

**HOWARD COUNTY PUBLIC SCHOOLS
PURCHASING DEPARTMENT**

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**ADDENDUM NO. 1
(Total Pages - 40)**

April 12, 2023

Invitation for Bids No. 055.23.B4

**Theatrical House Lighting and Controls for the Wilde Lake HS Auditorium
Opening Date: May 17th, 2023 Time: 10:00 A.M.**

The following shall be incorporated into the captioned solicitation as though included in the original documents issued.

The Board of Education authorizes the following changes, clarification and/or attachments to the solicitation documents; however such changes shall not relieve the firm of their responsibilities as otherwise required by the solicitation documents.

Questions

1. Question : It would appear that section 26-0923 that is listed in the table of contents is missing?

Answer: You are correct. This section was left out in error, and we have attached it for your review in this Addendum.

Attachments

1. New Document Section 26-0923. Please include with original Division 01 – 29 section

Note: It is the bidder's sole responsibility to monitor the HCPSS Purchasing website to ensure that they download any additional addendums or clarifications prior to submitting their bid or proposal and duly acknowledge receipt of and full understanding of said addendums on the proper bid submittal form. Failure to do so may result in non-receipt of important information prior to the closing date and may render the bid or proposal non responsive and ineligible to award. It is highly recommended that the submitting bidder ascertain if they have received all the addendums posted prior to submitting their bid/proposal. Failure of any bidder to obtain any such addendum or interpretation shall not relieve the bidders company from any obligation under his/her proposal as submitted.

SECTION 26 0923

LIGHTING CONTROL SYSTEMS

PART 1 GENERAL REQUIREMENTS

1.1 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Work of these Specifications is applicable to the Jim Rouse Theatre for the Performing Arts Theatrical House Lighting Controls project.
- C. Work in this section includes a new architectural lighting control system for integrated control of new house lighting fixtures and existing theatrical lighting.

1.2 WORK INCLUDED

- A. Furnish all labor, materials, and equipment to uninstall existing house lighting control systems equipment and install new lighting control systems as shown on the Drawings and described in these Specifications.
 - 1. Provide an Existing Conditions Site Inspection (or Inspections, as necessary) within three (3) weeks of project award to inspect and document existing conditions in the Jim Rouse Theatre.
 - a. All dimensions on the Drawings are to be Contractor-verified in the field.
 - b. Issue a formal request for information (RFI) for any inconsistencies, conflicts, or potential problems discovered during the Existing Conditions Site Inspection(s).
 - 2. Provide labor to carefully uninstall all existing house lighting systems equipment as indicated on the Drawings and in coordination with the Owner.
 - a. Decommission all electronics not intended to be reused in the new house lighting control system;
 - b. Decommission existing house lighting dimmer panels;
 - c. Perform modifications to electrical infrastructure (conduits and boxes) and cabling over 100V (high voltage) as required and as indicated on the Electrical Drawings;
 - d. Unmount existing house lighting dimmer panels, existing control processor (auxiliary control unit), and exposed cabling;
 - e. Uninstall all low voltage house lighting controls and lighting control connector plates;
 - f. Uninstall all cabling below 100V (low voltage);
 - 3. Turn over all decommissioned house lighting systems equipment (e.g., dimmer panels) to the Owner in good working order.
 - a. Note the Owner needs the existing dimmer panels for maintenance and for use as spares elsewhere in the School.
 - 4. Coordinate with the Owner to turn over or dispose of decommissioned lighting equipment as directed.
 - 5. New lighting system equipment provided as part of the renovation shall be new, unused, and of the latest design.
- B. Provide design and engineering as needed to configure the lighting control system to provide the functional features described in these Specifications and as requested by the Owner as part of the final system adjustment and set-up.

- C. Coordination:
1. Electrical.
 - a. House Lighting: Control of house lighting fixtures (architectural lighting) shall be integrated into the lighting control system by the Contractor.
 - 1) The Contractor is to furnish equipment and program the architectural lighting control processors as per applicable Code requirements, the sequences of operation on the Electrical Drawings, and other Division 26 Specifications (See Related Work, below). See Electrical Drawings and other Division 26 Specifications for additional lighting system programming/commissioning requirements.
 - b. Theatrical Lighting:
 - 1) House lighting fixtures (architectural lighting) shall be controlled only from the Owner's existing theatrical lighting control console during performances, when the lighting control system is in 'Show Mode.'
 - 2) Provide time/labor to help the Owner's Technical Personnel configure the existing theatrical lighting control console to communicate with the new lighting control system via Ethernet (sACN).
 - 3) The Owner's existing theatrical lighting fixtures shall be controlled from the new architectural lighting control system when the Theatre is not being used for performances, when the lighting control system is NOT in 'Show Mode.'
 - 4) Coordinate DMX addresses and control processor programming with the Owner to provide the desired control of theatrical lighting from architectural lighting control stations.
 2. Control System Programming:
 - a. The lighting control system custom graphical user interface (GUI) is vital to the success of the lighting system and its acceptance by both technical and non-technical End Users that will be using the system.
 - b. The Contractor is to schedule a programming meeting with the Owner and the Owner's technical staff within two (2) weeks of Contract Award notification to determine requirements for the lighting control system, to include functions and capabilities, one-button presets, GUI design requirements, and specific operational requirements.
 - 1) The Contractor shall provide an overview of the new architectural control system's features and capabilities so that the Owner can get the most out of the programming meeting and advise on programming requirements to meet their specific needs.
 - c. The Contractor is to allot a minimum of forty (40) hours dedicated to software programming time by a specialist certified by the manufacturer for programming and commissioning of the architectural lighting control system being provided. If the Contractor does not have this capability, the Contractor shall sub-contract these Services to a qualified Contractor as part of their Work, identifying the sub-contract organization name and qualifications as part of the Bid document submission.
- D. Provide four (4) site visits during the Warranty period to maintain lighting control systems equipment and to reprogram lighting systems to affect changes in the operational features as requested by the Owner.
- E. Provide two (2) identical training sessions of minimum four (4) hours duration to accommodate Owner and Technical Personnel staff schedules in the operation and maintenance of the lighting control systems.

1.3 DEFINITIONS

- A. The term “furnish” means to supply and deliver to the job site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. The term “install” is used to describe operations at the job site including the actual anchoring, applying, assembling, cleaning, curing, cutting, erection, finishing, patching, placing, protecting, pulling, terminating, unloading, unpacking, working to dimension, and similar operations that will render the systems complete and ready for the intended use.
- C. DMX: Digital Multiplexing.

1.4 RELATED WORK

- A. Related Sections include the following:
 - 1. 26 0101 “Electrical General Provisions”
 - 2. 26 0500 “Common Work Results for Electrical”
 - 3. 26 0501 “Excavation and Fill for Electrical Work”
 - 4. 26 0504 “Electrical Demolition”
 - 5. 26 0519 “Wires and Cables”
 - 6. 26 0526 “Grounding and Bonding”
 - 7. 26 0533 “Conduits”
 - 8. 26 0534 “Boxes”
 - 9. 26 0553 “Identification for Electrical Systems”
 - 10. 26 5100 “Interior Lighting”

1.5 QUALIFICATIONS

- A. The Installing Contractor for the systems and equipment specified herein must specialize in the installation of theatrical lighting control systems.
- B. The Contractor shall have a minimum five (5) years of experience in engineering, installation, adjustment, and servicing of theatrical and architectural lighting systems similar to those described in these Specifications. The Contractor shall have full-time, skilled technicians who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and best industry practices for the proper installation of the work.
- C. The Contractor shall have been authorized dealers or representatives of the manufacturers of the primary components for a minimum of two (2) years.
- D. Where a manufacturer of a primary component offers factory training in the configuration and use of that component, the Contractor is to have received that training.
- E. The Contractor shall maintain and operate shops for the integration and service of the system components.
- F. No sub-contracting work is permissible unless the Sub-Contractor is named and included as part of the Bid. All terms and requirements as specified herein apply to the Sub-Contractor. The right is reserved to reject the proposed Sub-Contractor based on the terms stated herein.
- G. Network Specialist:
 - 1. The Contractor shall have a network specialist – certified by the manufacturer of the lighting systems equipment to install and configure lighting networks – dedicated to this project during the commissioning phase.

1.6 SUBMITTALS

- A. Contractor Approval: Prior to contract award, the apparent low bidding Contractor shall submit information listed below to verify that the Contractor has the necessary experience and qualifications to perform the specified Work.
1. Descriptive Materials: A detailed brochure describing the firm capabilities in terms of facilities, personnel experience background, examples of similar installations, and financial capability.
 2. References: Names and telephone numbers of individuals who may be contacted, showing satisfactory completion of at least two (2) lighting systems installations similar in scope and complexity within the past two (2) years to the lighting systems described in these Specifications.
 3. Line Card: A "line card" identifying manufacturers who have approved the Contractor as being factory-authorized to install and service their products.
 4. Bonding: Evidence that the Contractor satisfies the project bonding requirements to perform the specified Work.
 5. Warranty: Information on how the Contractor shall fulfill the requirements of the Warranty period.
- B. Product Data
1. Prior to installation, submit a complete list, in the same order and format as the equipment listing in these Specifications, of all equipment to be provided. For each equipment item, include Manufacturer's name and equipment model number. Include accessories or auxiliary equipment required or intended to be provided even if not explicitly listed in these specifications.
 2. Collect Product Data into a single submittal and organize by element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, performance curves, and photometric data. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."
 3. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with recognized trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
 - g. Material Safety Data Sheets (MSDS) for each product.
 - h. Catalog or data sheets indicating all component manufacturer's names, model numbers, and performance data, where applicable.
- C. Shop Drawings
1. Provide Submittals in accordance with Division 1.
 2. Show information necessary to explain fully the design features, appearance, function, fabrication, installation, and use of the system components in all modes of operation. Include the following at a minimum:
 - a. Signal, control, and power Block Diagrams detailing equipment, faceplates, interconnecting wires with unique identification labels, terminating devices (connectors or terminal strips), and multi-conductor wiring. Describe functional capabilities that are software programmable or configurable within control processors.

- b. Faceplate fabrication Drawings detailing devices, finishes, and engraving.
- c. Mounting details:
 - 1) Plans and elevations showing layout of new and existing lighting systems equipment on the Catwalk and indicating clearances.
 - 2) Details showing mounting of new lighting systems equipment on the Catwalk, including supplemental structure (strut channels, etc.) required to adequately support the equipment.
- d. Programmable Control Panels: Provide the items listed below in a separate submittal after programming meetings with the Owner and Technical End Users have confirmed GUI requirements and the proposed programming has been signed-off on by the Owner.
 - 1) Drawings printed in color showing graphical user interface (GUI) screen images intended to be used for touch screen control panels.
 - 2) Narrative description of how control panel will function for each control panel.
 - 3) Logical control flow (tree) diagram for each control panel.
 - 4) Schedule listing user / login types intended to be provided at each touch screen control panel location and indicating capabilities allowed for each user / login type. A unique access code shall be provided for each user / login type and shall be coordinated with the Owner.
- 3. Do not commence fabrication, installation, and erection until Shop Drawings have been approved by the Engineer.
- 4. Provide uniformly sized sheets in the Submittal.
- 5. Include a title sheet listing sheets in the Submittal.
- 6. Include manufacturer-published information sheets of proposed equipment intended to be provided as part of the project.
- 7. Perform a field survey to confirm proposed infrastructure modifications are adequate to support the installation of theater rigging and lighting systems as described in these specifications and note any areas of concern in a Request for Information.
- 8. Perform a field survey at the project site to confirm all applicable dimensions affecting the installation of lighting systems equipment. Note any possible conflicts to the lighting system installation, or areas of concern in a Request for Information.
- D. Miscellaneous: Prior to installation, submit copies of documentation listed below.
 - 1. Bid Addenda: A written statement acknowledging receipt of all bid addenda.
 - 2. Regulatory Requirements: Copies of licenses, permits, or other local jurisdictional approvals obtained by the Contractor to perform the specified Work.
 - 3. Test Plan: Description of tests to be performed on the lighting systems.
 - 4. Training Plan: Description of lighting systems training and instruction sessions to be provided to the Owner.
- E. As Built Drawings:
 - 1. Include all information submitted in the shop drawings and initial settings.
 - 2. Provide one (1) sets hard copy.
 - 3. Provide one (1) electronic set of As Built Drawings in DWG file format.
 - 4. Provide one (1) electronic set of As Built Drawings in PDF file format.
- F. Operation and maintenance manuals, PDF file format with sectioned tabs, including the information listed below.
 - 1. Table of contents.
 - 2. Equipment Manufacturer's catalog sheets, operating instructions, and service information.
 - 3. Operating instructions prepared by the Contractor for each subsystem describing the functions, operation, and maintenance written in language for comprehension by non-technical people.

