or replace any faulty item the next day without charge, including parts and labor and assist owner's staff in replacing, reprogramming or recalibrating this equipment to make entire system functional.
- 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. Contractor will make available to Owner the exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information is to be part of Project Record Set.
- E. Contractor shall submit alternate pricing for extended maintenance contracts on displays and control systems based on the above criteria.

PART 2 - PRODUCT

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2.1 OFFERERS

- A. Recommended Offerers.
- a. CBS Outdoor
 - b. Daktronics
 - c. Mitsubishi
 - d. Nanolumens
 - e. Panasonic
 - f. Sony
 - g. TS Sports

NOTE: If it is determined during the evaluation process that each device included in an offeror's proposal does not meet all of the specifications, then that offeror's proposal will be deemed "non-responsive" and removed from further consideration.

- B. Offerors to submit the following:
1. A list of all major equipment and their quantities including manufacturer and model numbers with software release numbers.
 2. A one-line schematic diagram of all equipment signal and control connectivity for review.
 3. Identify four facilities where the submitted product/system were installed within the last two years and if requested, supply pictures of the facility and applicable information regarding the facility that provide the viewer with a complete virtual walkthrough of the facility, and an online demonstration of video display, input manipulation and operational capabilities.
 4. Submit all else stated for submittals in Part 1.6B Bid Submittals.
- C. All equipment supplied will be new and meet the latest published specifications of that product.
- D. Take care during installation to prevent scratches, dents, chips, etc.
- E. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on value of the product at bid time disclosed in the schedule of values.

2.2 SYSTEM REQUIREMENTS

- A. Technical and Engineering Standards
1. General
 - a. Large format display systems shall allow "hot" repair while the system is operating.
 2. LED Display Systems
 - a. The display systems will be comprised of full color LED pixel technology capable of 6,000 cd/sq.m pixel brightness with full white (100 IRE) input.
 - b. Brightness of individual adjacent LED's must vary no more than 2%, and no more than 10% across the entire display.
 - c. Minimum effective color pixel density of 2,900 pixels/m² with LED physical pixel density of 15-16mm in a flicker less display.
 - d. The display system will be equipped with an illumination sensor exterior to the display and allow for both automatic and manual control of preset illumination levels in at least 20% increments up to 100%.
 - e. The display must be capable of 140 degree minimum horizontal angle of viewing and 30 degree upper and 60 degree lower minimum vertical angle (defined at 50% brightness and zero color shift).

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- f. Individual display module PCB's used outdoors must be conformal coated to protect them from the environment.
 - g. 'Black Face' to mean the full front surface of the LED chip to have a black cover.
 - h. 'Black Body' to mean the diode portion of the chip to have a white cover but the surrounding area to be a black surface.
3. Media Servers and Content Provisioning
- a. The Contractor shall provide a video content server with key and fill for each of the primary displays (east and west main). Provide a backup key and fill server for the primary systems.
 - b. The Contractor shall provide a video content server to provide graphics resolutions to the wing displays on each of the main displays (west wings left/right; east wings left/right).
 - c. The Contractor shall provide video content servers to provide graphics resolutions to all ribbon displays mounted to the bowl fascia.
 - d. The Contractor shall provide video content servers to provide graphics resolutions to all sponsor displays.
 - e. The Contractor shall provide two backup content servers to be used in the event of a failure with the wings, fascia, or sponsor signs.
 - f. The Contractor shall allow for (4) 1080p inputs from the video production routing system.
4. Control and Signal Processing/Distribution Systems.
- a. The Contractor shall provide all user interface, transmission, and processing software; all electronics; and all cabling to independently place, size, tile, layer, and control High Definition (HD-SDI SMPTE 424M) signals for the primary displays (east and west)
 - b. The Contractor shall provide all user interface, transmission, and processing software; all electronics; and all cabling to independently place, size, tile, layer, and control Graphic (VGA/DVI) input signals on all wing, fascia, and sponsor displays.
 - c. The Contractor shall provide backup processing and transmission equipment in duplication of primary systems with equipment for manual switchover, distribution amplification, and/or splitting of all necessary video, control, data and signal cabling.
 - d. All control equipment to operate and provide signal to the displays shall be located in the production equipment room. The Contractor shall provide all connections, cabling, and terminations between display, operating equipment, and the production equipment room. Coordinate with the data vendor to provide control on the field and in an alternate Aux Booth for smaller events. Provide a laptop for remote control of the entire graphics system from a remote location.
 - e. The Contractor will provide systems for remote power up and shut down of the displays, systems will allow displays to be turned on and off from the video production equipment room in addition to within the displays.
 - f. The Contractor shall provide one remote control user interface station in the rack room to provide complete control of system input, display power up/down, freeze, position, size, aspect ratio, color, hue, contrast, brightness and delay for use in setup, testing and operation.
 - 1) Avocent HMX1070-001 User Station
 - g. The Contractor shall provide computer interfaces for all CPU devices in their scope.
 - 1) Avocent HMIQSHDI-001 Computer Interface
 - h. Processing equipment shall allow for video delay/buffering on all video input channels of up to 400ms of High Definition (1080p60 HD-SDI SMPTE 424M) video to allow synchronization with the bowl audio system.
 - i. Processing and control equipment shall allow for external control of input selection and transitions via GPI triggers, RS-422/232, and VDCP protocols.

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- j. Processing and control equipment to receive and decode closed captioning data and display on the two dedicated closed captioning display.
 - k. Processing and control equipment to receive an emergency contact closure and to display an emergency message independent of any video production control equipment and return the system to the original condition without additional programming.
 - l. The Contractor shall provide Diagnostic Software to assist the Owner in diagnosing, isolating and repairing deficiencies in the display and control system, including defective elements.
 - m. The Contractor shall provide uninterruptible power supply for any touchscreens or control computers. The project will provide a central UPS for the video equipment in Video Control (07.16.01) and Video Rack Room (07.16.5).
 - n. The Contractor shall provide backup computer discs, all software manuals and license certificates and upgrades for all software loaded on all control systems.
5. Control and Signal Processing/Distribution Cabling
- a. Installation shall include re-patching of all necessary low voltage control and fiber optic cabling.
 - b. The Contractor will verify all connector details required for installation of equipment, including make, model, connector sex, attachment configuration, pin-outs, and cable clamp accessories.
 - c. The following cables will be used by the Contractor for all wiring within the production areas:

Signal Type	Manufacturer	Cable Part	Color
HD Video	Belden	1505A	Violet
SD Video	Belden	1505A	Green
Analog Video	Belden	1505A	Black
Sync/Reference	Belden	1505A	Red
Analog Audio	Belden	9451	Black
RS-232/422/485 Control	Belden	8723	Chrome
Network (CAT6)	Belden	2412	Blue
KVM	Belden	2412	Light Blue
Intercom	West Penn	D439	White

- 6. Equipment Racks:
 - a. Contractor shall utilize six racks provided by others for mounting equipment in the Engineering Rack Room. Coordinate with 27 41 00 (contracted direct to Owner).
- 7. Structural Engineering
 - a. The display systems shall be designed, fabricated and installed by the Contractor in their entirety.
 - b. All necessary primary structure, catwalks, stairways, access doors and access ladders (including fall arrest systems to code) are a part of work by others. For display systems that are to attach to facility structure, reference project drawings. The Contractor shall be responsible for field verification and submittal of stamped structural details for final connection meeting all state structural and seismic criteria for final approval prior to any work being performed on site.
 - c. Any secondary steel needed by the Contractor for installation is the responsibility of the Contractor.
 - d. Provide electrolytic protection between different adjoining metals.
- 8. Electrical

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- a. All power distribution from the feeder to individual display panels will be provided by the Display Contractor, inclusive of distribution panels, panelboards, and remote power on/off at the East and West main Video Displays.
 - b. Interior convenience outlets on each catwalk for maintenance of the displays will be provided by others.
 - c. Interior lighting shall be provided by others to maintain uniform coverage throughout interior of displays with switch mounted near enclosure entrance point.
 - d. Lighting Control for the static signage to be extended to the nearest building lighting control panel for central control.
9. Cooling / Ventilation
- a. Provide natural, forced or conditioned ventilation with thermostatic and manual override control as required for operation of all components as recommended by manufacturer for maximum display life. Provide any/all necessary environmental filtration for the ventilation system.
 - b. Background noise levels attributed to this ventilation and all system components shall not exceed 55 dB(A) at nearest regularly occupied public seating, and shall not exceed a sound pressure level of 65 dB in any octave band from 125 Hz to 8000 kHz. Contractor will submit noise measurements using Type 1 Integrating Sound Level Meter meeting all requirements of ANSI:S14-1983, Type S(1) standards.
 - c. Exhaust fans, if required by the proposing manufacturer for the installation, shall be equipped with neoprene mountings (Mason Industries Type ND or equivalent) to vibration isolate fan unit from building structure. The Contractor is responsible for complete weatherproofing of fan and assembly to surrounding structure for outdoor displays.
10. Spares
- a. Provide one spare 6 strand fiber optic cable and two spare low voltage cables of each type installed between the Control Room equipment and the display.
 - b. Supply 1% spare of each type of LED module.
 - c. Supply 1% spare (or a minimum of 2, whichever is greater) of the following items located within the video display enclosure: data and signal distribution components, and printed circuit boards for anything other than a basic LED module.
 - d. Provide sufficient heavy duty shelving for the storage of all spare equipment. All spare equipment will be inventoried, boxed and sealed, and clearly labeled.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place.
- C. Cover edges of cable pass-through holes in enclosures, chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting. Adhesive-backed electrical tape and friction tape is not acceptable for insulating or protective purposes.
- D. All rack and console dimensions must be verified against field conditions prior to fabrication and again prior to installation.
- E. Where possible, mount equipment and fully wire and test before delivery to job site. If field conditions prevent prior assembly, notify Consultant in writing that systems shall be fabricated on site and the reasons for the change.

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- F. Inspect all racks, consoles, and enclosures prior to installation. All rough or sharp edges that may cause injury to personnel must be deburred or a permanent protective coating applied.
- G. Provide ventilation adequate to keep temperature within equipment racks below 85 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 85 degrees. This ventilation system must be temperature actuated.
- H. Provide a non-fluorescent service lamp in the top of each equipment rack.
- I. Provide blank rack-mount panels installed in all rack openings not occupied by equipment. Blank filler panels will not exceed five rack units in size. Custom rack 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.) Custom connector plates (cable TV, speaker, microphone, etc.) are typically stainless steel; however, verify plate finish with the Architect and Owner. Plastic and or wood plates or panels shall not be accepted.
- J. Install rack mounted equipment with black 10-32 Phillips head machine screws.
- K. Panels or equipment mounted on the rear rack rails must not block access to any front mounted components. Front mounted equipment will be given ample space to allow for access to rear connection.
- L. The process of acceptance testing the Display Systems may necessitate moving and adjusting certain component parts - e.g., video monitors.
- M. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
- N. AC Power and Grounding
 - 1. Coordinate final connection of power and ground wiring to racks. Hardwire power wiring directly to power contacts or internal AC receptacles to ensure uninterrupted operation.
- O. Caution Padding
 - 1. Provide padding and yellow caution tape on any structural element lower than 80" in catwalk service areas directly behind main video displays.

3.2 CABLING

- A. Exercise care in wiring; damaged cables or equipment shall not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation.
- B. Wiring entering equipment racks and enclosures will be run directly to equipment. Use of splices or connectors to extend cabling to equipment will not be accepted.
- C. Wiring and connections will be completely visible and labeled in equipment racks and enclosures.
- D. Horizontally routed wiring to equipment will be managed with lacing bars and should include a service loop for future adjustments and terminations.
- E. For equipment mounted on slides, additional service loops will be provided to accommodate the full range of travel of the slides. This includes all power, ground, control and signal cables.

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- F. Neatly bundle excess AC power cables from rack-mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or hook and loop tie wraps.
- G. All cables in cable trays shall be neatly installed with maintaining separation of the different cable types.
- H. Screw Connections: Only insulated crimp on spade terminals will be used for application to barrier strips. Multiple gang lugs or ring lugs are not acceptable for this purpose.
 - 1. This is only applicable to stranded conductor wires. Solid conductors will be attached directly to the barrier strip.
 - 2. All conductors will be stripped prior to installation underneath screws on terminals. Provide crimp lugs on stranded control cables, solid conductor wire will not require crimp lugs on individual conductors. All screw terminated solid conductors will be wrapped in the same direction as screw rotation during tightening.
- I. Multiconductor Cables: Follow a uniform application of color codes for multiconductor cables throughout the Facility. Where there are unused conductors or pairs in a cable assembly, they can be insulated as a group, left long enough for future termination, and folded into the connector hood. Where this is impractical, they may be folded back along the outer jacket of the cable and covered with heat-shrinkable tubing.
- J. Multipin Connectors: Where jumpers are indicated between pins of the same connector, they will be installed internal to the connector shell and will not have any cable number designations applied to the jumper.

3.3 LABELING

- A. General
 - 1. The attachment method for equipment identification plates will be designed for permanency unless otherwise described. All labels will be protected prior to installation, and will not be installed if damaged or scratched. Follow manufacturer's recommended procedure for surface preparation, which must be free of any dust, dirt or film.
 - 2. On black laminated engraving stock labels, engraved panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored pushbuttons, letters shall be black.
 - 3. Mount labels in a neat, plumb and permanent manner except where indicated.
- B. Rack Labels
 - 1. Provide engraved labels with the Rack Number on the front of each rack in 1" high Arial text.
- C. Panel Labels
 - 1. Provide engraved labels for all terminations in 1/8" high Arial text.
- D. Cable Labels
 - 1. Cables and wiring to be logically, legibly and permanently labeled for easy identification.
 - 2. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing.
 - 3. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label.
 - 4. Hand-written or self-laminating type labels are not acceptable.
 - 5. Wiring designations to be an alphanumeric code that is unique for each cable.
 - 6. Locate the cable designation at the start and end of each cable run and within 2 inches of the point of termination or connection.
 - 7. Actual cable designation assignments to be determined by Contractor.

