SECTION 11 61 53A

CAÑADA COLLEGE THEATRICAL LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes architectural lighting control equipment for operation of Stage, House and Work Lights in the Theater.

B. The work under this section shall be supplied by a qualified stage lighting contractor and installed per Division 26.

C. Contractor's Qualifications: The Contractor for the work of this Section shall:

1. Have been continuously in the business of supplying stage lighting control equipment for at least five years.
2. Maintain a shop adequately equipped and staffed for the fabrication and setup of the work of this Section.
3. Have successfully completed during the past five years five stage lighting controls projects of scope and complexity at least equal to this project.
4. Have in permanent employ or association engineers and other technical staff capable of the layout, detailing and engineering of the work of this section.
5. Have all licenses and local qualifications required to perform the work of this section in the project location.
6. Provide proof of qualification as part of bid submission which includes a list of similar projects completed, including names and current phone numbers of references.

D. The following companies shall be a standard of qualification for stage lighting contractors:

1. Musson Theatrical, 890 Walsh Avenue, Santa Clara, CA 95050, 408-986-0210, contact: David Rimerman
2. Holtzmueller Corporation, 1000 25th Street, San Francisco, CA 94107, 415-826-8383, contact: Jim Schelstrate.

1.2 SECTION INCLUDES

A. Provision of all equipment for control of house and work lighting in the theater, all complete and operative, including, but not limited to the following principal control items:

1. House lights control stations “HLM” and “HL.”
2. Worklight control stations “WL”
3. Architectural Lighting Processor
4. House Lighting Dimmers & Relays.
5. Network gateway
6. DMX Jumper Cables

B. Furnish materials list, shop drawings, operation and service manuals.

C. Test and adjust installed equipment for specified performance.

D. Demonstrate and instruct Owner's personnel in operation and service.

1.3 RELATED SECTIONS

1.	General Requirements	Division 1
2.	Electric Basic Requirements	Section 26 00 00
3.	Low-Voltage Electrical Power Conductors & Cables	Section 26 05 19
4.	Hangers & Supports for Electrical Systems	Section 26 05 29
5.	Raceways	Section 26 05 33

6.	Boxes	Section 26 05 34
7.	Identification for Electrical Systems	Section 26 05 53
8.	Lighting	Section 26 51 00

1.4 DEFINITIONS

A. Contractor: Refers to the contractor responsible for the work of this Division.
B. Provide: Furnish item(s) in the lighting control system as enumerated under this Section.
C. Furnish: Deliver items to the site.
D. Consultant: Consultant responsible for design of house lighting system as described in this section: Landry & Bogan, 733 West Evelyn Ave., Mountain View, CA 94041 (650) 969-5195, fax (650) 969-4965. Contact: Heather McAvoy, heather@landb.com
E. Engineer: Electrical Engineer of Record for the project: Interface Engineering, 717 Market Street, Suite 500, San Francisco, CA 94103, (415) 489-7244. Contact: Jason Lau, jasonl@interfaceEng.com

1.5 GENERAL REQUIREMENTS

A. Electrical equipment and materials shall bear a UL label.

1.6 SUBMITTALS

A. Submit the following in accordance with Division 1 except as modified below.
B. Schedule and Review: Submit shop drawings and related documents for review in ample time for completion of the Work of the Contract. Prior to fabrication or delivery of equipment or materials to the site, receive submittals back from Consultant stamped "Reviewed - resubmission not required".
C. Materials and Equipment List: Submit complete systemized list of all equipment, catalog cuts, brochures, descriptive information, and performance data referenced either to applicable specification paragraphs or to item numbers shown on contract drawings.
D. Manufactured Items: See Division 1.
E. Deviations from requirements of contract documents: Bring all deviations (if any) to the Consultant's attention in writing at the time the drawings are submitted for review.
F. Drawings required:

1. Submit at least six black line prints (min. 11" x 17") for each item of equipment (electronic version via .pdf file is an acceptable substitution.)
2. Equipment shop drawings for each unit of control equipment.
3. Connection/installation drawings for each unit of equipment showing terminal markings corresponding to the as-built equipment.

G. Information on all drawings shall be complete, clear, and sufficient to make connections including wire count, wire gauge, wire type, and other information necessary for satisfactory interconnection between lighting control devices and building equipment.
H. Riser diagrams for control network:

1. The riser diagrams on the drawings show diagrammatically the intended conduit and other wireways for installation of control and signal conductors, including existing conduits.
2. Review the riser diagrams on the drawings, review the wiring listed, and develop riser diagrams as part of the required submittals. The submitted riser diagrams shall include the conduit and wireways shown on the contract drawings. Riser diagrams which do not include such conduit and wireways are not acceptable.
3. Where controls interconnect to building equipment, and devices, or where power is required, indicate clearly the source and destination of the interconnections.

1.7 OPERATION AND SERVICE MANUALS

A. Prepare one stage lighting system manuals for each venue, namely:

1. OPERATING INSTRUCTIONS

   a. Include table of contents and specific instructions for operating controls and functions for the following equipment:

      1. House Light control stations.
      2. Worklight control stations
      3. Architectural Lighting Processor.
      4. DMX/Ethernet Gateway
      5. Dimmer & relay modules.

   b. Exclude operating instructions and diagrams which do not apply to the furnished equipment.

B. SERVICE AND MAINTENANCE

1. Include:

   1. Maintenance and service instructions for all equipment.
   2. Test procedures.
   3. Wiring diagrams with terminal designations.
   4. Data sheets (catalog cuts) for off-the-shelf units.
   5. Equipment parts lists with part numbers.
   6. Equipment fabrication drawings.
   7. Factory location and telephone number for trouble-shooting assistance.

2. Exclude data sheets, lists, and diagrams which do not apply to furnished equipment. If standard service and maintenance sheets include various models in addition to furnished model(s), clearly mark the particular reference to furnished unit.
3. Group sheets in a logical manner and separate groups with indexed divider sheets corresponding to the table of contents.
4. Fold large drawings to 8 1/2" x 11" for binding.
5. Reinforce binding holes to reduce tearout.
6. Place operating and service instructions in one heavy-duty 3-ring binder and label spine with the name of the Project, Venue, Owner, Consultant, Engineer, Manufacturer, and date of completion.
7. Delivery of Manuals:

   a. Email draft copy of manual to Heather McAvoy at heather@landb.com for comment before issuing preliminary manuals for comment. Do not include any pre-manufactured manuals but clearly note which manuals will be submitted separately.
   b. Deliver two copies of preliminary manuals not later than one month prior to initial power on of the lighting control system for review and approval prior to completion of the manuals. If the Consultant requires additions or if revisions are required, the Manufacturer shall make them and resubmit revised preliminary manuals. After approval in writing by the Consultant, deliver four final copies of the manuals to the Consultant. The system installation will not be considered complete and ready for inspection until the manuals have been submitted for review.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements

1. Conform to all current State rules and all local codes and ordinances, including but not necessarily limited to the following:

a. ANSI (American National Standards Institute).
b. IEEE (Inst. of Electrical & Electronic Engineers).
c. IPCEA (Insulated Power Cable Engineers Association.)
d. CEC (California Electrical Code).
e. NEMA (Nat'l Electrical Manufacturers Assoc.).
f. NFPA (National Fire Protection Association).

B. California Building Code

1. UL (Underwriters' Laboratories).

C. Where these Specifications call for a higher standard than the above-mentioned rules, the Specifications shall govern. Should there be any direct conflict between the above-mentioned rules and these Specifications, the rules shall govern.

D. Nothing in these Plans or Specifications is to be construed to permit work not conforming to Codes.

1.9 SUBSTITUTIONS

A. Manufacturers, trade names and model numbers are given for the purposes of identification, and are not intended to be exclusive of other items of equal suitability. However, the design is based on components of individual characteristics, in combinations proven in use.

B. Where a material is identified by trade name (e.g., Formica), the intent is to indicate in short form the type of material and a standard of quality. Where an item is identified by manufacturer or trade name, and a model number or catalog number, the intent is to establish a standard of quality and specific characteristics of design and performance.

C. Requests for substitutions will be considered if the request to substitute is reflected in a list of materials, catalog cuts, performance data, electrical characteristics submitted to the Consultant within the specified time.

D. The following criteria will govern the consideration of requests for substitutions:

1. The item considered must be on the whole equal to or better than the item specified and have a satisfactory field history at installed locations for at least 6 months of operation after date of acceptance of the installation.
2. The item must be equally suited to the design as a whole. If modification of the design is necessary to accommodate the item, it may be rejected on this ground alone.
3. If the item specified is a factory production standard, the Consultant may reject proposed substitutions which must be specially modified in order to be equal.

E. If in the opinion of the Consultant either the acceptance or the necessary evaluation of a proposed substitution may delay completion of the Work beyond the Contract Time, he may summarily reject it if sufficient technical data are not received within the specified time.

F. Materials specified by manufacturer or trade name are based on the manufacturer's ability and experience. In some cases, continued service beyond the warranty period and spare parts are a factor in the choice of a particular supplier. Proposed substitutions must be manufactured by a firm of equal reputation, qualifications and stability to the specified manufacturer.

1.10 CLOSEOUT SUBMITTALS (AS-BUILTS)

A. Provide project record drawings and specifications as required by other sections of the specifications and as outlined in the Operating and Service Manuals. Such drawings shall fully represent installed conditions including true panel board connections, correct conduit and wire sizing as well as routing of new runs, revised fixture scheduling listing the manufacturer and products actually installed and revised panel schedules.

B. All changes to drawings shall be made by qualified draftspersons to match existing line work and lettering as closely as possible.

1.11 BUILDING DRAWINGS AND SITE CONDITIONS

A. Accuracy:

1. Plans and specifications are complementary, what appears in one shall be binding in both.
2. Drawings for the work under this Division are diagrammatic.
3. Existing building conditions may not be documented in the drawings. Confirm site conditions before proceeding with work.

1.12 WARRANTY

A. Guarantee equipment against defective material and workmanship for one year from date of completed installation and completion of punch-list work (if any) except where longer periods are specified.

B. During the guarantee period, furnish emergency service without additional cost. The emergency service includes on-site adjustment, repair, and replacement of parts necessary to return the equipment to satisfactory operating status.

C. Provide the emergency service within 24 hours of notification (or a longer period if agreed to in advance by the Owner).

D. When any component fails at any time during the guarantee period, the guarantee period for replaced components and all other components which are inactive because of said failure shall be extended for a period as long as the inactivity or for two months, whichever is longer.