4. Troubleshooting guide prepared by the Contractor for lighting systems listing the procedures to follow in the event of equipment failure, written in logical outline form.
5. Illustrative drawings to include lighting systems wiring diagrams, connector and cable location plans, log for tagged system connectors and cables, and as-built record drawings.
6. Copies of lighting systems operational software and documentation.
7. Copies of software files in editable file formats noting software application version required.
8. Results of lighting systems commissioning tests and safety inspections.
9. Equipment Inventory listing every item furnished or provided that includes the following information:
 - a. Item Description (i.e., "Lighting Control Processor")
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Firmware Version (where applicable)
 - f. Quantity (If not given a serial number, IP, or MAC address)
 - g. Mac Address (if applicable)
 - h. IP Address or "DHCP" (if applicable)
 - i. Computer Name (for Owner Furnished Computers)

1.7 QUALITY ASSURANCE

- A. **Manufacturer:** A firm who has been continuously engaged in the production of architectural and theatrical lighting control equipment for at least fifteen (15) years and in the manufacture of theatrical dimming systems and dimmers for a minimum of ten (10) years.
- B. **Latest Equipment:** The Contractor is to provide the latest models or versions of equipment specified at time of Bid.
- C. **Equipment Control Software:** Adjustment or programming of lighting system control software shall be performed by Contractor personnel who have received factory training in the control software, otherwise adjustment and programming shall be performed by the Manufacturer.

1.8 EQUIPMENT SUBSTITUTION

- A. **Basis of Design:** Certain items of equipment are specified by manufacturers' model numbers to indicate an acceptable standard of quality and performance ("Basis of Design"). Proposed substitutions for lighting control systems equipment shall be considered as long as such substitutions provide a level of performance and functionality equal to or better than the equipment or items listed as "Basis of Design" described in these Specifications.
- B. **Equipment Substitution Documentation:** For each proposed "Basis of Design" equipment substitution, the Contractor shall submit for review the materials listed below.
 1. **Product Literature:** Manufacturer's product literature with a complete listing of the proposed substituted equipment operational characteristics and performance parameters.
 2. **Product Differences:** A complete listing of the operational and performance differences between the specified and the proposed substituted equipment.
 3. **Installation Differences:** A complete listing of changes to electrical wiring accompanied by interconnection block diagrams showing the changes required in related equipment or a statement that no changes are required, whichever is applicable.
 4. **Pricing:** The price differential between the specified and proposed substituted equipment.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. **Delivery:** Deliver lighting control systems equipment, including equipment racks fabricated in the Contractor's shop, cardboard-wrapped or crated to provide protection during transit and job

storage.

- B. Acceptance at Site: Contractor shall accept and inventory all equipment upon delivery and provide copies of the inventory to the Owner.
- C. Site Storage: Store lighting control systems equipment at the building site under cover and away from sources of moisture. Place boxes on minimum 4-inch-high wood blocking. Provide minimum ¼ inch spacers between stacked boxes to permit air circulation. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber. If packaging becomes wet, immediately remove equipment from cartons.
- D. Thermal Conditions: The temperature and humidity conditions within the storage area shall not be lower than 45°F and 20 percent relative humidity or higher than 90°F and 80 percent relative humidity.

1.10 WARRANTY

- A. General: Warranties specified herein shall not deprive the Owner of other rights covered by other provisions of the Contract Documents and will be in addition to, and run concurrent with, other warranties made by the Contractors under requirements of the Contract Documents.
 - 1. Warranty Terms: The Warranty shall be written and executed by the lighting control systems equipment Manufacturer and Contractor agreeing to adjust, repair, or replace equipment that fail in materials or workmanship (including installation workmanship) within a two-year period from the date of Final Acceptance. Replace items as required above within thirty (30) days after notification. Make replacements without cost to the Owner.
 - 2. Manufacturer's Authorization: The Contractor shall be authorized by the lighting control systems equipment Manufacturer, or have subcontractor arrangements with Others, to execute the Manufacturer's equipment Warranty.
- B. Warranty Period: Manufacturer's standard warranty but not less than 2 years after date of Final Acceptance.

PART 2 PRODUCTS

2.1 INTELLIGENT BREAKER PANEL (RELAY PANEL RP-1)

- A. General
 - 1. Breaker Panels shall be UL508, UL67, and UL924 Listed, and shall be so labeled when delivered.
 - 2. Breakers shall be UL489 listed and shall be labeled when delivered.
 - 3. Breaker Panels shall consist of a main enclosure with 12, 24, or 48 pole breaker subpanels, integral control electronics for low voltage terminations and provision for accessory cards.
 - a. Up to three accessory cards shall be supported per breaker panel
- B. Mechanical
 - 1. The panel shall be constructed of 16-gauge galvanized steel. All panel components shall be properly treated or finished in fine-textured, scratch resistant paint
 - 2. Breaker panels shall be capable of being mounted on the surface of a wall or recessed mounted
 - 3. Breaker panels shall be available in 12, 24, and 48 pole configurations
 - a. 12 pole MLO (No provision for main Breaker)
 - 1) 31 inches high, 14.25" wide and 4" deep (with front panel attached)

- b. 12 pole (with provision to add main breaker)
 - 1) 40.25 inches high, 14.25" wide and 4" deep (with front panel attached)
 - c. 24 pole (with provision to add main breaker)
 - 1) 50.25 inches high, 14.25" wide and 4" deep (with front panel attached)
 - d. 48 pole (with provision to add main breaker)
 - 1) 64 inches high, 20" wide and 5.25" deep (with front panel attached)
 - 4. Choice of panel covers shall be available for surface or recess mount applications. This outer panel shall ship complete with a locking door to limit access to electronics and breakers
 - a. Optional center-pin reject security screws shall be available for all accessible screws
 - b. Optional recess mount doors shall extend 1" beyond all panel edges to hide wall cut-out
 - 5. The unit shall provide interior cover over the control electronics and accessory cards to allow access only to class 2 wiring and prevent direct access to class 1 line voltage components
 - 6. The panel shall support up to twelve, twenty-four, or forty-eight single pole branch circuits
 - a. Branch circuits shall range from 15A to 30A capable of holding full rated load for minimum of three hours continuously.
 - b. Two and three-pole circuits shall be supported at decreased density where each pole constitutes one of the available single-pole circuits. Mixing of circuits in any combination shall be supported.
 - 7. Breakers shall provide manual switching control while power is unavailable to the panel such that critical lighting can be set to an on state, without the need for power to the panel.
 - 8. Breaker output lugs shall accept 10-14 AWG dual conductor wire.
 - 9. Breaker output lug shall support solid or stranded 6-14 AWG class B, C, or K copper wire.
 - 10. Control wiring for DMX, station bus, and Emergency input terminations shall land on removable headers for contractor installation.
- C. User Interface
 - 1. The user interface shall contain an LCD display with button pad to include 0-9 number entry, up, down back arrow navigation and enter
 - 2. Test shortcut button shall be available for local activation of preset, sequence and set level overrides
 - 3. The user interface shall have a power status LED indicator (Blue), a DMX status LED indicator (Green), a network status LED indicator (Green) and an LED indicator (red) for errors
 - 4. Interface shall allow the backlight to timeout and shall provide user editable options to shut off backlight completely as well as adjust screen contrast
 - 5. Ethernet interface (when installed) shall default to automatic IP through link local and DHCP. Upon receiving IP address, the address of the Network Interface Card (NIC) shall display in the about menu. Static address and settings shall also be possible
 - 6. The control interface shall support a USB memory stick interface for uploads of configurations and software updates
- D. Functional
 - 1. Panel setup shall be user programmable. The control interface shall provide the following breaker setup features (per circuit):
 - a. Type (1 pole, 2 pole, or 3 pole)
 - b. Name
 - c. Circuit Number

- d. DMX address
 - e. sACN address (network enabled panels only)
 - f. Space Number
 - g. Circuit Modes
 - 1) Normal (priority and HTP based activation and dimming)
 - 2) Latch-lock
 - 3) Fluorescent
 - 4) DALI
 - h. On threshold level
 - i. Off threshold level
 - j. Include in UL924 emergency activation
 - k. Allow Manual
2. Breaker panels shall support discrete addressing of each breaker. Panels that are restricted to use of start address with sequential addressing, and cannot assign each 0-10V output control to any internal circuit shall not be acceptable
 3. The panel shall be capable of switching 6 poles on or off at once, or in a user-selectable delay per breaker using a period of 0.1 to 60 seconds, in 0.1 second increments
 4. Control electronics shall report the following information per branch circuit:
 - a. Breaker state (On/Off)
 - b. Breaker state (Open/Closed)
 - c. Current draw (In Amps)
 - d. Voltage
 - e. Energy usage
 5. Built in Control shall include:
 - a. Ability to record up to 16 presets in each space from the control panel, connected control stations, or timed events
 - b. Presets shall be programmable by recording current levels (as set by DMX or connected control stations), by entering levels on the control panel directly, manually selecting breaker state on each breaker, or a combination of these methods. From the control panel, stations, or timed events it shall be possible to record values for up to 16 zones per space
 - c. Up to 8 spaces in a single rack for total of up to 16 spaces shall be supported per system or system subnet
 - d. Indication of an active preset shall be visible on the control panel display
 - e. One 16-step sequence per space for power up and power down routines
 - f. The panel shall have a UL924-listed contact input for use in Emergency Lighting systems. The panel shall respond to the contact input by setting included breakers to "on", while setting non-emergency breakers "off". Each breaker can be selected for activation upon contact input
 - g. Upon Data loss the system shall provide options to hold last look infinitely or hold for a configured time period set by the installing technician then fade/switch to the input of the next available priority
 - h. Control electronics shall respond directly to control stations for zone, preset, and sequence control. Systems that require secondary control systems for this functionality are not acceptable
 - i. After power loss, electronics shall be capable of holding the system in its previous state until new level data (DMX, architectural presets, sequences and zones, or local overrides) is received to make each breaker change state
 6. The control of lighting and associated systems via timed and Astronomical clock controls
 - a. The breaker panel shall allow the activation of presets, sequence, and zone

- programming of up to 50 time clock events via a built in real and astronomical time clock
- b. System time events shall be programmable via the control panel
 - 1) Time clock events shall be assigned to system day types. Standard day types include: everyday, weekday, weekend, Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday
 - 2) Time clock events shall be activated based on sunrise, sunset, time of day or periodic event
 - 3) System shall automatically compensate for regions using a fully configurable daylight saving time
 - 4) Presets shall be assigned to events at the time clock
- c. The time clock shall support event override
 - 1) It shall be possible to override the timed event schedule from the face panel of the time clock
- d. The time clock shall support timed event hold
 - 1) It shall be possible to hold a timed event from the face panel of the processor
 - 2) Timed event hold shall meet California Title 24 requirements
- 7. The panel shall receive ESTA DMX512-A control protocol. Addressing shall be set via the user interface button keypad with any circuit patched to any DMX control address
 - a. 2,500V of optical isolation shall be provided between the DMX512 inputs and the control electronics as well as between control and power components
 - b. The breakers shall respond to control changes (DMX or Stations) in less than 25 milliseconds. DMX512 update speed shall be 40Hz
 - c. Setting changes shall be able to be made across all, some, or just one selected breaker in a single action from the face panel
 - d. DMX data loss shall allow for levels/breakers to be held for ever or for a specified time before switching to a lower priority source
 - e. Initial Panel setup
 - 1) The breaker panel shall automatically detect the type of breaker or dimmer installed in each location without need for manual configuration of the physical arrangement
 - 2) Quick rack setup shall be available to apply address settings across all circuits for rack number, DMX Start Address, sACN universe, and sACN start address
 - 3) Emergency Setup Menu shall provide optional delays when emergency is activated or deactivated, and option to turn off non-emergency circuits shall be available. Record function shall allow circuits that are turned on to be added to the emergency setting

E. Electrical

- 1. Breaker Panels shall be available to support power input from:
 - a. 120/208V three phase 4-wire plus ground
 - b. 120/240V single phase 3-wire plus ground
- 2. Conduit Entry:
 - a. Feeders:
 - 1) Top or upper 6" of either side
 - 2) Bottom or lower 6" of either side
 - 3) Feeders shall enter through the top or bottom according to the orientation of the enclosure.
 - 4) Feeder entry shall be nearest to the location of the feeder lugs or main breaker.

