ADDENDUM #1  February 20, 2012

This Addendum becomes part of the contract documents and shall be acknowledged by the Design/Build contractor. All parts of the RFP documents dated February 7, 2012, shall remain in force except as modified by this addendum.

MECHANICAL, PLUMBING AND FIRE PROTECTION REVISIONS:

1. Refer to the attached WJHW addendum No. 1, for clarifications to the replay system and the acoustic requirements.

END OF ADDENDUM #1
1.1 SCOPE OF WORK

A. Work under this Contract includes all labor, materials, tools, transportation services, supervision, coordination, etc., necessary to complete the installation of the Video Scoreboard Control Rooms, as described in these specifications and illustrated on the associated drawings. The systems shall be called the “Video Scoreboard Control Room” and the installer the “Systems Integrator”. The systems include the following major items:
1. Video Scoreboard Control Room
2. Remote equipment connections and cabling at fiber inter-connected facilities.
3. All electrical distribution within each system at each installation point.
4. Technical Millwork and Furniture Consoles

B. The Contract also includes:
1. Verification of dimensions and conditions at the job site.
2. Preparation of submittal information.
3. Coordination with other trades.
4. Installation in accordance with the contract documents, manufacturer’s recommendations, and all applicable code requirements.
5. Manufacturer’s commissioning for all major items of equipment.
6. Initial tests and adjustments, written report, and documentation.
7. Instruction of operating; provision of manuals.
8. Maintenance services; warranty.

C. The Installer is responsible for all subsequent design and engineering not included within the RFP documents. The Installer is responsible for providing all components necessary for complete and operational system. Any system changes or revisions necessary to make the system conform to the building, walls, steel, electrical services etc, shall be included at time of proposal and installed without claims for additional compensation.

D. The Contract Documents are complementary and are intended to include or imply all items required for the proper execution and completion of the work. Any item of work required by the Specifications or other portion of the Contract Documents, but not shown on the drawings, or shown on the drawings but not required in the Specification, shall be provided by the Contractor without extra charge as if shown or mentioned in both.

1.2 SYSTEM DESCRIPTION

A. The Video Control Room is the central video production and control room located at the Event Level of Coors Event Center to support video scoreboard and broadcast video production. It is connected via dedicated single mode fiber connections provided outside this contract to multiple campus facilities. Connection locations are:
1. Folsom Field
2. Kittredge Field
3. Prentup/Potts

B. The Video Control Room is the system that will generate:
1. Video signals to be displayed on each Facility’s Main Seating Bowl Video Display(s), to the distributed TV network, to edit stations and to an internet stream.
2. Video, audio, intercom, data and control signals will be provided with fiber multiplexing components over existing fiber cable to various athletic facilities on campus.
3. One channel of HD and SD content will be created by the Video Scoreboard Control Room and sent to Folsom Field’s existing RF distribution Headend. Coordination with the University is required.
C. A number of existing video cameras are dedicated to the Video Scoreboard Control Room.
   1. Each camera may be connected at a number of locations throughout each facility via
      SMPTE camera cables where they will be connected back to the Camera Control
      Base Stations in the video control room.
   2. Video sources (camera "isos") are introduced to the system from the Outside
      Broadcast Television (OB) Trucks parked in the Video Truck Areas or Folsom Field
      and the Coors Event Center.

D. In addition to the existing cameras the following equipment is provided for video replay
   use:
   1. Character generator
      a. A data feed will be made available from the existing scoring computer system; this
         scoring computer system shall be interfaced to the Character Generators and
         text/stat capable Clip and Still Store Devices to allow automatic extraction and CG
         display of scoring and statistics information from the scoreboard system.
   2. Multi-channel file server used for multi-camera slow motion playback
   3. Existing Apple Edit computers
   4. Video Recorders/Servers are provided to:
      a. Make archival video recordings of game and truck program
      b. Playback individual plays in the event of a failure of a file server
      c. Make archival video recordings of the individual camera iso angles.
      d. Create “dubs” and duplications of footage for common distribution.
   5. A separate audio mix room for mixing separate shows (in-stadium entertainment,
      campus TV, internet stream).
   6. A routing switcher (video with audio) is used to route sources throughout the Video
      Scoreboard Control Room, Video Board Processor(s) and other devices within the
      Video Scoreboard Control Room.
   7. Miscellaneous distribution, conversion and equalization components.
   8. Preview, program and confidence monitoring.
   10. The entire Video Scoreboard Control Room is fully equipped with intercom
       (communication) interconnected to the “house” PA/intercom system at both facilities.
       a. Multi-channel circuits are connected to a “source-assignment” panel for ease of
          configuration.
       b. The Video Scoreboard Control Room contractor is responsible for coordinating
          terminations, supplying equipment, and assisting in balancing and configuring the
          system.

E. The installation of the Video Scoreboard Control Room Production System shall be
   coordinated with the Owner as several pieces of existing and Owner furnished equipment
   will be utilized within this system and are detailed within these specifications and on the AV
   drawings.
   1. Coordinate delivery of existing components.
   2. Inspect components for functionality and notify the Owner and Owner’s representative
      if existing pieces are missing and/or non-functional.

F. The installation of the Video Scoreboard Control Room should be coordinated with the
   existing Broadcast Cabling, Structured Cabling, large direct view LED display systems and
   facility Sound Systems (among others).
   1. The actual camera cabling and audio, video and intercom lines from each position to
      the fiber transmit location are provided by this installer. The University’s IT department
      will supply the fiber tie lines from each facility to the Video Scoreboard Control Room.

G. Work to be performed outside the immediate area of the control and audio rooms:
   1. Supply and Mounting Fiber Optic Transmitters and interconnecting cables at Folsom
      Field.
   2. Installation of fiber optic camera cabling and tie lines.
3. Installation of new wireless intercom system and most importantly antennas; location is assumed to be in front of the existing Scoreboard/PA Control Room at Folsom Field.
4. Installation of permanent optical to electrical connections for video feeds at Folsom Field.
5. Testing of remote production at:
   a. Folsom Field

1.3 RESPONSIBILITY AND RELATED WORK

A. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or on the drawings, without claim for additional payment.

B. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Systems Integrator to supply systems in full working order. Notify the Technical Consultant of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.

C. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner.

D. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Installer is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems.

E. If a conflict develops between the contract documents and the appropriate codes and is reported to the Technical Consultant prior to proposal opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

F. All structural support, design, and engineering for installation of all system components.

G. Power shall be provided within the space at a breaker panel. Refer to General Contractor drawings for reference. The Installer shall be responsible for distributing electrical power from the isolator to the equipment as required. This will include necessary distribution boards and cabling for a complete installation.

H. The Installer shall be responsible for connecting appropriate grounds to all equipment in accordance with applicable codes and standards.

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

J. Paint any/all POV camera housings to a color selected by Owner.

1.4 QUALITY ASSURANCE

A. Installer’s Qualifications: Firm experienced in the installation of systems similar in complexity to those required for this project. Specific proposal submission requirements are:
   1. Experience with at least three (3) comparable scale projects within the last three years. At least one (1) shall be a renovation project.
      a. Provide reference information and contact information for each project.
      b. In the event sport specific projects are not available, other projects may be considered.
2. Maintain a fully staffed and equipped service facility. In the event the integrator is outside a one (1) hour support time for the project, identify local resource(s) to be developed and assigned to support the project during the warranty duration.

3. Installer authorized to sell all equipment specified within this system.

4. The Installer shall demonstrate that he has:
   a. Adequate plant, equipment bonding and insurance capabilities to complete the work.
   b. Adequate staff with commensurate technical experience. Identify the following roles for the project and provide appropriate resumes:
      1. Senior Project Engineer(s).
      2. IT Project Engineer
      3. Project/Site Supervisor (aka lead installer).
      4. Project/Off-site project manager.
      5. Purchasing and expediting staff
      6. Vice President/Owner for escalation contact in the event of difficulties
      7. Other staff and their experience that may assist in evaluating the installer's proposed deployment team
   c. Suitable financial status to meet the obligations of the work.

5. State of Colorado licensed electrician

6. A proposed project schedule with manpower loading diagram (based on a system of this complexity).

7. Sample submittals are encouraged as part of the proposal submittal. This is including but not limited to:
   a. One-line diagrams
   b. As-built documentation
   c. Photographs of work (showing the rear of equipment racks, not the fronts).
   d. Commissioning procedure(s)
   e. Training documentation
   f. Other information that may assist in evaluating the vendor's past performance.

1.5 SUBMITTALS

A. Submit all shop drawings and submittals in accordance with Project Requirements.

B. Shop drawings and submittal data shall contain sufficient information to describe the Work to be performed. Drawings shall be executed at an appropriate scale. Submit all Shop Drawing information at one time.

C. The following outlines expected submittal packages:
   1. Project and Submittal schedule.
   2. Product Data
      a. A material list of all equipment to be furnished, arranged in specification order. This list shall be followed by catalog data sheets, arranged in specification order, of all equipment to be furnished. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
      b. Proposed cable labeling technique.
   3. Equipment layout and Millwork details (with console elevations)
      a. Location of all equipment in racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
   4. One Line diagrams for all signals (without cable numbering or patch points)
      a. Wiring diagrams. Complete, detailed wiring diagrams for all systems, based on the contract documents but including cable types, identification and color codes, and detailed wiring of connections, both at equipment and between equipment racks and wiring in conduit.
      b. Schematic drawings of any custom circuitry or equipment modifications, including connector pinouts and component lists.
      c. Stamped electrical drawings
5. Detail Submittal
   a. Patch panel layouts and designation (labeling) strips.
   b. Custom Plates. Provide complete shop drawings on custom fabricated plates or
      panels. Drawings to include dimensioned locations of components, component
      types, engraving information and plate material and color.
   c. Representative equipment labeling sizes, styles, and numbering.
   d. Any structural mounting details (including structural engineers seal as
      appropriate)
      1. POV cameras
      2. Wireless antennae
   e. Samples as required in various specification paragraphs.

6. User Interface (UI) Submittal. This submittal is to provide sufficient information to
   indicate that the Installer has appropriately configured software and user interfaces in
   accordance with user requests, as well as in common scoreboard/video replay
   configuration. The submittal can be in PDF, Excel, or as configuration files as
   appropriate. In some cases this submittal, may need to be incremental, with multiple
   deliveries. Items covered by this submittal shall include, but not be limited to:
   a. Routing Switcher, inputs, outputs, virtual naming, intercom panel configuration,
      alphanumericics and the like. A “dummy” version of the configuration file is
      preferred for review.
   b. Production Switcher
   c. Intercom
   d. Tally
   e. Control System (e.g. Crestron, AMX, etc.) if any

7. Commissioning Plan and Training Resume Submittal
   a. Provide integrators commissioning plan, if it differs from the plan in Part 3.
   b. Part 3 lists training that is to occur on the system. Provide resumes where
      required for training on specific device(s).
   c. If Installer desires to utilize own forces for specified manufacturers
      commissioning, submit resume and relevant references for approval.

8. Commissioning Completion Submittal. At the conclusion of the commissioning
   process provide a written submittal indicating the completion of each commissioning
   task.

9. Training and Event Attendance Submittals:
   a. All Operations and Maintenance manuals, as well as as-built drawings must be on
      site for all sessions of training.
   b. Following discussions with Owner, formally submit a Training and Event
      Attendance submittal 2-4 weeks prior to first training. Submittal shall:
      1. Include a separate page/entry for every training session.
      2. Indicate date, time, and approximate length of training session.
      3. Indicate person(s) conducting training.
      4. Indicate whether training will be video recorded.
      5. Intended curriculum and most appropriate attendees (e.g. engineer,
         operations, IT, etc.)
   6. Include signature and title lines for:
      a) Owner acknowledgement and acceptance of training schedule.
         Include both an accepted and rejected box. An alternate schedule
         time should be suggested by the Owner in the event the schedule is
         rejected.
      b) Countersigning by trainer indicating that training actually occurred.
      c) All persons attending training. Where attendees do not stay for the
         entire session, this should be noted on the form and initialed by
         Technical Consultant attending training.
      d) Technical Consultant attending training at the end of the session shall
         initial that:
            (1) Training Occurred.
            (2) Training Materials were provided and left with owner.
            (3) Training was not interrupted or shortened by equipment or system
                troubleshooting. If it is, then there should be a line where Owner
and Contractor can indicate when make-up training will be provided and how long it should be.

(4) Training was generally sufficient for the proposed curriculum.

c. Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.).

d. Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.

10. Final Inspection Notification Report. Two copies of a typed, neatly prepared checkout report for each piece of equipment and the entire system shall be prepared and submitted; it shall include:

a. A complete listing of every piece of equipment, the date it was tested and by whom, the results and date re-tested (if failure occurred during any previous tests).

b. The final report shall indicate that every device tested successfully.

c. A performance test report indicating that the system meets all of the Installer testing requirements of Part III.

11. Contract close-out submittals:

a. Keep a complete set of drawings on the job, note any changes made during installation, and submit 1 corrected set of reproducible drawings showing Work as installed.

b. Submit the following data for review, prepared as indicated, at least one week prior to acceptance testing (exceptions noted):

   1. System Operation and Instructions. Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.

   c. Final Documents:

      1. A list of all equipment, indicating manufacturer, model, serial number, power consumption, warranty terms if greater than the specified warranty and equipment rack location. Update following acceptance testing, if changed.

      2. Manufacturer's Instruction Manuals for all items of equipment, incorporating or followed by manufacturer's warranty statements.

      3. Where manufacturer registration is required, register warranty in Owner's name, and at an address determined by Owner. Provide copy of registration.

      4. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.

      5. A list of settings of all semi-fixed controls. Update following acceptance testing. (This shall specifically include all computer based software settings, e.g. IP addresses, gateways, drive mapping, backup procedures etc.)

      6. Schematic wiring diagrams of the video replay sub-system, based on the as-built documentation, at a reduced scale easy to handle but fully legible.

      7. Maintenance Instructions, including Installer's maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.

      8. A legend of acronyms and abbreviations must accompany all documentation.

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

    10. System Reference Manual: Furnish multiple copies as required by Project Requirements, in 3 ring binders, sized to hold the material plus 50% excess, with clear vinyl pockets on cover and spine for project title.

    11. Electronically editable files for all project work:

       a) Autocad DWG

       b) Excel

       c) Word

       d) PDF is not considered an editable file.
1.6 PROJECT CONDITIONS

A. Verify all conditions on the job-site applicable to this work. Notify Technical Consultant in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The drawings diagrammatically show cables, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist at the job site which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Technical Consultant for approval, showing how the work may be installed.

1.7 ACCEPTANCE TESTING

A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Technical Consultant.

B. Provide two persons familiar with all aspects of the system to assist the Technical Consultant during acceptance testing.

C. The process of acceptance testing the System may necessitate moving and adjusting certain component parts; perform such adjustments without claim for additional payment.

1.8 WARRANTY

A. Warrant labor and materials provided under this agreement for one year following the date of substantial completion.

B. System to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics; repair or replace defects occurring in labor or materials within the Warranty period without charge. Warrant all replaced products as new.

