

SECTION 26 09 61

~~~ PROJECT NOTE ~~~~~

ARCHITECT OF RECORD/ENGINEER OF RECORD IS RESPONSIBLE FOR REVIEWING THIS SPECIFICATION SECTION IN DETAIL FOR COORDINATION WITH THE PROJECT SCOPE OF WORK.

ALL "PROJECT NOTE" TEXT IS TO BE REMOVED FOLLOWING REVIEW OF THE CONTENT OF EACH NOTE BY THE ARCHITECT OF RECORD/ENGINEER OF RECORD.

EDIT THE DOCUMENT FOOTER TO INCLUDE THE PROJECT NAME AND NUMBER.

EDIT THE DOCUMENT HEADER TO INDICATE THE ARCHITECT OF RECORD PROJECT ISSUE" DATE. THE "CPS CONTROL" DATE SHOULD NOT BE EDITED.

ANY MODIFICATIONS TO THE TECHNICAL STANDARDS IN THIS SECTION - INCLUDING THE REMOVAL OR ADDITION OF MANUFACTURERS - MUST BE APPROVED BY CPS.

REQUESTS FOR MODIFICATION ARE TO BE SUBMITTED TO THE DESIGN MANAGER DURING THE DESIGN PHASE FOR REVIEW AND APPROVAL.

~~~ END OF PROJECT NOTE ~~~~~

THEATRICAL LIGHTING CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Fabrication, furnishing, delivery, and installation, and commissioning of theatrical lighting systems.

1.02 SUMMARY

- A. Work shall include furnishing and installing all equipment and assemblies for the Theatrical Lighting Control System and providing all manufacturer's engineering services for the Control System including:
 - 1. Remote control panels and receptacles
 - a. Lighting control console.
 - b. Network data system.
 - c. Architectural lighting control processing equipment.
 - d. Distribution devices including plug strips and plug boxes.
 - e. Relay Panels.
 - f. Dimming Panel.
 - g. Fixed house and work lighting.
 - h. Portable production lighting equipment as scheduled in plans.
 - i. Installation and focus of production lighting equipment.
 - 2. It is the intent that all equipment herein be furnished by an Authorized Dealer of the Theatrical Lighting Systems manufacturer. The installation of this equipment, including supply of standard electrical supplies (i.e. conduit, wire, standard boxes, breaker panels), shall be by the Electrical Contractor. The Theatrical Lighting Systems manufacturer or their Authorized Dealer shall be responsible for commissioning, configuring and training of the system. The Electrical Contractor bears the responsibility for the complete system unless otherwise contracted.

- B. It is the intent that all equipment herein be furnished by an Authorized Dealer of the Theatrical Lighting Systems manufacturer. The installation of this equipment, including supply of standard electrical supplies (i.e. conduit, wire, standard boxes, breaker panels), shall be by the Electrical Contractor. The Theatrical Lighting Systems manufacturer or their Authorized Dealer shall be responsible for commissioning, configuring and training of the system. The Electrical Contractor bears the responsibility for the complete system unless otherwise contracted.
- C. Related work not included in this specification includes:
 - 1. General requirements for all electrical work.
 - 2. Electrical service.
 - 3. General lighting system.
 - 4. Theatrical rigging system.
 - 5. Theatrical sound, public address and communications system.
 - 6. Electrical raceways, conduit, and similar wiring materials.
 - 7. Wire and cable for power and data to interconnect the equipment and not an integral part of a factory assembled component.
 - 8. Handling or installation except as incidental to the system commissioning, as is a part of the manufacturer's normal service.

1.03 REFERENCE STANDARDS

- A. ANSI E1.11 - Entertainment Technology - USITT DMX512-A - Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories; 2008 (Reaffirmed 2013).
- B. ANSI E1.20 - Entertainment Technology - RDM - Remote Device Management over USITT DMX512 Networks; 2010.
- C. City of Chicago Building Code - Municipal Code of Chicago for the Building Industry; 2017.
- D. Chicago Electrical Code - Municipal Code of the City of Chicago, Building/Electrical Code Requirements; 2018.
- E. TIA/EIA-568 - Commercial Building Telecommunications Cabling Standard. (consists of 3 Parts, listed below); Rev C, 2012, and latest addenda.
- F. UL 508 - Industrial Control Equipment; Underwriters Laboratories Inc; Current Edition, Including All Revisions.
- G. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

1.04 SYSTEM DESCRIPTION

- A. Contractor shall provide all items and work necessary for complete, safe, fully functional systems as described herein, including:
 - 1. Tools, scaffolding, equipment, labor and supervision, even though they may not be specifically enumerated
 - 2. Preparation and submission of complete shop drawings and samples for review prior to fabrication.
 - 3. Verification of dimensions and conditions at the job site.
 - 4. Coordination of work of this section with the sprinkler systems, HVAC systems, roof drains, conduit, and other such systems whether under this contract or performed under a separate, prime contract.

5. Notification of the Architect/Engineer of Record of any conditions, measurements, quantities, or other data, as required for proper execution, fit and completion of all work, and for safe and proper operating clearances.
 6. Shipment of equipment to job site and the secured storage of all non-fixed equipment.
 7. Installation and completion, in accordance with these Specifications, related Drawings, the Equipment Manufacturer's recommendations, established trade criteria, and applicable code requirements.
 8. The inspection, demonstration, and necessary adjustment of the completed installation by the Manufacturer's engineering personnel.
 9. Preparation and submission of complete record drawings and operational and maintenance data and certificates.
 10. Specific instruction of the Board's personnel in the operation and programming of the system and equipment.
- B. Errors, omissions, or ambiguities found in these documents do not relieve the Stage Lighting Manufacturer of the responsibility of providing all items necessary for complete and fully functional systems. Any errors, omissions, or ambiguities shall be brought to the attention of Architect/Engineer of Record or their consultants for clarification.
- C. The above is for reference only and is not intended to define the limits of the work for a complete installation.