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8. Add cable designation codes to system schematic drawings included with Project Record Drawings.

3.4 TESTING

- A. During all consultant walkthroughs, the project manager will be present.
- B. If during acceptance testing it becomes evident that further adjustment or work may be required to bring the system into compliance, the Contractor will continue to work until the system is acceptable at no additional charge over the contract price. If approval is delayed because of defective equipment, poor installation, or failure of equipment to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Architect and their Consultant at their standard rate in effect at that time, during any extension of the acceptance testing period. The Contractor will provide rental or loaner equipment to make the system operational in critical cases of equipment failure prior to contract completion.
- C. Make available three portable UHF business band radios for use during acceptance testing. Radios should have a transmission range sufficient to cover entire project. Radios to include rechargeable batteries and re-charger 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. Confirm that radio frequencies used are not in use elsewhere on project site.
- D. System Tests
 1. The following procedures will be performed prior to testing of System:
 - a. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
 - b. Adjust, balance, and align equipment for optimum quality including brightness, viewing angles, brightness uniformity, black level uniformity, color uniformity, hue uniformity, pixel mapping, scaling and resolution of video image to meet the manufacturer's published specifications.
 - c. Allow for a continuous 48 hour period of "Burn In" running a looped test signal including equal intervals of Black, Green, Red, Blue and 100% White.
 2. Display Power Down And Up Again:
 - a. Display shall be adjusted to 6500K color temperature.
 - b. Display shall be set at full brightness level with a standard 100 IRE white signal as its source. Screen will be allowed to stabilize and display controls shall be adjusted for a uniform brightness across the display.
 - c. Both display and processing platform will be powered down together completely and then immediately powered up again.
 - d. This procedure will be performed twice more in succession.
 3. Uniformity At All Viewing Angles:
 - a. Display shall be set at a brightness level appropriate for the facility. Screen will be allowed to stabilize and display controls shall be adjusted for a uniform brightness across the display.
 - b. A signal generator will be used to generate each of the following colors for examination
 - 1) White (100 IRE)
 - 2) Black (7.5 IRE)
 - 3) Green
 - 4) Red
 - 5) Blue
 - 6) Cyan
 - 7) Magenta

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- c. A "walk around" will be performed viewing the display at all possible angles of the display for each of the colors.
 - d. Display (and overall processing) will be examined for module to module uniformity and pixel to pixel uniformity.
 - e. Display will be measured using a spot photometer to verify manufacturer brightness and viewing angles.
4. High Contrast Image Performance:
 - a. Display will be viewed in many lighting conditions.
 - b. Display shall be set at a brightness level appropriate for each lighting condition. Screen will be allowed to stabilize and display controls shall be adjusted for a uniform brightness across the display.
 - c. Display (and overall processing) will be examined for trueness of team colors, gama and contrast handling.
 5. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
 6. Installed, loose and spare equipment shall be inventoried for correct quantity.
 7. Any other test on any piece of equipment or system deemed appropriate by Consultant.
 8. The omission of a description of a device, function, signal path, or test in this document shall not exempt the Contractor from responsibility for checking all devices and signal paths for appropriate compliance with Industry Performance Standards and making corrections necessary to bring system(s) into compliance with the applicable standards.

3.5 TEST EQUIPMENT

- A. Make available the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, submit a list to the Consultant of test equipment make and model numbers that will be used.
 1. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A.
 2. Spot Photometer.
 3. CAT6 cable tester.

3.6 ACCEPTANCE

- A. 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 damage occurring to the facility, including broken glass, 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.
- B. Submit a pre-commissioning systems report to the Owner and Project Consultant two weeks prior to the scheduled systems commissioning proving all systems to be in full compliance. Report shall include test results, date of each test, pertinent conditions such as control settings, etc., and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for acceptance testing.
- C. Acceptance testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and supply required test equipment. Contractor will make available at least three technicians familiar with installation, available for

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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 will be submitted by the Contractor. The Contractor will keep a running list of all acceptance tests performed and submit a final copy of the results with the closeout submittals as listed in Part 1.6. Testing process is estimated to take 2 days up to 10 hours per day and may require multiple crews / shifts.

3.7 INSTRUCTION OF OWNER PERSONNEL

- A. Upon completion of the installation of the specified display systems, and prior to any facility events, make available designated operating personnel training on the equipment operation. This training will be performed at the site by the Contractor's and the manufacturer's education staff.
- B. The System Reference Manuals must be complete and on-site prior to the time of the first instruction.
- C. Coordinate schedule of instruction with the Owner subject to availability of Owner's personnel. This may require scheduling instruction during weekends or evenings.
- D. Training will be provided in a series of classes to operations personnel to review all aspects of operation and maintenance of the system. Follow-up sessions to better enhance the operator's ability to expand or maximize the system will be made available.
- E. The system training will include three (3) days or twenty one (21) hours of technical training covering the explanation of the system, including use of all software and hardware, documentation, configuration, interfacing and diagnostics. Make available training of the system operators and maintenance personnel as follows:
 - 1. System Overview: Explanation of system includes documentation, configuration, interfacing and basic diagnosis.
 - 2. Operator Training: Training in the use of system devices including powering and general operation of overall systems.
 - 3. Maintenance/Trouble Shooting: Advanced training in display and control system troubleshooting and maintenance. Manufacturer's representative will conduct scenario based training creating isolated system failures requiring owner to investigate and solve system failure problems as a means of gaining hands on knowledge of the systems.
- F. Training sessions are to be video-recorded and made available to the client in an MP3 or MOV format. An agenda shall be prepared two weeks ahead of the training dates and submitted to the Owner for approval.
- G. In addition to the training listed in 3.7E, the trainer shall be present for the first rehearsal days, the first two home football games, and one additional non-football event.

END OF SECTION

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SECTION 27 41 32

CREATIVE DISPLAY SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. THIS SPECIFICATION IS ISSUED FOR REFERENCE ONLY.
- B. All prequalified LED display manufacturers and direct sale representatives are invited to provide a proposal based on specifications prepared by Idibri Consulting. for the Minnesota Sports Facilities Authority.
- C. All requirements in this section of the solicitation as well as in other sections of the solicitation, Referenced Documents or Practices, and any Amendments to the solicitation shall be considered a part of this section (Section III. Scope of Work / Specifications). Each Offeror to the solicitation is responsible for becoming thoroughly familiar with all its contents as to requirements which affect this Section. Contractor is responsible for coordinating all items of this section with the Owner and Project Consultant to insure that all items of this section are furnished in accordance with the Owner's (the Minnesota Sports Facilities Authority) standards.

1.2 REFERENCES

- A. National Fire Protection Association (N.F.P.A.).
- B. American National Safety Institute (A.N.S.I.).
- C. National Electrical Code (N.E.C.).
- D. Underwriters Laboratories (U.L.).
- E. Electronics Industries Association (E.I.A.).
- F. Standard for Electric Signs, UL-48.
- G. Standard for Control Centers for Changing Message Type Signs, UL-1433.
- H. Federal Communications Commission Regulation Part 15.
- I. Project Drawings
- J. Specification for the Project: Structure, Electrical, Structured Cables, Production Control Room, IPTV System, HVAC, pang and coatings.

1.3 DEFINITION OF TERMS AND ABBREVIATIONS

- A. Provide: to supply and install.
- B. Supply: to supply but not install.
- C. Install: to install but not supply.

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- D. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- E. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- F. Future: Equipment that will be provided by owner at a later date. Accommodations shall be provided for future equipment as shown on the drawings.
- G. Contract Documents: This specification and included conceptual display drawings.
- H. Project Consultant: Idibri Consulting

1.4 RESPONSIBILITY AND RELATED WORK

- A. Coordinate scheduling of work with the Owner.
- B. The systems described in this section will be called the "Display Systems" and the installer will be called "The Contractor." The Contractor will provide all labor, materials, equipment, necessary tools, test equipment, hoisting, transportation, supervision and coordination necessary to complete the installation of the "Display Systems" as described in the construction documentation.
- C. The Contract Documents are intended to include or imply all items required for the proper execution and completion of the work.
- D. The Display Systems consist of the materials, equipment and systems described in this specification, related drawing details, and any schedules that are part of the contract documents. This Contract is for equipment, material, installation and training. The work of this section includes complete and operational Display Systems.
- E. The Contractor will provide all accessories, such as connectors, adapters, matching devices and equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.
- F. The Contractor shall provide complete, turnkey Display Systems, fully tested and ready for intended use according to the design intent of the contract documents.
- G. Obtain all insurance, bonding, licenses and permits necessary to complete the work, and for operation by the Owner.
- H. Contractor will comply with all equity and union jurisdiction and prevailing wage requirements for the completion of the project.
- I. If a conflict is identified between the Contract Documents and the appropriate codes and is reported to the Owner and confirmed prior to contract award, the Project Consultant will prepare the necessary clarification or revision. When a conflict is reported after contract award, the Contractor will propose a resolution of the conflict and, upon approval, perform related work.
- J. Coordinate with other Contractors as required and in a timely fashion to convey all information (scheduling, structural, electrical, technical or otherwise) necessary to complete the project.
- K. The Contractor shall be responsible for:

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1. Verification of dimensions and conditions at the project for the display and control equipment locations prior to ordering/manufacturing.
2. Submittal of State registered structural stamped designs and calculations with the shop drawing submittals. This will be for the final design and connection from the provided steel structure to the display only.
3. Provision of all transportation and hoisting.
4. Furnish protective covering during construction/installation to prevent damage or entrance of foreign matter.
5. Replace at no expense to Owner/project, product damaged during delivery, storage or handling.
6. Provision of safe and protected storage. The owner takes no responsibility for damage or theft relating to negligence in failure to secure equipment by The Contractor.
7. Installation in accordance with the Contract Documents, manufacturer's recommendations, and all applicable code requirements.
8. Provision of complete assemblies (sub-structure, enclosure, and finishes) and all necessary attachment hardware, and framing.
9. Provision of all panels, branch circuit distribution, and remote on/off contactors are the responsibility of the Display Contractor. Main feeders will be brought to the nearest electrical closet.
10. Provision, termination and testing of all necessary signal cabling and remote operation control cabling.
11. Provision of all transmission, processing, receiver electronics to distribute control signals to the display systems.
12. Coordination of any installation of rack mounted devices into equipment racks (provided by others) with other related trades with equipment in the same space.
13. Connecting ground point to all equipment in accordance with NEC code and standards specified. Coordinate with Division 26.
14. UL Certification of all pertinent equipment including control and display systems attached with identification labels. If any equipment requiring certification is not UL Certified, then The Contractor shall arrange onsite inspections and certification at no additional expense to the contract/project.
15. All control equipment to operate the display shall be located in the facilities' control room. Any necessary signal/control conduit and cable raceways for cable runs to and from display components will be provided by others.
16. All submittals detailed within the Contract Documents
17. Initial tests and adjustments
18. Final performance testing, calibration and adjustment prior to first use.
19. Maintenance services contract, warranty for equipment and workmanship.
20. Provision of required shelving and inventory labels for all spare equipment.
21. Provisions of preseason cleaning of the displays within 14 days of the first event held in facility for the first year.
22. Provide protection for finished areas during the installation. Any damage caused during construction is the full responsibility of the Contractor to repair or replace at no additional cost.
23. Electrical Bonding of equipment and racks as required to the facility ground buss to ensure equipment meets FCC guidelines for RF noise interference.
24. Terminate all unused BNC outputs.

1.5 SYSTEMS DESCRIPTIONS

- A. The following display descriptions are intended to augment the Van Wagner concept renderings. Creativity and original designs are encouraged to meet the final goal.
- B. Plaza Viking Ship LED Video Display / Sail

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1. The Viking ship displays are designed to look like a sail filled with wind. One side will be concave and the other convex. The mesh type display is intended to be transparent so that it doesn't feel like a large video advertisement. The sign should have the ability to show graphical content as well as video from the primary control room on both sides. The sail is roughly 50'W x 40'H. All structure to support the display should be included in the proposal.

C. West Prow Exterior Free-Form LED Display

1. The West Prow of the building will extend over the west plaza. This large surface will be the home for the free form LED that will display iconic signage as well as video. The feathering of the LED that fades into the façade is unique to the concept and should be considered in the design. No hard edges should be used in order to maintain the oval appearance. The overall display should be 70'W x 109'-5"H. All additional rigging hardware and supports needed to mount the display should be included in the proposal.

E. Full System Base Warranty, 3 Years.

1.6 SUBMITTALS

A. Bid Submittals

1. Any visible representation of the Manufacturer's name or logo at the facility must be specifically negotiated as part of the contract with the Owner. Only upon approval of the Minnesota Sports Facility Authority Purchasing Department through a change order to the contract will any visible representation of the Manufacturer's name or logo be allowed at the facility.
2. Offeror must have previously installed at least four jobs of similar magnitude to the job described in the solicitation. The jobs of similar magnitude must be completed within the last five years within the USA. In your proposal, submit name, phone number, and current email address of contact person for each representative project reference. Also, in your proposal, identify at least one such completed job available for inspection by the Project Consultant and Owner's Representatives. The Minnesota Sports Facility Authority reserves the right to inspect offeror's completed job with the permission of the project owner prior to awarding contract from the solicitation.
3. In its proposal, Offeror will confirm in writing that it has at least five years of experience with equipment and systems of the types specified in the solicitation, that it maintains a fully staffed and equipped service facility in the region of the United States that includes Minneapolis Minnesota, and that it is franchised dealer and authorized service facility for any equipment used on the contract project not manufactured by the offeror, and that the offeror is properly licensed to work in the project home state (Minnesota).
4. In its proposal, Offeror will confirm in writing that any Sub-contractor it uses in performance to contract has five years of experience with the primary contractor's / offeror's equipment and systems and that the subcontractor's company is properly licensed to work in the project home state (Minnesota). In its proposal, Offeror will identify all Subcontractors on the Proposal Response team and provide a detailed scope of work for each Subcontractor it plans to use in performance to contract.
5. In its proposal, Offeror will include resumes of its project manager, lead engineer and lead installers that will be working on the contract project. This will include key team members of any Sub Contractor that the offeror plans to use in performance to contract. Resumes must be submitted with offeror's proposal response.
6. In its proposal, Offeror will submit preliminary power requirements for its proposed display at 100%, 50%, and 5%.
7. In its proposal, Offeror will submit horizontal and vertical viewable dimensions for each display and any voluntary alternates.