C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

D. Within the warranty period, answer service calls within 8 hours, and correct the problem within twenty-four hours.

E. Register all manufacturers’ warranties (e.g. software, computers, etc.) in Owner’s name.

1.9 SPECIFIED PRODUCTS AND MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Regardless of the length or completeness of the descriptive paragraph herein, each device shall meet all of its published manufacturer’s specifications. Verify performance as required. Where two or more acceptable products are listed, the Installer may use either at his option.

B. Other qualified manufacturers will be considered subject to approval of complete technical data, samples, and results of independent testing laboratory tests of proposed equipment, submitted in accordance with project requirements.

C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review.

D. Include a list of previously installed projects using proposed equipment that are similar in nature to specified system.
E. If product is discontinued or made obsolete due to continuing product development, replace it with manufacturers’ equivalent at time of installation at no additional cost.

1.10 OPTIONS. OPTIONS SHOULD REFLECT THE NET COST (ADD OR DEDUCT) FOR THE OPTION AND ALL IMPACTED ELEMENTS.

A. Option 11 63 50 - A. Cost to remove fiber SMPTE camera cabling, SB/PA booth tie lines and TV truck tie lines from Folsom Field scope of work.

B. Option 11 63 50 – B. Cost to remove fiber SMPTE camera cabling and SB/PA booth tie lines from CEC scope of work.

C. Option 11 63 50 - C. Character Generator. Provide incremental cost to replace specified base bid production character generator.
   1. Type 1 Character Generator (CG1)
      a. Type 2 Character Generator consisting of the following parts:
      b. Harris Inscriber
         1. Harris G5 XT
         2. Harris Dual Channel G5 Upgrade
         3. Harris 3D DVE per channel
         4. Dual Channel Clip Option
         5. Harris Remote Playback
         6. Offline Licenses
         7. Quantity: 1

D. Option 11 63 50 D. Slow Motion Device. Provide incremental cost to replace specified base bid Slow Mo device.
   1. Type 1 Production SLOW MO (SLOW MO1):
   2. Abekas Mira-IR-8-02: 100 hours of storage at 100 Mbits (Quantity: 1)
   3. Abekas Mira-DABP-8CH: AES I/O for 8-channel Mira (Quantity: 1)
   4. DNF Controls DMAT-AB (CLIPS RCP) control panel specifically for the Mira (Quantity: 2)
   5. AES unbalanced audio distribution amplifiers to distribute four (4) Stereo pair (unbalanced) to each channel of the Slow Motion unit. Note that this distribution is not shown on the drawings.
      a. Amplifiers
         1. Evertz 500DA2Q-AESU (Quantity: 4)
         2. Harris AES6800+BS (Quantity: 8)
         3. Ross ADA-8401-A (Quantity: 8)
         4. GVG 8912RDA-D (Quantity: 4) or GVG 8911. (Quantity: 8)
         5. Snell or Probel as approved.
      b. Power Supply and Frame. As required.

E. Option 11 63 50 – E. Cost to provide image stabilizer to Type 2 lens configuration

F. Option 11 63 50 – F. Cost to provide HD Hard Disc Record/Playback (HD-DVR)
   1. Front panel control
   2. Single Channel
   3. Up to 18 hours record time
   4. Acceptable product:
      a. Fast Forward Video Omega HD Essential
      b. With analog audio option
      c. With 320GB storage drives
      d. With Genlock option

G. Option 11 63 50 –G. Cost to replace base bid Routing Switcher and Multi-image viewer with Harris option.
   1. Harris Platinum
a. Harris PM-FR-9 9RU Frame with power supply and controller  
b. Harris PM-128x128-3G9 Crosspoint Module  
c. Harris PM-HS-IB+ 8-input HD/SDI module (Quantity: 8)  
d. Harris PM-HSR-OBG+ 8 output HD/SDI module (Quantity: 8)  
e. Harris PM-AE BT DCT-IB 16 input analog stereo module (Quantity: 4)  
f. Harris PM-DA AECT-OB 16 output analog stereo module (Quantity: 4)  
g. Harris HV-SXH-32x2 Multi-viewer module  
h. Harris EDGE-SMS7000 protocol converter

H. Option 11 63 50 – H. Cost to provide POV camera at Folsom Field  
   1. POV Camera (POV)  
      a. Remote operated 16x9  
      b. Acceptable Product:  
         1. Sony BRC700  
         2. Sony BRUH700 optical mux unit (POV CCU)  
         3. Sony BRBKH700 HD optical mux card  
         4. Sony BRCSDP16 Outdoor dome housing (for outdoor locations)  
         5. Custom wall/ceiling mount  
   2. POV Controller (POV CNTL)  
      a. Acceptable Product  
         1. Sony RM-BR300

I. Option 11 63 50 – I. Cost to replace base bid Character Generator (CG) with Chyron solution.  
   1. Chyron Micro X3.1  
      a. HD/SDI single channel  
      b. Lyric Pro Offline creation software  
      c. Full function keyboard  
      d. 2D DVE  
      e. Lyric Pro software + premium bundle package  
      f. Intelligent interface

J. Option 11 63 50 – J. Cost to provide wireless camera transmitter, receiver and fiber optic multiplexing equipment. Connects to FOT  
   1. Support Configuration:  
   2. Type 1 Wireless transmitter (WT1) and Type 1 Wireless Receiver (WR1)  
      a. MicroLite HD-MLS-Elite Kit:  
         1. RF Central 58MLT – MicroLite transmitter (Quantity: 1)  
         2. RF Central 58MLR – MicroLite receiver (Quantity: 1) NOTE: Base station will be utilized in a temporary fashion so one unit can be used between the different facilities, i.e. in the control room rack for football, in the CEC scoreboard control room.  
         3. RF Central CO580-6 – 6dB Omni Antenna (for 58MLT) Quantity: 2  
         4. RF Central SCR580-12 – 12dB Compact Sector Antenna (for 58MLR) Quantity: 2  
         5. RF Central VFA-10 – Magic Arm (to mount the 58MLR) Quantity: 2  
         6. RF Central TDSC-10 – “C” Clamp Mount (for Magic Arm) Quantity: 2  
         7. The kit also includes all power cables for both 58MLT and 58MLR, wall wart power supply for 58MLR, camera mounting hardware bracket for 58MLT, antenna mounting brackets for 58MLR and Pelican hard carrying case.  
         8. Tripod for mounting 2nd set of antennae in a temporary/portable fashion for use at ancillary athletic facilities
   3. Frame sync (FS), Type 1 SDA and Type 2 CPXM

K. Option 11 63 50-K. Cost to provide closed caption encoder and decoder  
   1. Closed Caption Encoder (CCE)
a. EEG EN530

2. Closed Caption Decoder (CCD)
a. EEG DE280 WITH SOFTWARE DECODE TO SCORING SYSTEM

L. Option 11 63 50-L. HD Encoders and Modulators. Provide cost to replace existing distributed TV encoding headend at Folsom Field.
1. Type 1 HD Encoder (ENC1; HD ENC1)
a. Evertz Solution
   1. Evertz 7880ENC-MP2HD-1+3RU
   2. Evertz 7721AE4-HD+3RU
   3. Evertz 7780M4-ASI+3RU
   4. Blonder Tongue AQM
b. Harris Solution
   1. Harris HALRENC-H11-ATSC MPEG-2
   2. Harris HALRTMX-M12-TNL1
   3. Blonder Tongue AQM

2. Type 1 HD Encoder (ENC1; HD ENC1) Frame
a. Evertz Solution
   1. Frame
      a) Evertz 7800FR-QT with power supply
   2. Frame Controller
      a) Evertz 7800FC (Quantity: 1 overall)

b. Harris Solution
   1. Frame
      a) Harris HALRSYS-1700AC-A22
   2. Frame Controller
      a) Harris HALRSYS-A22-CTL (Quantity: 1 overall)
   3. Power Supply
      a) Harris HALRPWR-SUP-AC (Quantity: 2; for redundancy)

c. Quantity: 1

3. Type 1 Encoder Multiplexer (MUX2)
a. Blonder Tongue DQMx-20

4. Type 1 SD Modulator (MOD1)
a. Blonder Tongue AV10E-QAM with SmartVM.com DVI-D to VGA converter (CON-DVI-ANA). (Quantity: 1)

5. RF Combiner (COMBINER):
a. Blonder Tongue OC8

6. RF Amplifier (RFA)
a. Blonder Tongue RMDA 86A-30

M. Option 11 63 50 – M. Cost to replace base bid production switcher with Ross Vision
1. Ross Vision 2M
   a. Ross V2MP-001 2M Control Panel
   b. Ross V2MP-076 Redundant Power
   c. Ross V2MP-005 Mnemonics for Custom Control Macro Panels
   d. Ross V2MP-105 Mnemonics for MLE1 Sources
   e. Ross V2MP-205 Mnemonics for MLE2 Sources
   f. Ross V1MP-001 Vision 1M Control Panel
   g. Ross V1MP-005 Mnemonics for Custom Control Macro Panels
   h. Ross V1MP-076 Redundant Power
   i. Ross V1MP-501 Vision End Blocks
   j. Ross QMD-002 Live Production Engine (2MLE) Rack Frame
   k. Ross QMD-020-16 MD Inputs, 16 additional
   l. Ross QMD-020-10 MD Inputs, 10 additional
   m. Ross QMD-021 MD Outputs, 16 Timed Outputs
   n. Ross QMD-140 Squeeze and Tease MD Carrier for MLE1, 2
   o. Ross QMD-141A Migrating Squeeze and Tease MD Channels 1 & 2 for MLE1
   p. Ross QMD-241A Migrating Squeeze and Tease MD Channels 1 & 2 for MLE2
   q. Ross QMD-903 Video Server Control
r. Ross QMD-905 Routing Switcher Interface
s. Ross QMD-012 Proc Amps
t. Ross QMD-013 RGB Color Corrector
u. Ross QMD-055 Aux Keys
v. Ross QMD-090 On-Site Operational Training
w. Ross QMD-091 On-Site Operational Training
x. Ross QMD-093 On-Site Commissioning
y. Ross QMD-096 Serial Tally Interface

1.11 UNIT COSTS; SUPPLY AND INSTALL

A. Unit Costs 11 63 50-A. Cost to provide fiber optic test equipment
   1. Meeting TIA/EIA-526-14A and TIA/EOA-526-7 standards
   2. Able to test SM and MM cable
   3. Acceptable manufacturer
      a. Fluke Networks

B. Unit Costs 11 63 50-B. Extended support options. Annual support costs shall be following
   the warranty period. They shall be exercised 30 days before the expiration of the warranty
   or preceding annual support period whichever is later.
   1. Unit Costs 11 63 50-B1. Provide annual costs for all software and hardware support
      for full Production Switcher Systems specified as Base Bid following the expiration of
      the warranty period. Annual costs shall be for nine years following expiration of the
      warranty period.
   2. Unit Costs 11 63 50-B2. Provide annual costs for all software and hardware support
      for full Routing Switcher and Multi-image viewing Systems provided as base bid.
      Annual costs shall be for nine years following expiration of the warranty period.

Part 2 PRODUCTS

2.1 GENERAL

A. All equipment and materials shall carry original manufacturer’s warranty. B-stock or floor
   demonstration equipment is allowed and encouraged for all equipment, other than video
   and audio monitors and patch panels. Given the construction cycle NAB or IBC or
   intervening trade shows may be accounted for. Take care during installation to prevent
   scratches, dents, chips, etc.

B. Regardless of the length or completeness of the descriptive paragraph herein, each device
   shall meet all of its published manufacturer’s specifications. Verify performance as
   required. Where two or more acceptable products are listed, the Installer may use either at
   his option.

C. Provide engraved lamicoid labels at the front and rear of all signal processing equipment
   mounted in racks. Mount labels on the equipment and attach in a neat, plumb, and
   permanent manner. Embossed labels will not be accepted. Provide engraved labels at the
   rear only of equipment mounted in furniture consoles.

D. Custom rack panels shall be 1/8" thick aluminum, standard rack sizes, brushed black
   anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.)
   Custom connector plate (speaker, microphone, etc.) finishes shall be selected from
   manufacturer’s full range of standard finishes. Plastic plates will not be accepted, even if
   they are building standard in other areas.

E. All engraving shall be 1/8" high block sans serif characters unless noted otherwise. On
   dark panels or push buttons, letters shall be white; on stainless steel or brushed natural
   aluminum plates, or light-colored push buttons, letters shall be black.
F. In accordance with IEC-268 standard, all XLR connectors shall be wired pin 2 hot (high), pin 3 low, and pin 1 screen (shield).

G. All patch panels shall be wired so signal “sources” (outputs from devices) appear on the upper row of a row pair; all “loads” (inputs to devices) appear on the lower row of a row pair. All patch panel designation strips shall utilize alphanumeric and descriptive labels. The jack positions in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings.

2.2 OWNER FURNISHED EQUIPMENT

A. Coordinate delivery, connectivity and functionality with owner.

B. Provide inventoried equipment list of existing components prior to installation.

C. Verify all components and existing cabling from control room to camera locations are operational. If a certain existing component is deemed not functional, notify Owner of defect and method to either replace or repair. If existing camera cabling is damaged or not operational, provide appropriately rated cable.

D. Components
   1. Panasonic AGHPX500 (CAM₁)
      a. (Qty: 4)
   2. Fujinon 17x7
      a. (Qty: 4)
   3. Telecast Copperhead G3200 Camera Unit (MUX₁)
      a. (Qty: 4)
   4. Telecast Copperhead G3200 Base Station (MUX₂)
      a. (Qty: 4)
   5. Telecast Telethon
      a. (Qty: 2)
      b. PROVIDE TRADE IN VALUE OR UPGRADE TOWARDS PURCHASE OF RECONFIGURED TELETHON (FOT₂).
         c. Unit to have 4x4 HD/SDI and 4x4 fiber over single strand
   6. Telecast Adder II (MUX₃)
      a. (Qty: 2)
   7. Telecast Wafer power supply
      a. (Qty: 2)
   8. Telecast OpticalConn SM PTE hybrid cable (XXX ft)
   9. Apple Edit Stations (EDIT)
      a. (Qty: 3)
   10. Kona Cards (4)

2.3 VIDEO SCOREBOARD CONTROL ROOM CAMERA AND SUPPORT EQUIPMENT

A. For use with existing Panasonic cameras:
   1. Lens Type 1
      a. 2x extender
         1. Fujinon ZA22x7.6BERM (Qty: 3)
   2. Lens Remote Type 1 (focus)
      a. Fujinon MS-11 (Qty: 3)
   3. Lens Type 2
      a. Without image stabilizer
         1. Fujinon HA42x9.7BERD (Qty: 1)
   4. Lens Remote Type 2 (focus)
      a. Fujinon MS-11D/3 (Qty: 1)
5. Microphone Kit  
   a. Panasonic AJ-MC700 (Qty: 4)  

6. EFP Tripod with mid level spreader and zoom control built into second pan arm  
   a. Libec LS-60M (Qty: 4)  

7. Tripod adapter plate (Qty: 4)  

8. Camera monitor  
   a. Panasonic BTHL90W (Qty: 4)  
   b. With monitor mount and cabling  
   c. With viewfinder hood  

9. Recordable Media  
   a. (4) 32GB cards  
   b. Panasonic AJ-P2EO32XG  

10. Camera Control Unit  
    a. With remote control panel  
    b. Panasonic AG-RC10G to Telecast interface cables (Qty: 4)  
       1. Provide with Panasonic RC050M extension cables  
    c. Mount into millwork  

11. Battery charger  
    a. Anton Bauer Quad 2702 each with an Anton Bauer XLR-4 (Quantity: 4)  

12. Power supply (Qty: 4)  

13. Mounting plate (Qty: 4)  

14. Lithium Ion batteries  
    a. Anton Bauer AB Dionic (Qty: 4)  

15. Appropriate rain slicker sized for camera, lens and adapters  
    a. Porta Brace (Qty: 4)  

16. Castered, hard camera case to support camera, lens, camera adapter, etc.  
    a. As configured above (Qty: 4)  
    b. NOTE: based on finished hallways/corridors, expansion joints, outdoor terrain and pathways, determine if casters or inflatable tires will be needed to cushion the transport of cameras and lenses.  