1.13 OWNER'S INSTRUCTIONS

A. Operation and service manual must be approved and delivered to the owner prior to owner instruction.

B. After completion of the installation, time shall be allotted by the Contractor for demonstrations and instructions for operating and maintenance personnel in the use of all systems. All personnel shall be instructed at one time, the Contractor making all necessary arrangements with the manufacturer's representatives. The equipment manufacturers shall provide product literature and application guides for the users' reference.

C. Determine instruction schedule in cooperation with the Owner's Representative and the control equipment manufacturer. Allow one full 8-hour day for instruction.

D. Costs, if any, for the demonstration and instruction shall be the responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All major house and work lighting systems components (signal processors, control stations, and dimmers) shall be by the same manufacturer. In some cases, components require compatibility with existing equipment.

B. Current products:

1. Hardware: Should the manufacturer have developed a later model of specified units, the latest developed unit shall be provided without additional cost to the Owner. If the latest model of a unit exceeds the specifications (or the manufacturers' previously published specifications), manufacturer shall notify the Consultant and provide a list of differences for review and acceptance prior to delivery.

C. Load equipment and control equipment shall bear a UL label where UL procedures have been established.

2.2 MANUFACTURERS

A. Acceptable manufacturer for control and dimming equipment (to match existing equipment):

1. Electronic Theater Controls, Inc. (ETC West), 6640 Sunset Blvd, Ste. 200, Hollywood, CA 90028, Contact: Randy Pybas, (323) 461-0216

B. Other equipment manufacturers: As listed under specification paragraphs.

2.3 CONDUCTORS

A. In equipment: 600 v. rating unless low voltage wiring isolated from high voltage wiring. Conductors shall be UL listed for use within equipment enclosure and for the intended use.
B. Low voltage signal and control conductors where 300 v. insulation permitted: Shielded and unshielded multi-conductor signal and control cable, color coded tinned copper conductors, PVC insulated, and PVC outer jacket; Belden, Alpha, or equal.
C. Power conductors: THHN/THWN as specified elsewhere in Division 26.
D. All conductors UL listed for application.
E. Signal and control wiring types and wiring topography are specific to each stage lighting equipment manufacturer. Contractor must obtain specific recommendations of the manufacturer of lighting controls and dimmers.

2.4 CONTROL EQUIPMENT, GENERAL

A. Engrave and paint fill designations directly on control panels and signal receptacle panels as shown on plans and as required for identification. Unless noted specifically, separable nameplates attached to control panels are not acceptable.
B. Separate nameplates of aluminum, steel, or laminated phenolic may be employed on equipment other than control panels and signal receptacle panels. Anchor such nameplates with screws or adhesive and screws. Embossed tape markers are not acceptable.
C. Identify fuses and circuit breakers by function and capacity.
D. Provide overload and short-circuit protection for auxiliary and control circuits via circuit breakers or lamp indicating fuse holders; Buss HKL series, Littlefuse 344000 series, or equal.
E. Provide convenient access to circuit breakers, fuses, and other interior components via hinged doors or panels, or removable panels, and without interrupting operation of control panels. Support lift- type panels (if any) with hardware to prevent gravity closing and excessive travel.
F. Fabricate cabinets in modules, if necessary, to pass through doorways, corridors, stairs, and other restricted passageways on site.
G. Fabricate cabinets of welded steel structural members covered by panels of CRS (l6 ga. min.) or l/8" thick aluminum to form mechanically and electrically safe units.
H. Fabricate drawers, doors, etc., to conform to metal furniture standards to be quiet, easy to operate, to have no sharp corners or raw edges, and a generally professional appearance.
I. Treat steel cabinets with a phosphate type dip, and prime all surfaces with zinc chromate or similar rust inhibitor. Finish interior surfaces with one coat (min.) of enamel. Finish exterior of cabinets with two coats (min.) of solid color semi-gloss or gloss baked enamel or epoxy type finish.
J. Provide rubber silencers in the frames for swinging door panels in cabinets located in noise-sensitive areas (e.g., on the stage).
K. Control Panels: Fabricate panels of 14 ga. minimum CRS or .10”-.125” aluminum with hard, sealed black finish. Other panel finishes may be submitted for review and approval. If requested, submit two samples of panel finish to Consultant and obtain written approval prior to finishing. Mount components with dark color flush-head, or blind screws. Neither bright finish nor cut washers are acceptable on visible surface of panel.
L. Key Schedule: Key according to schedule and provide 6 keys for each lock or switch.

M.

LOCK	KEY
Signal Processor Door	A
Lockout Station	B

N. Equipment UL listed and labeled where listing procedures have been established by Underwriters Laboratories.

2.5 DIGITAL HOUSE AND WORK LIGHTS CONTROL SYSTEM

A. Description: System for control of Theater House Lights and worklights via remote stations. System shall operate through digital protocol via the signal processor Dimmers shall be controllable by designated control stations and by existing control console (ETC Ion) on a pile-on basis (highest-level signal takes precedence).

B. System setup: Manufacturer shall obtain data from the Consultant prior to the programming and system testing period as aid in initial configuring of the system to achieve the specified and implied operations.

C. System capacities and features:

1. Dimmers controlled: Minimum of 302.
2. Remote control sources: Minimum of 16.

D. House Light Master Station "HLM"

1. Functions and operations:

a. Permits setting channel levels via slide faders.
b. Permits mastering channel slide faders with master slide fader.
c. Permits recording channel level settings into selected preset.
d. Control stays local until another station seizes control.

2. Description:

a. Controls:

1. "Manual" pushbutton switch: Depressing switch permits use of local channel faders. When station is active, depressing switch returns system to condition existing prior to seizing control and prevents use of local preset switches and faders.
2. Individual slide faders: Permits setting channel level under manual control. Slider travel 1.75" minimum.
3. Master slide fader: Provides proportional adjustment of all individual channel faders when under manual control. Slider travel 1.75" minimum.
4. "Blackout" pushbutton switch: Fades all houselights to black.
5. "Preset" pushbutton switches: Provide the following modes:
6. Assign preset number to slider settings when control is local and station is in "Record" mode.
7. Initiate fade to previously established preset at fade rate set by last used fade-rate station when control is local.
8. Display: LED integral with each switch at 50% illumination in red in pilot light mode and 100% illumination in green to indicate active mode.

b. Electronics: Integral with face plate.
c. Physical: 0.1" - 0.125" aluminum face plate with black semi-gloss finish and white screened (or engraved) characters mounted on new 4-gang surface code gauge steel back box.

E. Acceptable Unit: ETC "Unison Paradigm" #UH40407-4-1F.

F. Houselight Station "HL"

1. Functions and operations:
2. Preset switches: When control is local, depressing switch initiates automatic fade into selected preset recorded at the master station. Digital switch with raised button.

a. Display: LED integral with each switch increases intensity to indicate active mode, otherwise remains ON at lower level.

3. Physical: 0.1" - 0.125" aluminum face plate with black semi-gloss finish and white screened (or engraved) characters to mount on existing recessed single gang back box under existing locking cover.
4. Indicator light: LED at 50% illumination in red in pilot light mode and 100% illumination in green to indicate active mode. .
5. Acceptable unit: ETC "Unison Paradigm" #UH10105-4-1F

G. Work Light Panel "WL"

1. Functions and operations:

a. Preset switches: When control is local, depressing switch initiates automatic fade into selected preset. Digital switch with raised button.
b. Display: LED integral with each switch at 50% illumination in red in pilot light mode and 100% illumination in green to indicate active mode.

2. Electronics: Integral with control.
3. Physical: Integral with enclosure, with black semi-gloss finish and white screened or engraved designations.
4. Acceptable Unit: ETC "Unison Paradigm" #UH1005-4-1F.

H. House/Work lights Control Station at existing Stage Manager's Panel:

1. EIA standard, 19" wide modular control panel to mount within existing surface metal cabinet containing controls and electronic components for operation of lighting and signaling circuits in conjunction with controls at other stations.
2. Physical: 0.1" - 0.125" aluminum face plate with black semi-gloss finish and white screened (or engraved) characters. Controls integral to panel.
3. House Light Station: Same as House Light Station "HL"
4. Worklight Station: Same as Worklight Station "WL"
5. Lock-out Key Switch:

a. Function: Lock-out operation of house and worklight controls at Stage Manager's Rack location.
b. Physical: 3-position, center-off, momentary contact rotary type.

6. Acceptable unit: ETC "Unison Paradigm" #UH10105, UH1005 and UH11K00

2.6 HOUSE LIGHTING RELAY MODULES

A. Dual plug-in units compatible with existing ETC Sensor 24 dimmer rack utilizing mechanically held relays in the same form factor as the existing ETC D20 dimmer modules.
B. Design for operation at full load in an ambient temperature range of 0 degrees to 40 degrees C. and relative humidity range of 25% to 90% without exceeding stud temperature as specified by manufacturer.
C. Cast aluminum chassis, finished with textured epoxy paint and keyed to prevent insertion in inappropriately rated rack positions.
D. UL listed and labeled for continuous duty at 100% of rated load.
E. Power Input range: 90v to 140v 60Hz.
F. Protection:

1. High speed, magnetic circuit breaker for disconnect and overload protection, rated for:

a. 100% switching duty applications.
b. Inrush current of 20 times rated capacity without opening.

c. 125%, 10-120 seconds, must-trip rating.
d. 100,000A Short Circuit Current Rating
e. Modules withstand hot-patching of cold loads up to full rating.

2. Relays:

a. 20A, level activated mechanical relay rated for 200,000 full load activations and 5 million no load applications, minimum.
b. Rated for 1.50HP at 20.0A.

G. Relay Module quantities:
H. Theater: (6) six dual 20A relay modules.
I. Acceptable unit: ETC “Sensor” R20” series

2.7 ETHERNET/DMX GATEWAY

A. General: DMX data port smart nodes to permit DMX512 data to be encoded, routed and decoded over ACN compliant Ethernet network and to permit ACN compliant Ethernet data to be encoded, routed and decoded over DMX512 network.
B. Node shall incorporate four 5-pin XLR type female connectors and one XLR type RJ-45 female connector. (Nuetrik EtherCon or equal)
C. Node shall incorporate a backlit graphical LCD display for identification (soft-labeling) and status reporting. Labeling shall be user configurable.
D. Node shall provide routing and patching of a minimum of 2048 DMX address over 64 DMX universes.
E. All configuration data for each node shall be held at the node and system operation shall not require continuous on-line operation of network configuration software.
F. Power to DMX node shall be supplied via POE system without the additional need for any external power supply or additional wiring.
G. Rack mounted DMX node must be mountable into a standard EIA 19" rack.
H. Acceptable unit: ETC Net 3 Gateway.
I. Quantity: Provide one.