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8. In its proposal, Offeror will submit horizontal/vertical physical pixel count of its proposed display and any voluntary alternates
9. In its proposal, Offeror will submit preliminary total weight and structural calculations for its proposed display and any voluntary alternates.
10. In its proposal, Offeror will submit a schedule to indicate durations for shop drawing submittal, procurement, and fabrication, shipping requirements, installation timelines for each major system and test and commissioning sessions. Coordinate these milestone dates in the schedule with project schedule and intended completion dates for the contract project in the solicitation.
11. In its Cost Proposal, Offeror will submit Schedule of Values for each item listed in Sub-Part 1.5 Systems Description of the solicitation. Breakout display, processing and any additional costs for each display system. Breakout system cabling cost and provide a per foot unit cost for additional cable that may be required once construction starts.

B. Project Submittals:

1. Product Data Submittal: Contractor shall submit manufacturer's product data sheets for each item of equipment to be used for the contract project in electronic form via email as PDF electronic files.
2. Shop Drawings Submittal: Contractor shall indicate complete details and dimensions of work to be performed and indicate types and locations of equipment, fabricated equipment, and other details to completely describe work to be performed.
3. Contractor shall submit the above information via email and memory device as PDF electronic files for review and distribution to the Owner's Representative. There shall be no contract work authorized on site without the prior submittal of a complete set of shop drawings. Any exceptions to this contractual requirement must be in writing and approved by the Owner's Representative.
4. Shop Drawing Details to include the following:
 - a. Plan, Elevation and Section Views of the displays.
 - b. Drawings showing the connection of contractor supplied equipment to the structure at each different condition.
 - c. Wiring diagrams. Complete, detailed wiring diagrams for all systems including cable types, identification and color codes, and detailed wiring of connections, both at equipment and between equipment racks and wiring in conduit.
 - d. Location of all equipment in racks, consoles, millwork, and enclosures. Provide dimensions; wire routing and cabling within housings; AC power outlets, terminal strip and UPS locations.
 - e. Conduit riser diagrams for all systems.
 - f. Schematic drawings of any custom circuitry or equipment modifications, including connector pinouts and component lists.
 - g. Equipment rack elevations for front and rear mounted equipment.
 - h. Schedule of terminations for all systems.
 - i. Coordinate rack AC Power Schedule and circuiting information with the Owner.
 - j. Terminal strip layouts for all proposed terminal strips to be used in junction boxes or in the equipment racks.
 - k. Power consumption at 100%, 50% and 5% illumination levels for each display.

C. Contract Closeout Submittals

1. Contractor shall keep a single complete set of approved shop drawings on the project site for the full duration of the project until after the final system commissioning. Non-approved shop drawings will not be allowed on the job site. Contractor shall note any changes made during installation on these single set of drawings. Contractor shall submit three corrected sets of reproducible drawings showing work as installed. All "as-built" drawings are to be submitted both in electronic form (PDF and ACAD 2014 or later) and in hard copy (42"x30").

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2. Owner Reference Manual: Before owner training commences, Contractor shall submit the following as Adobe .pdf files on 3 CD's and as hard-copy in a single 3 ring binder with project title. Contractor shall submit individual sub-directories/tabular dividers with the following headings:
 - a. A legend with acronyms and abbreviations.
 - b. A catalog of all equipment, organized by manufacturer, model, serial number, including the room and rack number where the device is located.
 - c. System Operation Instructions: Narrative verbiage with photographs and diagrams detailing operational procedures for all equipment as a system.
 - d. Manufacturer's User Manuals for all equipment.
 - e. Warranty Information for all equipment. Include warranty period and service department contact information.
 - f. System Maintenance Instructions: Narrative verbiage with photographs and diagrams detailing owner's responsibilities for preventative maintenance to include schedules and any specific products, procedures or specialized/custom tools required for maintenance of the display system.
 - g. Battery Replacement Schedule: Schedule of dates/intervals for replacement of all batteries. This is to include UPS and control systems.
 - h. As-Built Drawings fully legible at C size (24"x18") bond folded appropriately for binder.
 - i. A list of all test results performed on the systems as outlined in Section 3.4 proving the systems to be in full compliance.
3. As-Built Drawings are to be fully legible at C size (24"x18") bond. Each page to be individually laminated. Set is to be loosely bound using a minimum of two binder rings.
4. Contractor shall submit a complete list of spares in inventory to include quantity, manufacturer, model number, and serial number.

1.7 CODE COMPLIANCE

- A. All work performed by the Contractor and materials used by the Contractor in performance to the contract shall comply with all applicable codes and regulations to meet or exceed Federal, State, City, and Local Building Codes and Regulations (including seismic). Contractor shall advise the General Contractor if anything in the Drawings or Specifications is out of compliance with codes and/or laws prior to proposal submission.
- B. The governing building code shall be the 2007 Minnesota State Building Code, including any local city Amendment's.

1.8 PROJECT CONDITIONS

- A. Contractor shall notify the Owner in writing of any issues on the job site negatively affecting the contractor's pursuance of work under their scope. Contractor shall submit recommendations for resolution and assist in coordinating solutions with other trades.
- B. Contractor shall verify position and elevation of structure and its layout for display equipment. Contractor shall verify dimensions by field measurements.
- C. Contractor shall verify mounting structure is capable of supporting the display system weight and seismic loads in addition to any required attachment and structural support metals.

1.9 GUARANTEES

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- A. Contractor shall warrant labor and materials on the display systems for three (3) years following the date of Substantial Completion as a base offering. This warranty will include components whose manufacturer warranty is less than the 3 year window.
- B. Within the warranty period, Contractor shall:
 - 1. Make available an exchange program to supply replacement parts for components that fail during the coverage period. To minimize downtime, the exchange parts will be shipped on the same day the order is received or on the following day. The manufacturer will also enclose an air bill for return of the defective components.
 - 2. Make available a 24/7 help desk with a toll-free number fully staffed by experience technicians and coordinators who are thoroughly familiar with the display products and available for technical support. This contractor help desk staff must be available at no additional cost to the customer and provide an "on-call" service during weekends.
 - 3. Make available a access to a local factory representative or factory authorized service company that can repair or replace any faulty item the next day without charge during the warranty period, including parts and labor.
- 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. Contractor will make available to Owner the exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information is to be part of Project Record Set.
- E. Contractor shall submit alternate pricing for extended maintenance contracts on displays and control systems based on the above criteria.

PART 2 - PRODUCT

2.1 OFFERERS

- A. Recommended Offerers.
 - a. CBS Outdoor
 - b. Daktronics
 - c. Mitsubishi
 - d. Nanolumens
 - e. Panasonic
 - f. Sony
 - g. TS Sports

NOTE: If it is determined during the evaluation process that each device included in an offeror's proposal does not meet all of the specifications, then that offeror's proposal will be deemed "non-responsive" and removed from further consideration.

- B. Offerors to submit the following:
 - 1. A list of all major equipment and their quantities including manufacturer and model numbers with software release numbers.
 - 2. A one-line schematic diagram of all equipment signal and control connectivity for review.
 - 3. Identify four facilities where the submitted product/system were installed within the last two years and if requested, supply pictures of the facility and applicable information regarding the facility that provide the viewer with a complete virtual walkthrough of the facility, and an online demonstration of video display, input manipulation and operational capabilities.

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4. Submit all else stated for submittals in Part 1.6B Bid Submittals.
- C. All equipment supplied will be new and meet the latest published specifications of that product.
- D. Take care during installation to prevent scratches, dents, chips, etc.
- E. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on value of the product at bid time disclosed in the schedule of values.

2.2 SYSTEM REQUIREMENTS

- A. Technical and Engineering Standards
 1. General
 - a. Large format display systems shall allow "hot" repair while the system is operating.
 2. LED Display Systems
 - a. The display systems will be comprised of full color LED pixel technology capable of 7,000 cd/sq.m pixel brightness with full white (100 IRE) input.
 - b. Brightness of individual adjacent LED's must vary no more than 2%, and no more than 10% across the entire display.
 - c. The display system will be equipped with an illumination sensor exterior to the display and allow for both automatic and manual control of preset illumination levels in at least 20% increments up to 100%.
 - d. The display must be capable of 140 degree minimum horizontal angle of viewing and 30 degree upper and 60 degree lower minimum vertical angle (defined at 50% brightness and zero color shift).
 - e. Individual display module PCB's used outdoors must be conformal coated to protect them from the environment.
 3. Media Servers and Content Provisioning
 - a. The Contractor shall provide video content servers to provide graphics resolutions to the prow and ship displays independently.
 - b. The Contractor shall provide a backup content server to be used in the event of a failure.
 - c. The Contractor shall allow for (3) 1080p inputs from the video production routing system.
 4. Control and Signal Processing/Distribution Systems.
 - a. The Contractor shall provide all user interface, transmission, and processing software; all electronics; and all cabling to independently place, size, tile, layer, and control High Definition (HD-SDI SMPTE 424M) and Graphics (DVI) inputs signals on each of the displays.
 - b. The Contractor shall provide backup processing and transmission equipment in duplication of primary systems with equipment for manual switchover, distribution amplification, and/or splitting of all necessary video, control, data and signal cabling.
 - c. All control equipment to operate and provide signal to the displays shall be located in the production equipment room. The Contractor shall provide all connections, cabling, and terminations between display, operating equipment, and the production equipment room.
 - d. The Contractor will provide systems for remote power up and shut down of the displays, systems will allow displays to be turned on and off from the video production equipment room in addition to within the displays.
 - e. The Contractor shall provide one remote control user interface station in the rack room to provide complete control of system input, display power up/down, freeze,

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position, size, aspect ratio, color, hue, contrast, brightness and delay for use in setup, testing and operation.

- 1) Avocent HMX1070-001 User Station
- f. The Contractor shall provide computer interfaces for all CPU devices in their scope.
 - 1) Avocent HMIQSHDI-001 Computer Interface
- g. Processing and control equipment shall allow for external control of input selection and transitions via GPI triggers, RS-422/232, and VDCP protocols.
- h. The Contractor shall provide Diagnostic Software to assist the Owner in diagnosing, isolating and repairing deficiencies in the display and control system, including defective elements.
- i. The Contractor shall provide uninterruptible power supply for any touchscreens or control computers. The project will provide a central UPS for the video equipment in Video Control (07.16.01) and Video Rack Room (07.16.5).
- j. The Contractor shall provide backup computer discs, all software manuals and license certificates and upgrades for all software loaded on all control systems.
5. Control and Signal Processing/Distribution Cabling
 - a. Installation shall include re-patching of all necessary low voltage control and fiber optic cabling.
 - b. The Contractor will verify all connector details required for installation of equipment, including make, model, connector sex, attachment configuration, pin-outs, and cable clamp accessories.
 - c. The following cables will be used by the Contractor for all wiring within the production areas:

Signal Type	Manufacturer	Cable Part	Color
HD Video	Belden	1505A	Violet
SD Video	Belden	1505A	Green
Analog Video	Belden	1505A	Black
Sync/Reference	Belden	1505A	Red
Analog Audio	Belden	9451	Black
RS-232/422/485 Control	Belden	8723	Chrome
Network (CAT6)	Belden	2412	Blue
KVM	Belden	2412	Light Blue
Intercom	West Penn	D439	White

6. Equipment Racks:
 - a. Contractor shall utilize one rack provided by others for mounting equipment in the Engineering Rack Room. Coordinate with 27 41 00 (contracted direct to Owner).
7. Structural Engineering
 - a. The display systems shall be designed, fabricated and installed by the Contractor in their entirety.
 - b. All necessary primary structure, catwalks, stairways, access doors and access ladders (including fall arrest systems to code) are a part of work by others. For display systems that are to attach to facility structure, reference project drawings. The Contractor shall be responsible for field verification and submittal of stamped structural details for final connection meeting all state structural and seismic criteria for final approval prior to any work being performed on site.
 - c. Any secondary steel needed by the Contractor for installation is the responsibility of the Contractor.
 - d. Provide electrolytic protection between different adjoining metals.

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8. Electrical
 - a. All power distribution from the feeder to each display panels will be provided by the Display Contractor, inclusive of distribution and remote power on/off.
 - b. Interior convenience outlets on each catwalk for maintenance of the displays will be provided by others.
 - c. Interior lighting shall be provided by others to maintain uniform coverage throughout interior of displays with switch mounted near enclosure entrance point.
 - d. Lighting Control for the static signage to be extended to the nearest building lighting control panel for central control.
9. Cooling / Ventilation
 - a. Provide natural, forced or conditioned ventilation with thermostatic and manual override control as required for operation of all components as recommended by manufacturer for maximum display life. Provide any/all necessary environmental filtration for the ventilation system.
 - b. Background noise levels attributed to this ventilation and all system components shall not exceed 55 dB(A) at nearest publically accessible area near the display, and shall not exceed a sound pressure level of 65 dB in any octave band from 125 Hz to 8000 kHz. Contractor will submit noise measurements using Type 1 Integrating Sound Level Meter meeting all requirements of ANSI:S14-1983, Type S(1) standards.
 - c. Exhaust fans, if required by the proposing manufacturer for the installation, shall be equipped with neoprene mountings (Mason Industries Type ND or equivalent) to vibration isolate fan unit from building structure. The Contractor is responsible for complete weatherproofing of fan and assembly to surrounding structure for outdoor displays.
10. Spares
 - a. Provide one spare 6 strand fiber optic cable and two spare low voltage cables of each type installed between the Control Room equipment and the display.
 - b. Supply 1% spare of each type of LED module.
 - c. Supply 1% spare (or a minimum of 2, whichever is greater) of the following items located within the video display enclosure: data and signal distribution components, and printed circuit boards for anything other than a basic LED module.
 - d. Provide sufficient heavy duty shelving for the storage of all spare equipment. All spare equipment will be inventoried, boxed and sealed, and clearly labeled.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place.
- C. Cover edges of cable pass-through holes in enclosures, chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting. Adhesive-backed electrical tape and friction tape is not acceptable for insulating or protective purposes.
- D. All rack and console dimensions must be verified against field conditions prior to fabrication and again prior to installation.