- b. Load:
 - 1) Load wiring shall enter through the top or bottom of the enclosure through the surface nearest to the breaker sub panel
 - 2) Load wiring may also enter through left and/or right side provided a low voltage chase is not required through the same area. If class 2 chase is required, a field installable barrier panel shall be provided upon request. The side of the panel where the barrier has been installed shall not permit load wiring
- c. Low Voltage:
 - 1) Top or upper 6" of either side
 - 2) Bottom or lower 6" of either side
 - 3) For low voltage conduit entry at the breaker end of the cabinet, conduits shall be located at the outer 3" of the top/bottom panel
- 3. Breaker
 - a. Bus connection type: Stab on
 - b. 1, 2, or three poles
 - c. UL489 listed
 - d. 15 amp, 20 amp, or 30 amp
 - e. 22,000 SCCR; 65,000A series rated with main breaker
 - f. High inrush trip curve (matches all Sensor breakers)
 - g. Maintains trip curve through entire thermal range
 - h. Guaranteed not to trip at full load
 - i. Load lugs accept 6-14awg load wiring
 - j. Multi-conductor listed output terminal
 - k. Integral mechanically held air gap relay
 - l. Manual control of relay state using breaker handle w/o power
 - m. Integral current sensing
 - n. Integral position and trip sensing
 - o. Control and status provided by contact pads directly at bottom of the breaker case
 - p. No external wires or connections required for control or feedback
 - q. The breaker shall be capable of switching up to 30A
- 4. The breaker panel shall support a maximum feed size
 - a. 100 Amps at 12 circuits
 - b. 200 Amps at 24 circuits
 - c. 400 Amps at 48 circuits
- 5. Breaker panels shall support main circuit breaker options:
 - a. Main breaker options shall be optional and available for purchase upon request
 - b. Main breakers shall be field installable
 - c. Main breakers shall be available in up to 100 Amps for 12 circuit panels, up to 200 Amps for 24 circuit panels, and up to 400A for 48 circuit panels at 120V
 - d. Series SCCR ratings apply as follows with appropriate main breaker:
 - 1) 22,000A or 64,000 at 120/208V
 - e. Main breakers shall allow the following range of wire sizes:
 - 1) Up to 300kcmil at 100A and 200A
 - 2) Up to 2x250kcmil at 400A
 - f. Main Lug input shall support up to 2x250kcmil
 - g. Breaker panel shall support a 500kcmil main lug option for 48-circuit panels
 - h. Breaker remote switching ratings
 - 1) Mechanical 1,000,000 cycles

- 2) 24A Resistive 100,000 cycles
 - 3) 16A Ballast (HID) 75,000 cycles
 - 4) 15A Electronic (LED) 100,000 cycles
 - 5) 15A Tungsten 45,000 cycles
 - 6) 30FLA; 180 LRA Motor Load 50,000 cycles
 - 7) Tested duty cycle: 12 operations (6 cycles) per minute
 - 8) Decreasing duty cycle significantly increases switch life
 - 9) Isolation: 4000V RMS
 - 10) Current reporting accuracy: 5%
 - 11) Latching state mechanical relay
6. Breaker Panel Accessories
- a. An Ethernet option shall provide advanced control of relays over streaming ACN (sACN) and transmit status, control override, and measured energy usage per branch circuit to a web browser based or central monitoring interface
 - b. A low voltage 0-10V dimming option shall provide up to 24 0-10v control outputs that are linked to relay circuits within the panel. Each output shall support up to 400mA of current sink per output
 - c. A contact input option shall provide 24 dry contact inputs to be linked for direct or group relay control, to activate a preset, or to activate a sequence. Controller software shall allow for normally open maintained, normally closed maintained, or momentary toggle
 - d. A DALI control option shall provide 24 control loops of broadcast DALI control, with each loop controlling up to 64 DALI devices
 - e. A RideThru option shall provide short-term power backup of control electronics by automatically engaging when power is lost, and recharging when normal power is present
 - f. An Isolated Ground option shall provide each circuit in the panel with a ground terminal that is electrically isolated from the equipment ground
 - g. Main Breaker options shall be available as shown in Section E.4
- F. Thermal
1. The panel shall be convection cooled. Panels that require the use of cooling fans shall not be acceptable
 2. The panel shall operate safely in an environment having an ambient temperature between 32°F (0°C) and 104°F (40°C), and humidity between 5-95% (non-condensing).
- G. Provide one (1) 12-circuit intelligent breaker panel with network interface option card, recessed door, and 3-phase normal power tap kit equal to Sensor IQ12 as manufactured by ETC, Inc.

2.2 EMERGENCY LIGHTING TRANSFER SYSTEM

- A. General
1. The Emergency Lighting Transfer System (ELTS) shall provide automatic transfer of branch circuits from normal to emergency power when normal power fails. Each system shall consist of power transfer switches and a control circuitry interconnected to provide complete, automatic protection.
 2. The ELTS shall transfer designated lighting load branch circuits from dimmers or secondary control outputs to a second power source in the event of a loss of power to the dimmer rack, a normal system failure, or activation of fire alarm.
 3. The system shall comply with ANSI / UL1008 Transfer Switch Equipment, ANSI / NFPA 110 Standard for Emergency and Standby Power Systems, and ANSI / NFPA 70 (NEC), including Article 700, 701 and 702 safety standards. Emergency transfer systems that do not comply with the below stated NEC articles and sections shall not be permitted

- a. Satisfies requirements of the National Electrical Code (NFPA 70):
 - 1) Article 700 – Emergency Systems
 - 2) Article 701 – Legally Required Standby Systems
 - 3) Article 702 – Optional Standby Systems
 - 4) Section 518.3(C) – Assembly Occupancies
 - 5) Section 520.7 – Theatres and Similar Locations
 - 6) Section 540.11(C) – Motion Picture Projection Rooms
4. Emergency Transfer equipment shall comply with the US seismic requirements of the International Building Code (IBC) for equipment in the emergency life-safety chain and be approved for seismic applications. Seismic certification shall include installation applications for Roof, Grade, Below Grade, and Intermediate Level installation in the USA with an Ss level of 3.42 and SDS level of 2.28. Emergency transfer equipment that does not meet or exceed the seismic acceptance criteria for non-structural components and systems per the applicable building code or as set forth in the ICC AC-156 shall not be acceptable.
 - a. The following building codes are addressed under this certification.
 - IBC 2000 – referencing ASCE 7-98 and ICC AC-156
 - IBC 2003 – referencing ASCE 7-02 and ICC AC-156
 - IBC 2006 – referencing ASCE 7-05 and ICC AC-156
 - IBC 2009 – referencing ASCE 7-05 and ICC AC-156
5. The ELTS shall be a self-contained system for up to 24 circuits at 20 amps and available for single or three phase power (120/208V, 120/240V or 277/480V). The unit shall be available with either discrete emergency branch circuit feeds from an external circuit breaker panel (by others) or emergency main feed with built-in branch circuit distribution and over current protection.

B. Transfer Switch

1. The switch shall be a UL 1008 LISTED, electrically operated and mechanically held (maintained) transfer switch.
2. The switch shall be positively locked and unaffected by voltage variations or momentary outages so constant contact pressure is maintained and temperature rise at the contacts is minimized.
3. The switch shall be mechanically interlocked to ensure only one of the two possible positions, either Normal or Emergency.
4. Each switch shall be configured as guaranteed break-before-make
5. Built-in fuses shall provide up to 65000A Short Circuit Current Rating (SCCR) on connected emergency circuits.
6. Built-in fuses class G shall be provided on each output for compliance with NEC Section 700.27 Coordination – larger upstream breakers cannot be tripped by downstream branch circuit faults.
7. Switch contacts shall withstand transfer without welding, with 180° phase displacement between Normal and Emergency power sources, both sources energized and with 80% load.
8. Transfer switch contacts shall be rated for mixed loads, including electric discharge lamps and tungsten filament lamps.
9. Transfer switches shall be rated for 6000 cycles at full tungsten load.

C. Control Circuit

1. The control circuitry shall direct the operation of the transfer switch.
2. User configurable timing delays shall be provided for power transfer between:
 - a. loss of normal power and the transfer to emergency up to 10 seconds.
 - b. restoration of normal power and the transfer from emergency back to normal power

up to 60 seconds.

3. A normally closed dry contact closure fire alarm input shall be provided.
4. Transfer switch shall support connections for up to 5 Remote Stations which can manually switch between normal and emergency power.

D. Operation

1. Transfer to alternate supply will occur when normal supply voltage drops below 80V when used at 120V, or 185V for the A phase and 80V for the B and C phase when used at 277V.
2. A self-supervising isolated signal input shall be provided for connection to the facility fire alarm. The ELTS2 shall automatically transfer the loads to the Emergency power source when the facility fire alarm is activated as part of a normally-closed loop.
3. A key-operated switch shall be provided to manually control the ELTS2. All automatic functions shall override this control. Two indicator lights shall be provided to show the position of the transfer switch.
4. All automatic functions shall override remote control functions. Any combination of open or shorted wiring to remote stations shall not affect automatic functions, or disable the local switch.

E. Remote Stations (Optional)

1. Optional remote control stations shall be available for the ELTS2. Each remote control station shall contain a 3-position key switch. The left and right positions shall be momentary and the switch shall always return to the center position.
2. The faceplate shall be labeled Normal for the left switch position, Emergency for the right switch position and Auto for the center position.
3. The faceplate shall contain two LEDs to confirm transfer switch position.
4. Each remote station shall mount in a standard, two-gang wall box (4" x 4" x 3.5").
5. Remote stations shall not be incorporated into or mounted onto other equipment.
6. All wiring to remote stations shall be by 5-conductor, Class 2 wiring (24V DC). A terminal strip shall be provided for contractor wiring.

F. Enclosure

1. The ELTS2 shall be mounted in a NEMA 1 interior or NEMA 4 watertight type enclosure finished in textured epoxy paint. It shall be equipped with a hinged locking door. Material shall be no less than 14 gauge steel.
2. An enclosure containing up to 24 (twenty-four) 20A circuits shall be 48"H x 30"W x 8.5"D.
3. The enclosure shall provide power distribution and branch circuit protection for all emergency power circuits. Systems requiring external emergency power circuit protection shall not be acceptable.
4. The enclosure shall be separate and independent of all other equipment. In no instance shall the ELTS2 be enclosed in a dimmer rack or in an enclosure containing other equipment.
5. The system shall be provided with an approved overlay mounted on the front of the enclosure, stating, "EMERGENCY LIGHTING TRANSFER SYSTEM".
6. The enclosure shall be provided with an approved label indicating that the system is UL1008 LISTED.

- G. Provide one (1) Emergency Lighting Transfer System equal to ETC ELTS2-1-D-120-06.