2.8 ARCHITECTURAL CONTROL PROCESSOR

A. Physical:

1. Surface mounted panel constructed of 18 gauge formed steel panels with a hinged, lockable full-height door containing an integral electrostatic air filter.
2. Enclosure door with opening to allow limited access to the control module face panel.
3. Convection cooled without the use of fans.
4. Capacity to accept one or two Control Processors and one or two Station Power Modules, including various options and accessories.
5. Supports a single Station Power Supply module.
6. All enclosure components shall be properly treated and finished.
7. Exterior surfaces finished in fine textured, scratch resistant, powder based epoxy paint.
8. Top, bottom, and side knockouts to facilitate conduit entry.
9. Enclosures designed to allow easy insertion and removal of all control and option modules without the use of tools.
10. Supports provided for precise alignment of modules into power and signal connector blocks.
11. With modules removed, enclosures shall provide clear front access to all power and control wire terminations.

B. Ethernet Switch

1. 5-port Ethernet Switch, with at least 4 ports supplying Power over Ethernet (PoE).
2. 100BaseTX, auto MDI/MDIX, 802.3af PSE compliant.
3. Power, status, and activity indicators. Indicators visible when the enclosure door is open.
4. A test switch/indicator shall be available without opening the rack door or removal of any modules/components.

C. Electrical

1. Available in 100, 120, 230 and 240 volt, single-phase configurations.
2. Pre-wired by the manufacturer. The contractor shall connect input and control wiring.
3. Support the following wire terminations:

   a. AC (single phase)
   b. Echelon link power (Belden 8471 or equivalent)
   c. 24Vdc (2- 16AWG Wire)
   d. DMX512A Port A (In or Out) (Belden 9729 or equivalent)
   e. DMX512A Port B (In or Out) (Belden 9729 or equivalent)
   f. RS232 Serial In/Out (Belden 9729 or equivalent)
   g. Unshielded Twisted Pair (UTP) Category 5 Ethernet
   h. Contact Closure In (14AWG to 26AWG Wire)
   i. Contact Closure Out (14AWG to 26AWG Wire)
   j. Contact Closure Out shall provide 1A @ 30vDC

D. Station Power Modules

1. Provide LinkPower for up to 32 stations and 1.5A@24VDC of Auxiliary (AUX) power.
2. Support over-current/short protection for LinkPower and Aux. LinkPower shall support fault detection on each leg of the balanced data bus.
3. All control wire connections terminated via factory provided connectors.

E. Thermal

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

F. Quantities: Provide (1) one

G. Acceptable unit: ETC “Unison” ERn2” with Unison Paradigm Architectural Control Processor, Station Power Module and 4-port Ethernet switch option.

2.9 DMX CAT5 JUMPER CABLES

A. Note: DMX over CAT5 cable shall only be used for permanently installed conditions. It is not to be used for direct connection to portable equipment or to non-DMX equipment such as Ethernet switches.

B. Comply with ANSI #1.27-2: Standard Wiring Practice for Permanently Installed Control Cables for use with ANSI E1.11 DMX512-A

C. Connector type: RJ45

D. Cable lengths and quantity as shown on the drawings

2.10 FORESTAGE DOWNLIGHT FIXTURES (FIXED FOCUS ELLIPSOIDAL SPOTLIGHTS WITH ROTATING LENS)

1. General: Complete with 36" long three-wire high temperature leads; heat-resistant lamp socket; steel yoke, “C”-clamp for 1-1/2” Schedule 40 pipe; installed male NEMA L5-20 (twistlock) connector, heat resistant black exterior finish; UL label.
2. Physical:

a. Die-cast aluminum body.
b. Integral cable clamp for power leads.
c. Positive locking of lamp focus.
d. Independent lamp alignment controls.
e. High-impact, thermally insulated knobs and shutter handles.
f. Reflector secured with shock mounts.
g. Rotating bi-planar shutter assembly with stainless steel shutters.
h. Lens secured with silicone shock mounts.
i. Provision for interchangeable lens tubes for different fields (except 5 deg.).
j. Teflon guides for lens tube movement.
k. Color frame holders with two accessory slots and top-mounted, quick-release color frame retainer.
l. Steel yoke with two mounting positions with 300+ deg. rotation of fixture within yoke.
m. Positive locking, hand-operated yoke clutch.
n. Slot for drop-in iris and motorized pattern devices.

3. Optical train:

a. Molded borosilicate reflector with multiple dichroic layers.
b. Visible light reflected, 95%; infrared transmitted through reflector, 90%.
c. Projector-quality lenses with anti-reflective coating

4. Lamp: 750 watt, 115V, compact filament halogen lamp w/integral heat sink; HPL750 115 X (long life). Provide 1 per fixture + 10% spare.

5. Acceptable Manufacturer:

a. ETC Source 4, #436 (36 deg)

6. Quantity of fixtures: Per drawings.

7. Accessories:

a. Colorframe: ETC 400CF, one per fixture.
b. Safety cable: Black, ETC #400SC OR EQUAL, one per fixture

PART 3 - EXECUTION

3.1 GENERAL TESTS

A. At completion of installation, but prior to powering the lighting control systems, conduct tests to determine conformity with applicable codes and with these specifications. Where tests depend on energizing the lighting control systems, make such tests after confirmation by system manufacturer's on-site representative. Tests shall include, but are not limited to, the following:

B. Insulation Resistance: Perform 500-volt DC tests for one minute on all feeder and branch circuit conductors, including the neutral, and make a typed record of all readings to be included in the maintenance instructions. Repair or replace circuits showing less than 4 megohms resistance to ground. Make tests using Biddle Insulation Resistance Megger, or equal.

C. Circuits Conformity: Test all feeder and branch circuits for continuity. Test all neutrals for improper grounds.

3.2 INSTALLATION OF LIGHTING CONTROL EQUIPMENT

A. Obtain and follow equipment manufacturer's instructions for termination and connection of equipment. Manufacturer's instructions will be available without cost to the Contractor via telephone and shop and installation drawings.

B. Terminate all DMX signal wiring in compliance with industry wiring standards as described in "Recommended Practice for DMX512" by Adam Bennette, pub. USITT.

C. Terminate all house and work lighting control wiring.

3.3 TESTS OF HOUSE & WORK LIGHTING CONTROL SYSTEMS

A. Coordinate and request the services of field technician representing control equipment manufacturer for final checkout prior to system turn on.

B. Assist the manufacturer's field technician to test and adjust the operation of the lighting control system to conform to the contract documents and manufacturer's technical manuals.

C. Control and signal verification (after stage lighting systems are powered): It is the responsibility of the contractor to verify that all system functions are operating properly.

D. Contractor shall certify network to category 5 specifications utilizing a Fluke DSP LAN test meter or equivalent. Supporting documentation shall be turned over to the consultant upon request.

E. Assist the manufacturer's technician in verifying that all signal and control cables are as per manufacturer's recommendation and are installed as required for proper function.

F. After all tests show conformance, notify the Consultant in writing that the installation is complete, satisfactory, and ready for final inspection by the Consultant.

3.4 INSPECTION AND TESTS BY CONSULTANT

A. The Consultant will make final inspection and tests and prepare a punch list of corrective or incomplete work, if any, caused by the installation work.

B. When the conditions due to installation work which are cited on the punch list (if any) are corrected, notify the Consultant in writing that the work is completed and ready for a second inspection.

C. If the second inspection and tests show the need for corrective work of such an extent that additional visits to the site by the Consultant are required to verify completion of the work, such visits shall be at the expense of the Contractor.

D. If test reports and demonstrations are satisfactory, and the Consultant, upon inspection, finds the systems generally operable for the uses intended, the Consultant may elect to consider the work substantially complete and waive liquidated damages. The Contractor shall proceed immediately to correct conditions (if any) which do not conform to the Contract Documents.

END OF SECTION

SECTION 11 61 53B

COLLEGE OF SAN MATEO HOUSE & WORK LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes architectural lighting control equipment for operation of House and Work Lights in the Theater.

B. The work under this section shall be supplied by a qualified stage lighting contractor and installed per Division 26.

C. Contractor's Qualifications: The Contractor for the work of this Section shall:

1. Have been continuously in the business of supplying stage lighting control equipment for at least five years.
2. Maintain a shop adequately equipped and staffed for the fabrication and setup of the work of this Section.
3. Have successfully completed during the past five years five stage lighting controls projects of scope and complexity at least equal to this project.
4. Have in permanent employ or association engineers and other technical staff capable of the layout, detailing and engineering of the work of this section.
5. Have all licenses and local qualifications required to perform the work of this section in the project location.
6. Provide proof of qualification as part of bid submission which includes a list of similar projects completed, including names and current phone numbers of references.

D. The following companies shall be a standard of qualification for stage lighting contractors:

1. Musson Theatrical, 890 Walsh Avenue, Santa Clara, CA 95050, 408-986-0210, contact: David Rimerman
2. Holtzmueller Corporation, 1000 25th Street, San Francisco, CA 94107, 415-826-8383, contact: Jim Schelstrate.

1.2 SECTION INCLUDES

A. Provision of all equipment for control of house and work lighting in the theater, all complete and operative, including, but not limited to the following principal control items:

1. House lights control stations “HL” and “HLK”
2. Snapshot Control Stations “S”
3. Architectural Lighting Processor
4. House Lighting Dimmers & Relays.
5. Network gateway
6. DMX Jumper Cables

B. Furnish materials list, shop drawings, operation and service manuals.

C. Test and adjust installed equipment for specified performance.

D. Demonstrate and instruct Owner's personnel in operation and service.

1.3 RELATED SECTIONS

1.	General Requirements	Division 1
2.	Electric Basic Requirements	Section 26 00 00
3.	Low-Voltage Electrical Power Conductors & Cables	Section 26 05 19
4.	Hangers & Supports for Electrical Systems	Section 26 05 29
5.	Raceways	Section 26 05 33

6.	Boxes	Section 26 05 34
7.	Identification for Electrical Systems	Section 26 05 53
8.	Lighting	Section 26 51 00

1.4 DEFINITIONS

A. Contractor: Refers to the contractor responsible for the work of this Division.
B. Provide: Furnish item(s) in the lighting control system as enumerated under this Section.
C. Furnish: Deliver items to the site.
D. Consultant: Consultant responsible for design of house lighting system as described in this section: Landry & Bogan, 733 West Evelyn Ave., Mountain View, CA 94041 (650) 969-5195, fax (650) 969-4965. Contact: Heather McAvoy, heather@landb.com
E. Engineer: Electrical Engineer of Record for the project: Interface Engineering, 717 Market Street, Suite 500, San Francisco, CA 94103, (415) 489-7244. Contact: Jason Lau, jasonl@interfaceEng.com

1.5 GENERAL REQUIREMENTS

A. Electrical equipment and materials shall bear a UL label.

1.6 SUBMITTALS

A. Submit the following in accordance with Division 1 except as modified below.
B. Schedule and Review: Submit shop drawings and related documents for review in ample time for completion of the Work of the Contract. Prior to fabrication or delivery of equipment or materials to the site, receive submittals back from Consultant stamped "Reviewed - resubmission not required".
C. Materials and Equipment List: Submit complete systemized list of all equipment, catalog cuts, brochures, descriptive information, and performance data referenced either to applicable specification paragraphs or to item numbers shown on contract drawings.
D. Manufactured Items: See Division 1.
E. Deviations from requirements of contract documents: Bring all deviations (if any) to the Consultant's attention in writing at the time the drawings are submitted for review.
F. Drawings required:

1. Submit at least six black line prints (min. 11" x 17") for each item of equipment (electronic version via .pdf file is an acceptable substitution.)
2. Equipment shop drawings for each unit of control equipment.
3. Connection/installation drawings for each unit of equipment showing terminal markings corresponding to the as-built equipment.