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- E. Where possible, mount equipment and fully wire and test before delivery to job site. If field conditions prevent prior assembly, notify Consultant in writing that systems shall be fabricated on site and the reasons for the change.
- F. Inspect all racks, consoles, and enclosures prior to installation. All rough or sharp edges that may cause injury to personnel must be deburred or a permanent protective coating applied.
- G. Provide ventilation adequate to keep temperature within equipment racks below 85 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 85 degrees. This ventilation system must be temperature actuated.
- H. Provide a non-fluorescent service lamp in the top of each equipment rack.
- I. Provide blank rack-mount panels installed in all rack openings not occupied by equipment. Blank filler panels will not exceed five rack units in size. Custom rack 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.) Custom connector plates (cable TV, speaker, microphone, etc.) are typically stainless steel; however, verify plate finish with the Architect and Owner. Plastic and or wood plates or panels shall not be accepted.
- J. Install rack mounted equipment with black 10-32 Phillips head machine screws.
- K. Panels or equipment mounted on the rear rack rails must not block access to any front mounted components. Front mounted equipment will be given ample space to allow for access to rear connection.
- L. The process of acceptance testing the Display Systems may necessitate moving and adjusting certain component parts - e.g., video monitors.
- M. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
- N. AC Power and Grounding
 - 1. Coordinate final connection of power and ground wiring to racks. Hardwire power wiring directly to power contacts or internal AC receptacles to ensure uninterrupted operation.

3.2 CABLING

- A. Exercise care in wiring; damaged cables or equipment shall not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation.
- B. Wiring entering equipment racks and enclosures will be run directly to equipment. Use of splices or connectors to extend cabling to equipment will not be accepted.
- C. Wiring and connections will be completely visible and labeled in equipment racks and enclosures.
- D. Horizontally routed wiring to equipment will be managed with lacing bars and should include a service loop for future adjustments and terminations.
- E. For equipment mounted on slides, additional service loops will be provided to accommodate the full range of travel of the slides. This includes all power, ground, control and signal cables.

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- F. Neatly bundle excess AC power cables from rack-mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or hook and loop tie wraps.
- G. All cables in cable trays shall be neatly installed with maintaining separation of the different cable types.
- H. Screw Connections: Only insulated crimp on spade terminals will be used for application to barrier strips. Multiple gang lugs or ring lugs are not acceptable for this purpose.
 - 1. This is only applicable to stranded conductor wires. Solid conductors will be attached directly to the barrier strip.
 - 2. All conductors will be stripped prior to installation underneath screws on terminals. Provide crimp lugs on stranded control cables, solid conductor wire will not require crimp lugs on individual conductors. All screw terminated solid conductors will be wrapped in the same direction as screw rotation during tightening.
- I. Multiconductor Cables: Follow a uniform application of color codes for multiconductor cables throughout the Facility. Where there are unused conductors or pairs in a cable assembly, they can be insulated as a group, left long enough for future termination, and folded into the connector hood. Where this is impractical, they may be folded back along the outer jacket of the cable and covered with heat-shrinkable tubing.
- J. Multipin Connectors: Where jumpers are indicated between pins of the same connector, they will be installed internal to the connector shell and will not have any cable number designations applied to the jumper.

3.3 LABELING

- A. General
 - 1. The attachment method for equipment identification plates will be designed for permanency unless otherwise described. All labels will be protected prior to installation, and will not be installed if damaged or scratched. Follow manufacturer's recommended procedure for surface preparation, which must be free of any dust, dirt or film.
 - 2. On black laminated engraving stock labels, engraved panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored pushbuttons, letters shall be black.
 - 3. Mount labels in a neat, plumb and permanent manner except where indicated.
- B. Rack Labels
 - 1. Provide engraved labels with the Rack Number on the front of each rack in 1" high Arial text.
- C. Panel Labels
 - 1. Provide engraved labels for all terminations in 1/8" high Arial text.
- D. Cable Labels
 - 1. Cables and wiring to be logically, legibly and permanently labeled for easy identification.
 - 2. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing.
 - 3. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label.
 - 4. Hand-written or self-laminating type labels are not acceptable.
 - 5. Wiring designations to be an alphanumeric code that is unique for each cable.
 - 6. Locate the cable designation at the start and end of each cable run and within 2 inches of the point of termination or connection.
 - 7. Actual cable designation assignments to be determined by Contractor.

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8. Add cable designation codes to system schematic drawings included with Project Record Drawings.

3.4 TESTING

- A. During all consultant walkthroughs, the project manager will be present.
- B. If during acceptance testing it becomes evident that further adjustment or work may be required to bring the system into compliance, the Contractor will continue to work until the system is acceptable at no additional charge over the contract price. If approval is delayed because of defective equipment, poor installation, or failure of equipment to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Architect and their Consultant at their standard rate in effect at that time, during any extension of the acceptance testing period. The Contractor will provide rental or loaner equipment to make the system operational in critical cases of equipment failure prior to contract completion.
- C. Make available three portable UHF business band radios for use during acceptance testing. Radios should have a transmission range sufficient to cover entire project. Radios to include rechargeable batteries and re-charger 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. Confirm that radio frequencies used are not in use elsewhere on project site.
- D. System Tests
 1. The following procedures will be performed prior to testing of System:
 - a. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
 - b. Adjust, balance, and align equipment for optimum quality including brightness, viewing angles, brightness uniformity, black level uniformity, color uniformity, hue uniformity, pixel mapping, scaling and resolution of video image to meet the manufacturer's published specifications.
 - c. Allow for a continuous 48 hour period of "Burn In" running a looped test signal including equal intervals of Black, Green, Red, Blue and 100% White.
 2. Display Power Down And Up Again:
 - a. Display shall be adjusted to 6500K color temperature.
 - b. Display shall be set at full brightness level with a standard 100 IRE white signal as its source. Screen will be allowed to stabilize and display controls shall be adjusted for a uniform brightness across the display.
 - c. Both display and processing platform will be powered down together completely and then immediately powered up again.
 - d. This procedure will be performed twice more in succession.
 3. Uniformity At All Viewing Angles:
 - a. Display shall be set at a brightness level appropriate for the facility. Screen will be allowed to stabilize and display controls shall be adjusted for a uniform brightness across the display.
 - b. A signal generator will be used to generate each of the following colors for examination
 - 1) White (100 IRE)
 - 2) Black (7.5 IRE)
 - 3) Green
 - 4) Red
 - 5) Blue
 - 6) Cyan
 - 7) Magenta

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- c. A "walk around" will be performed viewing the display at all possible angles of the display for each of the colors.
 - d. Display (and overall processing) will be examined for module to module uniformity and pixel to pixel uniformity.
 - e. Display will be measured using a spot photometer to verify manufacturer brightness and viewing angles.
4. High Contrast Image Performance:
 - a. Display will be viewed in many lighting conditions.
 - b. Display shall be set at a brightness level appropriate for each lighting condition. Screen will be allowed to stabilize and display controls shall be adjusted for a uniform brightness across the display.
 - c. Display (and overall processing) will be examined for trueness of team colors, gama and contrast handling.
 5. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
 6. Installed, loose and spare equipment shall be inventoried for correct quantity.
 7. Any other test on any piece of equipment or system deemed appropriate by Consultant.
 8. The omission of a description of a device, function, signal path, or test in this document shall not exempt the Contractor from responsibility for checking all devices and signal paths for appropriate compliance with Industry Performance Standards and making corrections necessary to bring system(s) into compliance with the applicable standards.

3.5 TEST EQUIPMENT

- A. Make available the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, submit a list to the Consultant of test equipment make and model numbers that will be used.
 1. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A.
 2. Spot Photometer.
 3. CAT6 cable tester.

3.6 ACCEPTANCE

- A. 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 damage occurring to the facility, including broken glass, 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.
- B. Submit a pre-commissioning systems report to the Owner and Project Consultant two weeks prior to the scheduled systems commissioning proving all systems to be in full compliance. Report shall include test results, date of each test, pertinent conditions such as control settings, etc., and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for acceptance testing.
- C. Acceptance testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and supply required test equipment. Contractor will make available at least three technicians familiar with installation, available for

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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 will be submitted by the Contractor. The Contractor will keep a running list of all acceptance tests performed and submit a final copy of the results with the closeout submittals as listed in Part 1.6. Testing process is estimated to take 2 days up to 10 hours per day and may require multiple crews / shifts.

3.7 INSTRUCTION OF OWNER PERSONNEL

- A. Upon completion of the installation of the specified display systems, and prior to any facility events, make available designated operating personnel training on the equipment operation. This training will be performed at the site by the Contractor's and the manufacturer's education staff.
- B. The System Reference Manuals must be complete and on-site prior to the time of the first instruction.
- C. Make available trained personnel (two technicians) to be present during the first two preseason football games and the first regular season game. Provide 1 trained technician for each additional home football game for the remainder of the first season (up to 9 additional).
- D. Coordinate schedule of instruction with the Owner subject to availability of Owner's personnel. This may require scheduling instruction during weekends or evenings.
- E. Training will be provided in a series of classes to operations personnel to review all aspects of operation and maintenance of the system. Follow-up sessions to better enhance the operator's ability to expand or maximize the system will be made available.
- F. The system training will include two (2) days or sixteen (16) hours of technical training covering the explanation of the system, including use of all software and hardware, documentation, configuration, interfacing and diagnostics. Make available training of the system operators and maintenance personnel as follows:
 - 1. System Overview: Explanation of system includes documentation, configuration, interfacing and basic diagnosis.
 - 2. Operator Training: Training in the use of system devices including powering and general operation of overall systems.
 - 3. Maintenance/Trouble Shooting: Advanced training in display and control system troubleshooting and maintenance. Manufacturer's representative will conduct scenario based training creating isolated system failures requiring owner to investigate and solve system failure problems as a means of gaining hands on knowledge of the systems.
- G. Training sessions are to be video-recorded and made available to the client in an MP3 or MOV format.

END OF SECTION

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SECTION 27 41 00

VIDEO PRODUCTION SYSTEMS

PART 1 - GENERAL

1.1 OVERVIEW

- A. This specification is an exhibit to a request for proposal for the video production systems for the Minnesota Sports Facilities Authority.
- B. The Contractor will provide a proposal for design, procurement, and installation of the video production systems at the Minnesota Multi-Purpose Stadium which meet the requirements listed in this specification.
 - 1. SMPTE 424M, 425-5 and 2022-6 compliant, video production system for live LED production of events originating from the Minnesota Vikings Football Stadium. Destinations will include two End-Zone LED screens as well as a post-production suite for editing and recording.

1.2 REFERENCES

- A. National Fire Protection Association (N.F.P.A.).
- B. American National Safety Institute (A.N.S.I.).
- C. National Electrical Code (N.E.C.).
- D. Underwriters Laboratories (U.L.)
- E. Electronics Industries Association (E.I.A.).
- F. National Cable Television Association (N.C.T.A.)
- G. Society of Motion Picture and Television Engineers (S.M.P.T.E.)
- H. International Telecommunications Union (I.T.U.)
- I. Project Drawings and Photos
- J. Pre-Submittal Conference

1.3 RESPONSIBILITY AND RELATED WORK

- A. Coordinate and comply with project schedule as determined by the Owner (MSFA) and the General Contractor (Mortenson Construction).
- B. The systems described in this section will be called the "Production Systems" and the installer will be called "The Contractor." The Contractor will provide all labor, materials, equipment, necessary tools, test equipment, hoisting, transportation, supervision and coordination necessary to complete the installation of the "Production Systems" as described in these specifications and illustrated on the Project drawings.
- C. This RFP is intended to include or imply all items required for the proper execution and completion of the work.
- D. The Production Systems consist of the materials, equipment and systems described in this specification, related drawing details, and any schedules that are part of the construction document set. This Contract is for design, procurement, installation and training. The work of this section includes a complete and operational video production system.

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- E. The Contractor shall provide minor accessories, such as connectors, adapters, matching devices and equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.
- F. The Contractor shall design, procure, and install complete, turnkey Production Systems, fully tested and ready for intended use according to the design intent of the RFP.
- G. The Contractor shall obtain all insurance, bonding, licenses and permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner. See attached example Insurance Indemnity.
- H. The Contractor shall comply with all union jurisdiction and prevailing wage requirements for the completion of the project. Questions regarding jurisdiction and wage should be directed to the Owner.
- I. If a conflict is identified between the RFP and the appropriate codes and is reported to the Owner and confirmed prior to project award, the Architect will prepare the necessary clarification or revision. When a conflict is reported after project award, the Contractor will propose a resolution of the conflict and, upon approval, perform related work.
- J. Coordinate with other contractors as required and in a timely fashion to convey all information (scheduling, structural, electrical, technical or otherwise) necessary to complete the project.
- K. Coordinate any installation of rack mounted devices into non contractor provided equipment racks with others.
- L. Provide and install equipment racks in a manner in keeping with local seismic codes. Racks are to be electrically decoupled from flooring to prevent coming into contact with any safety grounded items during operation. Raised floor stringer grids must not make contact with the racks, but may be secured to rack risers. Racks should be mounted on rack risers that are bolted to the slab independently of the raised flooring systems. Rack risers may be separated from the racks using either rubber matting or masonite and bolts may be sleeved with nylon bushings for isolation.
- M. The Contractor shall be responsible for the supply and installation of AC power connections and circuits within the equipment racks that are to be provided under this section. The Contractor is to provide a 4"x4" J-Box at the bottom of each rack with power circuit cabling terminating in 24" pig tails. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel.
- N. The Contractor shall be responsible for connecting a #6AWG ground from each group of racks back to the telecom ground buss bar in the AV Rack room.
- O. The Contractor shall provide all transportation and hoisting.
- P. The Contractor shall provide safe and protected storage. The Owner takes no responsibility for damage or theft relating to negligence in failure to secure equipment by The Contractor. If secure on-site storage cannot be arranged with the Owner, it will be the responsibility of The Contractors to procure portable on-site storage.
- Q. The Contractor shall provide and install all cabling necessary to complete the full scope of work for all equipment provided and designated owner furnished pieces of equipment.
- R. The Contractor shall provide terminations in the Video Production Room and Production Rack Room of all cable types from throughout the facility as relate to the contracted scope of work. Any new facility cable extending to points outside of the video/audio production area will be provided and installed by the Contractor.