17. SMPTE Power Supply  
    a. Telecast Power Wafer (Qty: 2)  

18. Camera Cables  
    a. Camera adapter interface cables  
    b. Reel assembly  
    c. Tactical fiber  
    d. Optical Con SMPTE Fiber Connector  
       1. Telecast MX TAC4 fiber CASM BC 1T2S MX  
       2. 150 feet  
       3. Qty: 3  

2.4 FIBER OPTIC TRANSPORT  

A. Fiber Transmitter (FOT₁)  
   1. Four (4) bi-directional HD/SDI  
   2. Eight SM fiber inputs  
   3. Two One SM fiber outputs  
   4. Acceptable product:  
      a. Telecast Teleport TP-MNPP-W16  
      b. Telecast Teleport TP-QUPP-W16  
      c. Telecast ADAP-AC-04 (Qty: 2)  

B. Audio/Intercom Transmitter (MUX₂)  
   1. Four channels of intercom  
   2. Two channels intercom  
   3. Eight bi-directional analog audio feeds  
   4. Acceptable product:  
      1. Telecast Adder-II
C. Type 1 Frame Synchronizers (FS₁). Note that single and multi-path units are specified herein. Verify exact quantity against the functional drawings and adjust rack elevations accordingly.

1. Acceptable product:
   a. AJA FS2 with fiber input. NOTE THIS IS A DUAL PATH UNIT.
   b. Evertz 2012+2PS+CF2G+2RX. NOTE THIS IS A DUAL PATH UNIT.
   c. Harris X50-AV-2PS with OP+SFP+TR13P. NOTE THIS IS A SINGLE PATH UNIT.
   d. Ross Solution
      1. Ross UDC-8625. NOTE THIS IS A SINGLE PATH UNIT
      2. Ross FDR-6603. NOTE THIS IS A DUAL PATH UNIT; provide 1 unit for every two UDC-8625
      3. Ross DFR-8321-CN. Note this is a multiple card frame; provide quantity as appropriate.

2.5 VIDEO SYSTEM MONITORING AND MEASUREMENT COMPONENTS

A. Color Picture Monitors (CPXM):
   1. Type 1 Color Video Monitor (CPXM₁):
      a. 15"-17" camera monitor with HD/SDI
      b. Multi-format
      c. Acceptable product:
         1. Ikegami HTM1517R with DKH-501A/B
         2. Sony PVM1741
            a) With rack mount
            b) As Approved
   2. Type 2 Color Video Monitor (CPXM₂):
      a. 7" LCD with tally
      b. SDI, DVI and analog video inputs
      c. Analog audio inputs
      d. Acceptable Product
         1. TV logic LVM071W
         2. With rack mount
         3. As Approved
   3. Type 3 Color Video Monitor (CPXM₃):
      a. 17" LCD with HD/SDI
      b. Acceptable product:
         1. Ikegami 1704WR
         2. Sony LMD1751WHD
         3. As Approved
   4. Type 4 Color Video Monitor (CPXM₄):
      a. (3) 6" LCD monitors
      b. Composite inputs
      c. Rack mounted
      d. Acceptable product:
         1. Marshall V-R573P
         2. As Approved
   5. Type 5 Color Video Monitor (CPXM₅):
      a. Dual 10" HD/SDI with tally
      b. Acceptable product:
         1. Marshall Electronics V-R1042-IMD-TE4U
         2. As Approved
   6. Type 6 Color Video Monitor (CPXM₆):
      a. 47 Inch diagonal
      b. 1920x1080 minimum resolution
      c. Acceptable Product:
         1. Sony FWD-S47H1 LCD Monitor with BKM-FW16
         2. With Chief mounting bracket
3. As Approved

7. Type 7 Color Video Monitor (CPXM_7)
   a. 22", 1920x1080
   b. Acceptable product:
      1. Samsung S22A200B
      2. As Approved

8. Type 8 Color Video/Data Monitor (CPXM_8)
   a. 32" LCD
   b. Acceptable Product:
      1. Samsung LN32 series
      2. As Approved
      3. With Chief mounting bracket

B. Waveform Monitor/Vectorscope (WVS)
   1. Multi-format signal analyzer
   2. Integrated video and audio monitoring
   3. Acceptable product:
      a. Harris CVM-306
      b. Other Acceptable Manufacturers: Tektronix

C. Test, Sync Generator
   1. Sync Generator (SYNC)
      a. Integral test generator; digital black, and two independently adjustable black burst outputs.
      b. Acceptable Product:
         1. Evertz 5600MSC+GP+T+STG+HTG+WC
         2. Other Acceptable Manufacturers: Tektronix, Harris

2.6 PLAYBACK AND SOURCE DEVICES

A. DVD Blu-Ray Disc Device (DVD):
   1. Blue Ray Recorder
   2. Acceptable product:
      a. JVC SR-HD1500US with a Roland VC-50HD with Middle Atlantic RSH4S2R JVCXXX –C rack mount shelf with shelf clamp

B. DVI/VGA input Scaler (SCALER):
   1. HD/SDI output
   2. Analog and AES output
   3. Audio and delay level control
   4. Acceptable product:
      a. Ensemble Designs BrightEye Mitto HD ME2.BEM-2
      b. With rack mount

C. Tuner (TUNER)
   1. Acceptable Product:
      a. Contemporary Research 232+ ATSC (Quantity: 1)

2.7 ROUTING SWITCHER

A. Serial digital level and analog audio (RS):
   1. Sized at 64x64 HD/SDI, analog audio
   2. Serves the (MIV) with ability to expand in same frame to 128x128. Please note that the physical frame and size is the ultimate requirement, expansion is expected to be accommodated with the addition of additional input, output and cross point cards.
   3. Capable of passing alphanumeric information between production switcher and multi-image viewers
4. Allow control panels to intercommunicate. In the event that Ethernet protocol is used for the communication and it requires a separate physical network, then this supplier shall provide the network hardware required.

5. Provide base bid configuration without any options. If options require additional expansion, indicate this on option pricing not within base bid.

6. Acceptable Product:
   a. Evertz Magnum Xenon
      i. Evertz XE8-3232HX-Xlink video frame
      ii. Evertz XE-IP32HX HD/SDI input card
      iii. Evertz XE-OP32HX HD/SDI output card
      iv. Evertz XE8-3232-AAAESB audio frame
      v. Evertz XE-IP32-AAESB analog audio input card
      vi. Evertz XE-OP32-AAESB analog audio output card
      vii. Evertz 7867VIPX-32x2 Multiviewer (MIV)
           a) (Quantity: 2)
      viii. Evertz 8967VIPX-RP2 rear plate
      ix. Evertz Xlink-BHP-5 5M cable
      x. Evertz 7800FR+78P frame
     xi. Evertz PTX protocol converter

12. Evertz Magnum Linux computer
    13. With control and configuration software for router, multi-viewer and hardware
        a) Evertz Magnum Software module – router
        b) Evertz Magnum redundant software module
        c) Evertz Magnum software module – multi-viewer
        d) Evertz Magnum redundant software module

14. Alternate suppliers available for consideration: Harris, Sony

B. RS422 matrix (CNTL MATRIX)
   1. Normalled RS422 patch panel.
      a. ADC PPB3-5R422D9NS (Quantity: As required with 25% growth)

C. Routing Switcher Control Panels:
   1. Type 1 Button per source control panel (RS BPS₁)
      a. Full X-Y 8 levels of breakaway
      1. Evertz CP-6400E control panel
      2. Alternate suppliers:
         a) Harris, Sony
      b. Locations:
         1. As indicated on drawings
   2. Type 2 Button per source Control Panels (RS BPS₂)
      a. X-Y 4 levels of breakaway
      1. Evertz CP-3200E control panel
      2. Alternate suppliers:
         a) Harris, Sony
      b. Locations:
         1. As indicated on drawings

2.8 PRODUCTION SWITCHER

A. Production Switcher (PS) and Production Switcher Control Panel (PS CP):
   1. Ross Video Carbonite 2M (PS₁) (Quantity: 1)
      a. Ross C2M-224-001
      b. Ross CF-224
      c. Ross C2M-REDPSU-EXT
      d. Ross C2M-Panel (PS CP₁)
      1. In desk mounting
   2. Ross Video Carbonite 1M (PS₂) (Quantity: 1)
      a. Ross C1M-124-001
b. Ross CF-124  
c. Ross C1M-REDPSU-EXT  
d. Ross C1M-Panel (PS CP2)  

3. Switcher Commissioning  
a. Ross: As required  

2.9 CHARACTER GENERATORS, CLIP SERVERS, SLOW MO AND EDITING  

A. Character Generator (CG):  
1. Ross Expression Prime  
2. DataLinq Server Option  

B. Computer Type 1 (COMPUTER₁):  
1. Ethernet: 10/100/1000  
2. USB 2.0 minimum of 2 ports  
3. RS232 Serial Ports: minimum of two (2)  
4. 3 year warranty; 24 hour replacement with on site replacement  
5. Provide 1 spare hard drive of each type.  
6. Provide Hard Drive Image Ghost software and configuration for each type.  
7. Basis of Design Hardware Configuration  
a. Dell PowerEdge R710  
b. Two (2) Quad Core Intel® Xeon® processor (similar to: X3220 (2.4GHz, 8MB L2 cache, 95 Watts, 1066MHz FSB)  
c. 4GB Memory  
d. 4 x 100GB SATA 7,200/10000 rpm  
e. Hard Drive: RAID 5 drive set (requires above matching 4 hard drives)  
f. Smart Array Controller that supports RAID5  
g. Dual Gigabit NIC Adapters  
h. Optical Drive (CD/DVD-ROM)  
i. Serial port  
j. Redundant PSU desktop computer mounted on sliding shelf or rack mount  

C. Computer Type 2 (COMPUTER₂).  
1. Stealth Computer SR-2501 – with the following configuration:  
a. Processor: Intel Core i5-2500 (4C/4T), 3.3GHz, 32/64-Bit - Upgrade  
b. Memory: 8GB DDR3 Upgrade  
c. Hard Drive - 1: 500GB SATA Included  
d. Removable Hard Drive Kit (Available for Hard Drive 1 only): No Removable Kit included (standard)  
e. Optical Drive: DVD+-RW/Blu-ray Burner, SATA - Upgrade  
f. Operating System: Microsoft Windows 7 Professional, 64-Bit (installed)  
g. Power Supply: 90-264VAC, 400 Watt ATX (standard)  
h. Side Rails: 30" chassis slide rails  
i. Adjustable Slide Rail Extensions: 6" Adjustable Extensions  
j. Extended Warranty: 1 Year Warranty Extension - 3 Years Total  
k. Software as required to operate:  
1. Routing switcher and multi-viewer  
2. Slow Motion Device  
3. Intercom  
4. Distribution gear  

D. Apple Editing Computer (APPLE)  
1. Basis of Design Hardware Configuration is currently Mac Pro Configured:  
a. (2) 2.4GHZ Quad-cores Intel Xeon  
b. 1 TB 7200-rpm serial ATA 3Gb/s hard drive  
c. 48GB memory  
d. Apple Dual Channel 4Gb fiber-channel PCI Express Card  
e. Two ATI Radeon HD 5870 1GB graphics cards
f. Mac Pro Raid card

g. Blu Ray Drives; MCE BD10XMPE2009

h. Apple Magic Mouse and Trackpad

i. Apple Keyboard with numeric keypad
   1. Quantity: 2

j. Apple Dual Channel 4Gb fiber-channel PCI Express Card (Quantity: 4)

k. AJA Kona LHi capture card (Quantity: 3)

l. Aja Xena KLHi-Box (Quantity: 6)

m. Western Digital Caviar Black 1 TB 7200 RPM, 32MB Cache SATA 3 Gb/s 3.5" internal hard drive (Quantity: 6)

n. 12GB kit, 240-pin DIMM, DDR3 PC3-8500 memory module (Quantity: 2)

2. Software: OFE Final Cut
   a. Coordinate installation

E. Slow Motion Device (SLOW MO):
   1. 4 in/4 out
   2. Multi-viewer output
   3. Tightrope ZPlay HD
      a. With control panel (SLO MO CP)
      b. When ordering, ask for the Zeplay Sweet 16-2x8441HD

2.10 DISTRIBUTION GEAR

A. Configuration and Control Software
   1. Provide all manufacturers distribution/interface software available for controlling and monitoring distribution gear (EMAIL NOTIFICATION NOT REQUIRED). (Quantity: lot, as required).
      a. Ross
      b. Evertz
      c. Harris
      d. Grass Valley
      e. Snell, Pesa meeting these performance requirements

B. Distribution Gear Card frame (FR):
   1. Frame with cooling fan, network card with 1 power supply
      a. Ross FBK-8321-CN
      b. Evertz 500FR with single power supply and 500FC frame controller
      c. Harris 6800 + with single power supply and Ethernet resource card,
      d. Grass Valley 8900FFN: GeckoFlex 2RU Frame w/single power supply, 10 8900B-G, fans Ethernet network interface.
      e. Snell, Pesa, meeting these performance requirements

B. Distribution Gear Card frame (FR):
   1. Frame with cooling fan, network card with 1 power supply
      a. Ross FBK-8321-CN
      b. Evertz 500FR with single power supply and 500FC frame controller
      c. Harris 6800 + with single power supply and Ethernet resource card,
      d. Grass Valley 8900FFN: GeckoFlex 2RU Frame w/single power supply, 10 8900B-G, fans Ethernet network interface.
      e. Snell, Pesa, meeting these performance requirements

2. Spare Power Supply:
   a. Mounts in selected Distribution Gear Card Frame
   b. Acceptable product:
      1. Ross PS 8300. (Quantity: 1 for every 4 trays, round fractional numbers up)
      2. Evertz backup/redundant power supply (Quantity: 1 for every 4 trays, round fractional numbers up)
      3. Harris second power supply,
      4. Grass Valley 8900U-PSX: Redundant 125W Power Supply for GeckoFlex frames (90-240VAC)
      5. Snell, Pesa, meeting these performance requirements

C. Type 1 Serial Equalizing Amplifier (SDA1):
   2. Acceptable product:
      a. Ross DEA-8205-R2 (NOTE THIS MODEL NUMBER IS A DUAL PATH DISTRIBUTION AMPLIFIER.)
b. Evertz 500DA2Q-3G (NOTE THIS MODEL NUMBER IS A DUAL PATH DISTRIBUTION AMPLIFIER)
c. Harris DA-DHR6802+D (NOTE THIS MODEL NUMBER IS A DUAL PATH DISTRIBUTION AMPLIFIER)
d. Grass Valley 8945EDA (NOTE THIS MODEL NUMBER IS A DUAL PATH DISTRIBUTION AMPLIFIER)
e. Snell, Pesa, meeting these performance requirements.