2.3 EMERGENCY BYPASS DETECTION KIT

- A. Where required to detect the loss of normal power and trigger special-purpose lighting presets, the detection means shall be the Emergency Bypass Detection Kit (EBDK).
- B. Mechanical

1. The Kit Enclosure shall be a surface mounted, constructed of 16-gauge, formed steel panels with a removable front cover.
2. The Emergency Bypass Detection Kit shall include a 3-pole, 10 amp breaker for local over-current protection and simulation of normal power loss.
 - a. The enclosure shall have a lockable door to allow limited access to the over-current protection breaker
3. All components shall be properly treated and finished.
 - a. Exterior surfaces shall be finished in fine textured, scratch-resistant, powder coat paint
4. The enclosure shall provide discrete high and low voltage wiring compartments with voltage barrier.
5. The dimensions and weight shall not exceed:
 - a. 10.5" H x 14" W x 4.2" D 11 lb.
6. Accessories
 - a. Emergency Bypass Restore Switch (EBDK-SWITCH)
 - 1) The Emergency Bypass Detection Kit shall support an optional switch kit, requiring manual override before allowing the EBDK to return to a normal power state
 - 2) The Restore Switch shall be a single-gang device, fully finished, and supplied with mounting holes.
 - a) The EBDK Switch Kit shall be clearly labeled identifying intended operation
 - b) The Switch shall be labeled Lighting System Restore
 - c) The Switch shall include a red indicator that is illuminated when bypass operation is active
 - 3) The EBDK Switch shall require two 16-gauge wires for connection to the Emergency Bypass Detection Kit.
 - a) Up to two Bypass Restore Switches shall be supported per Emergency bypass Detection it

C. Electrical

1. Emergency Bypass Detection enclosures shall support 100 to 277-volt configurations
 - a. EBDK enclosures shall be field configurable for single-phase, bi-phase, and three-phase operation without the need for additional components.
2. Phase Loss Detection circuitry shall provide 0.5 second delay to prevent nuisance tripping
3. The EBDK shall provide an integrated circuit breaker for over-current protection and simulation of normal power loss
4. The Emergency bypass detection Kit shall support isolated outputs for connection to multiple dimming products simultaneously
 - a. Three isolated contacts shall be provided
 - b. Each contact shall support connection of up to four dimming products.
5. The Emergency Bypass Detection Kit shall be completely pre-wired by the manufacturer. The contractor shall provide input feed and control wiring.
6. All control wire connections shall be terminated via factory provided connectors.
 - a. Factory provided connector shall support 12 to 22-gauge wiring
 - b. Emergency lighting input shall support load shedding

7. The Bypass Detection Kit shall provide a normally-closed input for interface with fire alarm systems.
8. The Bypass Detection Kit shall be UL and cUL Section 924 Listed for interaction with similarly listed dimming and switching panels.

D. Thermal

1. Ambient room temperature: 0-40°C / 32-104°F
2. Ambient humidity: 10-90% non-condensing

E. Provide one (1) emergency bypass detection kit equal to ETC 'Emergency Bypass Detection Kit' with all necessary accessories.

1. Normal power sense for the emergency bypass detection kit shall be provided via 3-phase mains feed tap kit equal to 'IQ TAP' as manufactured by ETC for normal power sense from relay panel 'RP-1,' which serves emergency House lighting circuits.
2. Normal power sense shall be specified by the project Electrical Engineer.

2.4 UL924-LISTED 0-10V CONTROL GATEWAY

A. General

1. The lighting control gateway shall be a microprocessor-based unit specifically designed to provide 0-10V control for lighting systems. The gateway shall permit DMX-512 and Ethernet Data to be received and converted to 0-10V control outputs.
2. Gateways shall communicate over DMX and Ethernet directly with entertainment and architectural lighting control products and other compatible Ethernet interfaces.
3. Connections shall be made between gateways, consoles, architectural systems, and PCs over standard DMX512A and Ethernet distribution systems using 10/100BaseT.
4. The gateway shall support an input for use in Emergency Systems
5. The gateway shall support multiple protocols including:
 - a. ANSI E1.17 Architecture for Control Networks (ACN)
 - b. ANSI E1.31 Streaming ACN (sACN)
 - c. ANSI E1.11 USITT DMX512-A
6. The gateway shall be listed to the following standards:
 - a. UL924 listed for use in emergency systems.
 - b. The gateway shall be tested to UL standards and labeled as ETL Listed.
 - c. The gateway shall be RoHS Compliant (lead-free).
 - d. The gateway shall be CE compliant.
7. The gateway shall have a backlit display for identification (soft-labeling), status reporting and configuration.
 - a. Labeling shall be user configurable using ANSI E1.17 Architecture for Control Network (ACN), or a purpose built software configuration tool.
 - b. The display shall show gateway configuration and indicate the current input and output levels.
 - c. Gateways that do not indicate input and output control level and the presence of valid data signal shall not be acceptable.
8. Each gateway shall have power and network activity indicators on the front of the gateway

B. Processor

1. Maximum delay time from input to output shall not be greater than one packet time (approximately 22 mSec.).

2. A minimum DMX update rate of 40Hz shall be sustained under all conditions unless specifically configured for a slower rate for the sake of compatibility with 3rd party DMX devices.

C. Mechanical

1. The gateway shall be DIN-Rail Mounted on DIN 43880 (35/7.5) rail
 - a. The gateway shall be constructed of an extruded aluminum enclosure that fully encloses all of the control electronics. Gateways that utilize exposed PCB components shall not be acceptable.
 - b. Two wiring connections shall be required for connection to the lighting system
 - 1) Ethernet connection that supports standard Cat5/Cat5e cables, or:
 - 2) DMX input connection using an 8-pin pluggable terminal strip style connector
 - 3) DMX connections shall support Belden 9729 (or equal) cable using rising clamp screw terminals of Belden 1583A (or equal) cable using insulation displacement connectors. Gateways that do not support Cat5/Cat5e cabling for DMX shall not be acceptable.
 - 4) (24) terminal strip style connectors for 0-10V output
 - c. Dimensions shall not be more than 6.65" wide (169mm) x 4.13" (105mm) deep x 1.22" (31mm) high

D. Electrical

1. The gateway shall provide (24) 0-10V outputs.
2. Each supporting voltage source or sink
3. Each output shall have a 50mA maximum current
4. DMX Ports
 - a. DMX Ports shall comply with the requirements of ANSI E1.11 USITT DMX512-A standards.
 - b. DMX input shall be optically-isolated from the gateway electronics.
 - c. DMX output shall be earth-ground referenced.
 - d. DMX Port shall be capable of withstanding fault voltages of up to 250VAC without damage.
5. Power shall be provided by a low-voltage DC power input utilizing an isolated in-line power supply capable of an operating range of between 18-28vDC.
6. The gateway shall have a maximum 18W current
7. The Input for Emergency Systems shall support:
 - a. A dry contact input shall provide triggering of an emergency condition
 - b. A three position switch shall set the input as Normally Open (NO) Normally Closed (NC), or Off

E. Configuration

1. The gateway shall be locally configurable using an integrated display screen and a four button interface.
2. Each DMX gateway shall receive control from up to 512 DMX addresses, within the confines of 63,999 universes.
3. The gateway shall support a configurable start address from 1 to 512 and use consecutive addresses.
4. The gateway shall support three configurable dimming curves with each channel independently assignable. Supported curves shall be linear, mod-square and custom. 0-10V gateways that do not support custom curves shall not be acceptable.

5. Multiple DMX universes may be configured with any length up to 512 total addresses. Any range of DMX input addresses shall support selection and routing to the specified sACN output.
6. Multiple sACN sources may be combined with a priority may be assigned to each source sending data to the gateway
7. All relevant configuration information shall be stored in non-volatile memory at each gateway. The system shall recover from a power outage without requiring reconfiguration. Gateways that do not support non-volatile storage of data routing shall not be accepted.

F. Network

1. Communications physical layer shall comply with IEEE 802.3i for 10BASE-T, 802.3u for 100BASE-TX.
2. All network cabling shall be Category 5 (or better), conforming to TIA-568A/B, and shall be installed by a qualified network installer.
3. ANSI E1.17 Architecture for Control Networks (ACN) and ANSI E1.31 streaming ACN (sACN) shall be supported for level input. Gateways that do not support ANSI E1.31 shall not be acceptable.
4. Gateways shall support have built in priority on a per-universe or per-channel basis. Gateways that do not support prioritized merging of multiple network sources at independent priorities shall not be accepted.

G. Environmental

1. The ambient operating temperature shall be 0° to 40°C (32° to 104°F).
2. The storage temperature shall be -40° to 70°C (-40° to 158°F).
3. The operating humidity shall be 5% - 95% non-condensing.

H. Provide one (1) UL924 listed, DIN-rail mounted 0-10V gateway equal to ETC RSN-LV in 'DIN-2'.

1. The DIN enclosure housing the UL924 0-10V gateway is to be powered from an emergency power circuit to be specified by the project Electrical Engineer.

2.5 DMX EMERGENCY BYPASS CONTROL

A. The DMX Emergency Bypass Control (DEBC) shall trigger special-purpose lighting presets and bypass normal lighting controls during emergency or panic situations.

B. Functional

1. The DMX Emergency Bypass Controller shall be capable of overriding a single universe of ANSI E1.11–2008, USITT DMX512-A control signals from “Normal” to “Bypass” when a trigger signal is detected via a contact closure trigger input.
 - a. The DMX Emergency Bypass Controller shall output to a single DMX output or up to six optically-isolated DMX outputs
 - b. The DMX Emergency Bypass Controller shall poll the bypass trigger input after a power loss and react upon start up.
 - c. The default or recorded preset shall be recalled immediately on restart if the trigger is also applied at restart.
 - d. Controllers that do not support E1.11–2008 compliant DMX communication shall not be acceptable.
2. The DMX Emergency Bypass Controller shall be capable of recording a single DMX preset (snapshot) of 512 channels for recall during “Bypass” mode.
3. The DMX Emergency Bypass Controller (DEBC) shall have internally accessible, labeled DIP switches for configuration of:
 - a. DMX Record Mode
 - 1) All 512 channels (default)

- 2) Selected channels, snapshot
- b. Contact input type
 - 1) Normally open (default)
 - 2) Normally closed
- c. Wait Time for Restore incoming DMX (bypass trigger removed)
 - 1) 0 Seconds (default)
 - 2) 10 Second Wait
 - 3) 30 Second Wait
 - 4) 10 Minute Wait
- 4. The DMX Emergency Bypass Controller shall support a single bypass input using two input modes:
 - a. Bypass triggering shall be supported via a maintained contact input configurable for normally open (N.O.) or normally closed (N.C.) operation
 - b. The contact input shall support +12VDC wet input to provide interface with fire alarm or secondary triggering systems. Bypass controllers that do not support a fire alarm input shall not be acceptable.