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- S. The Contractor shall provide and install the patchbays within the Production Rack Room.
- T. Electrical Bonding of equipment and racks as required to ensure equipment meets FCC guidelines for RF noise interference.
- U. Terminate all unused BNC outputs.

1.4 SYSTEM DESCRIPTION

A. Production Control Suite Equipment Complement

1. Manned Camera Package:

- a. Eleven (11) new broadcast quality 4K Ultra HD SMPTE 304M cameras capable of mounting B4 lenses for handheld and/or tripod configurations with Camera Control Units (CCU), tripod plate, 9" OLED viewfinders, 2" LCD viewfinders, microphones, hard travel cases, and local media storage for recording native 4K content.
- b. Five (5) 100x9.3 lenses w/2x extenders.
- c. Two (2) 60x9 lenses w/2x extenders.
- d. Two (2) 22x7.6 lenses w/2x extenders.
- e. Two (2) 17x6.2 lenses w/2x extenders.
- f. Seven (7) heavy duty tripods with fluid heads for the 100x and 60x lenses.
- g. Two (2) medium duty tripods with fluid heads for the 22x lenses.
- h. Eleven (11) Operator Control Panels (OCP or RCP) to be mounted in the work surface of the custom Engineering console on the back row. Space should be allowed to mount a total of 18 RCPs.
- i. SMPTE stinger cables for field connection use. (2) 500', (4) 250', (2) 100', (7) 25'
- j. CCU SMPTE 304M outputs shall be connected to the SMPTE 304M Patchbay through jumpers.
- k. **(DEDUCT #1)** Provide a price to deduct one full camera chain including a 100x lens and tripod.

2. Pan/Tilt/Zoom Camera Package:

- a. Two (2) new broadcast quality 4K Ultra HD cameras capable of mounting fully remote controlled B4 lenses mounted to the main truss over the field for 'Overhead Viewing'.
- b. Two (2) 22x7.6 lenses w/remote 2x extenders
- c. Two (2) Operator Control Panels (OCP or RCP) to be mounted in the work surface adjacent to the other camera RCP controllers.
- d. Two (2) pan/tilt heads with a single touchscreen and joystick controller operated over single mode fiber.
- e. Eleven (11) new 1080p High Definition All-In-One Pan/Tilt/Zoom cameras for views of the field and inside club areas operated over single mode fiber.
- f. Two (2) Pan/Tilt/Zoom controllers with iris and shading controls.
- g. Fiber from PTZ locations to control room provided by others. Coordinate all locations with the ES drawings.
- h. **(DEDUCT #2)** Provide a price to deduct one full 1080p All-In-One PTZ camera including fiber conversion and mounting.

3. Wireless Camera Package:

- a. Three (3) new broadcast quality 1080p High Definition cameras.

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- b. Three (3) 14x4.3 lens.
 - c. Three (3) Operator Control Panels (OCP or RCP) to be mounted in the work surface adjacent to the other camera RCP controllers.
 - d. Three (3) fully integrated built-in camera wireless transmission units capable of:
 - 1) H.264/MPEG-4 Encoding
 - 2) Maximum 20ms delay
 - 3) Remote Camera Control
 - e. Provide diversity antenna coverage for the following areas:
 - 1) Main Bowl
 - 2) Home Team Locker Room
 - 3) Home Team Player Entry Tunnel
 - 4) Home Interview Room
 - 5) Main Concourse
 - 6) Fire Club
 - 7) Ice Club
 - 8) Club Purple
 - 9) Field sideline Club
 - 10) Stadium Club
 - 11) West Plaza – Outside Stadium
 - f. **(DEDUCT #3.1)** Provide a price to deduct one full RF camera including transmission.
 - g. **(DEDUCT #3.2)** Provide a price to deduct one fiber extension to a remote location. (ie. a club or interview room)
4. Truck Fiber Transport
- a. A 1RU frame will be installed at the truck dock to handle all Electrical to Optical (EO) and Optical to Electrical (OE) conversion.
 - 1) Twelve (12) EO conversions to send HD-SDI signals from the truck dock to the control room.
 - 2) Six (6) EO conversions to send HD-SDI signals from the control room to the truck dock.
 - b. The video rack room will house frame synchronizers and conversion to handle all truck dock signals.
 - 1) Twelve (12) 3G frame synchronizer with fiber SFP module.
 - 2) Two (2) triple 3G SDI EO fiber converters.
 - c. Provide one (1) 4K transmit and synchronization from the truck to the control room
(ADD Alternate #4)
5. Video Playback Systems:
- a. Each of the two (2) clip playback servers to have the following requirements:
 - 1) Two channel 1080p playback tied to the production switcher.
 - 2) Incorporate real-time statistics interfaces to the in-house sports database via serial or TCP/IP protocols.
 - b. **(DEDUCT #5)** Provide a deduct price to eliminate one clip player.
6. Video Replay Systems:
- a. All replay system inputs and outputs to be available to all controllers.
 - b. Each of the three (3) 1080p replay systems to have the following requirements:
 - 1) Standard fast action control panel

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- 2) Provide dual touchscreen monitors.
 - 3) Select and record (4) 1080p streams from the IP router
 - 4) Playback (2) 1080p streams to the IP router
 - 5) 7-TB of storage with multiple RAID configurations
 - c. One (1) 4K replay system will have the following requirements:
 - 1) Standard fast action control panel
 - 2) Provide dual touchscreen monitors.
 - 3) Select and record (2) 4K Ultra HD stream from the IP router
 - 4) Playback (1) 4K stream to the IP router or (1) 1080p cropped/zoomed image.
 - 5) 7-TB of storage with multiple RAID configurations
 - d. **(DEDUCT #6.1)** Provide a price to remove one 1080p replay system.
 - e. **(ADD Alternate #6.2)** Provide a price to add one 4K replay system.
7. Primary Control Room Video Recording Package:
- a. The primary server for capturing 4K content to have the following minimum requirements:
 - 1) Ten (10) 4K Ultra HD Inputs (or 24-1080p inputs)
 - 2) 60 hours of storage at 3840x2160 59.94p; 4:2:2; 10bit video.
8. Legacy Control Room Video Playback/Recording Package: **(ADD Alternate #8)**
- a. Two (2) High Definition XDCAM Dual Layer recording decks.
 - b. One (1) High Definition J-Series Playback deck.
 - c. One (1) HDCam Playback/Recording deck.
9. NFL Related Equipment:
- a. Provide integration of the following systems that are provided by the NFL.
 - 1) Stats In A Box (Qty: 2)
 - 2) Red Zone
 - 3) GSIS Data Integration (Coordinate with 27 41 33).
10. Utility Frame Synchronizers and Encoding
- a. Six (6) 1080p utility frame synchronizers shall be provided with patching in the rack room and extension patching to 6 locations in the production control room on a custom rack panel. Each should connect directly to the IP Router.
 - b. Six (6) 1080p utility frame synchronizers dedicated to the rack room. **(ADD Alternate #10)**
11. Character Generation
- a. Two (2) Dual-Channel 1080p real-time character generators to provide the following:
 - 1) Incorporate real-time statistics interfaces to the in-house sports database via serial or TCP/IP protocols.
 - 2) Provide custom quick access keyboard and all software licensing for the first 3 years.
 - 3) 4-Day Commissioning and On-Site Training.
 - 4) Provide one 21.5" LCD display.
 - b. **(DEDUCT #11)** Provide a deduct price to eliminate one CG.
12. Closed Captioning
- a. Provide one encoder to encapsulate closed captioning data onto one stream to be distributed to the in-house IPTV network.

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13. IPTV Confidence
 - a. Provide six (6) IPTV confidence feeds on the IP router for viewing on the monitor wall.
14. LED Sends
 - a. Provide eight (8) 1080p feeds from the primary router to the LED processors. Coordinate with 27 41 33.
15. Master Clock
 - a. Provide dual 3G Master Sync and Clock Generators with redundant power supplies, LTC, Tri-Level, Burst, and Word Clock outputs. Provide modem option for dial-in time sync and an automatic change over unit.
16. High Definition production switcher capable of the following minimum requirements:
 - a. High Definition 1080p switcher frame with 8 Multi-Level Effects (ME) with a minimum of 6 keyers per full 1080p ME.
 - 1) Base IP I/O Requirements:
 - a) 120 Input and 60 Outputs via 2022-6 Copper Connections
 - 2) Alternate Baseband I/O Method (if IP is not available):
 - a) 120 SMPTE 424M High Definition Serial Digital Inputs.
 - b) 60 SMPTE 424M High Definition Serial Digital Outputs.
 - 3) Four Channels of DVE per ME
 - 4) All GPI relays brought out to terminal strips
 - 5) TCP/IP and Serial Tally system with redundant power supply and GPI interface.
 - b. Primary Control Surface
 - 1) 4 ME stripes
 - 2) 32 crosspoint buttons
 - 3) Shot box controller.
 - 4) Aux panel
 - 5) Touchpanel Menu
 - c. Secondary Control Surface
 - 1) 2 ME stripes
 - 2) 24 crosspoint buttons
 - 3) Touchpanel Menu
 - d. Virtual Control Surface
 - 1) Touchscreen PC with control of one switcher ME.
 - e. Four channel clip server for playback using VDCP.
 - f. Four channel clip server for playback using VDCP. **(ADD Alternate #16)**
 - g. 4-Days switcher commissioning
 - h. 14-Days on-site post-commissioned training.
17. IP based routing switcher system capable of the following minimum requirements:
 - a. 160 SMPTE 2022-6 compatible ports.
 - b. Redundant Frame Controller
 - c. Redundant Power Supply
 - d. TCP/IP Control and Monitoring.
 - e. Hot swappable internal frame modules and power supplies.
 - f. Provision for multiple individually addressable programmable button and XY panels.

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- 1) (8) 1RU 16-button panels with dynamic mnemonic LED buttons
 - 2) (2) 2RU 48-button panels with dynamic mnemonic LED buttons
 - 3) (2) 3RU half-rack master engineering panels
 - g. Provide high density SDI gateways for all 4K Inputs and Outputs
 - 1) (8) 18-port high density 2022-6 converters with copper SFP.
 - 2) (2) 3RU Card Frames for the primary copper I/O.
 - 3) (2) 18- port high density 2022-6 converters with fiber SFP for remote inputs.
 - 4) (2) 1RU Card Frames for the remote fiber I/O
 - h. Provide high density SDI gateways for all 1080p Inputs and Outputs
 - 1) (7) 18-port high density 2022-6 converters with copper SFP.
 - 2) (2) 3RU Card Frames for the primary copper I/O.
 - 3) Spare: (2) 18-port high density 2022-6 converters with copper SFP. **(Add Alternate #17.1)**
 - i. 128 x 128 Stereo Analog Audio I/O Routing (configured as mono) connected to the primary IP matrix. All sources should be available for embed/de-embed from the router.
 - j. 2-Day off-site router commissioning.
 - k. 2-Day on-site router commissioning.
 - l. 2-Day on-site router training.
 - m. See Appendix A for a list of IP Ports
 - n. **(DEDUCT #17.2)** Provide a deduct price to provide an equivalent SDI Baseband Router.
 - 1) Minimum 512x512 Frame
 - 2) Minimum 256x256 3G/HD Active I/O
18. Production Video Monitoring:
- a. Primary video source, program and preview monitoring for the entire suite will be handled by an integrated multi-image processing system built into the routing system capable of the following:
 - 1) Ability to mirror any router input, output or tiled multi-image output.
 - 2) (10) HD-SDI outputs to feed displays showing 16 windows each.
 - 3) (10) HD-SDI outputs to feed displays showing 4 windows
 - 4) (10) HD-SDI outputs to feed displays a single router source
 - 5) (1) 18-port high density 2022-6 converter with a copper SFP
 - 6) Multiple window instances of inputs on one and/ or all displays
 - 7) Ability to reconfigure windows on all displays interactively live
 - 8) Provide time of day clock
 - 9) Provide running time code display
 - 10) Provide game in progress display
 - 11) Control panel with ability to save off up to 20 user configurations of the system.
 - b. Control Room Displays:
 - 1) Eight (8) 1920x1080 48" LCD displays for the primary monitor wall
 - 2) Two (2) 1920x1080 48" LCD displays for the secondary control room monitor wall.
 - 3) Twenty (20) 1920x1080 21.5" LCD displays with HD-SDI input for console multiview locations.