D. Type 2 Serial Equalizing Amplifier (SDA2):
   1. 1 x 8 General distribution amplifier
   2. Mounts in selected Distribution Gear Card Frame
      a. Ross SEA 8203A-R2
      b. Evertz 500DA-3G
      c. Harris DA-HR6802+D
      d. Grass Valley 8943RDA
      e. Snell, Pesa, meeting these performance requirements.

E. Type 3 Serial Equalizing Amplifier (SDA3):
   1. 1 x 2 General distribution amplifier
   2. Mounts in selected Distribution Gear Card Frame
      a. Ross TEA 8207-R2. (NOTE THIS MODEL NUMBER IS A TRIPLE PATH DISTRIBUTION AMPLIFIER.)
      b. Evertz 500DA2Q-3G (NOTE THIS MODEL NUMBER IS A DUAL PATH DISTRIBUTION AMPLIFIER)
      c. Harris DA-DHR6802+D (NOTE THIS MODEL NUMBER IS A DUAL PATH DISTRIBUTION AMPLIFIER)
      d. Grass Valley 8945EDA (NOTE THIS MODEL NUMBER IS A DUAL PATH DISTRIBUTION AMPLIFIER)
      e. Snell, Pesa, Grass Valley meeting these performance requirements.

F. Type 1 Analog Video Distribution Amplifier (VDA1):
   1. Mounts in selected Distribution Gear Card Frame
   2. Acceptable product:
      a. Ross UDA-8705A-R2
      b. Evertz 501ADA-EQ
      c. Harris VDA6800+S/D
      d. Grass Valley 8902-EQ-1694A
      e. Snell, Pesa, meeting these performance requirements.

G. Digital to Analog Composite (DAC). Note that single and multi-path units are specified herein. Verify exact quantity against the functional drawings and adjust rack elevations accordingly.
   1. Acceptable product:
      a. Single Path
         1. Evertz 510DCDA-HD
         2. Ross HDC 8222-R2
         3. Harris HDC6800+AD
         4. Grass Valley 8995DNC
         5. Snell, Pesa, meeting these performance requirements.
      b. Dual Path
         1. Evertz 7812DCDA-HD+3RU
         2. Harris, Pesa, Ross, Grass Valley meeting these performance requirements.

H. Down Converter (DC). Note that single and multi-path units are specified herein. Verify exact quantity against the functional drawings and adjust rack elevations accordingly.
   1. Acceptable product:
      a. Single Path
         1. Evertz 510DCDA-HD
UNIVERSITY OF COLORADO VIDEO SCOREBOARD CONTROL ROOM

2. Ross HDC 8222-R2  
3. Harris HDC6800+AD  
4. Harris X50  
5. Grass Valley 8995DNC  
6. Snell, Pesa, meeting these performance requirements.

b. Dual Path  
1. AJA FS2  
2. Evertz 7812DCDA-HD+3RU  
3. Evertz 2012  
4. Harris, Pesa, Ross, Grass Valley meeting these performance requirements.

c. Note: Evertz 2014 is also acceptable

I. Up Converter (UC)  
1. Acceptable product:  
   a. Single Path:  
      1. Harris X50  
      2. Ross UDC-8625  
   b. Dual Path:  
      1. AJA FS2  
      2. Evertz 2012  
   c. Note: Evertz 2014 is also acceptable

J. Component to Serial Digital Converter (ADC): Note that single and multi-path units are specified herein. Verify exact quantity against the functional drawings and adjust rack elevations accordingly.  
1. Acceptable product:  
   a. Evertz Solution (NOTE THIS IS A DUAL PATH UNIT)  
      1. Evertz HD2012+FR-HIO+FL-ADC-HD+AA+WPAES8-BNCM-6F  
      2. Evertz BHP-BNClU-48 (Quantity: 1 for EVERY 4 Type 1 ADC or Type 2 FS)  
   b. Harris X50-AV-2PS with X50OPTCAB-AES NOTE THIS IS A SINGLE PATH UNIT  
   c. AJA FS2 with Winford Engineering BRK25X-R-DIN or other approved analog breakout cable. NOTE THIS IS A SINGLE PATH COMPONENT INPUT UNIT.

K. Component to Serial Digital Converter Type 2 (ADC2):  
1. Acceptable product:  
   a. Evertz 7730ADC+3RU  
   b. Harris ADV6800+D  
   c. Ross Video ADC-8733A  
   d. Grass Valley 8950ADC  
   e. As approved

L. SDI TO DVI converter (DVI)  
1. AJA HDP2 with appropriate power supply

M. Type 2 HD Encoder (ENC2)  
1. Streaming Encoder  
2. HD/SDI and analog audio inputs  
   a. Elemental Technologies Live Stream

2.11 STORAGE AND PLAYBACK SERVER

A. Shared Storage Interface (STORAGE)  
1. 45 TB shared storage interface with edit and play out  
2. Fully redundant  
3. Fiber connectivity XSan/StorNext  
4. Serves up to XXXX clients  
5. Provide with fiber switch (SWITCH)

©WJHW  
February 6, 2012  
REVISED FEBRUARY 15, 2012  
11 63 50-20  
ADDENDUM #1
6. Acceptable supplier:
   a. Active Storage
   b. PROVIDE $675,000 ALLOWANCE for client configuration needs

2.12 AUDIO AND TIME CODE

A. Audio Mixer (MIXER)
   1. Up to 40 analog/digital channels
   2. Acceptable product:
      a. Soundcraft GB2R
      b. Yamaha 01V96VCM
      c. With Mini YGDAI AES card

B. Audio Amplifier (AMP):
   1. Crown D45

C. Speakers
   1. Type 1 Speakers (SPKR1):
      a. Tannoy i7 (BLACK) with i7 MAB mounting bracket i7 yoke; orient as shown on drawings
   2. Type 2 Speakers (SPKR2):
      a. Genelec 8240A
      b. With table stand

D. Audio Monitor (AM)
   1. Type 1 (AM1)
      a. 8 channel analog/2 channel AES
      b. Rack mount
      c. Acceptable product:
         1. Wohler VMDA-4
   2. Type 2 (AM2)
      a. 2 channel analog/AES
      b. Rack mount
      c. Acceptable product:
         1. Wohler AMP1-DA/106

E. Time Code Distribution Amplifier:
   1. Time Code Distribution Amplifier (TDA)
      a. Ross
   2. Distribution amplifier Frame and Power supply (DO NOT MIX WITH AUDIO DA’s).
      a. Ross AFR-7814

F. Word Clock Synthesizer and Distribution Amplifier (ADA1):
   1. Drawmer D-Clock

G. Audio Interfacing, Matching, and Line Driving Devices:
   1. Analog Audio to AES (AADC)
      a. Evertz 7720ADC-A4+3RU—note this is a multi-channel unit (two pair channels 1 way).
      b. Ross ADC-8432—note this is a SINGLE channel unit.
      c. Harris ADC6800+A4BCD—note this is a multi-channel unit (two pair channels 1 way).
   2. AES to Analog Audio (ADAC)
      a. Evertz 7720DAC-A4+3RU—note this is a multi-channel unit (two pair channels 1 way).
      b. Ross DAC-8416
      c. Harris DAC6800+B4A4D—note this is a multi-channel unit (two pair channels 1 way).
   3. Balancing Amplifier (BA; UBA)
UNIVERSITY OF COLORADO VIDEO SCOREBOARD CONTROL ROOM

a. RDL STA-1

4. Microphone to Line Level interface (MIC). NOTE DEPENDING ON MANUFACTURER OF CCU, MAY NOT BE REQUIRED.
   a. RDL STM-2 (Quantity: 2 per stereo connection)

5. Support
   a. RDL-STR-19 (Quantity: As required)
   b. RDL Power supply (Quantity: As required)

6. Rackmount Balun; 20 channels (BALUN)
   a. Acceptable Product
      1. Ward Beck IMP20A

7. Type 1 Balun; Individual Devices (BL₁)
   a. Acceptable Product
      1. Ward Beck IMP1
      2. Canare BJC-XS-TRB

8. Type 2 Balun Rack mount (BL₂). Pair of Baluns
   a. Acceptable Product: For each device provide two (2) of the following:
      1. Ward Beck IMP1
      2. Canare BJC-XS-TRB

9. Note: it is acceptable to use the Rackmount Balun system (BALUN) for all AES impedance conversions.
   a. RDL RU-BLA2 Adjustable Stereo Line Amplifier

H. 232 Transceiver. Units used to connect 232 connections over Cat 5/6 connections.
   1. Minicom Cat 5 232 Extender Local and Remote Unit with local power supplies. Provide as required.
   a. Onkyo T4555 with rack shelf

2.13 INTERCOM

A. Matrix Station (MATRIX):
   1. Riedel Artist 64.
      a. Riedel Artist 64 Frame MFR-064 G2 (Quantity: 1)
      b. Riedel Artist 64 Power Supply PSU-064 G2 (Quantity: 1)
      c. Riedel Artist Node Controller, Standalone. (Quantity: 1)
      d. Riedel Transformer balanced analog 4W interface AIO-108 G2. (Quantity: 2)
      e. Riedel Matrix client card CAT5-108 G2. (Quantity: 2)
      f. Riedel Director Artist/Performer Configuration Software (Quantity: 1)
      g. **Riedel PMX 2004-SFP panel multiplexer (Quantity: 2) (FOT₃)**
      h. **Riedel SFP-PMX-SM TX1310/RX1550 fiber optic module (Quantity: 2)**

B. Intercom Source Assignment Panel (SAP):
   1. Acceptable Product:
      a. RTS SAP 612

C. Intercom Power Supply (ICOM PS):
   1. Acceptable Product:
      a. RTS PS20

D. Intercom Interface (ICOM IF):
   1. **2-4 Wire interface**
   2. Acceptable Product:
      a. Riedel IF-2104
      b. Studio Technologies Model 4547

E. Intercom Stations (ICOM). Note: coordinate sex of headset connector to correlate with headsets and camera connections:
   1. Matrix Intercom Station Type 1 (ICOM₁)
      a. 12 key rack mount control panel
b. Acceptable Product:
   1. Riedel RCP-1012E/O with Riedel MIC-30 Microphone

2. Matrix Intercom Station Type 2 (ICOM₂)
   a. 16 key desktop control panel
   b. Acceptable Product:
      1. Riedel DCP-1016E/O

3. Intercom Station Type 3 (ICOM₃)
   a. 8 push button, 16 key operation rack mount panel
   b. Acceptable Product:
      1. Riedel DCP-5108 LCD with DCP RA

4. Intercom Station Type 4 (ICOM₄)
   a. Belt pack
   b. Acceptable Product:
      1. RTS BP-325

5. **Intercom Station Type 5 (ICOM₅)**
   a. 28 Keys rack mount control panel
   b. Acceptable Product:
      1. Riedel RCP-1028E/O

F. Wireless intercom system.
   1. Wireless Receiver and base station:
      a. Type 1 Wireless Receiver Base station (WR₁)
         1. Clearcom Four Channel System Base Station CM-944 and CCT-9RT
   2. Wireless Transceivers (WT):
      a. Type 2 Wireless Transceivers (WT₂)
         1. Clearcom CP942 belt packs.
   3. Spare Battery Pack:
      a. Clearcom Spare Battery (Quantity: 2)
   4. 5-bay Battery Charger:
      a. Clearcom CT-BC5A Charger (Quantity: 1) mounted to Middle Atlantic sliding shelves
      b. Clearcom T-LP1 Spare Battery (Quantity: 4)
   5. Remote Wireless antennae; connects to base station via CAT-5 cable.
      a. Clearcom CCT-9RT. (Quantity: 1)

G. Headsets: PROVIDE APPROPRIATE XLR CONNECTOR AT THE END OF EACH UNIT.
   1. Lightweight
      a. Clearcom CC-26K-XX (Quantity: 6)
   2. Single Muff
      a. David Clark 8592 (Quantity: 12)
   3. Dual Muff
      a. David Clark 8392 (Quantity: 20)
   4. Note: coordinate sex of headset connector to correlate with headsets and camera connections.
   5. Headphone
      a. Sony MDR-NC500D (Quantity: 2)
      b. Provide adapter to go from Intercom station to headset. (Quantity: 2)

H. Telephone Hybrid (HYBRID):
   1. For transmission of game program audio to a remote captioner.
      a. Comrex DH20. (Quantity: 1)

I. Keyboard, Video, Mouse Matrix Switcher:
   1. Unit to provide up to 8 Users access to each of the systems computer(s) without the need for re-booting or re-configuration of cabling.
   2. Frame (KVM MATRIX):
      a. Avocent AMX5000AM KVM Switch. (Quantity: 1)
b. Note: this unit shall be interconnected to other computers and workstations provided by Video Display, Video Control and Scoring installers.

3. User Stations (EXR₁):
   a. Avocent AMX5130. (Quantity: As shown on drawings plus 1).

4. Type 1 Computer Interface (EXT₁):
   a. Avocent AMIQDM-PS2. (Quantity: As shown on drawings plus 1)
   b. Avocent AMIQDM-USB. (Quantity: As shown on drawings plus 1)

2.14 VIDEO REPLAY EQUIPMENT REQUIREMENTS

A. Equipment Rack to be frame and panel type constructed of 16-gauge cold-rolled steel. Racks to have locking rear door mounted on the frame (not the rails). Empty mounting panel spaces to be filled with blank or vent panels, in a finish to match rack. Provide end panels and top panels as required. Provide shelving as required for equipment mounting within racks. Provide rack supports as required. Provide seven rack keys of each type. Rack color to be gloss or flat black. Provide a 60-watt “rough service” lamp in a locally switchable fixture mounted in the top rear of each rack. Include extra set of mounting rails in each rack for rear support of panels or equipment. Verify exact rack space required.