G. Information on all drawings shall be complete, clear, and sufficient to make connections including wire count, wire gauge, wire type, and other information necessary for satisfactory interconnection between lighting control devices and building equipment.
H. Riser diagrams for control network:

1. The riser diagrams on the drawings show diagrammatically the intended conduit and other wireways for installation of control and signal conductors, including existing conduits.
2. Review the riser diagrams on the drawings, review the wiring listed, and develop riser diagrams as part of the required submittals. The submitted riser diagrams shall include the conduit and wireways shown on the contract drawings. Riser diagrams which do not include such conduit and wireways are not acceptable.
3. Where controls interconnect to building equipment, and devices, or where power is required, indicate clearly the source and destination of the interconnections.

1.7 OPERATION AND SERVICE MANUALS

A. Prepare one stage lighting system manuals for each venue, namely:

1. OPERATING INSTRUCTIONS

   a. Include table of contents and specific instructions for operating controls and functions for the following equipment:

      1. House Light control stations.
      2. Snapshot control stations
      3. Architectural Lighting Processor.
      4. DMX/Ethernet Gateway
      5. Dimmer & relay modules.

   b. Exclude operating instructions and diagrams which do not apply to the furnished equipment.

B. SERVICE AND MAINTENANCE

1. Include:

   1. Maintenance and service instructions for all equipment.
   2. Test procedures.
   3. Wiring diagrams with terminal designations.
   4. Data sheets (catalog cuts) for off-the-shelf units.
   5. Equipment parts lists with part numbers.
   6. Equipment fabrication drawings.
   7. Factory location and telephone number for trouble-shooting assistance.

2. Exclude data sheets, lists, and diagrams which do not apply to furnished equipment. If standard service and maintenance sheets include various models in addition to furnished model(s), clearly mark the particular reference to furnished unit.
3. Group sheets in a logical manner and separate groups with indexed divider sheets corresponding to the table of contents.
4. Fold large drawings to 8 1/2" x 11" for binding.
5. Reinforce binding holes to reduce tearout.
6. Place operating and service instructions in one heavy-duty 3-ring binder and label spine with the name of the Project, Venue, Owner, Consultant, Engineer, Manufacturer, and date of completion.
7. Delivery of Manuals:

   a. Email draft copy of manual to Heather McAvoy at heather@landb.com for comment before issuing preliminary manuals for comment. Do not include any pre-manufactured manuals but clearly note which manuals will be submitted separately.
   b. Deliver two copies of preliminary manuals not later than one month prior to initial power on of the lighting control system for review and approval prior to completion of the manuals. If the Consultant requires additions or if revisions are required, the Manufacturer shall make them and resubmit revised preliminary manuals. After approval in writing by the Consultant, deliver four final copies of the manuals to the Consultant. The system installation will not be considered complete and ready for inspection until the manuals have been submitted for review.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements

1. Conform to all current State rules and all local codes and ordinances, including but not necessarily limited to the following:

a. ANSI (American National Standards Institute).
b. IEEE (Inst. of Electrical & Electronic Engineers).
c. IPCEA (Insulated Power Cable Engineers Association.)
d. CEC (California Electrical Code).
e. NEMA (Nat'l Electrical Manufacturers Assoc.).
f. NFPA (National Fire Protection Association).

B. California Building Code

1. UL (Underwriters' Laboratories).

C. Where these Specifications call for a higher standard than the above-mentioned rules, the Specifications shall govern. Should there be any direct conflict between the above-mentioned rules and these Specifications, the rules shall govern.

D. Nothing in these Plans or Specifications is to be construed to permit work not conforming to Codes.

1.9 SUBSTITUTIONS

A. Manufacturers, trade names and model numbers are given for the purposes of identification, and are not intended to be exclusive of other items of equal suitability. However, the design is based on components of individual characteristics, in combinations proven in use.

B. Where a material is identified by trade name (e.g., Formica), the intent is to indicate in short form the type of material and a standard of quality. Where an item is identified by manufacturer or trade name, and a model number or catalog number, the intent is to establish a standard of quality and specific characteristics of design and performance.

C. Requests for substitutions will be considered if the request to substitute is reflected in a list of materials, catalog cuts, performance data, electrical characteristics submitted to the Consultant within the specified time.

D. The following criteria will govern the consideration of requests for substitutions:

1. The item considered must be on the whole equal to or better than the item specified and have a satisfactory field history at installed locations for at least 6 months of operation after date of acceptance of the installation.
2. The item must be equally suited to the design as a whole. If modification of the design is necessary to accommodate the item, it may be rejected on this ground alone.
3. If the item specified is a factory production standard, the Consultant may reject proposed substitutions which must be specially modified in order to be equal.

E. If in the opinion of the Consultant either the acceptance or the necessary evaluation of a proposed substitution may delay completion of the Work beyond the Contract Time, he may summarily reject it if sufficient technical data are not received within the specified time.

F. Materials specified by manufacturer or trade name are based on the manufacturer's ability and experience. In some cases, continued service beyond the warranty period and spare parts are a factor in the choice of a particular supplier. Proposed substitutions must be manufactured by a firm of equal reputation, qualifications and stability to the specified manufacturer.

1.10 CLOSEOUT SUBMITTALS (AS-BUILTS)

A. Provide project record drawings and specifications as required by other sections of the specifications and as outlined in the Operating and Service Manuals. Such drawings shall fully represent installed conditions including true panel board connections, correct conduit and wire sizing as well as routing of new runs, revised fixture scheduling listing the manufacturer and products actually installed and revised panel schedules.

B. All changes to drawings shall be made by qualified draftspersons to match existing line work and lettering as closely as possible.

1.11 BUILDING DRAWINGS AND SITE CONDITIONS

A. Accuracy:

1. Plans and specifications are complementary, what appears in one shall be binding in both.
2. Drawings for the work under this Division are diagrammatic.
3. Existing building conditions may not be documented in the drawings. Confirm site conditions before proceeding with work.

1.12 WARRANTY

A. Guarantee equipment against defective material and workmanship for one year from date of completed installation and completion of punch-list work (if any) except where longer periods are specified.

B. During the guarantee period, furnish emergency service without additional cost. The emergency service includes on-site adjustment, repair, and replacement of parts necessary to return the equipment to satisfactory operating status.

C. Provide the emergency service within 24 hours of notification (or a longer period if agreed to in advance by the Owner).

D. When any component fails at any time during the guarantee period, the guarantee period for replaced components and all other components which are inactive because of said failure shall be extended for a period as long as the inactivity or for two months, whichever is longer.

1.13 OWNER'S INSTRUCTIONS

A. Operation and service manual must be approved and delivered to the owner prior to owner instruction.

B. After completion of the installation, time shall be allotted by the Contractor for demonstrations and instructions for operating and maintenance personnel in the use of all systems. All personnel shall be instructed at one time, the Contractor making all necessary arrangements with the manufacturer's representatives. The equipment manufacturers shall provide product literature and application guides for the users' reference.

C. Determine instruction schedule in cooperation with the Owner's Representative and the control equipment manufacturer. Allow one full 8-hour day for instruction.

D. Costs, if any, for the demonstration and instruction shall be the responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All major house and work lighting systems components (signal processors, control stations, and dimmers) shall be by the same manufacturer. In some cases, components require compatibility with existing equipment.

B. Current products:

1. Hardware: Should the manufacturer have developed a later model of specified units, the latest developed unit shall be provided without additional cost to the Owner. If the latest model of a unit exceeds the specifications (or the manufacturers' previously published specifications), manufacturer shall notify the Consultant and provide a list of differences for review and acceptance prior to delivery.

C. Load equipment and control equipment shall bear a UL label where UL procedures have been established.

2.2 MANUFACTURERS

A. Acceptable manufacturer for control and dimming equipment (to match existing equipment):

1. Electronic Theater Controls, Inc. (ETC West), 6640 Sunset Blvd, Ste. 200, Hollywood, CA 90028, Contact: Randy Pybas, (323) 461-0216

B. Other equipment manufacturers: As listed under specification paragraphs.

2.3 CONDUCTORS

A. In equipment: 600 v. rating unless low voltage wiring isolated from high voltage wiring. Conductors shall be UL listed for use within equipment enclosure and for the intended use.
B. Low voltage signal and control conductors where 300 v. insulation permitted: Shielded and unshielded multi-conductor signal and control cable, color coded tinned copper conductors, PVC insulated, and PVC outer jacket; Belden, Alpha, or equal.
C. Power conductors: THHN/THWN as specified elsewhere in Division 26.
D. All conductors UL listed for application.
E. Signal and control wiring types and wiring topography are specific to each stage lighting equipment manufacturer. Contractor must obtain specific recommendations of the manufacturer of lighting controls and dimmers.