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- 4) Eight (8) Dual 7"-3G 3RU rackmount LCD displays.
19. Engineering Stations
- a. Provide the following complement of equipment in three locations; control room shading, primary rack room QC, and primary EIC workstation.
 - 1) 1080p Waveform/Vectorscope with embedded audio option.
 - 2) SDI/Analog audio speaker/monitor station
 - 3) 21" 1080p OLED broadcast grade monitor.
 - 4) Dedicated router panel.
 - 5) For the shading station only provide GPI triggers from the RCP panels to the dedicated router panel to switch the WVS feed.
 - b. Provide the following complement of equipment in one location for monitoring 4K signals. **(Add Alternate #19)**
 - 1) 4K Ultra HD Waveform/Vectorscope with embedded audio option.
 - 2) SDI/Analog audio speaker/monitor station
 - 3) 21" 4K Ultra HD OLED broadcast grade monitor.
 - 4) Dedicated router panel.
20. Audio for Video
- a. Provide complete patching for the audio router and all audio distribution amplifiers.
 - b. Provide the following rackmounted audio monitors throughout the production area:
 - 1) (8) 1RU 2-Ch analog audio monitors
 - 2) (8) 1RU 2-Ch SDI audio monitors
 - 3) (2) 1RU 10-Ch stereo analog audio monitors
 - c. Provide a stereo pair of 8" powered speakers for each of the control rooms.
 - d. Provide a rackmounted 16-Ch analog mixer in each control room
 - e. Provide a rackmounted 16-Ch analog mixer for the program record feed.
 - f. All mixers should have a cue buss and level meters.
 - g. Provide the necessary interfaces to receive and send audio to the bowl mixing system.
21. Terminal Equipment:
- a. Provide additional 2022-6 transcoding for all inputs and outputs of the IP router that do not have native 10GbE connections.
 - b. Provide RJ45, SDI, analog audio, and fiber patching in and out of all routers and transcoding devices.
 - c. Provide bulkhead patching for all incoming SMPTE connector as well as jumpers to the individual CCUs.
 - d. Patch panels and rack cabling will be clearly marked and color-coded so as to differentiate between signal types.
22. Keyboard Video Mouse Transport (KVM)
- a. Provide TCP/IP based KVM system with redundant network managers and quick switching between devices. Provide 21.5" LCD monitor, keyboard and mouse for each user station.
 - 1) (20) Single DVI Transmitters
 - 2) (4) Dual DVI Transmitters
 - 3) (18) Single DVI User Stations
 - 4) (4) Dual DVI User Stations

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23. Communications:
- a. The communication system will be designed to handle production communication requirements. The system will be comprised of multiple matrixed communication channels with remote stations at all production positions within the video production areas and wireless to cover the field.
 - 1) (1) 64 Port Matrix Main Frame with 4-Ch Party Line interface
 - 2) (24) 1RU 12-key position user stations with dynamic mnemonics
 - 3) (4) 2RU 24-key position user stations with dynamic mnemonics
 - 4) (28) Single-Sided Lightweight Headsets
 - 5) (2) 4-Channel wireless base stations with remote antenna extensions to cover the bowl and club areas
 - 6) (10) 4-Channel wireless beltacks
 - 7) (2) 5-Bay charging stations
 - 8) (10) Spare wireless beltack battery packs.
24. Equipment LAN:
- a. Ethernet switches to handle control and communications between all equipment will be provided by others. Coordinate port quantity, static IP assignments, and VLANs prior to installation.
25. Time Code:
- a. The time code terminal equipment will comply with SMPTE standards for high definition LTC and VITC time code. Time code signals will be terminated to patch panels.
26. Furniture
- a. 24 equipment racks in two rows on 12" raised access floor are to be isolated from the production control room to control noise and cooling.
 - b. 3 equipment racks near the engineering desk inside the rack room for troubleshooting.
 - c. Provide dual outlet strips for all racks
 - d. Provide single outlet strips on all consoles.
 - e. Provide (22) 1RU panels with dual USB and 120V power outlets.
 - f. PCR Front Row: Linear Approximately 14' Console comprised of (2) Sections:
 - 1) TD Switcher Section: to include (3) Full Bases with Front / Rear Rack Rail and Front Doors, (1) Large Equipment Wedge for Large Production Switcher, (1) Custom Aux Bus Turret with 4RU Equipment Wedge and Rear Extrusion along Back of Countertop.
 - 2) Left Section: to include Extended 5-Bay Console with (2) Full Bases with Front/Rear Rack Rail and Front Doors, (5) 3RU Turrets with Rear Doors and Rear Extrusion. The end panel facing the field to have custom CNC 3-color raised Vikings logo.
 - g. PCR Rolling TD Cart: to include 7RU Sloped Front over 11RU Straight Front with Front / Rear Rack Rail Rear Door, Casters and Rear Extrusion along Back.
 - h. PCR Middle Row: Linear 10-Bay Console to include (4) Full Bases with Front / Rear Rack Rail and Front / Rear Doors, and (8) 4/2RU Turrets with Rear Doors and Rear Extrusion and (2) 8RU Flat-Top Turrets with Rear Doors and Rear Extrusion. The end panel facing the field to have custom CNC 3-color raised Vikings logo.

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- i. PCR Rear Row: Linear 10-Bay Console to include (3) Full Bases with Front / Rear Rack Rail and Front / Rear Doors, (1) Cut-in for RCP Controller and 1RU Router Panel and (10) 4/2RU Turrets with Rear Doors and Rear Extrusion. The end panel facing the field to have custom CNC 3-color raised Vikings logo.
- j. PCR Monitor Wall: Floor and Wall Mounted Monitor Wall to be Approximately 13' W x 8' H and include (8) Tilt Mounts for Large LCDs and (2) Speaker Shelves.
- k. Edit Pod Console: Linear 4-Bay Console to include (2) Full Bases with Front / Rear Rack Rail and Front / Rear Doors, (2) 4RU Equipment Wedges and Rear Extrusion. (Qty: 2)
- l. Streaming Console: Linear 6-Bay Console to include (2) Full Bases with Front / Rear Rack Rail and Front / Rear Doors, (6) 4/2RU Equipment Turrets with Rear Extrusion. The end panel facing the door to have custom CNC 3-color raised Vikings logo.
- m. Field View Shallow Console (left): to be approximately 23' and include (13) 3RU Equipment Wedges and Rear Extrusion. Countertop to be 14" deep.
- n. Field View Shallow Console (middle): to be approximately 20' and include (11) 3RU Equipment Wedges and Rear Extrusion. Countertop to be 14" deep.
- o. Field View Shallow Console (right): to be approximately 13' and include (6) 3RU Equipment Wedges and Rear Extrusion. Countertop to be 14" deep.

B. Bidder shall provide all labor required to complete all work indicated in this specification.

1.5 SUBMITTALS

A. Submit the following according to conditions of the Request for Proposal to:

The Owner (MSFA)

B. Submit all Requests for Information to:

The Owner (MSFA)

C. Bid Submittals

- 1. Contractor will have previously installed at least four jobs of similar magnitude, completed within the last two years. Provide name and phone number of reference for each representative project. Identify at least one such completed job available for inspection by Architect and Owner's Representatives.
- 2. Contractor will confirm in writing that they have at least five years of experience with equipment and systems of the types specified, that the company maintains a fully staffed and equipped service facility, and that the company is a franchised dealer and authorized service facility for any equipment used on the project not manufactured by them, and that the company employs Power Limited Technician's licensed to work in Minnesota.
- 3. Contractor will confirm in writing that any Sub-contractor has five years of experience with the primary contractor's equipment and systems and that their company employs Power Limited Technician's licensed to work in Minnesota. Qualifying contractor will identify all Sub-contractors on the Design/Build team and a detailed scope of work for each Sub-contractor.
- 4. Provide resumes of project manager, lead engineer and lead installers working on this project. This will include key team members of any Sub Contractor. Resumes must be submitted with this proposal response.

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5. Provide a schedule to indicate durations for shop drawing submittal, procurement, fabrication, shipping requirements, and installation timelines for each major system and test and commissioning sessions. Coordinate these milestone dates with project schedule and intended completion dates for this project.
 6. The based on scope of work described within this document shall be provided as a Total Cost for the project.
 7. Provide a Schedule of Values based on the supplied custom format as a spreadsheet representing a complete Production System. Indicate manufacturers, model numbers, descriptions, estimated quantities, unit costs, and extended costs. Break out time estimate (man-hours or man-days) for each of system administration, engineering, installation labor, and training as unit costs and provide aggregate of each as extended costs. Attach Schedule of Values at end of proposal.
 8. Provide a quotation for a fixed mark-up percentage on all change orders for the total scope/duration of the project. This markup should only be applied to equipment not specified in this document that is needed to fulfill the scope of work described. All engineering and documentation for the scope of work described is to be included in your base bid.
 9. Provide an hourly quotation for labor rates for administration, engineering, and installation labor for a change is scope that is not described in this document.
- D. Product Data Submittal
1. Submit manufacturer's product data sheets for each item of equipment to be used for the project in Adobe .pdf form on CD's. Provide 3 copies.
- E. Cable and Connector Submittal
1. Submit sample cables with connections and wire labels. Cable samples should be no greater than 24" in length. Submit 2 cable/connector assemblies for each type of cable used on the project. Cable jacket ID lettering must be included on sample cable.
- F. Shop Drawings Submittal
1. Indicate complete details and dimensions of work to be performed and indicate types and locations of equipment, fabricated equipment, and other details to completely describe work to be performed. Provide a set of drawings in D size (30"x42") in PDF form, for review and distribution to the Architect. There will be no work authorized on site without the prior submittal of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Owner. Details to include the following:
 - a. LCD Flat Panel locations, orientation, and mounting methods.
 - b. Custom Console Diagrams with overall dimensions including production switcher control panel and CCU control panel integration.
 - c. Rack/Furniture Layout and Location Diagrams with overall dimensions.
 - d. Location of all equipment in racks, consoles, millwork, enclosures or on counter top / tables with dimensions; wire routing and cabling within housings; AC power outlets and terminal strip locations.
 - e. Drawing of cable routing to racks and stations detailing plans for critical signal separation.
 - f. Antenna orientation, mounting elevation, and attachment hardware schedule.
 - g. Schematic diagrams for all Systems, including all wiring labels.
 - h. IP address schematic diagram showing network topology and each networked device with IP address.
 - i. Complete IP assignment spreadsheet with separate VLAN allocations
 - j. Patch Bay details, including all patch point labeling.

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- k. Schedule of terminations for all systems.
 - l. AC power schedule.
 - m. Schematic drawings of any custom circuitry or equipment modifications, including connector pinouts and component lists.
- G. Custom Control Software Programming and User Interface Submittal.
- 1. Provide for approval at least 6 weeks prior to system commissioning hard printed copies of all user interfaces and control logic flow diagrams. It is the Contractor's responsibility to provide any and all custom software interface programming for the systems provided under this section. Coordination with the Owner is required for the development of all user interfaces and control logic.
- H. Contract Closeout Submittals
- 1. Keep a single complete set of approved shop drawings on the project site for the full duration of the project until after the final system commissioning. Non-approved shop drawings will not be allowed on the job site. Note any changes made during installation on these single set of drawings. Submit three corrected sets of reproducible drawings showing work as installed. All "as-built" drawings to be provided both in electronic form (ACAD 2014 or later) and in hard copy (30"x42").
 - 2. Owner Reference Manual: Before Owner training commences, furnish the following as Adobe .pdf files on 3 CD's and as hard-copy in a single 3 ring binder with project title. Provide individual sub-directories/tabular dividers with the following headings:
 - a. A legend with acronyms and abbreviations.
 - b. A catalog of all equipment, organized by manufacturer, model, serial number, including the room and rack number where the device is located.
 - c. System Operation Instructions: Narrative verbiage with photographs and diagrams detailing operational procedures for all equipment as a system.
 - d. Manufacturer's User Manuals for all equipment.
 - e. Warranty Information for all equipment. Include warranty period and service department contact information.
 - f. System Maintenance Instructions: Narrative verbiage with photographs and diagrams detailing Owner's responsibilities for preventative maintenance to include schedules and any specific products, procedures or specialized/custom tools required for maintenance of the display system.
 - g. As-Built Drawings fully legible at C size (24"x18") bond folded appropriately for binder.
 - h. A list of all test results performed on the systems as outlined in Section 3.5 proving the systems to be in full compliance.
 - 3. As-Built Drawings fully legible at C size (24"x18") bond. Each page to be individually laminated. Set to be loosely bound using a minimum of two binder rings.
 - 4. Provide a complete list of spares in inventory to include quantity, manufacturer, model number, and serial number.
 - 5. Software Licensing and Manuals. Provide backup computer discs, all software manuals and license certificates for all software loaded on all systems.

1.6 CODE COMPLIANCE

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- A. All work and materials will comply with all applicable codes and regulations to meet or exceed Federal, State, City, and Local Building Codes and Regulations (including seismic). Advise the Owner if anything in the Drawings or Specifications is out of compliance with codes and/or laws prior to proposal submission.

1.7 PROJECT CONDITIONS

- A. Notify the Owner and Architect in writing of any issues on the job site negatively affecting the contractor's pursuance of work under their scope. Provide recommendations for resolution and assist in coordinating solutions with others.
 - 1. See contract for conditions pertaining directly to work at the Minnesota Multi-purpose Stadium.

1.8 GUARANTEES

- A. The Contractor will warrant new equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within one-year warranty will be rectified by replacement or repair.
- B. Within the Owner selected warranty period, provide answer to service calls and requests for information within a 24-hour period, and repair or replace any faulty item within a 72-hour period without charge, including parts and labor.
- C. Any Contractor provided guarantee will not void specific warranties issued by manufacturers for greater periods of time, nor will it void any rights guaranteed to the Owner by law.
- D. Contractor to provide Owner with exact beginning and ending dates of the warranty periods. Include the name of the person to call for service and telephone number. This information to be part of Project Record Set.

PART 2 - PRODUCTS

2.1 Offerers

- A. Recommended Offerers.
 - a. Alpha Video
 - b. Bexel
 - c. Burst Video
 - d. Diversified Systems
 - e. Panasonic
 - f. Sony

NOTE: If it is determined during the evaluation process that each device included in an offeror's proposal does not meet all of the specifications, then that offeror's proposal will be deemed "non-responsive" and removed from further consideration.

- B. Offerors to submit the following:
 - 1. A list of all major equipment and their quantities including manufacturer and model numbers.
 - 2. A one-line schematic diagram of major equipment signal and control connectivity for review.
 - 3. Identify four facilities where the submitted product/system were installed within the last two years and if requested, supply pictures of the facility and applicable information regarding the

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facility that provide the viewer with a complete virtual walkthrough of the facility, and an online demonstration of video display, input manipulation and operational capabilities.

2.2 UNAUTHORIZED MATERIALS

- A. Materials and products required for work of this section will not hazardous materials identified by the Owner.
- B. All devices and control stations will be UL Certified with attached identification label. If any equipment used is not UL Certified, then the Contractor will arrange onsite inspections and certification at no additional expense to the Owner.