1. Video Scoreboard Control Room Racks to be:
   a. Middle Atlantic MRK 4436
   b. Top
      1. Middle Atlantic MW-4QFT-FC
   c. Side Panels at ends of racks (Only need where exposed; at walls; leave exposed)
      2. Middle Atlantic

2. Support Equipment
   a. Blank Panels
   b. Vent Panels
   c. Rack screws—Middle Atlantic HS
   d. Power distribution
   e. Rack light
   f. Seismic bracing and bases for attachment of racks to structure
   g. Cable lacing bars
   h. Rack Shelves:
      1. Heavy Duty pull out shelf. (SLIDING SHELF)
         a) Middle Atlantic SS
      2. General shelf standard
         a) Middle Atlantic RSH with escutcheon
   i. Horizontal Cable Management (for CAT5/6 cable management)
      1. Middle Atlantic HHCM-2
   j. Vertical Cable Management
      1. Middle Atlantic PCD-4-4-44GRK

B. Rack sensor (SENSOR).
   1. Rackmount controller
      a. American Power Corporation (APC) NBPD0150. (Quantity: 1)
   2. Temperature and Humidity sensor
      a. APC AP9335TH (Quantity: 2)
   3. Moisture Sensor
      a. APC NBES0301 (Quantity: 2)

C. UPS (UPS):
   1. Rack Mount UPS
      a. APC SURT20KRMXLT-TF5 with APC APTF20KW01-20KVa (Quantity: 1)
   2. Additional Battery
      b. APC SURT192RMXLBP2U (Quantity: 3)
   3. Power Distribution Unit (PDU)
      a. As required
   4. Replacement Battery Cartridge
a. APC RBC44 (Quantity: 1)
5. Main Breaker as required to feed UPS.

D. Furniture Console:
1. Console shall be constructed to house audio, video, control and other equipment as shown on drawings. Console shall be constructed by expert craftsmen in a fully qualified cabinet shop regularly in business for furniture work. AWI quality grade: Premium.
2. The term “console” includes actual consoles housing equipment for work while seated; console desks housing little or no equipment; and other millwork or furniture housing monitors, timing or cueing devices, etc.
3. The primary structural material shall be 7- or 9-ply birch veneered hardwood plywood, A-2 grade, ¾” thick; surfaces shall be covered with matte plastic laminate selected by architect from manufacturer's full range of standard colors and finishes. Hidden surfaces shall be covered with “liner” to equalize stress.
   a. Note: Particleboard may be suggested as a cost savings alternate. Freestanding units must be manufactured with plywood to allow their occasional movement.
   b. Provide a metal sub-frame to support millwork.
4. All exposed edges of horizontal work surfaces shall be treated with a solid wood bull-nose edge in a stain compatible with laminate finish. Submit suggested profiles and finishes to owner for review and acceptance.
5. All shelves, counters and edges to be designed to support 250 pound point load at edge of counter in addition to equipment mounted in or on shelf.
6. Equipment rack frames with drilled and tapped mounting holes shall be included as shown on drawings (reference EIA standards). Unused rack space shall be filled with black blank panels, brushed anodized aluminum.
7. AC power distribution and other requirements shall be as in Section 3.01; for routing between sections of cabinet, metal conduit and/or wireway shall be used for shielding and protection of circuits or as required by applicable codes.
8. Cabling access is required at each and every counter location. Preferred cabling system is a slot or reveal in the millwork that allows user a great deal of flexibility in locating cabling. Where slot exists in a flat millwork piece, then slot should be equipped with a brush cover or other suitable filler material that allows cables to be easily connected and dressed through openings (e.g. www.mockett.com; brush wire manager series).
   a. Circular grommets are not acceptable.
   b. A slot or cable reveal at the intersection of counter with vertical "rack" elements is preferred wherever possible.
9. Certain equipment shall be mounted into the millwork (e.g. console mount intercom stations, camera control shading joysticks, etc.); do not cut into millwork, until on site and user can evaluate operating configuration.
10. Seismic bracing and bases for millwork as required.
11. Field verify all site conditions prior to final shop drawing submittal to Technical Consultant
12. Millwork Locations:
   a. Bays 20-27
   b. Bays 30-37
   c. Rack counter 13-14
      1. Castered Edit Station shown with motorized lift as well side CPU mount
      2. Bays 40-41
13. Acceptable Suppliers:
   a. TBC Consoles
      1. LCD mounts as detailed
      2. Counter Finish: Verify with Owner

E. Video Tally connections are to be provided to indicate when a particular source is “on-air”. Connections shall be provided between the video switcher and:
   1. All control console monitors
   2. All shading and tape machine monitors
3. Producer’s monitors multi-viewer
4. Camera control units

F. Patch Panels:
   1. Video and AES (unbalanced) patch panel with normal through patch jacks.
      a. ADC PPE4632-MVJ-BK. (Quantity: As required with 10% excess capacity)
   2. Audio and Intercom Patch Panels
      a. Identification strips to be printed labels of different color for each major connector grouping. Use a combination of colored fonts on white background and black fonts on colored backgrounds.
      b. Non-terminated inputs to be shorted through normalling contacts on rear panel.
      c. Provide one punch down tool and one replacement tip.
      d. Acceptable product:
         1. ADC PPA3-14MKIVSNO
      e. Provide additional panels for termination of Broadcast Audio cabling (refer to AV series drawings for cable distribution); terminations at patch panels by video replay contractor.
   3. General Purpose Interface contact closures available on the DVE, Still Store, Character Generator, Editor, and any other devices shall be brought to a patch panel (normals out) for wiring purposes.
      a. CAT5. (Quantity: As required)
      a. ADC PPI4632RS-CJMID-BK. (Quantity: As required with 10% excess capacity)
      b. Other Acceptable Suppliers: As Approved

G. Patch Cables:
   1. Video Patch Cables. Standard Video Patch Cords; each length in a different color
      a. 2’ in length
         1. ADC R2V-STM (Quantity: 24)
      b. 3’ in length.
         2. ADC G3V-STM (Quantity: 24)
      c. 4’ in length.
         3. ADC B4V-STM (Quantity: 24)
      d. 6’ patch to male BNC
         4. ADC 06V-STM-B (Quantity: 4)
      e. Conversion adapter
         5. ADC MBNC-3 (Quantity: 6)
   2. Machine Control Patch Cables
      a. ADC R2B (Quantity: 10)
      1. Other Acceptable Suppliers: ADC meeting same performance
   3. GPI Patch Cables
      a. CAT5 (Quantity: 20)
   4. Patch Cord Holder
      a. Quantity: as required
      b. Acceptable suppliers:
         1. Pomona 4408
         2. Trompeter CH50
         3. ADC PPH
   5. Impact Insertion Tool with spare tip.
      a. ADC QB 4 with QB 4T spare tip. (Quantity: 1)
   6. Audio Patch cords to be at least 1m long and have 2-conductor shielded plugs. Patch Cords to be:
      b. AES and Analog Standard audio patch cord:
         1. ADC
      c. With XLR Adapters
      d. With RCA Adapters:

H. Camera, Video and Audio Cables:
   1. **SMPTE Hybrid Cable**
      a. HDTV Hybrid fiber optic camera cable
b. **Provide with appropriate NEC rating**
c. **Copper and fiber connectivity**
d. **Acceptable product:**
   1. Mohawk M97673
   2. Belden equal

2. Broadcast truck umbilical:
   a. Length: 150 feet
   b. Overall Jacket
   c. Individually numbered cables
   d. Video Umbilical:
      1. 5 BNC—provide 2 foot breakout at the rack end and 4 foot breakout at the truck end.
         a) Gepco VS102000
         b) Install on Hannay C3218-25-26-F with slotted divider disc to allow appropriate tail to connect between truck connects
         c) Quantity: 1
   e. Audio Umbilical:
      1. End 1
         a) 6 Male XLRs
         b) 4 Female XLRs
      2. End 2
         a) 6 Female XLRs
         b) 4 Male XLRs
      3. Install on Hannay C3218-25-26-F with slotted divider disc to allow appropriate tail to connect between truck connects.
         a) Quantity: 1

3. Video Cables:
   a. Assembly:
      1. Gepco GVC11-BLUE-##
      2. Quantity and Lengths (note: lengths are in meters):
         a) 3 meter (Quantity: 4)
         b) 7 meter (Quantity: 4)
         c) 15 meter (Quantity: 2)
         d) 30 meter (Quantity: 2)
         e) 100 meter (Quantity: 3) install on Canare R3805 w/casters
         f) 150 meter (Quantity: 1) install on Canare R3805 w/casters
   b. Audio Cables:
      a. Assembly:
         1. Gepco GMC-5-BLUE-xx-MF-NBG
      b. Quantity and Lengths (note: lengths are in meters):
         (1) 3 meter (Quantity: 4)
         (2) 7 meter (Quantity: 4)
         (3) 15 meter (Quantity: 2)
         (4) 30 meter (Quantity: 2)
         (5) 100 meter (Quantity: 1) install on Canare R3005.

2.15 CABLING INTERFACE BOX PLATES

**A. JBT Camera Box**

1. Bulloch Manufacturing AV-RP-12x22x10-SD-DS-SS-S

**B. JBT Interface Plates:**

1. Mounts in junction boxes
2. Panels to be black anodized 16 gauge aluminum flanged design (Middle Atlantic ‘BL’ series).
3. XLR, Fiber and BNC connectors are offset to the bottom of the panel and engraving is to the side of the connector ash shown on typical panel details.
4. BNC connectors are to be crimp bulkhead cable jack with isolation washers.
C. Rack Mount Screws:
   1. Provide stainless steel flanged button cap screw fully threaded.
   2. Drive type: Hex socket.
      a. McMaster-Carr
      b. Or Equivalent

D. Camera JBT connector
   1. Neutrik NO2-4FDW panel connector

E. JBT Discrete fiber terminations
   1. Rack mounted enclosure.
   2. Provide for internal fusion splicing and cable management.
   3. Provide external strain relief for cables.
      a. Gepco GJBTFB-1RU3-12ST
      b. Or Equivalent

2.16 FIBER, GENERAL PURPOSE CABLE AND CONTROL WIRING

A. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.). Cables as follows:
   1. Video (under 100') and AES-U Cable.
      a. Precision video cable, PVC jacketed.
      b. Solid center conductor.
      c. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:
         1. Gepco VDM-260
         2. CommScope as approved
         3. Belden as approved
   2. Intra Control Room Video cable.
      a. Precision video cable, PVC jacketed.
      b. Solid center conductor.
      c. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:
         1. Gepco VSD-2001
         2. CommScope as approved
         3. Belden 1694A
   3. Outside Control Room video cable.
      a. Precision video cable, PVC jacketed.
      b. Solid center conductor.
      c. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:
         1. Gepco VHD7000
         2. CommScope as approved
         3. Belden 7855A
   4. Analog Audio Cable:
      a. Color: cable to be ordered in 6 colors (other than black) for each separate cabling system:
         1. Gepco 61801EZ
         2. CommScope 4201EZ
         3. Belden 9451
   5. AES-B Audio Cable
      a. Gepco DS401
   6. Horizontal UTP Cable: Provide compliant with NEC type CMP, CMR and CM rating as applicable:
      a. Impedance: 100 ohms, plus or minus 15 ohms.
      b. Velocity of propagation: at least 70 per cent nominal.
      c. Frequency attenuation at 60° F less than 6.5 dB per 100 ft at 100 MHz.
d. Acceptable product:
   1. CommScope 5504M
   2. Belden 1585A
   3. Mohawk M54998

7. Single Mode Fiber Optic Cabling
   a. Acceptable products:
      1. Belden M9W231
      2. CommScope R-006-0Z-8W-F-SU-YL
      3. Corning 006E8F-31131-A1

8. SMPTE Cable
   1. Mohawk

9. Other control cables to be 20 gauge with overall shield and appropriate number of conductors.
   a. Riser Rated

B. Connectors: All audio, video, and control equipment not a part of manufactured equipment shall have gold plated contacts excepting phone and patch jacks and plugs.
   1. Fiber Optic Connector
      a. Provide commercial style FC/APC/FC/SC and ST connections compatible with fiber equipment and where indicated on plans.
      b. Provide connectors recommended by the manufacturer for compatibility with equipment and mounting panels and sub plates.
      c. Acceptable product:
         1. Corning
         2. Panduit
         3. Siemon
   2. XLR type connectors:
      a. Shall incorporate metal shells and bodies and employ a non-hydroscopic dielectric.
      b. Panel connectors to be removable from panel front for solder and repair work. Male and Female panel connectors to fit in the same cutout.
      c. Acceptable supplier:
         1. Neutrik
   3. F Connector:
      b. Provide seal ring in all moisture intensive environments.
      c. Install with manufacturer recommended compression tool.
      d. Provide weatherized boots and seal covers for all antenna connections.
      e. Verify connector cable type, size and construction with manufacturer.
      f. Acceptable product:
   4. BNC Bulkhead Connections:
      a. Utilize gold plated center contacts
      b. Insulated from panel feed-through connection
         1. ADC BHFT-1
   5. BNC cable connections:
      a. Utilize gold plated center contact, dual crimp connections:
         1. ADC BNC

6. SMPTE Connector
   1. Neutrik

2.17 FIBER OPTIC CABELING AND TERMINATIONS

A. Fiber Optic Termination Panels
   1. Optical Fiber Rack Mount Patch Panel
a. 2U Panel, 24 – 48 Port
b. Acceptable Product;
   1. ADC PN# RMG-2000-000B
2. Fiber Pigtail Single Mode (3m long) APC (PN determines Connector Type)
a. Pigtail Adapter
   1. Acceptable Product;
   2. ADC PN# FPT9-APSC-S-003M
3. Termination Panel Inserts
   a. Single Density, Loaded with 3-SC single mode
      1. Duplex Adapters
      2. Acceptable Product;
         a) ADC PN# RMG-06ADPC3
   b. Double Density, Loaded with 6-SC single mode
      1. Duplex Adapters
      2. Acceptable Product;
         a) ADC PN# RMG-12ADPC3
   c. Single Density, Loaded with 6-SC single mode
      1. Simplex Adapters
      2. Acceptable Product;
         a) ADC PN# RMG-06ADPC1
   d. Double Density, Loaded with 8-SC single mode
      1. Simplex Adapters
      2. Acceptable Product;
         a) ADC PN# RMG-12ADPC3
   e. Double Density, Loaded with 12-SC single mode
      1. Simplex Adapters
      2. Acceptable Product;
         a) ADC PN# RMG-12ADPC3
   f. Blank Strip
      3. Acceptable Product;
         a) ADC PN# RMG-00ADP00

B. Fiber Optic Connectors
1. Single Mode Pigtailed
   a. ST Pigtail (12 Fiber Strands)
      1. Acceptable Product;
      2. ADC PN# FPM-04/0-M003M
   b. SC Pigtail (12 Fiber Strands)
      1. Acceptable Product;
      2. ADC PN# FPM-074/0-M003M
   c. SC Angle Polish (APC)
      1. Acceptable Product;
      2. ADC PN# FPM-0E/0-M003M
2. Single Mode fiber optic patch cords
   a. Simplex single mode patch cords
      1. SC to LC patch cords
      2. Provide in 2 and 3 meter and as appropriate
      3. Acceptable product:
         a) ADC FTL-7 series
   b. SC Patch Cord 568SC – 568SC
      1. SC Patch Cord 568SC – 568SC provide in 2 and 3 meter (6 and 10 feet)
         length as appropriate; “X” is equal to the length in meters
      2. Acceptable Product;
         a) ADC PN# FPC-SPSC-S-XM
   c. ST Patch Cord 568ST – 568ST
      1. ST Patch Cord 568ST – 568ST provide in 2 and 3 meter (6 and 10 feet)
         length as appropriate; “X” is equal to the length in meters
      2. Acceptable Product;
         a) ADC PN# FPC-SPST-S-XM
UNIVERSITY OF COLORADO VIDEO SCOREBOARD CONTROL ROOM

d. Angle Polished (APC) SC single mode Patch Cord 568SC – 568SC provide in 2 and 3 meter (6 and 10 feet) length as appropriate; “X” is equal to the length in meters

3. Acceptable Product;
   a) ADC PN# FPC-ADSC-S-XM

C. Fiber Optic Patch Panel Cord Management
   1. 19” Manager, Front, 1 RU Strain Relief
      a. Acceptable product;
         1. Hellermann Tyton PN# WMBN1
         2. Panduit PN# WMPFSE
         3. Belden PN# AX102032
         4. ADC PN# 6652 2 153-00

2.18 MANUFACTURERS COMMISSIONING

A. Provide manufacturers commissioning and setup for all systems provided as part of the Video Scoreboard Control Room including any selected options. This shall include, but not be limited to:
   1. Production Switcher; including interface to 3rd party devices such as file servers, audio mixers, routing switchers, cameras, etc.
   2. Routing Switcher and multi-image viewers
   3. Clip Server(s); including interface to other devices such as production switcher and data networks
   4. Character Generator; including interface to other devices such as production switcher and router system
   5. Tally System
   6. Intercom Systems
   7. Edit Systems including shared storage, archive management, and media asset management system
   8. Slow Motion Systems; including interface to other devices such as production switcher, Edit system and data networks

B. If Installer shall be using their own forces for commissioning then they need to submit qualifications of persons performing commissioning and three references for similarly commissioned projects.