2.4 CONTROL EQUIPMENT, GENERAL

A. Engrave and paint fill designations directly on control panels and signal receptacle panels as shown on plans and as required for identification. Unless noted specifically, separable nameplates attached to control panels are not acceptable.
B. Separate nameplates of aluminum, steel, or laminated phenolic may be employed on equipment other than control panels and signal receptacle panels. Anchor such nameplates with screws or adhesive and screws. Embossed tape markers are not acceptable.
C. Identify fuses and circuit breakers by function and capacity.
D. Provide overload and short-circuit protection for auxiliary and control circuits via circuit breakers or lamp indicating fuse holders; Buss HKL series, Littlefuse 344000 series, or equal.
E. Provide convenient access to circuit breakers, fuses, and other interior components via hinged doors or panels, or removable panels, and without interrupting operation of control panels. Support lift- type panels (if any) with hardware to prevent gravity closing and excessive travel.
F. Fabricate cabinets in modules, if necessary, to pass through doorways, corridors, stairs, and other restricted passageways on site.
G. Fabricate cabinets of welded steel structural members covered by panels of CRS (l6 ga. min.) or l/8" thick aluminum to form mechanically and electrically safe units.
H. Fabricate drawers, doors, etc., to conform to metal furniture standards to be quiet, easy to operate, to have no sharp corners or raw edges, and a generally professional appearance.
I. Treat steel cabinets with a phosphate type dip, and prime all surfaces with zinc chromate or similar rust inhibitor. Finish interior surfaces with one coat (min.) of enamel. Finish exterior of cabinets with two coats (min.) of solid color semi-gloss or gloss baked enamel or epoxy type finish.
J. Provide rubber silencers in the frames for swinging door panels in cabinets located in noise-sensitive areas (e.g., on the stage).
K. Control Panels: Fabricate panels of 14 ga. minimum CRS or .10”-.125” aluminum with hard, sealed black finish. Other panel finishes may be submitted for review and approval. If requested, submit two samples of panel finish to Consultant and obtain written approval prior to finishing. Mount components with dark color flush-head, or blind screws. Neither bright finish nor cut washers are acceptable on visible surface of panel.
L. Key Schedule: Key according to schedule and provide 6 keys for each lock or switch.

M.

LOCK	KEY
Signal Processor Door	A
Keyswitch Station	B

N. Equipment UL listed and labeled where listing procedures have been established by Underwriters Laboratories.

2.5 DIGITAL HOUSE AND WORK LIGHTS CONTROL SYSTEM

A. Description: System for control of Theater House Lights and worklights via remote stations. System shall operate through digital protocol via the signal processor Dimmers shall be controllable by designated control stations and by existing control console (ETC Ion) on a pile-on basis (highest-level signal takes precedence).

B. System setup: Manufacturer shall obtain data from the Consultant prior to the programming and system testing period as aid in initial configuring of the system to achieve the specified and implied operations.

C. System capacities and features:

1. Dimmers controlled: Minimum of 302.
2. Remote control sources: Minimum of 16.

D. Houselight Stations “HL”

1. Functions and operations:

a. Preset switches: When control is local, depressing switch initiates automatic fade into selected preset. Digital switch with raised button.
b. Raise and Lower buttons: Provides proportional adjustment of house light channels under manual control

2. Physical: 0.1” - 0.125” aluminum face plate with black semi-gloss finish and white screened (or engraved) characters to mount on existing recessed single gang back box.
3. Indicator lights: LED at 50% illumination in red in pilot light mode and 100% illumination in green to indicate active mode. .
4. Acceptable unit: ETC “Unison Paradigm” #UH10007-4-1F

E. Houselight Station “HLK

1. Functions and operations:
2. Preset switches: When control is local, depressing switch initiates automatic fade into selected preset. Digital switch with raised button.
3. Lock-out Key Switch:

a. Function: Lock-out operation of station.
b. Physical: 3-position, center-off, momentary contact rotary type.

4. Physical: 0.1” - 0.125” aluminum face plate with black semi-gloss finish and white screened (or engraved) characters to mount on existing recessed single gang back box.
5. Indicator light: LED at 50% illumination in red in pilot light mode and 100% illumination in green to indicate active mode. .
6. Acceptable unit: ETC “Unison Paradigm” #UH11K05-4-1F

F. Snapshot Stations “S”

1. Functions and operations:
2. Preset switches: When control is local, depressing switch initiates automatic fade into selected preset. Digital switch with raised button.
3. Physical: 0.1” - 0.125” aluminum face plate with black semi-gloss finish and white screened (or engraved) characters to mount on existing recessed single gang back box.
4. Indicator light: LED at 50% illumination in red in pilot light mode and 100% illumination in green to indicate active mode. .
5. Acceptable unit: ETC “Unison Paradigm” #UH100010-4-1F

2.6 HOUSE LIGHTING RELAY MODULES

A. Dual plug-in units compatible with existing ETC Unison DR12 dimmer rack utilizing mechanically held relays in the same form factor as the existing ETC D20 dimmer modules.
B. Design for operation at full load in an ambient temperature range of 0 degrees to 40 degrees C. and relative humidity range of 25% to 90% without exceeding stud temperature as specified by manufacturer.
C. Cast aluminum chassis, finished with textured epoxy paint and keyed to prevent insertion in inappropriately rated rack positions.
D. UL listed and labeled for continuous duty at 100% of rated load.
E. Power Input range: 90v to 140v 60Hz.
F. Protection:

1. High speed, magnetic circuit breaker for disconnect and overload protection, rated for:

a. 100% switching duty applications.
b. Inrush current of 20 times rated capacity without opening.
c. 125%, 10-120 seconds, must-trip rating.
d. 100,000A Short Circuit Current Rating
e. Modules withstand hot-patching of cold loads up to full rating.

2. Relays:

a. 20A, level activated mechanical relay rated for 200,000 full load activations and 5 million no load applications, minimum.
b. Rated for 1.50HP at 20.0A.

G. Relay Module quantities:
H. Theater: (6) six dual 20A relay modules.
I. Acceptable unit: ETC “Sensor” R20” series

2.7 ETHERNET/DMX GATEWAY

A. General: DMX data port smart nodes to permit DMX512 data to be encoded, routed and decoded over ACN compliant Ethernet network and to permit ACN compliant Ethernet data to be encoded, routed and decoded over DMX512 network.
B. Node shall incorporate four 5-pin XLR type female connectors and one XLR type RJ-45 female connector. (Nuetrik EtherCon or equal)
C. Node shall incorporate a backlit graphical LCD display for identification (soft-labeling) and status reporting. Labeling shall be user configurable.
D. Node shall provide routing and patching of a minimum of 2048 DMX address over 64 DMX universes.
E. All configuration data for each node shall be held at the node and system operation shall not require continuous on-line operation of network configuration software.
F. Power to DMX node shall be supplied via POE system without the additional need for any external power supply or additional wiring.
G. Rack mounted DMX node must be mountable into a standard EIA 19" rack.
H. Acceptable unit: ETC Net 3 Gateway.
I. Quantity: Provide one.

2.8 ARCHITECTURAL CONTROL PROCESSOR

A. Physical:

1. Surface mounted panel constructed of 18 gauge formed steel panels with a hinged, lockable full-height door containing an integral electrostatic air filter.
2. Enclosure door with opening to allow limited access to the control module face panel.
3. Convection cooled without the use of fans.
4. Capacity to accept one or two Control Processors and one or two Station Power Modules, including various options and accessories.

5. Supports a single Station Power Supply module.
6. All enclosure components shall be properly treated and finished.
7. Exterior surfaces finished in fine textured, scratch resistant, powder based epoxy paint.
8. Top, bottom, and side knockouts to facilitate conduit entry.
9. Enclosures designed to allow easy insertion and removal of all control and option modules without the use of tools.
10. Supports provided for precise alignment of modules into power and signal connector blocks.
11. With modules removed, enclosures shall provide clear front access to all power and control wire terminations.

B. Ethernet Switch

1. 5-port Ethernet Switch, with at least 4 ports supplying Power over Ethernet (PoE).
2. 100BaseTX, auto MDI/MDIX, 802.3af PSE compliant.
3. Power, status, and activity indicators. Indicators visible when the enclosure door is open.
4. A test switch/indicator shall be available without opening the rack door or removal of any modules/components.

C. Electrical

1. Available in 100, 120, 230 and 240 volt, single-phase configurations.
2. Pre-wired by the manufacturer. The contractor shall connect input and control wiring.
3. Support the following wire terminations:

   a. AC (single phase)
   b. Echelon link power (Belden 8471 or equivalent)
   c. 24Vdc (2- 16AWG Wire)
   d. DMX512A Port A (In or Out) (Belden 9729 or equivalent)
   e. DMX512A Port B (In or Out) (Belden 9729 or equivalent)
   f. RS232 Serial In/Out (Belden 9729 or equivalent)
   g. Unshielded Twisted Pair (UTP) Category 5 Ethernet
   h. Contact Closure In (14AWG to 26AWG Wire)
   i. Contact Closure Out (14AWG to 26AWG Wire)
   j. Contact Closure Out shall provide 1A @ 30vDC

D. Station Power Modules

1. Provide LinkPower for up to 32 stations and 1.5A@24VDC of Auxiliary (AUX) power.
2. Support over-current/short protection for LinkPower and Aux. LinkPower shall support fault detection on each leg of the balanced data bus.
3. All control wire connections terminated via factory provided connectors.

E. Thermal

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

F. Quantities: Provide (1) one

G. Acceptable unit: ETC “Unison” ERn2” with Unison Paradigm Architectural Control Processor, Station Power Module and 4-port Ethernet switch option.

2.9 DMX CAT5 JUMPER CABLES

A. Note: DMX over CAT5 cable shall only be used for permanently installed conditions. It is not to be used for direct connection to portable equipment or to non-DMX equipment such as Ethernet switches.

B. Comply with ANSI #1.27-2: Standard Wiring Practice for Permanently Installed Control Cables for use with ANSI E1.11 DMX512-A
C. Connector type: RJ45
D. Cable lengths and quantity as shown on the drawings

PART 3 - EXECUTION

3.1 GENERAL TESTS

A. At completion of installation, but prior to powering the lighting control systems, conduct tests to determine conformity with applicable codes and with these specifications. Where tests depend on energizing the lighting control systems, make such tests after confirmation by system manufacturer's on-site representative. Tests shall include, but are not limited to, the following:
B. Insulation Resistance: Perform 500-volt DC tests for one minute on all feeder and branch circuit conductors, including the neutral, and make a typed record of all readings to be included in the maintenance instructions. Repair or replace circuits showing less than 4 megohms resistance to ground. Make tests using Biddle Insulation Resistance Megger, or equal.
C. Circuits Conformity: Test all feeder and branch circuits for continuity. Test all neutrals for improper grounds.

3.2 INSTALLATION OF LIGHTING CONTROL EQUIPMENT

A. Obtain and follow equipment manufacturer's instructions for termination and connection of equipment. Manufacturer's instructions will be available without cost to the Contractor via telephone and shop and installation drawings.