1.05 QUALITY ASSURANCE

- A. All bidders shall fully inform themselves of the conditions under which the work is to be performed. No compensation shall be allowed for any additional labor, materials, or equipment due to conditions of which the Contractor could have been fully aware prior to the bid date.
- B. The systems shall conform to all the applicable code requirements and shall be in conformance with industry standards of operation and practices. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the end user to arrange and operate a safe assembly and working environment for audience and user's personnel.
- C. Equipment specified herein shall be the sole responsibility of a single prime manufacturer.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Submit component and installation drawings and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation.
1. The drawings shall be no less detailed than as provided in the contract documents.
 2. All submittals including shop drawings, related data, and samples must be submitted complete and at one time as much as possible within the constraints of the schedule imposed on this specific project.
 3. Submittal drawings shall be submitted electronically or on electronic media in portable document format (pdf file) designed to be printed in ledger and/or letter sizes on monochromatic printers.
- C. Submittals shall be reviewed for conformance to the design intent by the Architect/Engineer of Record or their consultants before beginning any fabrication, installation, or erection.
1. Review of shop drawings and samples is for quality and design.
 2. Such review does not change the requirements of contract drawings or specifications, does not change the requirement to install all products according to manufacturer's

- recommendations, nor reduce quality or quantity or size of items to be supplied, unless so stated in writing.
3. Further, such review does not relieve the Stage Lighting Manufacturer of the responsibility of providing complete and safe systems and equipment in accordance with the intent of the specifications.
- D. In lieu of drawings, Stage Lighting Manufacturer may submit catalog cuts for standard portable equipment only:
1. Catalog Cuts must contain full information on dimensions, construction, applications, etc. to permit proper evaluation. In addition, they must be properly identified as to their intended use.
- E. Submittals shall clearly indicate all variations from the design and arrangements indicated in the contract drawings and specifications, whether or not these variations have been formally or informally reviewed by Architect/Engineer of Record or their consultants.
- F. Submit samples of any equipment component requested by the Architect/Engineer of Record for review.
- G. Final submittal. Within thirty (30) business days of final tests, and as a condition for final review, the Contractor shall submit to the Architect/Engineer of Record:
1. Receipts for delivery of all turn-over items, i.e., all items designated, "deliver to Board."
 2. Three (3) sets of "As built and Approved" drawings and wiring diagrams showing all systems and components as installed, including all field modifications.
 3. Three (3) sets of operation and service manuals, schematics, and parts lists for each unit of equipment installed or provided.
 4. Certificates of warranty.
- 1.07 WARRANTY
- A. Manufacturer shall warrant parts replacement and/or repair for two years. Equipment which does not meet the manufacturer's published photometric standards or other published design features shall be replaced at no cost to the Board.
- B. Manufacturer shall Warrant parts replacement and system repair and site visits by factory representative, including time and travel expenses. All warranty work shall be coordinated with Board's requirements for facility use. All warranty work shall be performed within thirty (30) days of notification.
1. Ordinary wear and defects due to improper usage are excluded.
 - a. Three signed copies of the above are required as a condition for final approval of the work.
- 1.08 DEALERS
- A. Dealers: Subject to compliance with requirements, the equipment indicated herein shall be provided by a qualified theatrical dealer meeting the following qualifications:
1. Approved Dealer or authorized reseller of an approved manufacturer.
 2. The Dealer shall have been in business and providing theatre lighting systems for a period of ten years or more, and shall have completed at least ten projects of this type and scope.
 3. Theatre Consultant shall be the final judge of the suitability of experience.
 4. Dealer shall be responsible for project management including submission of shop drawings, samples, equipment delivery, coordinating the integration and performance of all elements of the system described in this Section

5. Member in good standing of PLASA-North America (formerly ESTA) and maintain qualifying membership for the duration of the project.
6. The dealer shall be an Entertainment Technician Certification Program (ETCP) Recognized Employer during the duration of the project.
7. A qualified and experienced supervisor for the Theatrical Lighting Dealer shall be at the site during the installation of all portable lighting equipment and shall actively direct and supervise the work. This supervisor shall be an ETCP Certified Electrician.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 1. Dimming and Control
 - a. Electronic Theatre Controls (ETC); www.etcconnect.com
 - b. Philips Strand Lighting; www.strandlighting.com
 - c. Pathway Connectivity; www.pathwayconnect.com
 2. DMX Splitters and Mergers
 - a. Electronic Theatre Controls (ETC); www.etcconnect.com
 - b. Philips Strand Lighting; www.strandlighting.com
 - c. Pathway Connectivity; www.pathwayconnect.com
 - d. Doug Fleenor Design; www.dfd.com
 3. Luminaires and Accessories
 - a. Electronic Theatre Controls (ETC); www.etcconnect.com
 - b. Philips Strand Lighting; www.strandlighting.com
 - c. Philips Selecon Lighting; www.selconlight.com
 - d. Altman Stage Lighting; www.altmanlighting.com
 4. Distribution Components
 - a. Electronic Theatre Controls (ETC); www.etcconnect.com
 - b. Philips Strand Lighting; www.strandlighting.com
 - c. SSR; www.ssrconline.com
 - d. Union Connector Co.; www.unionconnector.com
 5. Lighting Control System
 - a. Philips Strand Lighting; www.strandlighting.com
 - b. Electronic Theatre Controls (ETC); www.etcconnect.com
- B. Other manufacturers seeking acceptance for Stage Lighting Systems must submit the following information at least ten (10) business days prior to the bid opening date. Acceptance of contractors will be by addenda:
- C. Preliminary Bill of Materials and complete data sheets for approval
- D. A written list of five equivalent installations including:
 1. Name, address and telephone number of Board.
 2. Name, address and telephone number of Architect/Engineer of Record.
 3. A brief written description of the scope of work with approximate value
- E. Dealers: Subject to compliance with requirements, the equipment indicated herein shall be provided by one of the following dealers:
 1. Chicago Spotlight; www.chicagospotlight.com
 2. Designlab Chicago; www.designlab-chicago.com
 3. Barbizon; www.barbizon.com