2.3 ACCEPTABLE MANUFACTURERS

- A. Owner will consider other qualified manufacturers for the award of this scope. The Contractor will supply complete technical data specifications at the time of proposed substitution. The Contractor will arrange for product demo at the request of the Owner and will pay ground freight shipping to and from the project site
- B. Post Bid Substitutions: Formally request and submit a project substitution for review. Any proposed substitutions must meet or exceed all specifications of the originally specified equipment. No product substitution will be accepted without written approval from the Owner. The Contractor will remove all unauthorized substitutions and replace with the specified product with no additional request for payment.
- C. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on value of the product at bid time disclosed in the schedule of values.
- D. Approved Primary Manufacturers:
 - 1. Camera Systems
 - a. Ikegami
 - b. Grass Valley
 - c. Hitachi
 - d. Sony
 - 2. Lenses
 - a. Canon
 - b. Fujinon
 - 3. Support
 - a. Vinten
 - 4. Production Switcher
 - a. Grass Valley
 - b. Ross Video
 - c. Sony
 - 5. Routing System
 - a. Evertz
 - b. Imagine Communications

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- 6. Intercom
 - a. Clear-Com
 - b. RTS
- 7. Furniture
 - a. Forecast Console
- 8. Cable
 - a. Belden
 - b. Gepco
- 9. Production Displays
 - a. Ikegami
 - b. Plura
 - c. Samsung
 - d. Sony
- 10. Replay Systems
 - a. Abekas
 - b. Evertz
 - c. EVS
 - d. Grass Valley

2.4 GENERAL

- A. All equipment supplied will be new and meet the latest published specifications of that product.
- B. Take care during installation to prevent scratches, dents, chips, etc.
- C. Shipping and Handling.
 - 1. Handle and ship in accordance with manufacturer's recommendation.
 - 2. Provide protective covering during construction/installation to prevent damaging or entrance of foreign matter.
 - 3. Replace at no expense to Owner, product damaged during delivery, storage or handling.
- D. Final quantities of all equipment will be determined by The Contractor in collaboration with and approval by the Owner.
- E. Custom rack panels shall be 1/8 inch thick aluminum, standard EIA sizes, brushed black anodized finish unless otherwise noted, and flanged for strength. (Brush in direction of aluminum grain only.) Custom connector plates (cable TV, speaker, microphone, etc.) are typically stainless steel; however, verify plate finish with the Owner. Plastic plates shall not be accepted.
- F. 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 plates, or light-colored pushbuttons, letters shall be black.
- G. Contractor shall be responsible for the complete integration of camera components into complete and balanced systems. Camera Systems are to be ready prior to commissioning.
- H. The Remote Control Panels for the Camera CCU's will be integrated into a custom camera shading operator's console desktop to be implemented and installed by the Contractor. Contractor will provide manufacturer RCP mount. RCP GPI trigger to be wired to router BPS panel.

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- I. Contractor shall provide a tally system integrated directly with the primary production switcher, graphics switcher, camera control units and their respective cameras.
 - 1. A dual colored Talley system shall be integrated between the production switcher and monitor wall. Red will represent the Large Video Display feed and Green will represent a secondary video feed (e.g. in-house CATV channel or Phone/Tablet Streaming). Yellow will be preview for both feeds.
 - J. Contractor shall integrate playback and record devices with appropriate rack mounting accessories and/or shelves, using minimum rack space.
 - K. Contractor to install all software and hardware. Present client with all original software disks, instructions and documentation. Contractor will install and test all software applications and hardware.
 - L. Contractor shall verify all computer components meet software recommended specs.
 - M. Contractor shall assure that all internal system components and the latest software versions to support all options are installed and/or configured by the manufacturer or manufacturer's rep.
 - N. All managed Ethernet switches to be configured to handle VLANs to manage internet, router control, and KVM to avoid data slowdowns.
 - O. Contractor to provide a SMPTE 304M Fiber Patch Bay on the rear rack rails. Contractor to provide Blank panels on front rails to hide cables from front of rack view.
 - P. Equipment furniture color and work surfaces to be coordinated with Architect and Owner. Colors listed are for general pricing only.
 - Q. Verify exact rack space requirements for accommodation of all new and owner furnished equipment, and provision of a service lamp in the top of each equipment rack. Verify racks to have rear door and top fan kits.
 - R. Video Systems Installer to provide two (2) local single rack mounted rocker switch power on/off controls, one for each area, for all components located within the Production Console and Engineering Rack locations.
 - S. Contractor will arrange for Equipment Commissioning and Operator Training by the manufacturer. This will include their expenses. Provide the training schedule when the equipment ships to the site.
- 2.5 CABLE, CONTROL WIRING & TERMINATIONS
- A. Electrical conductors installed under this contract, except where otherwise specified, will be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper.
 - B. Video Connectors: All primary video equipment will use crimp-on style BNC connectors. If consumer grade equipment is furnished with RCA connectors, the cable will be terminated in a crimp-on style RCA connector. It will not be acceptable to use BNC to RCA adapters for consumer grade connections.
 - C. Audio Connectors: Employ XLR connectors wherever possible. Wire nut "Scotchlock" connectors are not acceptable. Do not wire any cables with a polarity reversal between connectors, end of end.

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- D. Connectors: All cable-mounted connectors will be covered by a connector hood or will have crimp ferrules, which securely grasp the cable outer jacket. All connectors will have incorporated a mechanical means of attaching the connector to its mate. Only connectors with tarnish resistant contact surfaces will be used.
- E. The Contractor will verify all connector details required for installation of equipment, including make, model, connector sex, attachment configuration, pin-outs, and cable clamp accessories.
- F. The following cables will be used by Video Contractor for all wiring within the production areas:

Signal Type	Manufacturer	Cable Part	Color
HD Video	Belden	1505A	Violet
SDI Video	Belden	1505A	Green
Analog Video	Belden	1505A	Black
Sync/Reference	Belden	1505A	Red
Camera Cable	Belden	7804/1858	Black
Analog Audio	Belden	9451	Black
Time Code	Belden	9451	Orange
Tally	Belden	8740	Chrome
RS-232/422/485 Control	Belden	1419A	Chrome
Network (CAT6)	Belden	1752A	Blue
KVM	Belden	1752A	Light Blue
Intercom	Belden	9451	White

- G. All cable terminations will be made using the following connectors except where direct connection is made to a device or patch bay:

Connector Type	Manufacturer & Part Number
BNC (Cable Termination)	Canare 75 Ohm
RCA (Cable Termination)	Canare 75 Ohm
BNC (Panel)	Neutrik NBB75DFI Recessed, Feed Through, Isolated
SMPTE (Cable Termination)	Gepco Breakout SMPTE
SMPTE (Panel)	Gepco GHF92B-0-x-SB
Data (Panel)	Neutrik EtherCon RJ45 Series
XLR (Cable Termination)	Neutrik X-HD Series
XLR (Panel)	Neutrik P Series
SM Fiber Optic	Amp Metallic ST style (Flat Finish)

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.

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- B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place.
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommeting. Adhesive-backed electrical tape and friction tape is not acceptable for insulating or protective purposes.
- D. All rack and console dimensions must be verified against field conditions prior to fabrication and again prior to installation.
- E. Inspect all racks, consoles, and enclosures prior to installation. All rough or sharp edges that may cause injury to personnel must be deburred or a permanent protective coating applied.
- F. Provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 85 degrees. This ventilation system must be temperature actuated.
- G. Provide a magnetic LED service lamp in the top of each equipment rack.
- H. Provide blank rack-mount panels installed in all rack openings not occupied by equipment. Blank filler panels will not exceed five rack units in size.
- I. Custom rack panels will be 1/8 inch thick aluminum, standard EIA sizes, brushed black anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.)
- J. Custom connector plates (cable TV, speaker, microphone, etc.) are typically stainless steel; however, verify plate finish with the Owner. Plastic plates will not be accepted.
- K. Install rack mounted equipment with black 10-32 Phillips head machine screws.
- L. Panels or equipment mounted on the rear rack rails must not block access to any front mounted components. Front mounted equipment will be given ample space to allow for access to rear connection.
- M. The process of acceptance testing the Production System may necessitate moving and adjusting certain component parts - e.g., LCD monitors.
- N. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
- O. AC Power and Grounding
 1. Coordinate final connection of power and ground wiring to racks. Hardwire power wiring directly to power contacts or internal AC receptacles to ensure uninterrupted operation.
 2. Install 3-conductor, 120 VAC outlets in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel.
 3. Each equipment rack will have sufficient power outlets to provide an outlet for every power cord required by installed equipment or equipment designed for future installation.
 4. The A/V system ground will be bonded to the metal frame of all equipment racks by use of an uninsulated ground buss lug or bar mounted in each rack. When more than one rack exists, all equipment buss lugs will be bonded to one central equipment rack buss lug. This central equipment rack buss lug shall be connected to the telecom ground buss with a #6AWG ground wire.
 5. The Contractor shall be responsible for connecting a #6AWG ground from each group of racks back to the telecom ground buss bar in the AV Rack room.

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3.2 CUSTOM CONSOLE AND WORK SURFACE DESIGN

- A. Equipment rack and console construction, loading, and mounting must be in keeping with all state and local Seismic practices and codes.
- B. All consoles, work surfaces, and casework items will be rigidly constructed, and will allow for a minimum temporary additional load of 200 pounds at the edge of any horizontal surface without permanent deformation or tipping.
- C. Consoles will be aluminum or steel frame construction using extruded hollow square and angle sections welded together to form the sub-frame. This sub-frame will form the structural support for all equipment loads, work surfaces and writing surfaces.
- D. The aluminum or steel frame will be electrically arc welded or similar. Remove all spatter, and grind off excess weld and burrs. Prepare for shop priming by power wire brushing to remove rust. Degrease, shop prime, and finish with paint finish as specified. Protect for transport and shop/site and apply touch up paint as necessary. All arc weld hardware will be degaussed after the completion of all welding to be done on the piece.
- E. All dimensions and profiles will be checked with all right-angles true and uniform. Use blank rack mount panels to confirm accuracy of mountings.
- F. All attachments to viewable surfaces will be concealed. Attachments through the finish face of painted sections will be countersunk 1/4" below the surface. A resilient packing 1/16" thick will be placed over the screw before the hole is filled with a 2-part epoxy and finish sanded. When fitting panels allow clearances for paint finished. All laminate will be accurately scribed and fitted to the profiles required. Joints will be glued and screwed using frets or glue blocks where possible to ensure rigidity of the panels independently of the steel frame.
- G. Perforated metalwork will be folded accurately to match adjacent profiles with 3/4" returns lapped and spot welded to form a rigid unit. Hinges and accessories will be chrome or brass, including screws.
- H. All consoles will have removable rear panels for rear access to installed equipment. Removable front "kick panel" doors will also be required. All panels will remove completely during installation and service to facilitate installation work. The panels when installed will present a neat and finished appearance and will have a secure mechanical latch mechanism to avoid any rattles or buzzes.
- I. Provide a suitable method of cable access through the bottom and between sections of consoles.
- J. Control interfaces and panels mounted in custom fitted cutouts will provide a non-gaping interface to the surrounding surface to within a 1/32" tolerance.
- K. Clearances: There will be a minimum of 1 inch clearance inside all consoles between the top equipment mounting space and the console top. This is to allow airflow above equipment mounted in the top mounting position. Provide adequate ventilation grilles to allow continuous cooling in consoles containing equipment. This should include both supply and exhaust grilles. Provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 85 degrees. This ventilation system must be temperature actuated.
- L. All consoles and racks will have front and rear rack rails separated by at least 24 inches. The rails will be parallel and square and will conform to EIA RS-310C for 19-inch racks.

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- M. Console work surfaces will be finished with a material and color selected by the Owner. Painted and metal panels will be finished with sprayed polyester lacquer, satin finish, and color as selected by the Architect and Owner.
- N. Painting:
 - 1. Surface Preparation: Preparation for painting will involve fine paper sanding and dusting to ensure a perfectly smooth substrate.
 - 2. Primer: Sealer undercoat will be spray applied and sanded back using 250 grit. Touch up as needed and re-sand.
 - 3. Finish coats will be spray finished in an appropriate spray booth with approved ventilation, humidity control, dust extraction, and lighting. Finished paint thickness will be 1 mil minimum and will be free from runs, orange peeling, blooming or other blemishes. Metal panels will have a similar finish using appropriate metal primer.

3.3 CABLING

- A. Execute wiring in strict adherence to "standard broadcast practices," as excerpted from "Recommended Wiring Practices," Broadcast Audio Equipment for AM, FM, Television (5th Edition), Radio Corporation of America (RCA), Camden, N.J. 1962, and Appendix II, "Recommended Wiring Practices", Sound System Engineering, (2nd Edition), D. Davis, and performed in accordance with standard professional practice.
- B. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For unbalanced line level audio signals, float cable shields at the output of source device. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.
- C. Exercise care in wiring; damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, power circuits, video circuits and control/data circuits.
- D. Wiring entering equipment racks will be run directly to equipment. Use of splices or connectors to extend cabling to equipment will not be accepted. All signal wiring will be continuous and unbroken from connector plate/chassis to chassis/patch panel. Use of intermediate connections for inter rack cables is not acceptable. Use of splices or connectors to extend cabling to equipment is not acceptable.
- E. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Architect. Where crimp-on terminations are used, trim cable using manufacturer recommendations and crimp properly with ratchet type tools.
- F. If required, tally, GPI, or relay wiring entering equipment racks may connect via terminal blocks (Cinch 140 - 142 Series) or on Entrelec blocks; terminal blocks will be fully exposed, labeled, and mounted on 3/4 inch plywood board painted flat black. If quantity of terminals is too numerous to fit in rack, terminal blocks may be located on wall mounted plywood terminal board adjacent to rack. Mounting boards to be 3/4 inch A/C grade or hardwood plywood painted flat black. Terminal board wiring to meet the same requirements as internal rack wiring described below.
- G. Connect audio cable to active components through screw terminal connections whenever available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool.
- H. Connect loudspeakers electrically in phase, using the same wire color code for speaker wiring throughout the project.