B. Terminate all DMX signal wiring in compliance with industry wiring standards as described in "Recommended Practice for DMX512" by Adam Bennette, pub. USITT.

C. Terminate all house and work lighting control wiring.

3.3 TESTS OF HOUSE & WORK LIGHTING CONTROL SYSTEMS

A. Coordinate and request the services of field technician representing control equipment manufacturer for final checkout prior to system turn on.

B. Assist the manufacturer's field technician to test and adjust the operation of the lighting control system to conform to the contract documents and manufacturer's technical manuals.

C. Control and signal verification (after stage lighting systems are powered): It is the responsibility of the contractor to verify that all system functions are operating properly.

D. Contractor shall certify network to category 5 specifications utilizing a Fluke DSP LAN test meter or equivalent. Supporting documentation shall be turned over to the consultant upon request.

E. Assist the manufacturer's technician in verifying that all signal and control cables are as per manufacturer's recommendation and are installed as required for proper function.

F. After all tests show conformance, notify the Consultant in writing that the installation is complete, satisfactory, and ready for final inspection by the Consultant.

3.4 INSPECTION AND TESTS BY CONSULTANT

A. The Consultant will make final inspection and tests and prepare a punch list of corrective or incomplete work, if any, caused by the installation work.

B. When the conditions due to installation work which are cited on the punch list (if any) are corrected, notify the Consultant in writing that the work is completed and ready for a second inspection.

C. If the second inspection and tests show the need for corrective work of such an extent that additional visits to the site by the Consultant are required to verify completion of the work, such visits shall be at the expense of the Contractor.

D. If test reports and demonstrations are satisfactory, and the Consultant, upon inspection, finds the systems generally operable for the uses intended, the Consultant may elect to consider the work substantially complete and waive liquidated damages. The Contractor shall proceed immediately to correct conditions (if any) which do not conform to the Contract Documents.

END OF SECTION

SECTION 26 00 00

ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work included in 26 00 00, Electrical Basic Requirements applies to Division 26, Electrical work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.
2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS:

A. Contents of Section applies to Division 26, Electrical Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:
   a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
   b. Drawings
   c. Addenda
   d. Owner/Architect Agreement
   e. Owner/Contractor Agreement
   f. Codes, Standards, Public Ordinances and Permits

1.3 REFERENCES AND STANDARDS

A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 26, Electrical Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of California:
   a. CBC California Building Code
   b. CEC California Electrical Code
   c. CEC T24 California Energy Code Title 24
   d. CFC California Fire Code
   e. CSFM California State Fire Marshal
   f. DSA Division of State Architect Regulations and Requirements

C. General: Reference standards and guidelines include but are not limited to the latest adopted editions from:

1.	ABA	Architectural Barriers Act
2.	ADA	Americans with Disabilities Act
3.	ANSI	American National Standards Institute
4.	APWA	American Public Works Association
5.	ASCE	American Society of Civil Engineers
6.	ASHRAE	Guideline 0, the Commissioning Process
7.	ASTM	ASTM International
8.	CFR	Code of Federal Regulations
9.	ETL	Electrical Testing Laboratories
10.	FCC	Federal Communications Commission
11.	FM	FM Global
12.	IBC	International Building Code
13.	IEC	International Electrotechnical Commission
14.	IEEE	Institute of Electrical and Electronics Engineers
15.	IES	Illuminating Engineering Society
16.	ISO	International Organization for Standardization
17.	MSS	Manufacturers Standardization Society
18.	NEC	National Electric Code
19.	NECA	National Electrical Contractors Association
20.	NEMA	National Electrical Manufacturers Association
21.	NETA	National Electrical Testing Association
22.	NFPA	National Fire Protection Association
23.	OSHA	Occupational Safety and Health Administration
24.	UL	Underwriters Laboratories Inc.

D. See Division 26, Electrical individual Sections for additional references.

E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

1.4 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26, Electrical Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:

1. "No Exceptions Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect.
3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26, Electrical Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
    a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
    b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 26, Electrical specification Sections for specific items required in product data submittal outside of these requirements.
    c. See Division 26, Electrical individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural

components Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Part 3 of this Section.

7. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.

8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

9. Substitutions and Variation from Basis of Design:
   a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
   b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

10. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification Sections for additional requirements for shop drawings outside of these requirements.
    a. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

11. Samples: Provide samples when requested by individual Sections.

12. Resubmission Requirements:
    a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
    b. Resubmit for review until review indicates no exceptions taken or "make corrections as noted".

13. Operation and Maintenance Manuals, Owners Instructions:
    a. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
       1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
       2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's

recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.

3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
4) Include product certificates of warranties and guarantees.
5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
6) Include commissioning reports.
7) Include copy of startup and test reports specific to each piece of equipment.
8) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 26 00 00, Electrical Basic Requirements, Demonstration.

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

14. Record Drawings:

a. Maintain at site at least one set of drawings for recording “As-constructed” conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.

b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.

c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.

d. See Division 26, Electrical individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations.

B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

E. UL and CSA Compliance: Provide products which are UL listed

1.6 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

A. Prior to construction, coordinate installation and location of lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.

B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

C. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide like items from one manufacturer.

2.2 MATERIALS

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by state, county, and city authorities. Equipment/fixture supplier is responsible for obtaining State, County, and City acceptance on equipment/fixtures that are not UL approved or are not listed for installation.

B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

D. Hazardous Materials:

1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.

D. Firestopping:

1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
   a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

E. Plenums:

1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

F. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

G. Provide miscellaneous supports/metals required for installation of equipment and conduit.

3.2 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26 Electrical Sections.

B. Equipment Importance Factor: 1.0.

C. General:

1. Confirm Building Occupancy Category and Seismic Design Category with Architect.
2. Earthquake resistant designs for Electrical (Division 26, Electrical) equipment to conform to regulations of jurisdiction having authority.
3. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
4. Provide stamped shop drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for conduit and equipment. Submit shop drawings along with equipment submittals.
5. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for conduit crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details. Coordinate exact design requirements with project Structural Engineer.

D. Equipment:

1. Provide means to prohibit excessive motion of electrical equipment during earthquake.

3.3 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Underground conduit installation prior to backfilling.
2. Prior to covering walls.
3. Prior to ceiling cover/installation.
4. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch:

1. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:

1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
    a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
    a. Organize work to minimize duration of power interruption.
    b. Coordinate utility service outages with utility company.

3.5 CUTTING AND PATCHING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:

1. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
2. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
3. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect bus duct and similar items until in service.

3.8 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, and individual Division 26, Electrical Sections.

B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

D. Provide miscellaneous supports/metals required for installation of equipment.

3.11 PAINTING

A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. See individual equipment Specifications for other painting.
3. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
4. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.

3.12 DEMOLITION

A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
3. Examination:
   a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
   b. Verify that abandoned wiring and equipment serve only abandoned facilities.
   c. Demolition drawings are based on casual field observation and existing record documents.
      1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
      2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
   d. Report discrepancies to Architect before disturbing existing installation.
      1) Promptly notify Owner if utilities are found which are not shown on Drawings.
4. Execution:
   a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
   b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.
   c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.

d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.

e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.

f. Extend circuiting and devices in existing walls to be furred out.

g. Remove abandoned wiring to source of supply.

h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

j. Existing lighting which is to remain, leave luminaires in proper working order.

k. Repair adjacent construction and finishes damaged during demolition work.

l. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

3.13 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
   a. Cleaning
   b. Operation and Maintenance Manuals
   c. Training of Operating Personnel
   d. Record Drawings
   e. Warranty and Guaranty Certificates
   f. Start-up/Test Document and Commissioning Reports

3.14 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

B. Tests:

1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.

2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.15 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Electrical items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Wires and Cables
   2. Connectors
   3. Lugs and Pads

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wires and Cables:
   1. Carol
   2. General Cable
   3. Okonite
   4. Southwire
   5. Or approved equivalent.

B. Connectors:
   1. Stranded conductors by Anderson.
   2. Burndy

3. Ilsco
4. 3M
5. Thomas & Betts
6. Or approved equivalent.

C. Splices:

1. Branch Circuit Splices:
   a. Ideal
   b. Scotch-Lock
   c. 3M
   d. Or approved equivalent.
2. Feeder Splices:
   a. Not allowed.

D. Connectors:

1. Construction:
   a. T & B Series 60200
   b. Or approved equivalent.
2. Oxide-Inhibiting Joint Compounds:
   a. PENETROX A-13
   b. Or approved equivalent.

E. Lugs:

1. Anderson
2. Ilsco
3. Panduit
4. Thomas & Betts
5. 3M
6. Or approved equivalent.

2.2 WIRES AND CABLES

A. Copper, 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid or stranded. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THWN-2, XHHW-2 or THHN-2.

B. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.

C. Color Code Conductors as Follows:

PHASE	208 VOLT WYE	480 VOLT
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray or White w/colored strip

Ground	Green	Green

D. MC Cable: Not allowed.

E. AC Cable (Armored Cable): Not allowed.

F. SO Cord: Annealed copper conductors, 600 volt rated. Minimum size No. 12 AWG with ground wire. Maximum of six conductors and ground per cable. 90 degrees C rated thermoset jacket.

2.3 CONNECTORS

A. Copper Pads: Drilled and tapped for multiple conductor terminals.

B. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical lugs for use with solid branch and feeder circuit conductors.

C. Split bolt connectors not allowed.

D. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG through 8 AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable.

2.4 LUGS AND PADS

A. Ampacity: Cross-Sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wires and Cables:

1. Conductor Installation:
   a. Install conductors in raceways having adequate, code size cross-Sectional area for wires indicated.
   b. Install conductors with care to avoid damage to insulation.
   c. Do not apply greater tension on conductors than recommended by manufacturer during installation.
   d. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation.
2. Conductor Size and Quantity:
   a. Install no conductors smaller than 12 AWG unless otherwise shown.
   b. Provide required conductors for a fully operable system.
3. Provide dedicated neutrals (one neutral conductor for each phase conductor) in all 120V and 277V circuits.
4. Homeruns:
   a. Do not change intent of branch circuit homeruns without approval. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns. Apply derating factors as required per NEC. Increase conductor size as needed.

5. Identify wire and cable under the provisions of Section 26 05 53, Identification for Electrical Systems. Identify each conductor with its panel and circuit number as indicated.
6. Exposed cable is not allowed.
7. Exposed cable must be run parallel or perpendicular to building lines and hidden from view when possible.

3.2 FIELD QUALITY CONTROL

A. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit test reports with project closeout documents.