2.02 GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the City of Chicago Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with the City of Chicago Electrical Code.
- C. Components shall be new, in good condition, and under warranty.
- D. Components shall bear NRTL labels and labels identifying the manufacturer, model number, and serial number. Labels shall be permanently attached in a conspicuous location.
- E. Control and receptacle face plates not described elsewhere in this specification shall be black anodized aluminum or black painted steel, and all labels and legends shall be permanently engraved or silk screened directly on the faceplate.
 - 1. Engravings shall be filled with white paint. Minimum text height if not specified elsewhere: $\frac{1}{4}$ inch.
 - a. Micarta, lamacoid, and other types of engraved plastic labels shall not be used without approval of the Theatre Consultant except where specifically indicated in the drawings and specifications. Where engraved plastic labels are accepted, these labels shall be mechanically attached using blind rivets or pan head machine screws of matching color.
 - 2. Dry transfer, decals, plastic "dymo," or other types of adhesive labels shall not be used.
 - 3. All faceplates shall have beveled edges and rounded corners.
- F. DMX control signal protocol and connector types shall comply with ANSI E1.11.
- G. Network shall comply with Recommended Practice for Ethernet Cabling Systems in Entertainment Lighting Applications published by ESTA.
- H. Control, signal, and video connectors shall be of substantial construction and shall be of the locking or latching type. All plate-mounted connectors shall be bolted to faceplates - rivets shall not be acceptable.
- I. Components requiring external electrical power connections of more than eight (8) conductors shall include barrier-type terminal strips properly sized and permanently labeled.
- J. Components requiring external data connections shall include barrier-type terminal strips properly sized and permanently labeled OR shall be plug and receptacle connected and shall include the connector for the cable installed in the building as a part of the component.
- K. Keys for devices in each theatre (i.e., control console, entry panels, dimmer racks, etc.) shall be keyed identically. Provide a total of two (2) keys for each keyed device.
- L. Where specification allows for "approved equal," substitutions shall be proposed to the Theatre Consultant at least ten (10) days prior to bid date.

2.03 CONTROL FUNCTIONAL DESCRIPTION

- A. Design intends a system that utilizes as much as possible manufacturer's standard components in custom configurations. Where standard components which meet the operational criteria and functional goals are not available, the design intent is to use multiple standard components in an enclosure and through configuration of the system achieve goals.

- B. A very high degree of commonality and interchangeability of components between the various spaces and systems within the project shall be assured.
- C. Custom labeling particular to the project and intended function of a standard component should in so far as possible be incorporated in the face plate or bezel to make the electronic or electrical part of the standard component unaltered and thereby interchangeable or available from the manufacturer's inventory without customization required.
- D. Design intends further that the control be generally divided into two interconnected networks in each space:
 - 1. Architectural control addressing primarily control of a limited sub-set of the dimmed or non- dimmed circuits in a space. This is delegated to an architectural control system with either a central processor or distributed processors, which send data to the dimmers and non-dims and is a network protocol proprietary to each manufacturer.
 - 2. Entertainment lighting control addressing primarily the dimming or non-dimming production lighting as well as the control of automated lighting fixtures and other effects via an Ethernet and entertainment lighting nodes using TCP/IP protocol.
 - 3. As a subset of the entertainment lighting system the handheld remote focus unit is intended to be via radio frequency or 802.11g WiFi wireless Ethernet.
 - 4. The architectural controls shall be capable of recording settings or "snapshots" for all channels within the architectural and production lighting systems as scheduled in the plans. If not scheduled, provide capacity for at least the minimum number of channels utilized by the entertainment lighting control console to address all specified portable lighting equipment (i.e. dimmers, DMX-controlled solid state lighting, automated lighting, etc.).
- E. Subject to the above requirements, the architectural control systems specified shall utilize one of the following:
 - 1. ETC "Paradigm".
 - 2. Strand "Vision.Net".
- F. Also subject to the above requirements, the Ethernet systems shall be designed by the same stage lighting manufacturer who manufactures the architectural control system and shall be fully integrated.

2.04 NETWORK DATA SYSTEM

- A. The Network Data System shall provide for the interconnection of devices used solely for theatrical lighting system and special effects.
- B. A dedicated network is required for each performance space in the project.
- C. The Theatrical Lighting System Manufacturer shall be responsible for performance of the complete system and shall furnish all materials, components, and services necessary to provide a complete network data system indicated in this Section.
- D. Control devices shall operate as part of the network. If the manufacturer's system requires devices that are not network compatible, manufacturer shall provide all required hardware to accommodate those devices to meet the intent of this specification. Contractor shall provide and install conduits, boxes, and conductors to accommodate these devices, as part of the work of this Section.
- E. In order that consoles and devices such as moving lights that are not a part of this project may be used in these spaces, nodes shall be provided that permit communication conforming to ANSI E1.11.