C. Mechanical

- 1. The DMX Emergency Bypass Controller (DEBC) enclosure shall be a surface mounted enclosure with a removable cover, constructed of 16-gauge, formed steel with a removable front cover.
 - a. All components shall be properly treated and finished in fine textured, scratch-resistant, powder coat paint.
 - b. DEBC enclosure shall have a minimum of four keyed mounting holes for wall attachment.
 - c. DEBC enclosure shall have a visible label stating the product name, manufacturer name, indicator functions, control functions, ratings and listings.
- 2. The DMX Emergency Bypass Controller (DEBC) enclosure shall provide discrete high and low voltage wiring compartments with voltage barrier.
- 3. The DMX Emergency Bypass Controller (DEBC) shall have a single bi-color LED indicator visible from the exterior of the enclosure.
 - a. LED shall indicate Normal state with a "green" color light
 - 1) Normal state illuminates steady green when Power and DMX are present
 - 2) LED Off indicates Power or DMX are not present
 - b. LED shall indicate Bypass state with a "red" color light
 - 1) Bypass state includes bypass input contact trigger or 'test' active
- 4. The DMX Emergency Bypass Controller (DEBC) shall have a single test button accessible from the front of the enclosure without removing any panels.
 - a. The test button shall immediately trigger bypass state for as long as it is held down, and release the bypass state immediately upon release of the button
 - 1) The test button shall be momentary only
 - 2) The test button shall be recessed to prevent accidental triggering
- 5. The DMX Emergency Bypass Controller (DEBC) shall have a single, internally accessible button for DMX Record (snapshot) with an indicator LED for record action
 - a. The record button shall be momentary only and held for at least 3 seconds before activation to prevent accidental recording

- b. The LED indicator will flash rapidly when record function is active
- c. The LED indicator will illuminate steady when record function is complete
- 6. The DMX Emergency Bypass Controller (DEBC) dimensions and weights shall not exceed:
 - a. 9" H x 11" W x 2" D,
 - b. 8lbs (single output); 14.5lbs (multi-output)

D. Electrical

- 1. The DMX Emergency Bypass Controller shall be completely internally pre-wired by the manufacturer
- 2. The contractor shall provide input feed and control wiring to the provided terminals
 - a. DMX Emergency Bypass Controllers (DEBC) shall support 100 to 277 volt input power, 50/60 Hz, 150mA maximum current
- 3. DEBC shall support labeled terminations for two 24 – 10 AWG solid or stranded power wires
- 4. DEBC shall support one Grounding Lug for 24-14 AWG solid or stranded ground wire
- 5. DEBC shall support labeled, socketed termination connections for DMX Input and DMX Output wiring
 - a. Terminations shall support Belden 9729 cable or equivalent
 - 1) DMX Termination kits for Belden 9729 shall be supplied with the controller
 - 2) Optional Termination kits for Belden 1583A (or equivalent Category 5 cable) shall be available from the manufacturer
- 6. DEBC shall support labeled, socketed termination for the bypass contact input
 - a. Termination shall support two, 30-12 AWG low-voltage wires
 - b. The bypass input shall support a maintained normally open (N.O.) or normally closed (N.C.) dry contact input
 - c. A +12VDC wet contact input shall also be available for interface to fire alarm systems.
 - d. DEBC shall support socketed DMX transceiver chips
 - 1) A spare DMX transceiver chip shall be supplied in a labeled, inactive socket
- 7. The DMX Emergency Bypass Controller (DEBC) shall internally switch from the normal DMX input (pass through) to the bypass DMX output using electromechanical relays when triggered
 - a. The DEBC shall have non-volatile memory for storage of a single recorded sequence of 512 channels
 - 1) The recorded sequence shall persist through power outages
 - 2) The default sequence shall have all 512 channels at "full" if no sequence is recorded
 - b. The DEBC shall have a DMX baud rate of "Slow" (20 packets per second) for increased compatibility during bypass DMX output
- 8. The DEBC shall be available in two versions capable of output to a single DMX line or up to six optically-isolated DMX lines.
- 9. The DMX Emergency Bypass Controller shall be UL and cUL Section 924 LISTED for interaction with similarly listed products.

E. Thermal

- 1. Ambient room temperature: 0-40°C / 32-104°F
- 2. Ambient humidity: 10-95% non-condensing

- F. Provide one (1) 6-output DMX emergency bypass controller equal to 'DEBC-6' as manufactured by ETC, Inc.

1. The DMX emergency bypass controller shall be powered from an emergency power circuit to be specified by the project Electrical Engineer.

2.6 ARCHITECTURAL CONTROL PROCESSOR (ACP)

- A. The Architectural Control Processor (ACP) assembly shall be designed for use in wall mounted control enclosures.
- B. The processor shall utilize microprocessor based, solid state technology to provide multi-scene lighting and building control.
 1. ACP shall support functions such as station programming, macro sequencing, electronic lockout, room combine and astronomical time clock events. ACP station processor shall allow configuration of the control system via the menus. See software section for additional system details.
 2. When used in a dimming enclosure, the ACP shall allow access to dimming control menus including the status screen, dimming configuration screen, backup menu, test menu and configuration menu.
- C. One ACP shall be rated to drive 1024 channels of control, 1024 zones, 64 rooms, 512 presets, 62 button or button/fader stations and 6 Touchscreen Stations.
- D. ACP module electronics shall be convection cooled.
- E. The ACP shall provide front-panel RJ45 jack, Secure Digital (SD) card slot, and Universal Serial Bus (USB) Port for configuration and data exchange.
- F. Architectural Lighting System configuration and program information shall be stored in flash memory, which does not require battery backup.
- G. The ACP shall be contained in a plug-in assembly and require no discrete wiring connections; all wiring shall be terminated into Dimming or Control Enclosure.
 1. The ACP shall support the following communications:
 - a. Echelon LinkPower.
 - b. 10/100BaseTX, auto MDI/MDIX, 802.3af compliant Ethernet networking with TCP/IP, ESTA BSR E1.17 Advanced Control Networks (ACN) and ESTA BSR E1.31 (sACN) Protocols.
 - c. EIA-232 serial protocol.
 - d. ESTA DMX512A, configurable as input or output ports.
 - e. Dry contact closure inputs.
 - f. Dry contact closure outputs, rated at 1A@30VDC.
- H. Provide one (1) architectural control processor equal to the Unison Paradigm P-ACP series control processor as manufactured by Electronic Theatre Controls, Inc.

2.7 CONTROL PROCESSOR ENCLOSURES

- A. Mechanical
 1. The control processor enclosure shall be a surface mounted panel constructed of 18 gauge formed steel panels with a hinged, lockable full-height door containing an integral electrostatic air filter.
 - a. The enclosure door shall have an opening to allow limited access to the control module face panel.
 - b. Enclosures shall be convection cooled without the use of fans.

2. Control processor enclosures shall be sized to accept one architectural control processor (ACP), including options and accessories.
 - a. The Control Enclosure for a single control processor shall support a single Station Power Module (SPM).
3. All enclosure components shall be properly treated and finished.
 - a. Exterior surfaces shall be finished in fine textured, scratch resistant, powder based epoxy paint.
4. Top, bottom, and side knockouts shall facilitate conduit entry.
5. Enclosures shall be designed to allow easy insertion and removal of all control and option modules without the use of tools.
 - a. Supports shall be provided for precise alignment of modules into power and signal connector blocks.
 - b. With modules removed, enclosures shall provide clear front access to all power and control wire terminations
6. Required Accessories
 - a. RideThru Option (RTO)
 - 1) The Control Enclosure shall support an optional, short-term back-up power source for the control electronics.
 - 2) RideThru Option (RTO) provides power for controls electronics during brief power outages or drop outs.
 - 3) The short-term back-up power source shall automatically engage upon the loss of normal power, seamlessly transitioning the supply power for the control electronics power to itself.
 - 4) The short-term back-up power supply shall detect the return of normal power, and seamlessly return the control electronics to normal power.
 - 5) The short-term back-up power source shall support the control electronics for at least 10 seconds.

B. Electrical

1. Control processor enclosures shall be available in 100, 120, 230 and 240 volt, single-phase configurations.
2. Control enclosures shall be completely pre-wired by the manufacturer. The contractor shall provide input and control wiring.
 - a. All control wire connections shall be terminated via factory provided connectors.
3. Control processor enclosures shall be designed to support the following wire terminations:
 - a. AC (single phase)
 - b. Echelon link power
 - c. 24Vdc
 - d. 2x configurable DMX512A (In or Out)
 - e. RS232 Serial In/Out
 - f. Unshielded Twisted Pair (UTP) Category 5 Ethernet
 - g. 4x Contact Closure In
 - h. 4x Contact Closure Out.
4. Station Power Modules
 - a. Station power supply modules shall provide LinkPower for at 63 stations and 1.5A@24VDC of Auxiliary (AUX) power.
 - b. Station power repeater modules shall provide LinkPower for 30 stations

and 1.5A @ 24VDC of Auxiliary (AUX) power.

- c. Station power module shall support over-current/short protection for LinkPower and Aux. LinkPower shall support fault detection on each leg of the balanced data bus.
- d. Station power supply and repeater modules shall provide support for up to 63 total stations. Additional stations shall be supported with the use of a Network Station Power Supply, expanding the total to 128 stations per processor.

C. Thermal

- 1. Ambient room temperature: 0-40°C / 32-104°F
- 2. Ambient humidity: 10-90% non-condensing

- D. Provide wall-mounted control processor enclosure equal to the Unison Ern2-W-120 as manufactured by Electronic Theatre Controls, Inc.

2.8 STATION POWER MODULES (SPM)

- A. The Station Power Module (SPM) assembly shall be designed for use in the specified control processor enclosure.

- B. The SPM shall convert input power into low-voltage (Class II) power with data line and a secondary auxiliary low-voltage line to energize button, button/fader, touchscreen, and interface devices for multi-scene lighting and building control.

- C. The SPM, in conjunction with a matching Architectural Control Processor (ACP), shall support Echelon LinkPower communications with remote devices, including button, button/fader, touchscreen and interface stations, and shall interoperate with LonMARK-approved third-party devices.

- 1. The LinkPower network shall utilize polarity-independent, low-voltage Class II twisted pair wiring, type Belden 8471 (unshielded) or Belden 8719 (shielded) or equivalent. One # 14 AWG drain wire will be required for system not using grounded metal conduit.
- 2. The LinkPower network shall be topology free. Network wiring may be bus, loop, home run, star or any combination of these.
- 3. Link power wiring shall permit a total wire run of 1640 ft. (500m).

- a. Repeaters allow an additional wire run of 1640 ft. (500m).
- b. Dual-repeaters allow two additional wire runs of 1640 ft. (500m).
- 4. Link power wiring between stations shall not exceed 1313 ft. (400m).
- 5. The SPM shall support auxiliary power for certain remote devices, including touchscreen and interface stations, as required by the device.

- a. The auxiliary power network shall utilize polarity-dependent, low-voltage Class II wiring, consisting of two # 16 AWG wires.
- b. Auxiliary wiring shall permit a total wire run of 1640 ft. (500m).
 - 1) Repeaters allow an additional wire run of 1640 ft. (500m).
 - 2) Dual-repeaters allow two additional wire runs of 1640 ft. (500m).

- c. The SPM shall supply 1.25 amps at 24v DC continuously.

- D. ACP module electronics shall be convection cooled.

- E. Each SPM shall:

- 1. Supply power for up to 32 button and button/fader stations.
 - a. Repeaters and dual-repeaters allow 30 additional stations, 62 total.
- 2. Supply auxiliary power for a similar number of interface stations.

3. Shall supply auxiliary power for up to four Touchscreen stations, when a like number of other stations are deducted from the total.
 4. Repeaters and dual-repeaters allow two additional Touchscreens (six total) when a like number of other stations are deducted from the total.
- F. Provide one (1) station power module to support control stations shown on the Drawings, equal to the Unison Paradigm P-SPM Series as manufactured by Electronic Theatre Controls, Inc.

2.9 WALL-MOUNTED NETWORK SWITCH

A. General

1. The 8-port Installation switch provides Ethernet connectivity for small systems that require basic network connectivity between system devices. The installation switch combines an 8-port PoE network switch with a patch panel in a convenient wall-mount installation box. This provides a simple solution for systems that have multiple dimmer racks, a console and other network devices, without requirements for a full equipment rack.

B. PHYSICAL

1. Fully enclosed surface-mount box
2. 16 gauge steel construction
3. Finished in gray fine-textured powder coat
4. Conduit knockouts on all four sides
5. Removable keyed cover for easy access

C. ELECTRICAL

1. Switch power supply integrated within enclosure
2. 120VAC, 20A (max) feed required
3. ETL Listed

D. ELECTRONICS

1. 8-port PoE switch supplied with enclosure
2. Includes UTP termination panel and patch cables
3. Supports up to two fiber connections with optional SFP modules

- E. Provide one (1) wall-mounted network switch with PoE equal to the 8-Port Simple Network Box (SNB-8) as manufactured by Electronic Theatre Controls, Inc.