B. Inspect and test in accordance with NETA Standard ATS, except Section 4.

C. Perform inspections and tests listed in NETA Standard ATS, Section 7.3.2.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:

1. Hangers, Supports, Anchors, Threaded Rod and Fasteners
2. Support Channel

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
2. Support systems to be supplied by a single manufacturer.
3. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
   a. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

A. General: Provide conduit and equipment hangers and supports in accordance with the following:

1. When supports, anchorages, and seismic restraints for equipment and supports, anchorages and seismic restraints for conduit, cable tray and equipment are not shown on the Drawings, the Contractor is responsible for their design.
2. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems: The following support systems to be designed, detailed, and bear the seal of a professional engineer registered in the State of California.

1. Support frames such as conduit racks or stanchions for conduit and equipment which provide support from below.
2. Equipment and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for conduits to support multiple conduits capable of supporting combined weight of support systems and system contents.

D. Provide heavy-duty steel trapezes for piping to support multiple conduit capable of supporting combined weight of supported systems and system contents.

E. Provide seismic restraint hangers and supports for conduit and equipment.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Support Channel:

1. B-Line
2. Kindorf
3. Superstrut
4. Unistrut
5. Or approved equivalent.

B. Anchors:

1. Anchor It
2. Epcon System
3. Hilti-Hit System
4. Power Fast System
5. Or approved equivalent.

2.2 MATERIALS

A. Hangers, Supports, Anchors, Threaded Rod and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

1. Channel Material: Carbon steel.
2. Coating: Hot dip galvanized.

B. Concrete Inserts: Cast in concrete for support fasteners for loads up to 800 lbs.

C. Pipe Straps: Two-hole galvanized or malleable iron.

D. Luminaire Chain: 90 lb. test with steel hooks.

E. Anchors and Fasteners:

1. Do not use powder-actuated anchors.
2. Obtain permission from Architect before using powder-actuated anchors.
3. Concrete Structural Elements: Use precast inserts.
4. Steel Structural Elements: Use beam clamps.
5. Concrete Surfaces: Use self-drilling anchors.
6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
7. Solid Masonry Walls: Use expansion anchors.
8. Sheet Metal: Use sheet metal screws.
9. Wood Elements: Use wood screws.

2.3 MISCELLANEOUS METAL

A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings that are necessary for completion of the project. The Contractor is responsible for their design.

1. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.

C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

G. Provide hot dipped galvanized components for items exposed to weather.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.

B. Safety factor of 4 required for every fastening device or support for electrical equipment installed. Supports to withstand four times the weight of equipment it supports.

C. Verify mounting height of luminaires prior to installation when heights are not detailed.

D. Install vertical support members for equipment and luminaires, straight and parallel to building walls.

E. Install horizontal support members straight and parallel to ceilings or finished floor unless otherwise noted.

F. Provide independent supports to structural member for electrical luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over suspended ceilings.

G. Do not use other trade's fastening devices as supporting means for electrical luminaires, equipment or materials.

H. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

I. Do not use supports or fastening devices to support other than one particular item.

J. Support conduits within 18-inches of outlets, boxes, panels, cabinets and deflections unless more stringently required by CEC.

K. Maximum distance between supports not to exceed 8 foot spacing unless otherwise required by CEC.

L. Support flexible conduits within 12-inches of outlets, boxes, panels, cabinets and deflections unless otherwise required by CEC.

M. Maximum distance between supports for flexible conduits not to exceed 48-inches spacing unless otherwise required by CEC.

N. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.

O. Provide seismic bracing per CBC requirements.

P. Use spring lock washers under fastener nuts for strut.

3.2 CUTTING AND DRILLING

A. Do not drill or cut structural members without prior permission from Architect.

3.3 FABRICATION - MISCELLANEOUS METALS

A. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

B. Finishes:

1. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with one coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
2. Metal in contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
3. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 05 33

RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:

1. Electrical Metallic Tubing (EMT)
2. Flexible Metal Conduit (FMC)
3. Conduit Fittings

B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on drawings and described in these specifications.

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:

1. Section 26 05 29, Hangers and Supports for Electrical Systems and Equipment
2. Section 26 05 34, Boxes

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 DEFINITIONS

A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Electrical Metallic Tubing (EMT):
1. Allied Tube & Conduit
2. Beck Manufacturing WL
3. Picoma
4. Wheatland Tube Company
5. Or approved equivalent.

B. Flexible Metal Conduit (FMC):
1. AFC Cable Systems Inc.
2. Electri-Flex Company
3. International Metal Hose
4. Or approved equivalent.

C. Conduit Fittings:
1. Insulated Grounding Type for Threaded Rigid IMC Conduit:
   a. O-Z Gedney BLG Series
   b. Or approved Equivalent.
2. Expansion/Deflection Fittings:
   a. EMT, O-Z Gedney Type TX
   b. Or approved equivalent.

2.2 ELECTRICAL METALLIC TUBING (EMT)

A. Description: UL 797, ANSI C80.3; steel galvanized tubing.

B. Fittings: NEMA FB 1; steel, compression type.

2.3 FLEXIBLE METAL CONDUIT (FMC)

A. Description: UL 1, Interlocked steel construction.

B. Fittings: NEMA FB 2.20.

2.4 CONDUIT FITTINGS

A. Raceway Connectors and EMT Couplings:
1. Steel connectors, couplings, and conduit bodies, with hot-dip galvanized.
2. Connector locknuts are steel, with threads meeting ASTM tolerances. Locknuts are hot-dip galvanized.
3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation bears only on plastic throat insert.

4. Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
5. Set screw connectors and couplings, without integral compression glands, are recognized for this contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within raceway assembly utilizing this type connector or coupling.

B. Provide expansion/deflection fittings for EMT.

PART 3 - EXECUTION

3.1 SEQUENCING AND SCHEDULING

A. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.

3.2 CONDUIT REQUIREMENTS

A. Conduit Size:
1. Minimum Size: 3/4-inch for power and control, unless otherwise noted.

B. Dry Locations:
1. Concealed: Use RMC.
2. Exposed: Use RMC.

C. Dry, Protected: RMC.

D. For Dry Areas: Recessed luminaires subject to movement or vibration, use flexible metallic conduit.

3.3 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.

C. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
1. Where shown on the structural drawings.
2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.4 INSTALLATION

A. Install raceways securely, in neat and workmanlike manner, as specified in NECA 1, Standard Practices for Good Workmanship in Electrical Construction.

B. Install steel conduit as specified in NECA 101, Standard for Installing Steel Conduits.

C. Conduit Supports:

1. Arrange supports to prevent misalignment during wiring installation.
2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
4. Do not attach conduit to ceiling support wires.

D. Flexible steel conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.

E. Keep 277/480 volt wiring independent of 120/208 volt wiring, and power wiring. Keep power wiring independent of communication system wiring.

F. Arrange conduit to maintain headroom and present neat appearance.

G. Do not install conduits across floors, unless otherwise noted on drawings.

H. Exposed conduits are permitted only in following areas:

1. Existing walls that are concrete or block construction.
2. Where specifically noted on Drawings.
3. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.

I. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.

J. Install continuous conduit and raceways for electrical power wiring .

K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

L. Maintain adequate clearance between conduit and piping.

M. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.

N. Cut conduit square using saw or pipecutter; deburr cut ends.

O. Bring conduit to shoulder of fittings; fasten securely.

P. Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate factory elbows for bends in metal conduit larger than 2-inch size.

Q. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

R. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

S. Flexible Conduit: Install 12-inch minimum slack loop on flexible metallic conduit and liquidtight.

T. Feeders: Do not combine or change feeder runs.

3.5 CONDUIT FITTINGS

A. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.

B. Condulets and Conduit Bodies:

1. Do not use condulets and conduit bodies.

C. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.

END OF SECTION

SECTION 26 05 34

BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Outlet Boxes
   2. Box Extension Adapter
   3. Conduit Fittings

B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 26 05 33, Raceways
   2. Section 26 05 53, Identification for Electrical Systems

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Outlet Boxes:
   1. Bowers
   2. Hubbell
   3. Raco

4. Steel City
5. Thomas & Betts
6. Or approved equivalent.

B. Conduit Fittings:
1. Killark
2. O-Z Gedney
3. Raco
4. Steel City
5. Thomas & Betts
6. Or approved equivalent.

2.2 OUTLET BOXES

A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.

B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep. Single- or two-gang flush device raised covers.

C. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.

D. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

E. Noise Control: Provide acoustic putty pad to back side of each outlet box installed in acoustic rated walls.

2.3 CONDUIT FITTINGS

A. Requirements: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and plastic conduit bushings of the type and size to suit each respective use and installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate locations of floor boxes and wall mounted wiring device boxes with architectural and structural floor plans prior to rough-in.

3.2 INSTALLATION

A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1, Standard Practice of Good Workmanship in Electrical Construction.

B. Secure boxes rigidly to substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.

C. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.

D. Set wall mounted boxes at elevations to accommodate mounting heights specified in Section.

E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.

1. Adjust box locations up to 10-feet if required to accommodate intended purpose.

F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

G. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.

H. Flush Outlets in Insulated Spaces: Maintain integrity of insulation and vapor barrier.

I. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.

J. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

K. Use flush mounting outlet box in finished areas.

L. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches separation. Provide minimum 24-inches separation in acoustic rated walls.

M. Apply acoustic putty pad on outlet box prior to installation of acoustical blanket.

N. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

O. Use stamped steel bridges to fasten flush mounting outlet box between studs.

P. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

Q. Use adjustable steel channel fasteners for hung ceiling outlet box.

R. Do not fasten boxes to ceiling support wires.

S. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12-inches of box.

T. Use gang box where more than one device is mounted together. Do not use Sectional box.

U. Use gang box with plaster ring for single device outlets.

V. Box Color Coding and Marking: Reference Section 26 05 53, Identification for Electrical Systems.

3.3 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Adjust boxes to be parallel with building lines. Boxes not plumb to building lines are not acceptable.

C. Install knockout closures in unused box openings.

3.4 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Device Labels
   2. Wire Markers

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
   2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 26, Electrical Sections. Where more than a single type is specified for application, provide single selection for each product category.

B. Device Labels:
   1. Kroy
   2. Brady

3. Or approved equivalent.

C. Wire Markers:

1. Brady
2. Panduit
3. Sumitomo
4. Or approved equivalent.

2.2 DEVICE LABELS

A. Extra strength, laminated, adhesive tape, with 3/16-inch black letters on clear background. Use only for identification of control device stations, etc. Indicate source panel and circuits. Embossed tape style labels, or similar, are not acceptable.