- F. Products utilizing the “DMX512” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA), ANSI E1.11, Entertainment Technology - USITT DMX512-A, Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories.
- G. Products utilizing the DMX512 standard Entertainment Services & Technology Association (ESTA), ANSI E1.11, Entertainment Technology - USITT DMX512-A, Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories shall comply with the rules and recommendations of the following standard: ANSI E1.27-1-2006, Entertainment Technology-Standard for Portable Control Cables for Use with USITT DMX512/1990 and E1.11 (DMX512-A)Products.
- H. Products utilizing the DMX512 standard Entertainment Services & Technology Association (ESTA), ANSI E1.11, Entertainment Technology - USITT DMX512-A, Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories shall comply with the rules and recommendations of the following standard: ANSI E1.27-2 - 2009, Entertainment Technology - Recommended Practice for Permanently Installed Control Cables for Use with ANSI E1.11 (DMX512-A) and USITT DMX512/1990 Products.
- I. Products utilizing the “ACN” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.17 - 2006, Entertainment Technology - Architecture for Control Networks.
- J. Products utilizing the “RDM” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.20, Entertainment Technology - RDM - Remote Device Management over USITT DMX512 Networks.
- K. Products utilizing “Lightweight/Streaming ACN” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.31 - 2009, Entertainment Technology - Lightweight streaming protocol for transport of DMX512 using ACN.
- L. The network shall provide for the connection of the following devices:
 - 1. Control Consoles.
 - 2. Wireless Handheld Remote Focus units.
 - 3. Dimmer feedback information.
 - 4. Remote video displays.
 - 5. Designer's remote control consoles.
 - 6. Wired remote focus units.
 - 7. Automated spotlights.
 - 8. Color changers.
 - 9. Moving yoke devices.
 - 10. DMX-controlled special effects.
 - 11. DMX-controlled portable dimmers.
- M. Cable shall be pulled in conduits, meeting the minimum bending radius permitted by the cable manufacturer. All cable shall be pulled with no more than the maximum pulling tension permitted by the cable manufacturer.
- N. UTP wiring segments shall be of continuous runs of not more than 250 feet. If a wiring run exceeds the noted maximum footage, manufacturer shall provide required repeaters and system elements to bring the segment wiring to the stated maximum run. Contractor shall provide and install such elements as part of the work of this Section.

- O. Cable shall meet the standards for TIA/EIA-568 TSB-36 Category 5e.
 - 1. Provide a current generation 100Mhz or higher, network/cable analyzer to perform testing on the cable plan and shall test all data pairs.
 - 2. Test cable for continuity, attenuation, near end cross talk, mutual capacitance, cable impedance, cable resistance, cable length, structural return loss and pair mapping.
 - 3. Certified cable technicians shall perform all testing. Provide cable analyzer printouts of all test performed, labeled by cable number as part of the final submittal.
- P. Wiring shall meet the TIA/EIA-568-B wiring standard.
- Q. Cable and installation shall accommodate 100Mbps transmission rate. "Thin Net" systems shall not be used.
- R. Design system for maximum 40 percent traffic utilization and maximum 10 percent collisions within the same collision domain. The use of switches is acceptable to manage network traffic.
- S. All Layer 2 switches shall provide for IGMP Layer 3 snooping to accommodate IP multicast events.

2.05 CONTROL CONSOLES

- A. Consoles shall support bidirectional communication with the lighting network via a TCP/IP interface, either natively within the console or utilizing a separate portable node.
- B. Products:
 - 1. Subject to compliance with requirements, provide the following:
 - a. ETC "Element 600" with 500 channels / 1024 outputs
 - b. Philips Strand "NEO" 91001 with one (1) additional 91002 DMX Universe.
 - 2. Console shall provide a minimum of 500 control channels and control at least 1,024 addresses and shall support a minimum of one local monitor with independent displays, remote video, and a wireless handheld remote focus unit.
 - 3. Console shall include:
 - a. Two (2) high resolution 21" touch screen LCD color displays.
 - b. One (1) set of 25-foot multi-conductor control cables terminating in locking connectors appropriate for mating with the Control Receptacle Panel.
 - c. Vinyl dust covers for the console.
 - d. Portable UPS capable of powering the console and associated accessories for not less than fifteen minutes.
 - e. Hinged road case, ATA Specification 300, Category 1 or approved equal, with handles and latching hardware. To contain all of the above equipment.
 - f. Rolling table unit of sufficient size for console and displays.

2.06 ENTRY PANELS

- A. Panels shall employ a multiplexed control signal.
- B. Panels shall be mounted as shown in the drawings and schedules, dead front, and completely wired internally, with terminals of the proper rating for all external wiring.
- C. Where indicated, face of panel shall be recessed and covered by a hinged latching cover with a clear view panel.
- D. Face of the panel shall contain momentary contact pushbutton switches. Switch quantity, labeling, and circuits controlled per drawings.

- E. Provide and install temporary blank, unlabeled cover plates for initial system turn on. Provide and install permanent plates with labels as required and as determined by the theatre consultant at system checkout.

2.07 CONTROL RECEPTACLE PANELS

- A. Control Receptacle Panels shall be mounted as indicated on drawings, dead front, and completely wired internally, with terminal strips of the proper rating for all external connections.
- B. Face of the panels shall contain flush mounted receptacles. Receptacles shall be of the locking type and shall be sized for the proper number and capacity of conductors as indicated on Drawings. Control connectors shall be equal to 4-pin or 5-pin XLR, Switchcraft D4M or D5M. Smaller or less substantial connectors shall not be acceptable.
- C. Face of each panel shall contain receptacles as indicated in the Control Device Schedule.
- D. Ethernet taps shall be Neutrik Ethercon Panel mount Category 5 RJ45 connectors and shall accept individual connectors of matching catalog number.

2.08 SIGNAL PROCESSOR RACK

- A. The Signal Processor Rack shall be 19 inch industry standard equipment rack. Design and configuration shall be as shown in the Drawings.
- B. Racks are intended to be wall mount with a center swing out panel for access to terminations, etc.. Refer to drawings for additional information.
- C. Rack shall contain the following:
 - 1. Identifying panel indicating venue, rack purpose or name, manufacturer contact information, etc.
 - 2. Lighting System Network Switch(es).
 - 3. Patch panels for interconnection.
 - 4. Cable Management panels.
 - 5. PC Connection for service if connection is not via network.
 - 6. DMX Splitters, mergers and related equipment.
 - 7. DMX Network Nodes.
 - 8. Phantom power for "power over Ethernet" if the switch does not provide this feature.
 - 9. Architectural Lighting System Processor, power supplies and related equipment.
 - 10. UPS sufficient for powering above devices for not less than 15 minutes.
- D. Network tap numbering:
 - 1. Network tap identification numbers shall correspond to the numbers on patch panels.
 - 2. Where more than two Signal Processing Racks are supplied, identify the rack to which the receptacle is connected.
 - 3. Special taps for critical or special devices (i.e. Architectural Processor, dimmer racks, etc.) shall be specially indicated.
- E. Identify wires at the jacket with separate numbers.
- F. Panel(s) shall include UPS protection and surge protection for all devices requiring a power source - APC, Tripp-Lite or approved equal.