2.10 TOUCHSCREEN CONTROL STATIONS

A. General

1. Touchscreen stations shall support fully graphical control pages.
2. The Touchscreen station shall operate using graphic buttons, faders and other images on at least 30 separate programmable control pages.
3. Touchscreen stations shall also allow programming of page pass-code, lock out and visibility levels.

B. Mechanical

1. Touchscreen stations shall consist of a seven inch, backlit liquid crystal display (LCD) with a minimum resolution of 800 by 400 pixels and 12-bit color depth with a touch interface.
2. Touchscreen bezels shall be constructed of aluminum and shall have no visible means of attachment.
 - a. The bezel shall install and remove without the use of tools.
 - b. The bezel shall provide two working positions for the Touchscreen: service and operating.

3. The Touchscreen shall have a protective overlay over the display.
 - a. The overlay shall reduce wear
 - b. The overlay shall reduce glare
4. Touchscreens shall offer optional hinged locking covers
 - a. Locking covers shall be made from aluminum and be painted to match standard touchscreen color options
 - b. Locking covers shall allow for viewing of system status on the touchscreen through a smoked Lexan window
5. The manufacturer shall provide back boxes for all LCD stations.
 - a. Flush back box for Touchscreens with or without locking covers shall be 7.94" wide x 5.33" high x 3.25" deep
 - b. Surface back box dimensions shall be 8.3" wide x 5.6" high x 2.75" deep
 - c. Surface back box for Touchscreens with locking cover dimensions shall be 10.0" wide x 6.7" high x 2.75" deep

C. Electrical

1. Touchscreens shall be powered entirely by the System network.
2. Touchscreens shall connect to the System using an Ethernet network with Power over Ethernet (PoE) or the Unison control station Echelon® Link power network.
 - a. Ethernet Network
 - 1) Ethernet network shall be 10/100BaseTX, auto MDI/MDIX, 802.3af compliant.
 - 2) Network shall utilize Unshielded Twisted Pair (UTP) Category 5 wiring.
 - b. Echelon® Link power network.
 - 1) Link power shall utilize low-voltage Class II unshielded twisted pair, type Belden 8471 or equivalent, and one #14 ESD drain wire (when not installed in grounded metal conduit).
 - 2) Touchscreen stations shall also require (2) #16 AWG stranded wires for 24Vdc operating power. 24Vdc wiring shall be topology free.
 - 3) Network wiring may be bus, loop, home run, star or any combination of these.
 - 4) Network insulation displacement connectors shall be provided with all stations.

D. Functional

1. System
 - a. The Touchscreen shall support configuration firmware upload from a Paradigm Processor as proxy
 - b. The Touchscreen shall support configuration or firmware upload from local removable media
2. Setup Mode
 - a. There shall be a setup display that is separate from any user-defined configuration
 - b. It shall be possible to view and modify connectivity settings
 - c. It shall be possible to view status information
 - d. It shall be possible to view and modify LCD screen settings
 - e. It shall be possible to perform Touchscreen calibration
 - f. It shall be possible to view and modify audio settings
 - g. The appearance of the setup display shall be standard and not editable
 - h. The setup display may be invoked from within the user-defined configuration and/or physical button on the Touchscreen

- i. There shall be a default protected method to invoke the setup display
- 3. Configurations
 - a. It shall be possible to have multiple configurations stored within an LCD Station
 - b. Only one configuration may be active on the LCD Station
 - c. It shall be possible for Touchscreen Stations connected via the Echelon® Link power network to select a configuration automatically based on the configuration of the physical connection.
 - d. Where multiple configurations are stored there shall be a boot menu to allow selection of a configuration
 - e. Each configuration shall be identified as a different Station within the System
- 4. Operation
 - a. The lighting control system shall be designed to allow control of lighting and associated systems via touchscreen controls. System shall allow the control of presets, sequences, macros and time clock events.
 - 1) System presets shall be programmable via Button, Button/Fader, Touchscreen, or LightDesigner software.
 - a) Presets shall have a discrete fade time, programmable from zero to 84,600 seconds with a resolution of one hundred milliseconds.
 - b) Presets shall be selectable via Touchscreen stations.
 - 2) System macros and sequences shall be programmable via LightDesigner system software.
 - a) Macro and sequence steps shall provide user selectable steps, and allow the application of conditional logic.
 - b) Macro and sequences shall be activated by button, time clock event or LightDesigner software.
 - 3) System time clock events shall be programmable via the Touchscreen, LightDesigner system software, the processor user interface, or the internal web server.
 - a) Time clock events shall be assigned to system day types. Standard day types include: anyway, weekday, weekend, Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday. System shall support programming of additional custom or special day types.
 - b) Time clock events shall be activated based on sunrise, sunset, time of day or periodic event. System shall automatically compensate for regions using a fully configurable daylight saving time.
 - 4) A Color picker, supporting Hue, Saturation and Brightness (HSB) color selection shall be available for color selection of color changing fixtures and provide visual feedback of the current color produced by the associated fixture.
 - a) The color picker shall be provided with a default layout that requires no user configuration
 - b) The Color Picker shall provide RGB faders in addition to the default HSB color wheel for color selection
 - c) Color picker values shall allow for numerical value input in addition to color wheel and fader control
 - d) The color picker shall be compatible with color mixing systems that use up to seven discrete color control channels
 - b. Touchscreen stations shall be designed to operate standard default or custom system

functions. Components shall operate default functions unless re-assigned via LightDesigner, the Windows-based configuration program.

- 1) Optional button functions include: preset selection, manual mode activation, record mode activation, station lockout, raise, lower, macro activation, and cue light, or room join/separate.
 - 2) Optional fader functions include master control, individual channel control, fade rate control or preset master control.
- c. Touchscreen stations shall allow programming of station and component electronic lockout levels via LightDesigner.
 - d. It shall be possible to adjust LCD contrast and brightness.
 - e. It shall be possible to program the station to dim during periods of inactivity.
- E. System Requirements: Program touch screen control stations as follows:
1. Provide graphical representation of each button/fader entry station listed below, plus a total of twelve (12) End User-recordable snapshots.
 - a. 8-button House Lights control station (7 presets and off);
 - b. 4-button Stage Work Lights control station (on, off, dim-up, and dim-down);
 - c. 4-button Catwalk Work Lights control station (on, off, dim-up, and dim-down).
 2. Coordinate touch screen station programming and presets with End User to meet their specific requirements.
 3. See Section 3.04 'Control System Programming' below for additional requirements.
- F. Provide one (1) surface wall-mounted LCD touchscreen control station at "TS-01" and one (1) surface wall-mounted LCD touchscreen control station with locking cover at "TS-02." Touchscreen stations are to be equal to Unison Paradigm Touchscreen P-LCD series as manufactured by Electronic Theatre Controls, Inc.

2.11 DIGITAL BUTTON AND FADER STATIONS

A. General

1. The lighting control station shall be a remote station on a LinkConnect network that can recall presets, provide direct zone control, play macros and provide room combine actions for a control system
2. The station shall consist of a dual function (control/ record) push-button with an integral tri-color backlight for each corresponding button and fader

B. Mechanical

1. Control stations shall operate using one, two, four, six or eight buttons. A four button with fader station shall also be available
2. All button stations shall be available with cream, grey, black or white decorator style faceplates
 - a. Manufacturer's standard colors shall conform to the RAL CLASSIC Standard
3. Stations shall have tri-color backlights for each button and fader
 - a. Indicators shall utilize a configurable color backlight for active status
 - b. Indicators shall utilize a configurable color backlight for inactive status to assist in locating stations in dark environments. Stations that do not support a lit inactive or deactivated state shall not be accepted
 - c. Stations shall support a "backlight off" state of inactive status when required for performances.
4. All faceplates shall be designed for flush or surface mounting and have no visible means of attachment

5. Station faceplates shall be constructed of ABS plastic and designed based on a standard decorator style faceplate.
6. Buttons shall be indelibly laser marked for each button function
7. Control station electronics shall mount directly behind the faceplate. The entire assembly shall mount into a single gang back box. Back boxes for flush mounted stations shall be industry standard back boxes. The manufacturer shall supply back boxes for surface mounted stations.

C. Electrical

1. Control station wiring shall be LinkConnect control wiring utilizing low-voltage, Class II unshielded twisted pair, type Belden 8471 or equivalent, and one #14 ESD drain wire (when not installed in grounded metal conduit).
2. The station shall operate on class 2 voltage provided by the control system via the LinkConnect network.
3. Station wiring must be topology free. It may be point-to-point, bus, loop, home run or any combination of these.
4. Wiring termination connectors shall be provided with all stations.
5. Control stations shall be UL/ cUL listed and CE marked and meet WEEE Compliance

D. Functional

1. The Control System shall be designed to allow control of lighting and associated systems via Button and Fader controls.
 - a. System presets shall be programmable via LightDesigner configuration software.
 - 1) Presets shall have a discrete fade time, programmable from zero to 1,000 hours with a resolution of one millisecond.
 - b. System macros and sequences shall be programmable via LightDesigner configuration software.
 - 1) Macro and sequence steps shall provide user selectable steps, and allow the application of conditional logic.
 - 2) Macro and sequences shall be activated by button, time clock event or LightDesigner software.
2. Control components shall be designed to operate default or custom system functions. Components shall operate default functions unless re-assigned via LightDesigner, the software-based configuration program.
 - a. Optional button functions include: preset selection, manual mode activation, record mode activation, station lockout, raise, lower, macro activation, or room join/separate.
 - b. Optional fader functions include manual master control, individual zone control, color control fade rate control or preset master control.
3. Stations (Button and Button/Fader) shall allow programming of station and component electronic lockout levels via LightDesigner.

E. Provide programmable button stations equal to Unison Paradigm Inspire series as manufactured by Electronic Theatre Controls, Inc. as follows:

1. Type:
 - a. Three (3) 8-button stations for control of House Lights (7 presets and off);
 - b. Three (3) 4-button stations for control of Stage Work Lights (on, off, dim-up, and dim-down);
 - c. Four (4) 4-button stations for control of Catwalk Work Lights (on, off, dim-up, and dim-down).
2. Engraving: Coordinate with the Owner to provide custom-engraved button labels that reflect their respective functions.

3. Locking Covers: Provide sliding locking cover with smoked polycarbonate window equal to ETC Unison Heritage Locking Cover installed with the key cylinder facing upward (for upward door opening) over all button panels.
4. Provide in finish color specified by Owner.

2.12 CONTROL PLUG-IN STATIONS

A. General

1. The Plug-in Stations shall consist of the appropriate connectors required for the functional intent of the system. These stations shall be available with DMX input or output, Remote Focus Unit, Network, or architectural control connectors. Custom control connectors shall be available.

B. Connector Options

1. The following standard components shall be available for Plug-in Stations:
 - a. 5-Pin male XLR connectors for DMX input
 - b. 5-Pin female XLR connectors for DMX output
 - c. RJ45 connectors for Network connections - Twisted Pair
2. Custom combinations and custom control connections shall be available.

C. Physical

1. Station faceplates shall be .80" aluminum, finished in fine texture, scratch-resistant black powder coat. Silk-screened graphics shall be white.
2. The station panel shall mount into an industry standard back box, depending on size and quantity of connectors. A terminal block shall be supplied for contractor terminations.

D. Provide the following:

1. One (1) dual-Ethernet plug-in station equal to ETC 'ECPB NET-NET' at 'PS-1.'
2. Provide custom-engraved labels reflecting network port identification number.