C. Unless otherwise noted, Installer is not responsible for providing commissioning of Owner Provided equipment.

PART 3 EXECUTION

3.1 GENERAL

A. All equipment and materials shall be new, unless B-Stock equipment is chosen as indicated in 2.1. Take care during installation to prevent scratches, dents, chips, etc.

B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least three. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.

C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommeting.
3.2 AC POWER AND GROUNDING

A. Coordinate and make final connection of power and ground wiring to racks. Hard wire power wiring directly to internal AC receptacles to ensure uninterrupted operation.

B. Install 3-conductor, isolated ground 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.

C. Install a copper ground buss bar top to bottom in each rack, insulated from the rack. Ground equipment chassis not having a three wire power cord to these busses using nuts, bolts and lock washers with No. 12 wire. Connect ground wire from each AC outlet in rack to this buss bar. Connect each rack buss bar to main ground wire in local power panel with properly sized insulated cable.

3.3 EQUIPMENT RACKS AND CONSOLES

A. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Technical Consultant in writing that racks will be fabricated on site and the reasons for the change.

B. Provide adequate whisper type ventilation.

C. Looking at the rack from the rear, locate AC power wiring on the left; line level audio, video, and RF wiring on the right. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.

3.4 SYSTEM WIRING

A. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For 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.

B. 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 in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.

C. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Technical Consultant; where spade lugs are used, crimp properly with ratchet type tool. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.
D. Execute wiring in strict adherence to:
   4. In accordance with standard professional practice.

E. Neatly lace vertical and horizontal wiring inside rack with lacing bars. Horizontal wiring in rack to be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Neatly bundle excess AC power cable from rack mounted equipment with velcro cable ties. Rack wiring to be bundled with velcro cable ties or lacing twine. Electrical tape and adhesive backed cable tie anchors are not acceptable.

F. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.

G. All mini-BNC, mini-DIN and RCA/phono connections shall be made directly to the cable in question; whips and adapters are not acceptable.

H. Wiring and connections shall be completely visible and labeled in rack. Termination resistors shall be 1% tolerance; fully visible and not concealed within equipment or connectors.

I. Custom rack panels shall be 1/8" thick aluminum, standard rack sizes, brushed black anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.) Custom connector plate (speaker, microphone, etc.) finishes shall be selected from manufacturer’s full range of standard finishes. Plastic plates will not be accepted, even if building standard in other areas.
   1. All engraving shall be 1/8" block sans serif characters unless noted otherwise. On dark panels or push buttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored push buttons, letters shall be black.

J. All patch panels shall be wired so signal “sources” (outputs from devices) appear on the upper row of a row pair; all “loads” (inputs to devices) appear on the lower row of a row pair. All patch panel designation strips shall utilize alphanumeric and descriptive labels. The jack positions in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings.

K. General Equipment and Cable Labeling:
   1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Mount labels in a neat, plumb and permanent manner. Embossed labels are not acceptable. Equipment labels to have at least three lines of engraving with the first line listing the general name of the device, i.e., COMB GENERATOR, or RF SWITCHER. The second line to include the schematic reference of the device, i.e., COMB GEN, or RF SWITCH. The bottom line to indicate what other devices or areas this equipment controls, i.e., FEEDS SPLITTER or MONITOR/RECEIVER.
2. Provide an engraved label over each user-operated control that describes the function or purpose of the control. Label size to be adjusted to fit available space.
3. Engraved labels to have 1/8" high characters minimum. Labels to be black with white characters except where indicated.
4. Cables, and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.
5. Wiring designations to be an alpha-numeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 3" of the point of termination or connection. For cable runs that have intermediate splice points, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Installer. Add cable designation codes to system schematic drawings included with Project Record Drawings.
6. Label each terminal strip with a unique identification code in addition to a numerical label for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Drawings.
7. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

L. Device labeling shall consist of two types: functional drawing reference and operational naming convention. Device physical labeling shall apply to functional drawings and physical labels on devices, operational naming convention shall allow user to provide flexible labeling between devices and their function (e.g. camera naming/numbering, file server labels).

3.5 INSTALLER TESTS AND ADJUSTMENTS

A. Verify the following before beginning actual tests and adjustments on the system:
   1. All products are installed in proper and safe manner according to manufacturer’s instructions.
   2. Insulation and shrink tubing are present where required.
   3. All Dust, debris, solder splatter, etc. is removed.
   4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
   5. All labeling has been provided.
   6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
   7. All products are neat, clean and unmarred and parts securely attached.
   8. All broken work, including glass, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
   9. All extra materials, portable equipment and spares shall be delivered and stored at the premises as directed.

B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards. Record the results of each test in the Project Record Manual.
   1. Electronic devices are properly grounded.
   2. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
   3. Powered devices have AC power from the proper circuit.
   4. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.

C. Preparation for Acceptance, prior to final inspection:
   1. Verify each individual component is operating properly
2. Verify each individual component’s performance meets the manufacturer’s published performance for this unit.
3. Verify proper operation from controlling devices to controlled devices.
4. Verify proper adjustment, balance and alignment of equipment for optimum quality and to meet the manufacturer’s published specifications.
5. Establish and mark normal settings for each level control, and appropriately record these settings within the “System Operation and Maintenance Manual.”
6. Verify that all communications and networking services are installed and in proper working condition (Ethernet, IP addressing)
7. Other tests on equipment or systems as deemed appropriate, such as, but not limited to:
   a. Cameras:
      1. Verify Camera power on
      2. Verify all indicators on Camera reflect no short circuit or open circuit conditions
      3. Verify Pan-Tilt arms function smoothly
      4. Verify Focus control is connected and working
      5. Verify Zoom control is connected and working
      6. Verify Camera Head is balanced in front, back and center
      7. Verify Intercom headset is working
      8. Verify Return Video is functional
      9. Verify the Video mode is set proper mode (HD/SD)
     10. Verify Aspect Ratio is set to proper mode (16:9/4:3)
     11. Verify audio is functional and at appropriate levels
   b. Camera Base Stations:
      1. Verify all connectors from base stations to cameras fit snugly into each other and are secure.
      2. Verify that there is no interruption in cable by checking communication link indicator between camera and base station is OK.
      3. Verify On-Air/Tally and ISO indicators function as per manufacturer’s specifications.
      4. Verify cable lengths do not exceed standard maximum recommended lengths for respective cable.
   c. CCUs/OCPs:
      1. Verify relevant cameras are assigned and connected to respective CCU/OCP.
      2. Verify assigned IP addresses and subnet mask are configured correctly
      3. Verify iris control sensitivity, mode, range and center is setup and joystick is calibrated
      4. Verify shading control is turned on
      5. Verify White Balance is set and parameters stored.
      6. Verify control of camera iris
   d. Video Production Switcher
      1. Verify assigned IP address and subnet mask is configured correctly
      2. Verify all sources are defined, labeled and routed accurately
      3. Verify all output assignments are accurate and labeled (program vs. preview)
      4. Verify all external devices (DDRs, VTRs, etc) are routed accurately
      5. Verify source to button mapping and labeling is to end user preferences
   e. Monitors
      1. Verify all camera preview cameras have picture from assigned cameras and are labeled as such
      2. Verify program and preview monitors have the correct picture routed to them from production switcher
      3. Verify DDRs, VTRs monitors have picture
      4. Verify aspect ratio is set to 16:9 for native HD signal
      5. Verify monitors are calibrated and color matched

D. Commissioning. Commissioning shall be performed by a combination of the integrator, the manufacturer or a separate commissioning agent retained by the integrator. The following
identifies some, but not all, of the commissioning tasks expected of the commissioning team. This list is not intended to be comprehensive, and should be considered a general guideline for the integrator without a defined commissioning process statement.

1. Cameras and tripods.
   a. Setup camera in accordance with Manufacturer’s procedure
   b. Balance camera and lens on tripod
   c. Confirm presence and proper operation of:
      1. Lens controllers
      2. Tripod feet, spreaders
      3. All cases and carts
      4. Rain slicker(s), if any
      5. Viewfinders and attachments
      6. Batteries and battery chargers
      7. Specified microphones
      8. Specified wireless hardware
      9. Specified camera lighting
   d. Set lens back-focus
   e. Exercise full zoom/focus control on lens
   f. Confirm Remote control panel properly interacts with camera
   g. Confirm tallies function as expected at each CCU and Camera. Provide/plan on green and red tally.
   h. Confirm Intercom connections are balanced and functional; including CCU front panel connections
   i. Confirm program audio connections are properly functioning
   j. Confirm return video functions as appropriate.

2. Time Code
   a. Confirm time code is set to appropriate clock and offset for team/league requirements
   b. Confirm time code is distributed to all devices with time code inputs (including file servers, tape machines, multi-viewers, etc.)
   c. Confirm time code records properly at all devices
   d. Confirm time code does not cross talk into audio or video circuits

3. Computers, Networking, IP and Data
   a. Coordinate IP address for any equipment supplied herein.
      1. Program Gateways
      2. Program subnets
      3. Coordinate subnets and V-lans with other systems including, but not limited to AV, scoring and video displays, and league statistics.
   b. Coordinate firewall and routing configuration if needed between Video Replay and house system
   c. Set all clocks, software and hardware, to listen to local or network NTP server.
   d. If appropriate create auto-logon scripts
   e. Establish logical share names, including, but not limited to, AV, scoring and video displays, and league statistics.
   f. Set startup process to include logging into appropriate services and servers (e.g. establish SQL connection between Character Generator and data service)
   g. Establish a defined back up process and train user
   h. Install all relevant software including, but not limited to:
      1. Clients preference for browser(s)
      2. Word processing, spreadsheet, presentation and general office software
      3. Adobe Acrobat
      4. Software used to control, monitor and troubleshoot any hardware provided herein
      5. Creative/Graphic suites as appropriate
   i. Ghost all boot and configuration hard drives after setup and acceptance, but before the users begin training.
   j. Ghost all boot and configuration hard drives 1 month after acceptance.
   k. KVM Systems
1. Label all source and destinations with meaningful labels (e.g. COMP 15-01 is not acceptable; C15-01; Riedel Director is).

2. As all sources appear on two separately provided KVMs (one by Video Replay and one by Video Scoring Displays) be sure to:
   a) Coordinate labeling
   b) Determine the extent that certain users should be locked out (e.g. not all users should have access to CG keyboard).
   c) Setup a default user environment as to which users can share or just monitor

3. Setup KVM in a training mode, to allow a single user to operate the software, while multiple users can Monitor only the trainer.

4. Connect all data interlinked devices (e.g. CGs, protocol translators, robotic cameras, etc) with their sources using appropriate control routing switcher, patches, distribution devices and the like, Confirm
   1. Baud rate, programming speed
   2. Desired operations are functional and reliable
   3. Interconnection with other systems including, but not limited to, AV, scoring and video displays, and league statistics.

m. Rack and UPS sensors (SENSOR).
   1. Setup all rack and room temperature, humidity and moisture sensors with appropriate alarming, notification, and SNMP alarms.
   2. Setup all UPS alarms with appropriate alarming, notification, and SNMP alarms

4. Intercom
   a. Setup each matrix station with labels as coordinated with the Owner.
   b. Setup each party line circuit with labels as coordinate with owner
   c. Program each matrix user station in accordance with Owner direction for sources and destinations. Unless otherwise noted, user stations of same type and functional use shall be initially programmed identically.
   d. Test each user station to every other station.
   e. Stress test the system under event standards so that users are located at each station and attempt to communicate as they would for the event.
   f. Setup all wireless communication so that talk/listen is available throughout the covered area. Test with high ambient noise conditions.
   g. Balance all users, user station, and intercom sources.
   h. Null all party line circuits
   i. Test Audio Monitoring Paths using the intercom system; verify appropriate gain structure, adjust as required.

5. Audio Phase and Stereo imaging.
   a. Check audio phase from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   b. Check Left/Right pairing from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   c. Set audio levels through each device to each destination, through routing switcher and direct patch for unity gain. Adjust interfacing devices to accommodate level differences that occur. Correct any anomalies.
   d. Use appropriate test tapes and signals and tones to verify playback level of file servers, tape machines and any device with audio playback capability.
   e. 5.1

6. SMATV, IPTV, Broadcast cabling and Sound System interconnections.
   a. Check audio phase from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   b. Check Left/Right pairing from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   c. Set audio levels through each device to each destination, through routing switcher and direct patch for unity gain. Adjust interfacing devices to accommodate level differences that occur. Correct any anomalies.