2.09 NETWORK TAP CONTROL RECEPTACLE PANELS

- A. Network receptacles shall include the following:

1. CAT5e Ruggedized connector, Neutrik Ethercon or approved equal.
2. Engraved Tap ID corresponding to the Patch Panel.
3. Title of "Lighting Network".
4. Designation of wire destination if more than one Signal Processing Rack in the system.
5. Maximum length of patch cable permissible from the receptacle, installed after network testing and certification; engraved plastic laminate plate mechanically attached.

2.10 NETWORK CABLES AND PATCH CABLES

- A. Cables shall be rated Category 5e to match wiring of installed wiring.
- B. Cables shall include RJ45 plugs at each end, for proper mating to receptacle panels and node devices. Provide Neutrik Ethercon or similar connectors for all cables 5 feet long or more.
- C. Patch cables and boots shall use multiple colors to differentiate collision domains. Extension cables and boots (cables 5 feet long or more) shall be black.
- D. Provide sufficient quantity to patch all installed taps portable devices. Cords for portable nodes shall be 25 feet. Other cords shall be of sufficient length for normal layout of equipment.
- E. Deliver to Board.

2.11 HOUSELIGHT DIMMING PANEL

- A. General
 1. The wall mount dimmer pack shall be NRTL Listed, and shall be so labeled when delivered. The pack shall also be UL Listed for UL 924 Emergency Bypass control.
 2. The dimmer pack shall consist of six 20A dimmers, twelve 10A dimmers.
- B. Mechanical
 1. The entire unit shall surface mount. Top, bottom, and side removable knockout panels shall facilitate conduit entry, with an internal pass-through plenum for side-by-side or top-to-bottom mounting. A lower front panel shall be easily removable as well for full front access to data connections.
- C. Thermal
 1. The pack may be cooled by fan-forced airflow from bottom to top. A temperature-controlled, low noise fan shall maintain the temperature of all dimmers under full load provided the ambient temperature does not exceed 104°F (40°C).
 2. Convection cooling accepted.
 3. The pack shall operate safely in an environment having an ambient temperature between 32°F (0°C) and 95°F (35°C), and humidity between 30-95% (non-condensing).
 4. The pack shall have a 96% or better power efficiency, assuming full load with maximum dissipation. The efficiency calculation is based on 3% of connected load (Max. 3,100 BTUs).
- D. Electrical
 1. The pack shall operate on three phase, four wire + ground, 120/208V AC 60Hz at an amperage sufficient to power the rack (120 Amps max).
 2. All line and neutral terminals shall accept up to No. 2 AWG wire. Standard output connections via DIN Rail tension clamp terminals shall be rated for up to No. 8 AWG.
 3. The control wiring shall land on a removable header for easy contractor installation. Removable terminals rated for a maximum of No. 12 AWG wire shall also be provided for DMX512, and a UL 924-Listed Emergency Contact.

4. The front panel shall include recessed semi-protected circuit breakers. The magnetic circuit breakers shall be fully rated to eliminate nuisance tripping.
- E. Electronics
1. The control panel on the pack shall have a power status LED indicator and a DMX status LED indicator. A menu-navigation keypad and a backlit LCD shall be provided for system control, configuration, and control status.
 2. The pack shall receive DMX512 control protocol. Addressing shall be set via the 6-button keypad. Any dimmer may be patched to any DMX channel.
 3. The dimmers shall be SCR-based and shall be capable of dimming multiple load types including incandescent, low voltage, and 2-wire fluorescent. The dimmers shall consist of modular SCR and bonded heat sink assemblies with superior thermal transfer, surge and short circuit immunity. Dimmers employing triac power devices, pulse transformers, or other isolating devices not providing at least 2,500V RMS isolation, shall not be acceptable.
 4. The dimmers shall contain high quality 200uS toroidal filters to reduce the rate of current rise time resulting from switching the SCRs. The filter shall limit objectionable harmonics, reduce lamp filament sing and limit radio frequency interference on line and load conductors. Rise time shall be measured at the worst-case slew rate (about 50 percent) from 10 to 90 percent of the output waveform with the dimmer operating at full load.
 5. 2,500V of optical isolation shall be provided between the DMX512 inputs and the control electronics as well as between control and power components.
 6. The dimmers shall respond to control changes in less than 25 milliseconds. Dimmer outputs shall exhibit no oscillating or hunting for levels. Dimmers set to the same level shall output within $\pm 1V$ of each other, regardless of phase or electronic module control. Each dimmer channel shall smoothly control loads from 10 watts to the rated load of the dimmer. DMX512 update speed shall be 40Hz.
 7. The output curve for each dimmer shall be selectable from the following options:
 - a. IES modified square law.
 - b. Linear.
 - c. Switched (50% threshold, non-regulated).
 - d. Fluorescent with adjustable low- and high-end cut-off.
 - e. Adjustable Pre-Heat.
 8. From the control panel, it shall be possible to record up to 32 presets. Presets shall be programmable by recording current dimmer levels (as set by DMX), by entering dimmer levels on the face panel directly, or a combination of both methods. Indication of an active preset shall be visible on the LCD display.
 9. The presets may be recorded sequentially as a Sequence with programmable fade and hold times, which shall allow for stand-alone operation. Indication of an active sequence shall be visible on the LCD display.
 10. Pack setup shall be user programmable. The control panel shall provide the following setup features:
 - a. Set language.
 - b. Adjust LCD Contrast.
 - c. DMX Start Address (Normal Mode) or DMX Patching (Advanced Mode).
 - d. DMX Loss Behavior - Hold Last Look, Wait and Fade, Fade to Preset.
 - e. Select Dimmer Curves.
 - f. Fluorescent Start Voltage.
 - g. Power-Up Behavior.
 - h. Restore Defaults.
- F. Provide one of the following dimmer panels: SmartPack by Electronic Theatre Controls or A21 by Philips Strand Lighting.