2.13 DMX ETHERNET GATEWAY – DIN RAIL GATEWAYS

A. General

1. The lighting control gateway shall be a microprocessor-based unit specifically designed to provide DMX-512 control of lighting systems and transport of RDM configuration and status messages. The gateway shall permit DMX-512 data to be encoded, routed over an Ethernet network and decoded back to DMX-512.
2. Gateways shall communicate over Ethernet directly with entertainment and architectural lighting control products and other Ethernet interfaces.
3. Connections shall be made between gateways, consoles, architectural systems, and PCs over standard Ethernet distribution systems using 10/100BaseT.
4. The gateway shall support multiple protocols including:
 - a. ANSI E1.17 Architecture for Control Networks (ACN)
 - b. ANSI E1.31 Streaming ACN (sACN)
 - c. ANSI E1.11 USITT DMX512-A
 - d. ANSI E1.20 Remote Device Management (RDM)
5. The gateway shall be tested to UL standards and labeled ETL Listed.
6. The gateway shall be RoHS Compliant (lead-free).
7. The gateway shall be CE compliant.
8. The gateway shall be UKCA compliant
9. The gateway shall have a graphic OLED display and four buttons for identification (soft-labeling), configuration, status reporting and troubleshooting

- a. Labeling shall be user configurable using ANSI E1.17 Architecture for Control Network (ACN), or a purpose built software configuration tool.
 - b. The OLED display shall show DMX port configuration indication as well as indicate the presence of valid signal.
 - c. Gateways that do not indicate port configuration (input/output) and valid data shall not be acceptable.
10. Each gateway shall have power and data activity LEDs on the front of the gateway
- B. DMX Ports
1. DMX Ports shall comply with the requirements of ANSI E1.11 USITT DMX512-A standards.
 2. Each DMX port shall be software or locally-configurable for either input or output functionality.
 3. DMX input shall be optically-isolated from the gateway electronics.
 4. DMX Port shall provide at least 500V isolation to ground and the rest of the electronics
 5. Each port shall incorporate one DMX512-A Connection
 6. Network gateways that do not indicate input/ output port configuration or presence of valid data shall not be accepted
- C. Processor
1. Each gateway shall have sufficient processing power to manage up to 63,999 universes (32,767,488 addresses).
 2. Maximum delay time from input to output shall not be greater than one packet time (approximately 22 mSec.).
 3. A minimum DMX update rate of 40Hz shall be sustained under all conditions unless specifically configured for a slower rate for the sake of compatibility with 3rd party DMX devices.
- D. Mechanical
1. The DIN Rail mounted gateways shall be included in an extruded plastic enclosure.
 2. Three variants of gateways shall be available:
 - a. One Port
 - b. Two Port
 - c. Four Port
 3. Two wiring connections shall be required for connection to the lighting system
 - a. Ethernet connection that supports standard Cat5 patch cables
 - b. DMX input or output connection using is terminal strip or IDC-style connector
 4. Optional accessories for rack-mount and pipe applications shall be available from the manufacturer. These accessories shall support installation by an end-user
- E. Power
1. Power for the gateway shall be provided over the Category 5 (or better) cable, utilizing IEEE 802.3af compliant Power over Ethernet (PoE). Power consumption using shall not be greater than 7 watts.
 2. An optional low-voltage DC power input shall be available utilizing an isolated in-line power supply capable of an operating range of 12-24VDC.
- F. Configuration
1. The Gateway must support local or remote configuration.
 2. Each gateway on the network shall be individually configurable using freely available software configuration tools. The primary configuration tool shall be Net3 Concert configuration software running on a network connected PC. The PC shall only be required for configuration and shall not be required for normal operation of the system.

3. Each port of the DMX gateway shall control up to 512 DMX addresses, within the confines of 63,999 universes.
4. The specific DMX data input or output by the gateway shall be freely configurable by the user.
5. Duplicate outputs of DMX lines (DMX splitter) and discrete outputs shall be fully supported.
6. Multiple DMX universes may be configured with any length up to 512 total addresses. Any range of DMX input addresses shall support selection and routing to the specified sACN output.
7. Multiple sACN sources may be combined with a priority may be assigned to each source sending data to the gateway
8. All relevant routing information shall be stored in non-volatile memory at each gateway. The system shall recover from a power outage without requiring the PC to be online. Gateways that do not support non-volatile storage of data routing shall not be accepted.

G. Network

1. Communications physical layer shall comply with IEEE 802.3i for 10BASE-T, 802.3u for 100BASE-TX and 802.3af for Power over Ethernet specifications.
2. All network cabling shall be Category 5 (or better), conforming to TIA-568A/B, and shall be installed by a qualified network installer.
3. Data transport shall utilize the TCP/IP suite of protocols to transfer the DMX data.
4. ANSI E1.17 Architecture for Control Networks (ACN) and streaming ACN (sACN) shall be supported. Gateways that do not support ANSI E1.17 shall not be acceptable.
5. Each DMX gateway shall control up to 512 DMX addresses, per DMX port within the confines of up to 63,999 universes (32,767,488 addresses) using Streaming ACN (sACN).
 - a. Any range of DMX addresses may be selected for each universe.
 - b. Multiple sources shall be supported by prioritized Highest Takes Precedence (HTP with priority). Each source shall support assignment of priority to allow override of default HTP behavior.
 - c. Each DMX port shall support its own universe and start address.
6. Gateways shall have built in DMX merger capability on a universe or channel-by-channel basis.
7. Gateways shall support have built in priority on a per-universe or channel-by-channel basis. Gateways that do not support prioritized merging of multiple network sources at independent priorities shall not be accepted.

H. Environmental

1. The ambient operating temperature shall be 0° to 40°C (32° to 104°F).
2. The storage temperature shall be -40° to 70°C (-40° to 158°F).
3. The operating humidity shall be 5% - 95% non-condensing.

I. Accessories

1. A Universal Power Supply with international plug-set shall be available. Multiple power supplies shall be able to fit in a vertically stacked power strip.
2. ETC Net3 Concert Configuration and monitoring Software

J. Provide one (1) 4-port DIN-rail mount DMX gateways with all necessary mounting hardware, accessories, and associated software equal to ETC Response Mk2 DIN rail DMX Gateway in 'DIN-1'.

2.14 DMX ETHERNET GATEWAY – ONE PORT

A. General

1. The lighting control gateway shall be a microprocessor-based unit specifically designed to provide DMX-512 control of lighting systems and transport of RDM configuration and status

messages. The gateway shall permit DMX-512 data to be encoded, routed over an Ethernet network and decoded back to DMX-512.

2. Gateways shall communicate over Ethernet directly with entertainment and architectural lighting control products and other Ethernet interfaces.
3. Connections shall be made between gateways, consoles, architectural systems, and PCs over standard Ethernet distribution systems using 10/100BaseT.
4. The gateway shall support multiple protocols including:
 - a. ANSI E1.17 Architecture for Control Networks (ACN)
 - b. ANSI E1.31 Streaming ACN (sACN)
 - c. ANSI E1.11 USITT DMX512-A
 - d. ANSI E1.20 Remote Device Management (RDM)
5. The gateway shall be tested to UL standards and labeled ETL Listed.
6. The gateway shall be RoHS Compliant (lead-free).
7. The gateway shall be CE compliant.
8. The gateway shall be UKCA compliant.
9. The gateway shall have a backlit OLED display and four buttons for identification (soft-labeling), configuration, status reporting and troubleshooting
 - a. Labeling shall be user configurable using ANSI E1.17 Architecture for Control Network (ACN), or a purpose built software configuration tool.
 - b. The OLED display shall show DMX port configuration indication as well as indicate the presence of valid signal.
 - c. Gateways that do not indicate port configuration (input/output) and valid data shall not be acceptable.
10. Each gateway shall have LED indicators for Power and network activity

B. DMX Ports

1. The DMX Port shall comply with the requirements of ANSI E1.11 USITT DMX512-A standards.
2. The DMX port shall be software-configurable for either input or output functionality.
3. DMX input shall be optically-isolated from the gateway electronics.
4. DMX port shall provide at least 500V isolation to ground and the rest of the electronics
5. The DMX port shall incorporate one DMX512-A Connection
 - a. Gateways shall be available with the following connection options: 5-pin male XLR, 5-pin female XLR, or Ethercon RJ-45, for DMX wiring.
6. Network gateways that do not indicate input/ output port configuration or indication of valid data shall not be accepted

C. Processor

1. Each gateway shall have sufficient processing power to manage up to 63,999 universes (32,767,488 addresses).
2. Maximum delay time from input to output shall not be greater than one packet time (approximately 22 mSec.).
3. A minimum DMX update rate of 40Hz shall be sustained under all conditions unless specifically configured for a slower rate for the sake of compatibility with 3rd party DMX devices.

D. Mechanical

1. The gateway shall be available in two versions
 - a. Wall-mount gateway

- 1) The gateway faceplate shall be constructed of injection molded plastic and be formed for use with any standard Decorator style faceplate
 - 2) A color matched faceplate shall be provided with the gateway
 - 3) Gateways shall be available in four standard colors
 - a) Cream (RAL 9001)
 - b) Gray (RAL 7001)
 - c) Black (RAL 9004)
 - d) Signal White (RAL 9003)
 - 4) The gateway shall support flush mounting using a standard RACO 1-gang, deep back box or equivalent.
 - a) Surface mounting shall also be supported using a manufacturer supplied back box.
- b. Portable gateway
- 1) The portable gateway shall include a complete enclosure finished in a black fine texture powder coat paint
 - 2) Wiring connections shall be required for connection to the lighting system
 - a) Ethernet connection that supports standard Cat5 patch cables or Ethercon cables. Gateways that do not support the use of Ethercon cables shall not be accepted
 - b) DMX input or output connections using is 5-pin XLR or RJ45 Ethercon style connector
 - c) Optional low-voltage DC power input connection

E. Power

1. Power for the gateway shall be provided over the Category 5 (or better) cable, utilizing IEEE 802.3af compliant Power over Ethernet (PoE). Power consumption using shall not be greater than 4 watts.
2. An optional 12-24vDC power input shall be available for all wall-mount gateways.

F. Configuration

1. The Gateway must support local or remote configuration.
2. Each gateway on the network shall be individually configurable using freely available software configuration tools. The primary configuration tool shall be Net3 Concert configuration software running on a network connected computer. The computer shall only be required for configuration, and shall not be required for normal operation of the system.
3. Each DMX gateway shall control up to 512 DMX addresses, within the confines of 63,999 universes.
4. The specific DMX data input or output by the gateway shall be freely configurable by the user.
5. Multiple DMX universes may be configured with any length up to 512 total addresses. Any range of DMX input addresses shall support selection and routing to the specified sACN output.
6. Multiple sACN sources may be combined with a priority may be assigned to each source sending data to the gateway.
7. All relevant routing information shall be stored in non-volatile memory at each gateway. The system shall recover from a power outage without requiring the configuration PC to be online. Gateways that do not support non-volatile storage of data routing shall not be accepted.

G. Network

1. Communications physical layer shall comply with IEEE 802.3i for 10BASE-T, 802.3u for 100BASE-TX and 802.3af for Power over Ethernet specifications.
2. All network cabling shall be Category 5 (or better), conforming to TIA-568A/B, and shall be installed by a qualified network installer.
3. Data transport shall utilize the TCP/IP suite of protocols to transfer the DMX data.
4. ANSI E1.17 Architecture for Control Networks (ACN) and ANSI E1.31 streaming ACN (sACN) shall be supported. Gateways that do not support ANSI E1.17 shall not be acceptable.
5. Switches shall comply with power-over-Ethernet IEEE802.3af, unless a separate in-line power supply is provided.
6. Each DMX gateway shall control up to 512 DMX addresses, per DMX port within the confines of up to 63,999 universes (32,767,488 addresses) using Streaming ACN (sACN).
 - a. Any range of DMX addresses may be selected for each universe.
 - b. Multiple sources shall be supported by prioritized Highest Takes Precedence (HTP with priority). Each source shall support assignment of priority to allow override of default HTP behavior.
 - c. Each DMX port shall support its own universe and start address.
7. Gateways shall support built in priority on a per-universe or channel-by-channel basis. Gateways that do not support prioritized merging of multiple network sources at independent channel priorities shall not be accepted.

H. Environmental

1. The ambient operating temperature shall be 0° to 40°C (32° to 104°F).
2. The storage temperature shall be -40° to 70°C (-40° to 158°F).
3. The operating humidity shall be 5% - 95% non-condensing.