B. Label all junction boxes to show system identification, source circuit, or raceway origin. In finished areas, utilize device label. In unfinished areas or above ceilings, use of permanent ink marker is acceptable.

C. Where labels are provided, write identical information in permanent ink marker on the backside of the cover.

2.3 WIRE MARKERS

A. Description: Vinyl-cloth self-adhesive type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.

C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.

D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive labels.

3.2 INSTALLATION

A. Install nameplates labels parallel to equipment lines.

B. Identify empty conduit and boxes with intended use.

C. Provide wire markers on each conductor for power, control, signalling and communications circuits.

D. Where changes are made in existing panels, distribution boards, etc., provide new labeling and typewritten schedules to accurately reflect the changes.

E. Provide labeling where switches control remote lighting or power outlets or where multiple switches are located in the same location.

F. Where switches control remote lighting or power outlets, or where switches or outlets in same location serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, plates with 1/8-inch black letters indicating function of each switch or outlet. Also label function light switches where two or more are mounted in same locations.

G. Provide receptacle device plates with panel and circuit designation labeled on the face, with Dymo-type label, and with circuit written in permanent marker on back of plate and back-box. Provide switch device plates with panel and circuit designation written in permanent marker on back of plate and back-box.

END OF SECTION

SECTION 26 08 08 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the Work of this Section.

B. Specific commissioning requirements are given in the following sections of these specifications.
   1. "Submittal Procedures." , "Contract Closeout."
   2. 01 91 13, "General Commissioning Requirements"
   3. 23 08 08, "Commissioning of HVAC Systems."

1.2 SUBMITALS

A. General:
   1. Comply with Section –Submittal Procedures.
   2. See submittal requirements in Section 01 91 13–General Commissioning Requirements

B. Prior to pre-functional testing:
   1. Provide an electrical systems test plan for approval by the CP
   2. Provide all Pre Functional Tests for approval to the CP
   3. Provide all Functional Tests for approval to the CP

1.3 COORDINATION

A. The Contractor shall coordinate all major equipment startup and installation with the Commissioning Provider (CP).

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Trade Contractor for the equipment being tested.

B. Datalogging equipment or software required to test equipment will be provided by the contractor, if required, but shall not become the property of the Owner.

C. All testing equipment shall be of sufficient quality and accuracy to test or measure system performance required by the Contract Documents.

PART 3 – EXECUTION

3.1 TESTING PREPARATION

A. General Procedures are described in Section 01 91 13 – General Commissioning Requirements.

B. Pre-functional Checklists:

1. Contractor to develop, fill out and sign pre-functional checklists according to 01 91 13 for the following equipment and systems:
    a. Theater Lighting Controls
    b. Lighting Controls related gateways and interfaces

C. Prerequisites for Functional Testing:

1. Contractor shall certify that electrical systems, subsystems, and equipment are completed, calibrated, and started based on the tests verified and approved by the CP
2. Contractor shall certify that all electric testing has been completed with discrepancies and problems resolved.
3. Contractor shall certify that all instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents.

3.3 TESTING

A. General procedures are described in the Division 01 Section "General Commissioning Requirements."

B. Contractor shall perform all pre-functional performance tests with the tests approved by the Commissioning Provider. The CP and the owner shall be advised of all tests as required by the general commissioning requirements in 01 91 13.

C. Contractor shall prepare and execute all functional performance tests.

D. The details of the functional performance tests shall be reviewed and refined during the construction phase by the Commissioning Provider. The final test will be provided to the contractor at least 5 business days before the test is conducted.

END OF SECTION 26 08 08

SECTION 26 51 00

LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Luminaires
   2. Lamps

B. Provide wiring for complete and operating lighting system.

1.2 RELATED SECTIONS

A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:
   1. Section 11 61 53 - Theatrical Lighting Control System

1.3 REFERENCES AND STANDARDS

A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:
   1. NECA 500 - Commercial Lighting

1.4 SUBMITTALS

A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01 General Requirements.

B. In addition, provide:
   1. Submit:
      a. Luminaires: Include electrical ratings, dimensions, mounting, material, required clearances, terminations, wiring and connection diagrams, photometric data, diffusers, and louvers.
      b. Lamps
   2. Submittal Cutsheets: Highlight, circle or otherwise graphically indicate which option(s) are being selected for the products submitted. Cutsheets that are not edited to indicate which products and options are submitted for this project or that list only catalog numbers to identify submitted options are not acceptable.
   3. Specified manufacturers are approved to submit bid. However, inclusion does not relieve manufacturer from supplying product as described.
   4. Provide the following operating and maintenance instructions as required by Section 26 00 00, Electrical Basic Requirements:
      a. Luminaires
      b. Lamps

1.5 QUALITY ASSURANCE

A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Provide luminaires acceptable to code authority for application and location installed.
2. Comply with applicable ANSI standards.
3. Comply with applicable NEMA standards.
4. Provide luminaires and lampholders that comply with UL standards and have been listed and labeled for location and use indicated by a testing agency acceptable by the AHJ (e.g. UL, ETL, and the like).
5. Comply with CEC as applicable to installation and construction of luminaires.
6. Comply with fallout and retention requirements of CBC for diffusers, baffles, and louvers.

1.6 WARRANTY

A. Warranty as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Ballast Manufacturer's Warranty: Not less than 5 years for electronic type ballasts, based on date of substantial completion. Include normal cost of labor for replacement of ballast.
2. Lamp Warranty: 30 days for incandescent, 1 year for compact fluorescent, 3 years for linear fluorescent and 1 year for HID lamps, based on date of substantial completion.
3. Warranty: LED systems and complete luminaires must have manufacturer's warranty of a minimum of 5 years from date of substantial completion, including driver.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. As specified in Articles below.

B. Or approved equivalent.

2.2 LUMINAIRES

A. Luminaires: Reference description and manufacturers in Luminaire Schedule on drawings.

B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.

C. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material. Verify with Architectural Reflected Ceiling Plan prior to submittals.

D. Finishes:

1. Manufacturer's standard finish (unless otherwise indicated) over corrosion resistant primer.
2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectance.

E. Light Transmitting Components:

1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
2. Prismatic acrylic, extruded, flat diffusers, 0.125-inch overall thickness, unless otherwise noted.

2.3 LAMPS

A. Provide lamps for luminaires.

B. Provide lamp catalogued for specified luminaire type.

C. Manufacturers: Osram Sylvania, General Electric, Philips, Venture, Ushio (MR only), EYE (MR only), or approved equivalent unless specific manufacturer is indicated in Luminaire Schedule.

D. LED (Light Emitting Diode):

1. LED manufacturer will include, but not be limited to, light source, luminaire, power supply and control interface with added components as needed for complete and functioning system.
   a. Comply with ANSI chromaticity standard for classifications of color temperature. See luminaire schedule for specified LED lamp color and color temperature. UL or ETL listed and labeled.
   b. Luminaire testing per IESNA LM-79 and LM-80 procedures.
   c. Lamp life for white LEDs: 50,000 plus hours with lamp failure occurring when LED produces 70 percent of initial rated lumens.
   d. Lamp life for color LEDs: 30,000 plus hours with lamp failure occurring when LED produces 50 percent of its initial rated lumens.
   e. LED Drivers: reverse polarity protection, open circuit protection, require no minimum load. Minimum 80 percent efficiency. Class A noise rating.
   f. Dimming: LED system capable of full and continuous dimming via DMX-RDM.
   g. LED light source manufacturers: Nichia, Cree, Osram Sylvania, GE Lumination.
2. Special types as indicated in luminaire schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install luminaires securely, in neat and workmanlike manner.

B. Install luminaires of types indicated where shown and at indicated heights in accordance with manufacturer's written instructions and with recognized industry practices to ensure that luminaires comply with requirements and serve intended purposes.

C. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.

D. Avoid interference with and provide clearance from equipment. Where indicated locations for luminaires conflict with locations for equipment, change locations for luminaire by minimum distance necessary as directed by Architect.

E. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors.

F. Interior Luminaire Supports:

1. Support Luminaires: Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
2. Maintain luminaire positions after cleaning and relamping.
3. Support luminaires without causing ceiling or partition to deflect.
4. Provide mounting supports for recessed and pendant mounted luminaires as required by IBC.

G. Wiring:

1. Recessed luminaires to be installed using flexible metallic conduit with luminaire conductors spliced to branch circuit conductors in nearby accessible junction box over ceiling. Junction box fastened to building structural member within 6-feet of luminaire.
2. Luminaires for lift out and removal from ceiling pattern without disconnecting conductors or defacing ceiling materials.
3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to support device.
4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.

H. Relamp luminaires which have failed lamps at substantial completion.

I. Replace ballasts deemed as excessively noisy by Architect, Engineer, or Owner.

J. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

K. Support luminaires larger than 2- by 4-foot size independent of ceiling framing.

L. Locate recessed ceiling luminaires as indicated on architectural reflected ceiling plan.

M. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

N. Exposed Grid Ceilings:

1. Support surface mounted luminaires in grid ceiling directly from building structure.
2. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
3. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.

O. Install recessed luminaires to permit removal from below.

P. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

Q. Install clips to secure recessed grid-supported luminaires in place.

R. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Architectural Drawings.

S. Install accessories furnished with each luminaire.

T. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

U. Bond products and metal accessories to branch circuit equipment grounding conductor.

V. Where manufactured wiring assemblies are used, insure that wiring assembly manufacturer sends components to appropriate luminaire manufacturer for respective installation of proper components.

3.2 COORDINATION

A. Coordination of Conditions: Coordinate ceiling construction, recessing depth and other construction details prior to ordering luminaires for shipment. Refer cases of uncertain applicability to Architect for resolution prior to release of luminaires for shipment. Where luminaires supplied do not match ceiling construction, replace luminaires at no cost to Owner.

B. Electrical drawings are schematic, identifying quantity and type of luminaires used and their approximate location, but are not to be used for dimensional purposes. Reference architectural drawings for exact locations, including mounting heights.

C. Provide lighting indicated on drawings with luminaire of the type designated and appropriate for location.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection in accordance with Division 01, General Requirements.

B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Aim and adjust luminaires as indicated.

B. Focus and adjust floodlights, spotlights and other adjustable luminaires, with Architect, at such time of day or night as required.

C. Align luminaires that are not straight and parallel/perpendicular to structure.

3.5 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosures.

C. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damaged finishes per by manufacturer's instructions.

3.6 CLOSEOUT ACTIVITIES

A. Demonstrate luminaire operation for minimum of two hours.

END OF SECTION