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- I. Wiring and connections will be completely visible and labeled in rack.
- J. Run vertical wiring inside rack using lacing bars and properly dressed cable looms.
- K. All power cables will run on the left side of the equipment rack, as viewed from the rear. All other cables will be run on the right side on the equipment rack, as viewed from the rear. Where signal cabling and any cabling types carrying power must cross, they will do so at right angles. Vertical wiring will be run with a bundling and support system, to maintain a clear and organized appearance.
- L. Horizontally routed wiring to equipment will be neatly tied in manageable bundles with cable lengths cut to minimize excess but still allow ready access for service and testing. Provide horizontal support bars if cable bundles sag
- M. For equipment mounted on slides, additional service loops will be provided to accommodate the full range of travel of the slides. This includes all power, ground, control and signal cables. All cables, except power, must be wrapped in flexible expandable sleeving to avoid snagging or entanglement.
- N. For short/thin chassis patch bays, cables are to be integrated in a “z” style service loop to allow the patch bay to be “hinged” outward from the front of the rack for maintenance.
- O. Neatly bundle excess AC power cables from rack-mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or lacing twine. Electrical tape and adhesive backed cable tie anchors are not acceptable. Cable tie and lacing installation will be accomplished using hand tools specifically designed to apply proper tension to the cable tie, and to cut it off flush with no protruding sharp edges. Cable ties will not be applied with excessive force, which may damage or deform sensitive and fragile cables.
- P. All cables in cabletrays will be neatly installed with maintaining separation of the different cable types.
- Q. Required production room cable paths and lengths must be predetermined especially in instances where timing is a factor. The information that is essential for the implementation of this task is as follows:
 - 1. Site Survey
 - 2. Floor and Ceiling Plans
 - 3. Elevation Design
 - 4. Equipment List
 - 5. Video and Audio Schematics
 - 6. Cable Trays and Conduits
- R. Screw Connections: Only insulated crimp on spade terminals will be used for application to barrier strips. Multiple gang lugs or ring lugs are not acceptable for this purpose.
 - 1. This is only applicable to stranded conductor wires. Solid conductors will be attached directly to the barrier strip.
 - 2. All conductors will be stripped prior to installation underneath screws on terminals. Provide crimp lugs on stranded control cables, solid conductor wire will not require crimp lugs on individual conductors. All screw terminated solid conductors will be wrapped in the same direction as screw rotation during tightening.

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- S. Multiconductor Cables: Follow a uniform application of color codes for multiconductor cables throughout the Facility. Where there are unused conductors or pairs in a cable assembly, they can be insulated as a group, left long enough for future termination, and folded into the connector hood. Where this is impractical, they may be folded back along the outer jacket of the cable and covered with heat-shrinkable tubing.
- T. Multipin Connectors: Where jumpers are indicated between pins of the same connector, they will be installed internal to the connector shell and will not have any cable number designations applied to the jumper.

3.4 LABELING

A. General

1. The attachment method for equipment identification plates will be designed for permanency unless otherwise described. All labels will be protected prior to installation, and will not be installed if damaged or scratched. Follow manufacturer's recommended procedure for surface preparation, which must be free of any dust, dirt or film. Wiping with a manufacturer-approved solvent is required. If a label is in a place that might be susceptible to damage, it will be protected with a layer of clear plastic, 1/16" or thicker, taped down. Internal labels will be replaced only if they become illegible. External labels will be replaced if they become scratched or marred.
2. On black laminated engraving stock panels or pushbuttons, letters will be white; on stainless steel or brushed natural aluminum plates, or light-colored pushbuttons, letters will be black.
3. Embossed labels are not acceptable.
4. Mount labels in a neat, plumb and permanent manner except where indicated.
5. Text heights will be as follows:
 - a. Rack designation labels will have 1" high block sans serif text.
 - b. Equipment labels will be 3/4" high block sans serif text.
 - c. Operator Control labels will be 1/4" high block sans serif text, this may be adjusted to fit available space.
 - d. Panel labels will be 1/8" high block sans serif text.
 - e. Patchbay, Cable and Connector labeling will be 10 point block sans serif text, this may be adjusted to fit available space.

B. Equipment Labels

1. Provide laminated engraving stock labels on the front and rear of active equipment mounted in racks. Front mounted equipment labels for the Production Suite video monitors are to be mounted with Velcro. Equipment labels to have one line of engraving, giving the schematic reference of the device, and/or its production function, i.e. "VTR #4", "PA-29A".
2. Unless equipment manufacturer has clearly labeled functions, provide an engraved label over each user-operated control that describes the function or purpose of the control.
3. If the manufacturer provides a protected labeling strip such as those used for switcher control panels and patch bays, then patch/routing point labels may be typed clearly on 80 pound paper stock.
4. Individual patch bay point labels to include alphabetic representation of patch bay row and numeric representation of patch point in row, as well typical device I/O abbreviation. Patchbay text to be a minimum of 8pt font (2.8mm H)

Example: CAM-02
 OUT

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(A-02)

C. Cable Labels

1. 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.
2. Wiring designations to be a unique repeating alphanumeric code that is unique for each cable.
Example: A-2000 <device alpha>
 A-2000 <source alpha>
 A-2000 <destination alpha>
3. Locate the cable designation at the start and end of each cable run and within 2 inches of the point of termination or connection. For cable runs that have intermediate splice points, the cable will have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings included with Project Record Drawings.
4. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

3.5 ACCEPTANCE

- A. Provide a pre-commissioning systems report to the Architect two weeks prior to the scheduled systems commissioning proving all systems to be in full compliance. Report will include test results, date of each test, pertinent conditions such as control settings, etc., and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the RFP, and is ready for acceptance testing.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and provide required test equipment. Contractor will provide at least three technicians familiar with installation, 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 will be furnished by the Contractor. The Contractor will keep a running list of all acceptance tests performed and submit a final copy of the results with the closeout submittals as listed in Section 1.6. Testing process is estimated to take 5 days up to 10 hours per day and may require multiple crews / shifts.
- C. During all scheduled inspections, The Contractor's Project Manager will be present.
- D. If during acceptance testing it becomes evident that further adjustment or work may be required to bring the system into compliance, the Contractor will continue to work until the system is acceptable at no additional charge to the contract price. If approval is delayed because of defective equipment, poor installation, or failure of equipment to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Architect at the Architect's standard rate in effect at that time, during any extension of the acceptance testing period. The Contractor will provide rental or loaner equipment to make the system operational in critical cases of equipment failure prior to contract completion.

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- E. Provide five portable UHF business band radios for use during acceptance testing. Radios should have a transmission range sufficient to cover entire project. Radios to include rechargeable batteries and re-charger 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. Confirm that radio frequencies used are not in use elsewhere on project site.

- F. 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.

- G. Grounding System Tests.
 - 1. Measure and record the DC resistance between the ground in any equipment rack or console and the main technical system ground. Resistance to ground should be 0.1 ohms or less. Provide this information in pre-commissioning report to Architect.

- H. Cabling Tests.
 - 1. Submit printed test reports proving the systems to be in full compliance to the Architect as part of the pre-commissioning systems report.
 - 2. After installation, and before termination, all wiring and cabling will be checked and tested with a megohmmeter to ensure there are no grounds, opens, or shorts on any conductor or shields.
 - 3. Verify all audio lines are wired to maintain proper continuity and polarity.
 - 4. Perform TDR measurements on all coax video cables.
 - 5. Perform sweep tests on all coax cables with a spectrum analyzer. When documenting the results of these tests, include the calculated loss based on length of the video cable measured with the TDR. Correct cabling for any field readings that differ more than 20% from the calculated loss.
 - 6. Test all CAT6 cables to verify they meet full CAT6 specifications. Tests will use a certified tester that will confirm bandwidth, cable distance, and error and bit rate detection.
 - 7. Optical Fiber Cable Testing
 - a. Test all fiber optic cable strands for continuity and performance before and after the cables are pulled and terminated.
 - b. Test link attenuation of all installed multimode fiber optic strands after splicing and termination in accordance with ANSI/TIA/EIA-568-B.1, Section 11.3.
 - 1) One direction with an optical light source and an optical power meter.
 - 2) Test at two wavelengths to account for attenuation differences due to wavelength:
 - a) 850 nm and 1300 nm for multimode strands
 - b) 1310 nm and 1550 nm for singlemode strands
 - 3) Test multimode strands in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper.
 - 4) For multimode strands, wrap reference jumper around mandrel to remove high-order mode transient losses as specified in ANSI/TIA/EIA-568-C.1, Section 11.3.3, Table 11-15.

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- 5) Test Singlemode strands in accordance with ANSI/EIA/TIA-526-7, Method A.1, One Reference Jumper.
 - 6) The total attenuation budget for each multi-mode fiber cable length (end-to-end) will equal the allowed attenuation for the fiber (0.2 dB per km times the length in km) plus the attenuation for each splice and connector. For example, a cable length of 3 km with 1 splice and 2 connectors would have an attenuation budget of $(3 \text{ km} \times 0.2 \text{ dB/km}) + (2 \times 0.2 \text{ dB}) = 1.2 \text{ dB}$.
 - 7) The total attenuation budget for each single-mode fiber cable length shall not exceed 1.0dB of loss.
- c. Test all installed fiber optic strands after splicing and termination with an OTDR (Optical Time-Domain Reflectometer) per TIA/EIA-455-61:
- 1) End-to-end bi-directional signature trace with fault finding, connection point reflection, fiber bend, pressure point location, etc.
 - 2) One wavelength, 1300 nm for multimode strands.
 - 3) One wavelength, 1550 nm for singlemode strands.
 - 4) Multimode fiber connector losses < 0.5 dB at 850 nm
 - 5) Singlemode fiber connector losses < 0.2 dB at 1310 nm
 - 6) Multimode fiber splice losses < 0.3 dB at 850 nm
 - 7) Singlemode fiber splice losses < 0.2 dB at 1310 nm
 - 8) Localized attenuation will not exceed 0.5 dB at any point
- d. Fibers that are broken or damaged will be replaced at no cost to the Owner and replaced fiber optic cables will be re-tested.
- I. System Tests.
1. The following procedures will be performed by the Contractor:
 2. Video Signal Verification: From all source inputs (for cameras, character generators, video tape units, etc.) through all VDAs, A/D and D/A converters, processors, switchers, etc., to all signal destinations. Verification of correct signal timing for each source via each path will be made using standard test patterns. Each processing device will be checked; the signal will pass through the device in the no processing mode such that unity luminance, chrominance, and signal timing and phasing conditions are achieved.
 - a. Video.
 - 1) 1 Volt (peak to peak) throughout video signal path
 - 2) S/N (peak to RMS), unweighted, DC to 4.2 MHz: 55 dB minimum.
 - 3) Crosstalk, unweighted, DC to 4.2 MHz: 45 dB minimum.
 - 4) Frequency Response: + 0.5 dB to 4.2 MHz.
 - 5) Line and Field Tilt: 2% maximum.
 - 6) Differential Gain: 2% maximum.
 - 7) Differential Phase: 2 degrees maximum.
 - 8) Signal level: within plus or minus 0.5 dB.
 - 9) System timing: Sync coincidence within 20 nanoseconds.
 - 10) Color timing: Within 1/2 degree at 3.58 MHz.
 - b. Digital Video.
 - 1) Verify strength of data signal throughout video signal path.
 - 2) Verify validity of data timing signals.
 - 3) Verify receiving device clock recovery

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- 4) Report input data errors
- 5) Report transport layer errors
3. Control functions will be checked for proper operation, from controlling devices to controlled devices.
4. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and record these settings, in the "System Operation and Maintenance Manual".
5. Installed and loose equipment will be inventoried for correct Qty.
6. Any other test on any piece of installed equipment or system deemed appropriate by Architect.
7. The omission of a description of a device, function, signal path, or test in this document will not exempt the Contractor from responsibility for checking all devices and signal paths for appropriate compliance with Industry Performance Standards and making corrections necessary to bring system(s) into compliance with the applicable standards.

3.6 TEST EQUIPMENT

- A. Provide the following equipment on site 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 Architect of test equipment make and model numbers that will be used.
 1. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A. Acceptable: Fluke 75.
 2. Dual-trace oscilloscope: 20 MHz bandwidth, 1 mV/cm sensitivity.
 3. Impedance Meter: Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4k Hz. Measurement Range: 1 ohm to 100k ohms.
 4. Audio Oscillator: bandwidth 20 Hz to 20k Hz +1 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level.
 5. Time Domain Reflectometer.
 6. Optical Time Domain Reflectometer.
 7. HD-SDI Generator
 8. HD-SDI Analyzer

3.7 INSTRUCTION OF OWNER PERSONNEL

- A. Upon completion of the installation of the specified AV systems, and prior to any facility events, provide designated operating personnel training on the equipment operation. This training will be performed at the site by the Contractor's and the manufacturer's education staff.
- B. The System Reference and Service Manuals must be complete and on-site prior to the time of the first instruction.
- C. Coordinate schedule of instruction with the Owner subject to availability of Owner's personnel. This may require scheduling instruction during weekends or evenings.
- D. Training will be provided in a series of classes to operations personnel to review all aspects of operation and maintenance of the system. Follow-up sessions to better enhance the operator's ability to expand or maximize the system will be made available.
- E. The general system training provided by the vendor will include seven (7) days or forty (40) hours of technical training covering the explanation of the system, including documentation, configuration, interfacing and diagnostics. Provide training of the video system operators and maintenance personnel as follows:

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1. System Overview: Explanation of system includes documentation, configuration, interfacing and basic diagnosis.
 2. Operator Training General: Basic training in the use of system devices including powering, timing and general operation of overall system.
 3. Operator Training Specific: Advanced training in use of system devices including terminal equipment, signal routing, switching, recording, cameras systems, replay systems, and audio operations. Training also includes overview of clip server and graphics system operation. Where specified, training will be by manufacturer representatives.
- F. Provide trained personnel (one person) to be present for all home preseason and first season home NFL games for the first season.
- G. Second season startup. Provide two trained personnel (one who is familiar with the system) for a period of one week prior to preseason of the second season. These technicians will verify that all systems are still operational and they will assist in game day preparation.
- H. Manufacturer training and commissioning is specified in this document. The Contractor will cover expenses such as flight, hotel, rental car, and meals and include them as part of the bid pricing.
- I. Training sessions are to be video-recorded and made available to the client in an MP3 or MOV format.

END OF SECTION