7. Coordinate proper naming and labeling between video and audio sources and destinations that originate elsewhere including, but not limited to Sound, Broadcast,
MATV, IPTV, Video Display and LED Scoring devices which may be related work. This shall include but not be limited to: common device labels and nomenclature at each end, rack numbering, all routing interfaces.

a. After cables are landed and coordinate verify proper connection with each supplier.
b. Confirm that physical labels correspond to drawing labels and most importantly any alphanumeric control system labels (e.g. Tuner 1 should also be called SAT RX 5 and DIRECTV 7)

8. Production and Routing switcher configurations to Owner/Operator preferences this shall include, but not be limited to:
   a. All equipment settings
   b. Configurations
   c. Software setup
   d. All hardware, button, and software labeling on devices into groups as requested by Owner/Operator.
   e. Routing switcher programming including real and virtual naming configurations, salvo setup and programming and the like.
   f. Audio Routing
      1. Provide appropriate virtual labels for audio sources; building mono, left right pairs as directed by the owner for recording multiple audio sources and/or routing to external locations.
      2. Set gain between exterior ties and the routing system
      3. Verify gain of feeds to and from the PA system, adjust as necessary
      4. Configure MADI routing paths to exterior devices, if MADI interface is present.
      5. Assist user in setting up routing to VCRs and File servers for appropriate game and non-game audio configurations.
   g. Proper Alphanumeric transfer of sources to destinations including under-monitor tally designations, tally and between production and routing switchers. This shall include, but not be limited to:
      1. Multi-viewers
      2. In-monitor tally/under monitor displays whether connected via router or direct to auxiliary bus
   h. Salvos
      1. Establish pre-game and game salvos for all video and audio sources and destinations.
      2. Modify salvos after all event attendance.
      3. Archive each salvo.
   i. Interfaces to other devices for proper operation (e.g. machine and file server control from the production switcher, through a control routing layer, to the end devices).
   j. Tally programming
   k. GPI and/or switcher peripheral setup and control of:
      1. Character Generator(s)
      2. File server(s)
      3. Video Display Processors (which are likely supplied by others)
      4. Routing Switcher
      5. Audio playback devices
      6. Audio Mixers
      7. Cameras and robotics
   l. Setup and configure all protocol converters that may be used between devices including but not limited to:
      1. Different switching systems
      2. Scoring and Video Display systems controllers

9. Video Routing and Multi-image viewing
   a. Using a SMPTE pattern test each check video path from each device to each destination, through routing switcher and direct patch. Correct any anomalies.
   b. With user, determine initial multi-image viewer configuration and layout.
   c. Assign both functional drawing reference and operational naming convention.
d. Video board processors

e. Setup of video processing returns

10. Distribution Gear and Signal Processing. Setup all software remote interface and operation software including but not limited to:
   a. Device labeling corresponding to drawings as well as functional use
   b. Signal path processing and/or interconnection paths as allowable
   c. Set alarm and notifications screens as allowed.

11. Closed Captioning
   a. Setup video and audio routing into and out of the device.
   b. Coordinate connection of the captioning steno machine to the encoder
   c. Set priority on encoder based upon user preference (e.g. local steno override, or is ignored).
   d. Coordinate addressing inputs/outputs from the decoder to scoring and video display.
   e. Setup intercom station to receive a headset only on the 2nd output of the intercom station
   f. Setup listening mix

12. Setup graticule generator, if provided, for proper alignment of video display and sources.

13. Record all software settings and creating appropriate back up records (paper and electronic as appropriate).

14. Confirm all equipment, loose or fixed is on site. Provide written list and confirmation of such. Note that this list may be the same as the serial number list required for closeout submittals.

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 Technical Consultant of test equipment make and model numbers that will be used.
   1. Dual-trace oscilloscope: 100 MHz bandwidth, 1 mV/cm sensitivity, TV trigger.
   2. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A.
   3. Television signal generator: Tektronix
   4. 25 75 ohm, 1 percent resistors.
   5. Video Test Tape for each format VCR. As supplied or recommended by manufacturer.
   6. Provide two portable VHF or 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 recharger along with “holster” for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

3.7 ACCEPTANCE

A. Upon completion of installation and initial tests and report specified in Part 3, acceptance testing shall be performed by the Technical Consultant.

B. Acceptance testing will include operation of each major system and any other components deemed necessary. Installer will assist in this testing and provide any test equipment required specified herein. Installer shall provide at least 1 technician available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the Installer. Testing process is estimated to take a minimum of 3 days.

C. The following procedures will be performed on each System:
   1. Video Signal: From all source inputs (for cameras, character generators, video tape units, etc.) through all VDAs, 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 such that the signal passes through the device in the no processing mode such that unity luminance, chrominance, and signal timing and phasing conditions are achieved.

2. Control functions shall be checked for proper operation, from controlling devices to controlled devices.

3. The audio fidelity test shall consist of driving the system with pink noise and measuring the response in each 1/3 octave band from 40 to 16,000 Hz. Octave, 1/3 octave, or notch filters as specified shall be used to adjust the response as necessary to fit the requirements of the space.

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 quantity.

6. Any other test on any piece of equipment or system deemed appropriate.

D. In the event the need for further adjustment or work becomes evident during equalization and/or acceptance testing, the Installer will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, the Installer will pay for additional time and expenses of the Technical Consultant.

E. The Technical Consultant’s fees and costs involved in acceptance testing are not the responsibility of the Systems Integrator, except as described in Part 3 of this specification.

F. In the event that the Video Scoreboard Control Room is used prior to final acceptance, attendance in support of that usage shall not be construed as acceptance, or as event attendance.

3.8 DEMONSTRATIONS AND TRAINING

A. Manufacturer’s trainers or manufacturer’s authorized or approved trainers to provide operations and service training on the following major equipment components and subject matter to the owner (this is not commissioning):

1. Production Switcher (96 hours; minimum). Submit resume on trainer on this device for approval.
   a. Provide an experienced switcher TD to program macros, custom controls, DVE moves, etc. for first events. This will include consultation on: creative content, programming of content, interfacing to file servers, etc.
   b. Switcher TD is specifically to be experienced in game entertainment production (not just broadcast production), preferably in a sporting facility with unique aspect ratio displays.
   c. It is expected that some of this involvement and time will be in advance to actual on site time and work.
   d. It is expected that trainer will need to attend two (2) games.
   e. Curriculum:
      1. Internal timing adjustments
      2. Normal switcher operations
      3. Use of aux busses with DVE
      4. Programming switcher effects memory
      5. Software configuration for:
         a) DVE
         b) Editor
         c) GPIs
         d) Automation System
         e) Routing Switcher
         f) Camera/robotic interfaces,
g) Other interfaced devices

f. Trainers Daily reports shall be emailed to those being trained, the Technical Consultant, the manufacturer’s training department, the systems integrator and as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

2. Character Generator implementation specialist (60 hours, minimum). Submit resume on implementation specialist on this device for approval.

   a. Provide an experienced CG operator to assist in development and implementation of CG templates. This will include consultation on: creative content, programming of content, interfacing to graphic and statistical systems, etc. Operator shall be experienced with creating IDS based stats templates.

   b. CG implementation is specifically to be experienced in game entertainment production (not just broadcast production), preferably in a sporting facility with unique aspect ratio displays.

   c. CG Operator is specifically to be experienced with database interfacing to IDS Stats, Daktronics DakStats, Statvision, RTD and summary database or other scoring systems (e.g. MLBAM XML; Scorepad, Status Pro, etc.).

   d. It is expected that some of this involvement and time will be in advance to actual on site time and work.

   e. It is expected that trainer will need to attend two (2) games.

   f. No more than 10 hours of this time shall be as traditional CG training; the bulk of the time shall be in assistance of building templates, transitions, 3D effects, clip playout and the like.

   g. Trainers Daily reports shall be emailed to those being trained, the technical consultant the manufacturer’s training department, the systems integrator and as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

3. Clips and Graphic Server(s) (24 hours ON EACH TYPE): Submit resume on trainer on the device(s) for approval.

   a. Trainers Daily reports shall be emailed to those being trained, the technical consultant, the manufacturer’s training department, the systems integrator and as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

4. Routing Switcher Training (24 hours)

   a. Include all costs for trainer and commissioning.

   b. See part 3 of this specification regarding other training considerations.

   c. Specific Issues:

      1. Programming switcher

      2. Programming and using salvos

      3. Interfacing routing switcher to the Tally Interface system with appropriate programming

      4. This training shall be distinct from any time that switcher manufacturer may spend commissioning switcher.

   d. Commissioning will be separate from training.

   e. Trainers Daily reports shall be emailed to those being trained, the technical consultant, the manufacturer's training department, the systems integrator and as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

5. Slow Motion training (24 hours; scheduled in at least two (2) separate sessions separated by 3-6 weeks as determined by owner). Training shall be separate from commissioning.
a. Trainers. Daily reports shall be emailed to those being trained, the technical consultant, the manufacturer’s training department, the systems integrator and as appropriate. The reports should include information required as part of the submittal; as well as detailed information on setup and operational training specific to the project installation. The Daily reports should be cumulative and edited as appropriate during the training duration.

6. Manufacturer’s training should be assumed to take place on the project site, unless agreed to by the owner.

7. Training should be scheduled to be non-overlapping, unless agreed to by the Owner.

8. Actual training schedule shall be by agreement with Owner. Do not assume that training will occur over 8 hour days. It is more likely that training will be scheduled in 2-4 hour increments; perhaps over a period of weeks (or even months).

9. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, commissioning the equipment, then the training time shall be extended an equal amount of time.

10. The following is a general idea of the training “curriculum”:
   a. A general familiarization of the architecture of the device.
   b. An explanation of how the device interfaces to the rest of the Video Scoreboard Control Room (including data connections; timing requirements and the like).
   c. General training on operating the device.
   d. Specific training on device operation (e.g. on the CG, entering statistics; how to access data retrieval sources; how to create repeatable formats and layouts).
   e. Saving information; backing information up.
   f. Basic troubleshooting
   g. Specific troubleshooting (this information may be conveyed to personnel other than the device’s “operators”).
   h. How to upgrade software; precautions taken while doing (e.g. backing-up existing software).

B. Provide not less than 24 hours of “systems operation and maintenance” instruction to Owner designated personnel on the use and operation of the System. This instruction will consist of two portions:

1. A minimum of five separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction.

2. Event Attendance within the following requirements:
   a. Be present at three home games or other events as designated by the owner.
   b. During these events, attendance shall begin at the first crew call and conclude when the crew is released. During these events perform such tasks (e.g. assistance with timing, patching, routing, shading, troubleshooting cabling problems, etc.) as requested by user. Tasks shall be strictly assistance, not operation.
   c. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance, or as event attendance.
   d. Schedule 2 days with team during mid-season to review systems and equipment operation.

3. Coordinate these schedules with the Owner.

- End of Section -
CU BOULDER - SCOREBOARD REPLACEMENT RFP
COORS EVENT CENTER - VIDEO REPLAY VIDEO FUNCTIONAL
February 15, 2012

FUNCTIONAL LEGEND:

- NTSC
- DVI
- COMPOSITE VIDEO OR AUDIO YUV (Y, R-Y, B-Y)
- 3 COAX COMPONENT CONNECTION
- YC - 2 COAX CONNECTION
- SERIAL DIGITAL INTERFACE (SDI)
- RGBHV - 5 COAX CONNECTION
- COMPONENT CABLE; SPECIAL YUV CONNECTION
- JACK CONNECTION
- ETHERNET
- IEEE 1394/FIREWIRE CONNECTION
- NORMAL THROUGH PATCH
- NON-NORMAL PATCH JACK
- FROM TO ANOTHER SHEET / SYSTEM
- FIBER
CU BOULDER - SCOREBOARD REPLACEMENT RFP
COORS EVENT CENTER - VIDEO REPLAY AUDIO FUNCTIONAL

February 15, 2012

AV12-19
19 January 2012

Mr. Steve King
Sink Comb Dethlefs
475 Lincoln Street, Suite 100
Denver, CO 80203

VIA Email: king@sinkcombs.com

RE: University of Colorado Folsom Field Renovations
Introduction to Mechanical Systems Noise Control

Dear Mr. King,

This letter is intended to introduce you to the kinds of HVAC noise issues we will be looking at and the information we will need to perform a complete acoustical analysis at the renovations of the University of Colorado Folsom Field.

Our analysis will be based on ASHRAE’s design guidelines for HVAC-related background sound levels in rooms. Noise criteria for key spaces are listed below in the Design Noise Levels section. Noise is cumulative, and we will consider duct borne noise, noise from diffusers and grilles, and breakout noise from mechanical equipment rooms in our analysis of each space.

Before we can carry out a detailed acoustical analysis of the HVAC system, we require specific information regarding the mechanical equipment. This includes a complete supply and return air duct layout with duct sizes and lengths as shown on plans and any sections or elevations that are available. Sound power data (inlet, discharge, and radiated) will be required for all air handlers and packaged air conditioning units. If mixing boxes will be used in the system, we will need the manufacturer’s model number, design cfm, and pressure differential across the box so that we can determine the sound power levels for these units. In addition, we will need the make and model of diffusers and grilles, the inlet neck size, and the designed maximum cfm to assess their acoustical performance. Attached to this letter is a checklist of all items we will need to perform a complete acoustical analysis.

In addition to the HVAC system, we will be closely analyzing the noise isolation requirements between the service equipment rooms and surrounding sound sensitive spaces. Sound power levels for chillers, boilers, pumps, generators, transformers or other mechanical or electrical equipment will be needed to determine the appropriate partition construction to provide good sound isolation. If manufacturers can provide this information, please forward it along to us for our analysis.

The following are some of the key design issues that are likely to occur on this project.

Design Noise Levels

Our recommended HVAC design noise levels for this project are as follows:

<table>
<thead>
<tr>
<th>Space</th>
<th>Noise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Room</td>
<td>NC 20-30</td>
</tr>
<tr>
<td>Edit Bays</td>
<td>NC 20-30</td>
</tr>
</tbody>
</table>
These recommendations vary based on expectations for the space and how the control and edit spaces will be used. For example, an editing bay where most audio playback will be done through a monitor should have a quieter NC level than if audio playback is through a headset. Further guidance on NC levels will be given as design progresses and the use of the rooms is more clearly defined.

Duct Velocities

The velocity of the air inside the duct is a key factor. Higher velocities cause more turbulence at elbows and other fittings, and turbulence results in noise generation. Therefore, as the air approaches the air-conditioned space, duct velocities are generally reduced, with quieter rooms requiring lower velocities than spaces where noise is not so critical.

Our guidelines for duct velocities are shown below.

<table>
<thead>
<tr>
<th>Duct Velocity</th>
<th>Velocity at Air Terminal</th>
<th>Initial 10 feet Before Terminal</th>
<th>10 to 20 feet Before Terminal</th>
<th>20 to 30 feet Before Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC 20 Supply</td>
<td>300</td>
<td>350</td>
<td>425</td>
<td>550</td>
</tr>
<tr>
<td>NC 20 Return</td>
<td>350</td>
<td>425</td>
<td>500</td>
<td>650</td>
</tr>
<tr>
<td>NC 25 Supply</td>
<td>350</td>
<td>425</td>
<td>550</td>
<td>700</td>
</tr>
<tr>
<td>NC 25 Return</td>
<td>425</td>
<td>500</td>
<td>650</td>
<td>800</td>
</tr>
<tr>
<td>NC 30 Supply</td>
<td>425</td>
<td>500</td>
<td>700</td>
<td>850</td>
</tr>
<tr>
<td>NC 30 Return</td>
<td>500</td>
<td>600</td>
<td>800</td>
<td>950</td>
</tr>
</tbody>
</table>

To further improve laminar airflow conditions at transitions, elbows, and other fittings, and therefore reduce regenerated noise in the mechanical system, the following duct configurations should be considered.
NOISIEST — BETTER — QUIETEST

Figure 1 - Minimizing Regenerated Noise in Elbows

NOISIEST — BETTER — QUIETEST

Figure 2 - Minimizing Regenerated Noise in Takeoffs

NOISIEST — BETTER — QUIETEST

Figure 3 - Minimizing Regenerated Noise in Transitions and Offsets

*Trailing edge length should be at least 3 times the vane spacing.
Sound Attenuators

- At the preliminary design stage, allow for attenuators on both the discharge and intake sides of air handlers. Attenuator length is largely determined by air handler sound power levels and available duct lengths. As a first guide however, allow for 5-foot attenuators on both the supply and return sides of each air handler.