I. Accessories

1. Hanging bracket kit shall allow gateway to be mounted using C-Clamp to U-bolt Hardware.
2. ETC Net3 Concert Configuration and monitoring Software

J. Provide one (1) portable one-port DMX gateways with all necessary mounting hardware, accessories, and associated software equal to ETC Response Mk2 model 'RSN-DMX1-I-P-4' in the Booth adjacent to 'PS-1'.

1. Coordinate installation location with JRT staff and mount where directed.
2. Provide cabling required to interface the gateway with the new lighting system and the Owner's existing lighting board, with additional slack to permit some movement for servicing.

PART 3 EXECUTION

3.1 GENERAL

- A. Install equipment in accordance with the approved Shop Drawings, Manufacturer's instructions, and referenced quality standards as indicated herein.
- B. Inspection: Prior to installation, carefully inspect the installed Work of other Trades and verify it is complete to the point where the lighting control systems equipment can be installed in complete accordance with the original design and the approved Shop Drawings. Ensure that all painting, wet, and dust-producing Work is completed. Verify the supporting structures for lighting equipment are acceptable and that no obstructions are present that would preclude installing the devices. In the event of discrepancy, immediately notify the Engineer in writing.
 1. Verify that job conditions are ready to receive work of this section. Notify Engineer of any existing conditions, measurements, quantities, and other data which will adversely affect execution, fit, and/or safe and proper operating clearances. Identify conditions detrimental

- to safe or timely completion. Beginning of execution will constitute acceptance of existing conditions.
2. Environmental Requirements:
 - a. Obtain approval of Owner before performing operations that generate contaminants.
 3. Field Measurements:
 - a. Verify actual support dimensions and layout for Catwalk equipment prior to the fabrication and installation of equipment.
 4. Trade Coordination:
 - a. Coordinate location and routing of conduit to support new lighting systems equipment.
- C. Installation Requirements: Install lighting control systems equipment in accordance with the general provisions listed below.
1. Prior to installing the lighting control systems equipment, confirm with the Owner any special installation or equipment adjustments that are needed. The Contractor shall comply with Owner installation and adjustment requests.
 2. Provide incidental materials, hardware, cables, conduit, back boxes, connection plates, terminating elements, and other accessories needed for system installation, even if not expressly specified or shown on the Drawings. Coordinate location, installation, and special requirements for these devices with the Owner.
 3. Furnish all labor, materials, and equipment to install new lighting control systems equipment as shown on the Drawings and described in these Specifications.
 4. Position all items accurately as indicated on the drawing(s) true, plumb and level.
 5. Note any deviations required to adjust for field obstructions and report to appropriate party to incorporate changes on as-built drawings.
 6. Coordinate work with trades performing adjoining work.
 7. Install lighting equipment and controls where shown, in accordance with manufacturer's written instructions and with recognized industry practice to ensure that lighting equipment complies with applicable requirements of NEW and UL standards and with the applicable portions of NECA's "Standard of Installation" and Trade Standards specified herein.
 8. Adjust, configure, and program lighting systems equipment to provide performance objectives as described in these Specifications. See Electrical Drawings, and coordinate House lighting requirements with the Electrical Drawings.
 9. Perform commissioning tests on the installed lighting systems. The Installing Contractor is responsible for configuring, programming, and commissioning the House lighting fixtures to meet the requirements of the Owner.
 10. Provide instruction and training sessions to Owner personnel on the operation of the lighting control systems.
 11. Provide four (4) site visits during the Warranty period to reprogram or reconfigure: network devices to include network switches; lighting control system devices to include processors and control panels; lighting console and lighting fixtures; and other devices as required. These site visits shall include services to provide changes to lighting system operational features as desired by the Owner.

3.2 PREPARATION

- A. Surface Preparation: Remove from surfaces to receive theater and stage equipment all construction debris, dust, dirt, and other potential contaminants prior to installation. Surfaces shall be smooth, level, and have final color coat paint.
- B. Conduit: Verify the conduit system is adequate for the lighting and/or rigging system(s) cables and their specified functions which have been installed by Others. Notify Architect of discrepancies or missing conduit.

- C. Cutting: Carefully cut walls, ceilings, casework, or furniture to receive anchoring devices, safety ties, wall boxes, or other devices specified herein. Coordinate with Architect before cutting casework or furniture.
- D. Protection: Protect floor and wall surfaces, windows, doors, furniture, and casework with covers or tarps to prevent damage when installing the lighting and rigging systems.

3.3 CONTROL SYSTEM PROGRAMMING

- A. Install and program lighting system software, touch screens, and control processors until the Owner's requirements have been met.
 - 1. Confirm any applicable Auditorium house lighting requirements as per the sequence of operations on the Electrical Drawings and other Division 26 Specifications are incorporated into lighting system programming.
 - 2. Meet with the Owner to determine programming requirements and preferences for the lighting system.
 - a. The Contractor is to lead the meeting with an understanding of the designed lighting system capabilities and project requirements, to describe these capabilities and project requirements to the End User and HCPSS, and to ask questions necessary to obtain the information necessary to program the new lighting system.
 - b. Take information obtained from the meeting and develop a lighting system program that meets all parties' requirements.
 - 3. Program the Auditorium architectural control processor (ACP) to provide time of day schedules and presets as requested by the Owner and School Staff.
 - 4. Touch Screen:
 - a. The touch screen shall provide for full control of House lighting and limited control of performance lighting fixtures for authorized personnel.
 - b. Configure the touch screen to provide for the following capabilities:
 - 1) Provide an interface showing House lighting control stations with the same presets mapped to each respective button. Provide independent dimming override of each lighting zone and a 'master' fader for dimming control of all zones simultaneously while maintaining relative illuminance between zones:
 - 2) Program performance/theatrical lighting presets in coordination with JRT staff, with the ability to override independent dimming control of grouped theatrical fixtures and/or a few important theatrical fixtures (i.e., lectern spots). Examples of performance presets may include:
 - a) Full Stage wash (tungsten white, 3200K);
 - b) Panel Discussion wash (white as above, only along the Stage apron);
 - c) Presentation Spot Left (only fixtures on the lectern at Stage left);
 - d) Presentation Spot Right (only fixtures on the lectern at Stage right).
 - 3) In addition to the above presets, provide presets that combine House lighting and performance/theatrical lighting as needed, as directed by the Owner and End User:
 - a) For example, a 'Lecture' lighting preset may have House lights at 25% or 50% for note-taking with theatrical fixtures on the lectern illuminated.
 - 4) The touch screen provides authorized End Users the ability to record custom lighting scenes (House lights and performance/theatrical fixtures) from the theatrical lighting board.
 - 5) Configure the touch screen to allow only authorized users to prevent control of House lights from architectural controls during performances, when the theatrical lighting board shall have exclusive control.

- a) Coordinate whether this “lockout” mode is desired by the End User; the lighting system should be configured to give priority to the theatrical lighting board when it is connected and to automatically lockout architectural button/fader stations.
- 5. House Lighting Control Button Stations:
 - a. Program 8-button control stations provide the same House lighting presets as the existing House lighting system presets with any Owner-requested changes. Note “On” recalls last used House lighting scene. Existing House lighting presets include the following:
 - 1) A – All On
 - 2) B – House Lights
 - 3) C – Backstage Blue Wing Lights and Front Work Lights
 - 4) D – House at 50%
 - 5) E – Sconces at 50%
 - 6) F – House at 50%
 - 7) G – Backstage Blue Wing Lights Only
 - 8) OFF – All Off
 - b. Coordinate lighting zones to be controlled by respective button/fader stations with Electrical Drawings.
- 6. Work Light Control Button Stations:
 - a. Program 4-button control stations as described below, and provide engraving as shown on the Drawings. Note “On” recalls last used illuminance level.
 - 1) ON
 - 2) Dims up
 - 3) Dims down
 - 4) OFF
 - b. Coordinate lighting zones to be controlled by respective button/fader stations with Electrical Drawings.
- B. Explain configuration options for the existing lighting console to the End User and incorporate their preferences into the lighting system setup.
- C. Provide backup copies of completed software configuration files (for all applicable devices) and lighting system programming for the Owner’s records. Note site licenses will not be required.
- D. Provide two (2) site visits by factory-authorized field service technician for programming of lighting systems.
 - 1. The first site visit shall be scheduled prior to occupancy for the purpose of initial programming of systems.
 - a. Coordinate functional and aesthetic requirements of the lighting control system with the Owner to be implemented on touch screens.
 - b. Implement preliminary programming to meet all functional requirements of the Owner.
 - 2. The second site visit shall be scheduled after occupancy for the purposes of refining the functional and/or aesthetic features programmed into the lighting systems.
 - 3. Further refinements or changes to lighting system programming shall be made during site visits provided as part of the Warranty.

3.4 INSPECTION

- A. General: The Engineer shall inspect the lighting systems for proper installation. Inspection shall be scheduled a minimum of seven (7) days in advance of project closeout.
 - 1. Perform tests in the presence of the Engineer using equipment provided by the Contractor.

2. Inspection will be made by the Engineer, following load testing, and after receiving written notification from the Contractor that installation is complete.
 3. At the time of the inspection the Contractor shall furnish sufficient workers to operate equipment and to perform such adjustments and tests as may be required by the Engineer. Equipment that fails to meet with the specifications shall be repaired or replaced with suitable equipment and the inspection shall be rescheduled under the same conditions previously specified.
 4. Demonstrate the operational and functional features of the lighting systems in all possible modes of operation.
- B. Punch List: The Engineer shall issue a written list to the Contractor identifying items relating to the lighting systems installation or performance that require correction. The Contractor shall be given fifteen (15) days to correct these items at no additional cost to the Owner.
 - C. Defective Work: Remove and replace defective or soiled Work with new materials, including mounting hardware and equipment that is unacceptable.
 - D. Final Inspection: The Contractor shall notify the Engineer upon completion of the lighting system corrections and schedule a final inspection with the Engineer or Owner.

3.5 DOCUMENTATION AND OWNER TRAINING

- A. General: Provide system documentation and training sessions to the Owner on the lighting systems. Schedule training with Owner with at least seven (7) days notice.
- B. Operation Manuals: Prepare and deliver complete Operation Manuals to the Owner no less than fourteen (14) days prior to the Owner training sessions.
- C. As-Built Drawings: Prepare and deliver "as built" drawings and other documentation to Owner illustrating changes to the lighting systems installation that deviate from the originally designed lighting systems.
- D. Training Sessions: Provide training sessions to Owner personnel after the lighting systems have been installed, fully programmed, and configured, and are in proper operating condition.
 1. Use Operation Manuals in the lighting system training sessions. Provide copies of these documents to participants for use in the instruction.
 2. A minimum of two (2) training sessions shall be provided, each at least four (4) hours in duration, and shall include an overview of the lighting systems features and functions, startup and shutdown, troubleshooting, servicing, and preventive maintenance. Schedule separate training sessions to accommodate:
 - a. General Training Sessions: End User (School) staff schedules.
 - b. Maintenance Staff Training Sessions: HCPSS maintenance staff schedules.
 3. Demonstrate the lighting systems in all operating modes and functions after conclusion of the training sessions.

3.6 CLEANING AND PROTECTION

- A. Work Area: Upon completion of the Work, remove from the building site all debris, unused materials, equipment, and leave the work area in a clean, acceptable condition.
- B. Final Cleaning: Clean and remove dust, dirt, fingerprints, and other contaminants from lighting control systems equipment prior to final acceptance by the Owner.
- C. Protective Coverings: Provide protective plastic wrapping on equipment racks and any other equipment if additional Work is to occur in the area that might soil or damage the equipment.

Remove such wrapping prior to Substantial Completion.

- D. Repair incidental damage to walls, ceilings, and floors resulting from the lighting control systems equipment installation to the satisfaction of the Owner.

3.7 ADJUSTMENTS AND SERVICING

- A. Service Agreement: As part of the Warranty the Contractor shall visit the site four (4) times to maintain, adjust, and reprogram operational features of the lighting control systems equipment as requested by the Owner.

END OF SECTION