2.12 RELAY PANELS

- A. Wall mount relay panel shall be Listed by UL or other NRTL (UL 508 FILE #E92154) and shall be so labeled when delivered.
- B. Relay panel shall consist of quantity of 20 amp relays, single- or double pole as indicated on the schedule with control electronics, sub-panel, and enclosure.
- C. Mechanical:
 - 1. Equally sized top, bottom, and side removable knockout panels shall facilitate conduit entry, with an internal pass-through plenum for side-by-side or top-to-bottom mounting. Front panel shall be easily removable as well for full front access to input, output and data connections.
 - 2. Unit shall ship with a cover complete with a locking door, allowing controlled access to the Class 2 wiring only.
 - 3. Panel enclosure shall be available separately from the sub-panel containing the control electronics to allow for pre-installation. Panel shall be NRTL Listed to be available in this configuration.
- D. Thermal:
 - 1. Panel shall be convection cooled.
 - 2. Panel shall operate safely in an environment having an ambient temperature between 32 degrees F and 104 degrees F, and humidity between 10-90 percent (non-condensing).
- E. Electrical:
 - 1. Panel control electronics shall operate on single phase, two wire + ground, 120/277V AC 60Hz, at an amperage sufficient to power the panel (8 Amps max). Standard fault current protection shall be 5,000 AIC.
 - 2. Individual relays shall be mechanically latching and capable of switching 20A at up to 300V circuits with no derating required for inductive lighting loads.
 - 3. Each relay shall have an associated manual override switch with on/off status indication.
 - 4. Panel shall be capable of switching all relays on or off at once, or in a user-selectable delay period of 0.1 to 60 seconds, in 0.1 second increments, per relay.
 - 5. Voltage barrier shall be available to separate relays carrying different voltages in the same panel. Barrier shall be capable of installation, without tools, between any two relays, and shall allow up to eight barriers per panel (4 per side).
- F. Electronics:
 - 1. Control panel on the pack shall have a power status LED indicator and a DMX status LED indicator. A menu-navigation keypad and a backlit LCD shall be provided for system control, configuration, and control status.
 - 2. Panel shall receive ESTA DMX512-A control protocol. Addressing shall be set via the keypad. Any relay may be patched to any DMX channel.
 - 3. Panel shall accept the manufacturer's network protocol or ACN-based protocol. Where the relay panel cannot accept these signals directly, provide an additional approved interface.
 - 4. Relays shall respond to control changes (DMX) in less than 25 milliseconds. DMX512 update speed shall be 40Hz.
 - 5. 2,500V of optical isolation shall be provided between the DMX512 inputs and the control electronics as well as between control and power components.
 - 6. From the control panel or optional button stations, it shall be possible to record up to 32 presets. Presets shall be programmable by recording current dimmer levels (as set by DMX), by entering dimmer levels on the face panel directly, manually selecting relay state on each relay, or a combination of both methods. Indication of an active preset shall be visible on the LCD display.
 - 7. Pack setup shall be user programmable.

- G. Provide one of the following relay panels: SmartSwitch by Electronic Theatre Controls, Contact by Philips Strand Lighting or equal by Lyntec.

2.13 WIRING DEVICES

- A. Lighting connectors shall be 20A slip pin, 2 wire plus ground Stage Pin Connectors, with integral strain relief. Plugs shall be as manufactured by Union Connector, Advanced Devices, Inc. or Bates Plug, unless otherwise scheduled in the drawings.
- B. Plugging Strips:
 - 1. Plugging strips shall be constructed of steel or extruded aluminum.
 - 2. Exterior finish shall be flat black baked enamel or black anodized aluminum.
 - 3. Terminal Strips:
 - a. Provide terminal strips of the proper rating and clearly labeled, for external connections.
 - b. Locate terminal strips at locations indicated on Drawings.
 - c. Size terminal strips to accept a range of wire from No. #12 to No. #4 AWG.
 - d. Where pigtails are indicated, 20A pigtails shall be 12-3 type S or SO cord, secured by cushioned strain reliefs or nylon "Heyco" bushings.
 - 4. Apply circuit numbers onto both sides of the wireway in letters not less than 1½ inches high. Circuit number legends shall be of contrasting color, die-cut vinyl decal or permanently affixed lamacoid plate.
 - 5. Construct mounting brackets of minimum 1½ inch wide, 7 gauge steel.
 - 6. Provide sufficient mounting brackets to support plugging strips min. 5 feet on center, plus additional mounting brackets as required for specific conditions.
 - 7. Plugging strips shall be shipped as folded segments for ease of installation. Maximum segment length shall be 10 feet.
 - 8. Units shall be NRTL listed and carry a label from a NRTL.
- C. Plugging Boxes:
 - 1. Plugging boxes shall be constructed of steel or extruded aluminum.
 - 2. Flat black baked enamel or black anodized aluminum exterior finish.
 - a. Provide knockouts on both sides and on the top.
 - b. Provide properly rated and clearly labeled terminal strips for external connections.
 - c. Size terminal strips to accept a range of wire from No. #12 to No. #4 AWG.
 - d. Where pigtails are indicated, 20A pigtails shall be 12-3 type S cord, length as per Drawings, secured by cushioned strain reliefs or nylon "Heyco" bushings.
 - e. Apply circuit numbers to the face plate in letters not less than one inch high. Mounting shall be as indicated.
 - f. All corners and edges exposed after installation shall be smooth and without overhanging plates or sharp edges. Units shall be NRTL listed and carry a label from a NRTL.