- We will generally size the attenuator cross section so as not to exceed 0.20 in. w.g. pressure drop at the design airflow.

- To achieve an attenuator’s rated performance, both the entrance and the exit of the attenuator must have a laminar flow condition. Therefore, locate attenuators at least 5 duct diameters from an elbow (upstream or downstream) of the air-handler.

- To keep mechanical noise from breaking back into the duct downstream of an attenuator, place attenuators either immediately before, or in the mechanical room wall (or abutting next to it if fire codes are an issue).

Air Diffusers

Air diffusers create a certain amount of self-noise as air passes through them. This noise is in addition to fan or other noise which arrives at the diffuser via the distribution ducts. The “self noise” of a diffuser at different flow rates is usually available as an NC rating from the manufacturer. As a general rule try to select as quiet a diffuser as practicable. In spaces with only a few diffusers (up to 6), each diffuser should be at least 5 points less than the overall room NC rating. In large spaces with many diffusers, each diffuser should be at least 10 points less than the overall room NC rating.

If necessary to reduce the diffuser’s NC rating, reduce the cfm through each diffuser by increasing diffusers’ size or by increasing the number of diffusers handling the total supply air volume to the room.

Never install volume dampers at diffusers. Keep them far enough upstream (at least 6 ft) that laminar flow (or a smooth velocity profile) is obtained well before the air hits the diffuser. Manufacturers rate their diffusers’ noise without obstructions that create turbulent airflow at the blades. Make corrections for estimated off-axis aiming of diffusers as well. The diagrams below illustrate proper and improper airflow conditions at diffusers to maintain the manufacturer’s noise rating.

Figure 4 - Minimizing Regenerated Noise in Duct Tees
Air Handler Vibration Isolation

Correct vibration isolation of the air handlers is a key part of any successful mechanical design. We recommend following ASHRAE guidelines wherever possible.

- Mount fan/motor assemblies on internal spring isolators with appropriate static deflection. The entire air handler casing should be mounted on Neoprene pads; use steel distribution plates where necessary to avoid pinching or overloading pads.

- Suspend connecting piping on spring isolating hangers. If piping must be rigidly suspended from the building, use a flexible pipe connection fitting (such as Mason Industries’ Super-Flex connectors).

- Attach electrical connections using flexible conduit with at least one 90-degree bend.

- Use flexible duct connections and take care that the duct geometry near the unit does not cause excessive air turbulence (see diagram below).
Rooftop Units

- Place rooftop units only over acoustically non-critical areas such as storage rooms, electrical rooms, or stairwells. Any other location will require the installation of a noise control ceiling throughout the rooms below the unit consisting of 2 layers of 5/8” gypsum board hung on isolating hangers.

- Mount the unit on a spring isolation curb with adequate static deflection. The static deflection is a function of roof stiffness and is commonly quite high. The ASHRAE Handbook gives a method for determining this value.

- Place rooftop units only where the roof has adequate vertical stiffness to withstand the unit’s vibration without transmission.

- Provide a good acoustical barrier inside the roof curb below the unit that attenuates the noise radiating off the bottom of the unit. The extent of the barrier needed is a function of the fan’s sound power level but usually includes 6-8 inches of mineral wool insulation with 2 layers of 5/8” gypsum board laid on top and resiliently sealed to the curb and duct penetrations.

- Route enough length of the first supply and return ducts over acoustically non-critical spaces to allow room for adequate attenuation measures (lined duct, plenums, sound attenuators, etc.).

- Use round duct above occupied spaces to reduce duct breakout noise. If adequate vertical clearance is not available split the duct into two or more smaller round ducts.

If the option is available, avoid placing air-handling units on the roof. Place them instead on the ground floor where their vibrations are simpler to control.

Terminal Boxes and Exhaust Fans

- Equipment commonly located in ceiling plenums above occupied areas must be carefully placed. Never place terminal boxes, fan coil units, or exhaust/relief fans above noise sensitive rooms (requiring an NC-35 or less).

- In less sensitive rooms (requiring an NC-40) ensure the radiated noise from the unit results in an NC rating in the room at least five NC points less than is recommended for the room.
example, an open plan office (NC-40) should not have any equipment in its ceiling plenum with a radiated noise rating higher than NC-35.

**Duct Lining**

Concerns have been raised recently regarding possible harmful health effects due to microbial growth or possibly carcinogenic loose fibers. It is generally felt that properly installed duct liner board in a properly designed HVAC system will not cause any adverse health effects.

If lined attenuators or ducts are not permitted, be aware that you will need to place motorized equipment even farther from the rooms served, and budget for packless attenuators, plenums, and other more sophisticated attenuation tools.

More information regarding HVAC noise and vibration control will follow as we get further into our analysis. We appreciate your help in providing information as it becomes available. The timely acquisition of this information will allow us to provide recommendations early enough for you to include them in your design. Our intention is to avoid any costly last minute problems and changes.

If you have any questions, please do not hesitate to contact us.

Sincerely,

**Wrightson, Johnson, Haddon, & Williams, Inc.**

Emily Piersol
Designer

Cc: Tom Falgien  WJHW, Inc.
Data Needed by Acoustical Consultant -- Checklist

The following information is needed from the Mechanical Engineer in order for it to be entered into our ASHRAE based noise calculation program:

- **Sound power data for the fan or air handler** serving the particular distribution system, typically available from the manufacturer or engineer’s in-house fan selection programs. We prefer discharge and inlet type data but can use total sound power levels, or can start with total static pressure, CFM, brake HP, and type of fan, to develop our own estimate. Sound power data should be in octave bands from 63 Hz through 4000 Hz.

- **Dimensions of ducts and fittings** as shown on plans. Sections and elevations are also helpful in determining vertical lengths of ductwork.

- **Whether ducts are lined** (and if the engineer or client will not allow use of internal duct lining at all) and the **lining thickness**.

- If **attenuators** are deemed necessary for sound control, how much **static pressure** can they add to the system? We try to design for the least additional static pressure consistent with adequate noise reduction. We do not want to force a re-selection of the fan. Will packless (no fibrous fill) or poly-bagged fill attenuators be required?

- Knowledge of the **return air path**, ducted or open.

- Sound power data for **Mixing Boxes** (VAV boxes, fan-powered boxes, etc.), if used, at designed maximum airflow. Absent this information, provide the NC level listed by the box manufacturer under designed maximum flow conditions.

- Sound power data or projected NC level of **diffusers/grilles** under maximum flow conditions.

The following is a sample calculation showing (in bold) where the above data is utilized:

### MECHANICAL SYSTEM NOISE CALCULATIONS

<table>
<thead>
<tr>
<th>#</th>
<th>63Hz</th>
<th>125Hz</th>
<th>250Hz</th>
<th>500Hz</th>
<th>1KHz</th>
<th>2KHz</th>
<th>4KHz</th>
<th>ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>96</td>
<td>92</td>
<td>85</td>
<td>84</td>
<td>81</td>
<td>78</td>
<td>74</td>
<td>Auditorium Unit: Trane MCC35, 1620cfm</td>
</tr>
<tr>
<td>2</td>
<td>-1</td>
<td>-6</td>
<td>-11</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>Elbow, lined rectangular, without turning vanes, 54 in. width.</td>
</tr>
<tr>
<td>3</td>
<td>-3</td>
<td>-8</td>
<td>-6</td>
<td>-17</td>
<td>-30</td>
<td>-23</td>
<td>-23</td>
<td>Duct, rectangular metal, lined, 1 in. lining, 46x54, 17 ft. long.</td>
</tr>
<tr>
<td>4</td>
<td>-6</td>
<td>-10</td>
<td>-18</td>
<td>-30</td>
<td>-42</td>
<td>-34</td>
<td>-23</td>
<td>IAC 5' Ms attenuator</td>
</tr>
<tr>
<td>5</td>
<td>-1</td>
<td>-1</td>
<td>-2</td>
<td>-6</td>
<td>-10</td>
<td>-6</td>
<td>-9</td>
<td>Duct, rectangular metal, lined, 1 in. lining, 46x54, 6 ft. long.</td>
</tr>
<tr>
<td>6</td>
<td>-5</td>
<td>-6</td>
<td>-6</td>
<td>-6</td>
<td>-6</td>
<td>-6</td>
<td>-6</td>
<td>Branch take-off ratio: 0.2609</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>-1</td>
<td>-4</td>
<td>-7</td>
<td>-7</td>
<td>-7</td>
<td>-7</td>
<td>Elbow, lined rectangular, with turning vanes, 18 in. width.</td>
</tr>
<tr>
<td>8</td>
<td>-1</td>
<td>-1</td>
<td>-2</td>
<td>-5</td>
<td>-10</td>
<td>-9</td>
<td>-8</td>
<td>Duct, rectangular metal, lined, 1 in. lining, 26x28, 4 ft. long.</td>
</tr>
<tr>
<td>9</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>Branch take-off ratio: 0.1111</td>
</tr>
<tr>
<td>10</td>
<td>-3</td>
<td>-8</td>
<td>-8</td>
<td>-14</td>
<td>-16</td>
<td>-14</td>
<td>-7</td>
<td>Duct, flexible, lined, 14 in. diameter, 5 ft. long.</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>60</td>
<td>94</td>
<td>74</td>
<td>57</td>
<td>dB add: 20 30 35 38 34 31.25, Titus TMS, 24x24, 10&quot;inlet, 400cfm, NC-22</td>
</tr>
<tr>
<td>12</td>
<td>-8</td>
<td>-8</td>
<td>-8</td>
<td>-8</td>
<td>-8</td>
<td>-8</td>
<td>-8</td>
<td>Room Effect / Multiple Diffusers</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>Add for 2 diffusers</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>60</th>
<th>45</th>
<th>31</th>
<th>34</th>
<th>29</th>
<th>26</th>
<th>20</th>
<th>NC</th>
<th>NC-B</th>
<th>RC-M I</th>
<th>RC-M II</th>
<th>dBA</th>
<th>GOAL:</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>27 R</td>
<td>30 R</td>
<td>30 L&amp;H QAI</td>
<td>13</td>
<td>38</td>
<td>NC-25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Partition Construction Details

**Type A (STC 53)**
Single stud configuration using 3-5/8 in. steel studs spaced 16 in. o.c., 3 total layers of 5/8 in. type X gypsum board (2 layers on one side, 1 on the other), and fiberglass or mineral wool insulation in the cavity. We can expect most normal voice conversations to be inaudible; music, especially low frequencies, may be heard.

**Type B1 (STC 55)**
Single stud configuration using 3-5/8 in. steel studs spaced 16 in. o.c., 4 total layers of 5/8 in. type X gypsum board (2 layers on each side), and fiberglass or mineral wool insulation in the cavity. We can expect loud speech to be heard with some effort, but music, particularly low frequencies, may be heard with little effort.

**Type B2 (STC 55)**
8 in. CMU block with recommended grout infill at and one layer 5/8 in. type X gypsum board. Gypsum board should be separated from CMU block with nominal 2 in. wood furring strips spaced 24 in. o.c. Fiberglass or mineral wool insulation should be provided in the cavity. We can expect loud speech to be heard with some effort; low frequencies will be less disruptive than partition type B1.

**Type C (STC 60)**
8 in. CMU block with recommended grout infill and a single stand-alone stud partition. The stud configuration should be separated from CMU block by minimum 1 in. air gap and consist of one layer of 5/8 in. type X gypsum board directly attached to 3-5/8 in. steel studs spaced at 24 in. o.c.; 3 in. thick fiberglass or mineral wool insulation should be provided in the cavity. We can expect loud speech to be essentially inaudible; music may be heard faintly.

**Type D1 (STC 65)**
12 in. CMU block with recommended grout infill and a single stand-alone stud partition. The stud configuration should be separated from CMU block by minimum 1 in. air gap and consist of one layer of 5/8 in. type X gypsum board directly attached to 3-5/8 in. steel studs spaced at 24 in. o.c.; 3 in. thick fiberglass or mineral wool insulation should be provided in the cavity. We can expect loud
speech and music to be essentially inaudible; noisy mechanical equipment may still be heard faintly.

*Type D2 (STC 65)*

8 in. CMU block with recommended grout infill and two stand-alone stud partitions (one on either side of the CMU block). The stud configurations should be separated from CMU block by minimum 1 in. air gap and consist of one layer of 5/8 in. type X gypsum board directly attached to 3-5/8 in. steel studs spaced at 24 in o.c.; 3 in. thick fiberglass or mineral wool insulation should be provided in the cavity on the side of the noise sensitive space (control room or studio). We can expect loud speech and music to be essentially inaudible; noisy mechanical equipment may still be heard faintly.
PARTITION TYPE A
STC 53

5/8" TYPE X GYPSUM BOAF
(2 LAYERS ONE SIDE, 1 LAYER OTHER SIDE)

3–5/8" STEEL STUDS

3" THICK FIBERGLASS OR MINERAL WOOL CAVITY INSULATION

PARTITION TYPE B1
STC 55

5/8" TYPE X GYPSUM BOARD

3–5/8" 25 GAUGE STEEL STUDS @ 16" O.C.

3" THICK MINERAL WOOL CAVITY INSULATION

PARTITION TYPE B2
STC 55

5/8" TYPE X GYPSUM BOARD

8" CMU, BLOCK FILLER PAINTED ON EXTERIOR
(RECOMMENDED OPTION: SAND OR GROUT FILLED)

2" WOOD FURRING STRIPS @ 24" O.C.

2" THICK FIBERGLASS OR MINERAL WOOL CAVITY INSULATION

PARTITION TYPE C
STC 60

5/8" GYPSUM BOARD

3" THICK MINERAL WOOL CAVITY INSULATION

3–5/8" 20 GAUGE STEEL STUDS @ 24" O.C.

1" GAP UNBRIDGED BY STRUCTURE
PARTITION TYPE D1
STC 65

5/8" GYPSUM BOARD
8" CMU
(Recommended option: sand or mortar filled)
3" THICK MINERAL WOOL CAVITY INSULATION
3-5/8" 20 GAUGE STEEL STUDS @ 24" O.C.
1" GAP UNBRIDGED BY STRUCTURE

PARTITION TYPE D2
STC 65

5/8" GYPSUM BOARD
12" CMU, BLOCK FILLER PAINTED ON EXTERIOR
(Recommended option: sand or grout filled)
3-5/8" 20 GAUGE STEEL STUDS @ 24" O.C.
3" THICK MINERAL WOOL CAVITY INSULATION
1" GAP UNBRIDGED BY STRUCTURE