2.14 PORTABLE LIGHTING EQUIPMENT

- A. General Theatrical Luminaire and Accessory Requirements:
 - 1. All equipment shall be listed under UL 1573.
 - 2. Products utilizing Stage Pin Connectors shall comply with the rules and recommendations of the following standard: ANSI E1.24 - 2006, Entertainment Technology - Dimensional Requirements for Stage Pin Connectors.
 - 3. Photometric product documentation for stage and studio luminaires used in the live entertainment and performance industries shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.9-2007, Entertainment Technology - Reporting Photometric Performance Data for Luminaires Used in Entertainment Lighting.

4. Lens quality documentation for pattern projecting luminaires intended for entertainment use shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.35 - 2007, Standard for Lens Quality Measurements for Pattern Projecting Luminaires Intended for Entertainment Use.
 5. Fixtures: Equipped with pigtail, yoke with pipe clamp, safety cable for batten mounting, and filter holder.
 6. Metal Parts: Free of burrs, sharp corners, and edges.
 7. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
 8. Fixture Doors and Their Internal Access: Smooth operating, free of light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Doors, lenses, diffusers, and other pieces arranged to prevent accidental falling during re-lamping and when secured in operating position.
 9. Pigtail: Factory wired 36-inch long, 3-wire cord and plug connector assembly with cord encased in woven fiberglass or silicone tubing. Connector shall be 2P&GM Stage Pin unless otherwise indicated.
 10. Lamp Sockets: Re-lamping without disturbing alignment or focus adjustment.
 11. Fixture Ventilation Openings: Baffled against light leaks.
 12. Fixture Operating Controls and Handles: Thermally insulated.
 13. Lenses: Borosilicate glass in silicone mountings.
 14. Framing Shutters: Stainless steel, four way; with each blade in a separate plane under adjustable tension mounting. Blades adjust plus or minus 30 degrees of rotation in gate, for 120-degree-minimum total angular rotation between adjacent blades.
 15. Color Filter Frame Holder: Attached to front of fixture.
 16. Fixture Yoke: Rigid metal arranged for vertical aiming of unit and equipped with T-bolt or hand screw to lock alignment.
 17. Lamps: Include one lamp per socket for each luminaire scheduled and spares as indicated. Lamps shall be GE, Osram, Philips or approved equal.
 18. All ellipsoidal spotlights shall be from one manufacturer for lamp compatibility.
 19. Pattern Holders shall be manufactured by the manufacturer of the luminaires or City Theatrical Inc.
 20. Drop-in iris units shall be shipped separately from the luminaires and only by the luminaire manufacturer.
 21. Luminaire pipe clamp shall be load rated for not less than 200 lbs and permanently marked to indicate the rating. Clamps shall be by The Light Source, Apollo, Doughty or approved equal.
 22. It is the intent of this specification that all solid state profile and wash luminaires shall be by the same manufacturer so that mixing shall be of a similar color system.
- B. LED Profile Spotlight
1. Fixed focus profile spotlight with Solid-State source. ETC Source4 LED Lustr+ Series 2, or Philips Selecon PLProfile4 LED or pre-approved equal.
 - a. Provide connectors, cables, yoke and clamps as required for pipe mounting.
- C. LED Wash Light
1. Minimum 4-colors (red, blue, green and white or amber).
 - a. Philips Strand PLFRESNEL1 or ETC Selador Desire D40 Vivid with spread lenses.
 - b. Fixed focus or non-adjustable luminaires shall include two (2) spread lenses determined during submittal.
 - c. Provide connectors, cables, yoke and clamps as required for pipe mounting.
- D. Cyclorama/Drop Lighting
1. One Cell LED color changing light.
 2. Minimum 4-colors (red, blue, green and white or amber).
 3. Philips Strand PL-CYC or ETC Source4 LED Cyc light.

4. Provide connectors, yoke, clamps, etc as required for pipe and floor mounting.
- E. PORTABLE WORK LIGHTS
1. A 60-watt Solid-State LED floodlight with yoke, clamp and cord. Provide Osram Sylvania Kreios FL or approved equal.
- F. ACCESSORIES
1. Stage cables shall conform to NEC. Each stage cable shall consist of a length of #12/3 AWG type S, SO, ST, or STO cable with two grounded 2P&G connectors. The length of the cable shall be clearly and indelibly marked at each end. One end of the cable shall have a firmly attached tie line, made of #4 black braided cotton cord, with two free ends at least 15 inches long or hook and loop strap. Provide stage cables in lengths indicated on plans.
 2. DMX-512 Extension Cables shall meet or exceed the recommendations of the DMX-512A Standard. Constructed with black polyurethane jacket. Provide LEX Products, TMB or approved equivalent.
 3. Two-fer's shall be Union Connector #2FTW-24-12/3Y, LEX Products or approved equivalent with UL or NRTL approved molded centerblock.
 4. Network Extension cables shall be CAT5e Neutrik Ethercon compatible connector. Constructed with black polyurethane jacket. Provide LEX Products, TMB or approved equivalent.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Coordinate the design, planning, and scheduling of the work of this section with the work of all other trades. Notify the Architect/Engineer of Record of any difficulties in coordinating work with other contractors. Failure to do so shall constitute acceptance of construction as suitable in all ways to receive the work of this section.
- B. Storage, placement, and hookup of all equipment provided by the lighting equipment manufacturer is covered under other Division 26 Electrical Sections.
- C. Provide all related power and distribution for equipment shown on drawings, schedules, and included in Theatrical Lighting Control specifications and drawings.
- D. Verify and coordinate with manufacturer all wire types and quantities and conduit size with manufacturer.
- E. Proper positioning of equipment specified in this section shall take precedence over all other installations. Report conflicts and problem conditions to the Architect/Engineer of Record within 24 hours of discovery, and immediately suspend installation work in the area involved.
- F. Stage Lighting Equipment shall be mounted using hardware, brackets, and devices supplied by the Stage Lighting Manufacturer as indicated.
- G. Protect all wiring devices and installed equipment from paint. Connector strips, receptacles, and pigtails shall be free from overspray. Such parts and assemblies not clean and in new condition shall be replaced.
- H. Upon completion of installation, all circuits shall be tested by bell or buzzer to verify correct connection and proper continuity.

- I. Equipment shall not be energized until manufacturer's engineer has inspected and approved the installation.
- J. Equipment Hookup Requirements:
 - 1. Do not remove equipment from crates and protective wrappings until building construction and cleanup are completed. Prior to this time, wiring may be pulled to equipment locations, and connector strips and plugging boxes may be installed and connected.
 - 2. Dimmer Panelboards:
 - a. Locate as drawings indicate. Maintain clearances from wall, ceiling, and vibration mounting clearance between rack, floor, walls, and other obstructions attached rigidly to the building.
 - b. Connections between rack and all rigid conduit and wireway to be with non-rigid connections as indicated on the drawings to minimize noise and vibration.
 - c. Equipment Room door shall be kept closed and locked at all times when installation work is not in progress.
 - d. Verify that maintained ambient temperature in Equipment Room is between 32 and 104 deg. F. with dimmers operating under full load and that the maximum relative humidity is 70%, non-condensing.
 - 3. Wiring Devices:
 - a. Plugging strips where fixed shall be uncrated, unfolded, sectioned together and installed whenever appropriate; and bracketed to proper mounting positions with Manufacturer supplied hardware.
- K. Completion and Notification:
 - 1. Upon completion and wiring checkout, notify Architect/Engineer of Record in writing.
 - 2. Upon Architect/Engineer of Record's approval, notify manufacturer that equipment is ready for checkout by factory engineer.
- L. Coordinate delivery of equipment per installation schedule, including expedited delivery of back boxes and wiring devices.
- M. Coordinate building provisions for hookup.
- N. Luminaire Installation
 - 1. Thirty (30) days prior to installation submit for approval a full-sized lighting plot using all of fixed luminaires. Include an instrument schedule spreadsheet and indication of focus points.
 - 2. Deliver, uncrate, lamp, bench focus, hang & focus all luminaires according the approved lighting plot.
 - 3. Luminaires not included in the plot shall be stored either in open positions on the lighting catwalks, stage electrics or another location at the Board's option.
 - 4. Patch lighting console and test the system
- O. Architectural Controls: Stage Lighting Equipment Dealer shall request architectural controls programming information from the Theatre Consultant not less than thirty (30) days prior to the system start-up. Configuration information may include but not be limited to:
 - 1. System Patch.
 - 2. Station button assignments.
 - 3. LCD station logic.
 - 4. Other special programming requirements such as lockouts, scheduled events, etc.
- P. Within ten (10) business days of written request, the Stage Lighting Manufacturer shall provide engineering personnel to check the installed equipment. Make adjustments or modifications as required, and energize and commission systems.

- Q. On completion of installation, energizing, and commissioning, the Stage Lighting Manufacturer shall conduct a complete pre-test of the system to ensure it is working properly and in conformance with this specification. This shall include a complete test of all systems and components. All tests shall be conducted as if the Architect/Engineer of Record or their consultant were present and appropriate corrections made before the final inspection.

3.02 INSPECTION AND TESTING

- A. During the installation of equipment the Contractor shall arrange for access as necessary for inspection of equipment by the Architect/Engineer of Record or their consultants.
- B. If specifications, the Architect/Engineer of Record's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Architect timely notice of its readiness for inspection, and of dates of inspections to be made by other authorities.
- C. Upon completing the installation of all equipment specified under this section, the Contractor shall notify the Architect/Engineer of Record, who will schedule a review of the work.
1. At the time of the review, the Contractor shall furnish sufficient workers to operate all equipment and to perform such adjustments and tests as may be required by the Architect/Engineer of Record or their consultants.
 2. The Theatre Lighting Controls engineering technician shall be present and assist the Theatre Consultant in testing and adjusting the work.
 3. The Stage Lighting Dealer's or the Manufacturer's Field Service Technician shall be present during the inspection to assist the Theatre Consultant in testing and make required adjustments to the system.
 4. At the time of these inspections, no other work shall be performed in the auditorium and stage areas.
 5. All temporary bracing, scaffolding, etc. shall be removed to permit full operation of, and access to, all equipment.
 6. Tests and inspections for final review may include any of the following and/or such other tests, inspections and operations as the Architect/Engineer of Record or their consultants or local authorities having jurisdiction may find necessary:
 - a. Visual examination, uncovering and disassembly of components.
 - b. Operation of all systems and equipment.
 - c. Final acceptance will be withheld until all systems have been thoroughly tested and found to be in first class operating condition.
- D. Any equipment, which is not in conformance with the plans and specifications, shall be repaired or replaced with suitable equipment.
1. Should deficiencies due to faulty equipment or installation require a second review; such second review will be scheduled under the same conditions as previously specified.
 2. Additional expenses resulting from a second review, including time and travel of the Architect/Engineer of Record and their consultants shall be the paid by the Contractor.
- E. Provide instruction as specified above at the convenience of the Board.

3.03 DEMONSTRATION

- A. Demonstration shall occur after the system has been reviewed and accepted by the Architect/Engineer of Record or their consultants.
- B. Stage Lighting System Manufacturer's representative shall instruct Board's designated staff or representatives in the operation and maintenance of all items. This instruction shall be scheduled for a minimum of two (2) four (4) hour sessions. While it may be possible to schedule

one of the instruction sessions to coincide with the system checkout, such coincidence shall not be assumed.

END OF SECTION 26 09 61