

## SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. Provide all labor, materials, equipment and supervision to construct complete and operable electrical systems as indicated on the drawings and specified herein.
- B. All materials and equipment used shall be new, undamaged and free from any defects.

#### 1.2 RELATED DOCUMENTS AND OTHER INFORMATION

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the portions of work specified in every Section, individually and collectively.

#### 1.3 PRODUCT WARRANTIES

- A. Provide manufacturers' standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's warranty be less than one (1) year from the date of substantial completion.
  - 1. Where manufacturer's warranty lists a start date of PO or date of ship, contractor shall purchase extended warranty to ensure warranty period extends to a minimum of 1 year after date of substantial completion.
  - 2. Sports lighting fixtures shall be warranted for 10 years minimum.

#### 1.4 PRODUCT SUBSTITUTIONS

- A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Architect at least 10 days prior to opening of bids.

#### 1.5 SUBMITTAL REQUIREMENTS

- A. Submit for review by the Engineer Architect a schedule with engineering data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive materials, i.e., catalog sheets, product data sheets, diagrams, performance curves and charts published by the manufacturer, warranties, etc., to show conformance to Specifications and Plan requirements; model numbers alone shall not be acceptable. Data submitted for review shall contain all information to indicate compliance with Contract Documents. Complete electrical characteristics shall be provided for all equipment. Submittals for lighting fixtures shall include Photometric Data. The Engineer reserves the right to require samples of any equipment to be submitted for review.

- B. The purpose of shop drawing review is to demonstrate to the Architect that the Contractor understands the design concept. The A/E's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviations from the drawings or specifications unless he has, in writing, called the A/E's attention to such deviation at the time of submission, and received written permission from the A/E for such deviations.
- C. Where cut sheets include an entire product family, mark all specific items to be utilized for this project on equipment cut sheets. Generic cut sheets with no indication of which items on the cut sheet shall be used will be rejected.
- D. Response to Submittals: Shop drawings shall be noted with the following classifications:
  - 1. "Reviewed": No corrections, no marks. Contractor shall submit copies for distribution.
  - 2. "Provide as Corrected": A few minor corrections. Items may be ordered as marked up without further resubmission. Submit shall submit copies for distribution. Formally correct prior to submitting O&M manuals.
  - 3. "Revise and Resubmit": Minor corrections. Items may be ordered at the Contractor's option. Contractor shall resubmit documents with corrections noted.
  - 4. "Rejected": Major corrections required or not in accordance with the contract documents. Contractor shall correct and resubmit documents.

#### 1.6 ELECTRICAL DRAWINGS

- A. Electrical contract drawings are diagrammatic and indicate the general arrangement of electrical equipment. Do not scale electrical plans. Obtain all dimensions from the Architect's dimensioned drawings and field measurements. The Contractor shall review Architectural plans for door swings and built-in equipment; conditions indicated on those plans shall govern for this work.
- B. Coordinate installation of electrical equipment with structural and mechanical equipment and access thereto. Coordinate exterior electrical work with civil and landscaping work.
- C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be installed to provide the better quality or greater quantity of work; or comply with the more stringent requirement; either or both in accordance with the A/E's interpretation.

#### 1.7 ELECTRICAL WORK SCHEDULE

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart, or Gantt chart) for review by the Architect/Engineer and Owner at least 10-days prior to beginning work. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project. Specific items shall include (but not limited to) the following:
  - 1. Date of on-site arrival of electrical equipment and accessories required for system installation.
  - 2. Estimated dates and duration of all service outages.
  - 3. Estimated start date and completion date for the demolition of each existing

panelboard.

4. Estimated start date and completion date for the installation of each panelboard.
5. Estimated dates and duration of required work access to areas that are not in the current phase, or scope of work.

#### 1.8 SUBMITTALS – GENERAL ELECTRICAL

- A. Electrical coordination drawings shall be provided as described below:
  1. Feeders over 100 Amps: The routing of main feeders is not shown on the drawings. Actual routing shall be determined by the contractor in accordance with the specifications and shall be coordinated with work by other trades. For underground lines, show all utility crossings.
  2. Drawings Format: Drawings shall be prepared at a scale of no less than 1/16" = 1'-0" for feeder routes and 1/4" = 1'-0" for electrical rooms / equipment yards. Drawing shall be titled to define Project Name, Drawing subject and date prepared. Drawings are to be prepared in AutoCAD or compatible software.
- B. Firestopping Submittals shall be provided for each proposed system type prior to installation. Submittal shall include the following:
  1. Firestopping Materials
  2. Firestopping Installation Drawings for each conduit penetration, cable in metal sleeve penetration, and blank metal sleeve penetration for each type of wall / floor construction encountered.
  3. Provide fire rated "putty-pads" on all electrical boxes in fire rated partitions.

#### 1.9 SYSTEMS REQUIRING ROUGH-IN

- A. Rough-in shall consist of all outlet boxes/raceway systems/supports and sleeves required for the installation of cables/devices by other Divisions and by the Owner. It shall be the responsibility of this Contractor to determine the requirements by reviewing the contract documents and meeting with the Superintendent of the trade involved and Owner's representative to review submittal data, shop drawings, etc.
- B. Sealing of all sleeves, to meet the fire rating of the assembly, whether active or not, is work of this Division.

#### 1.10 EXISTING SERVICES AND FACILITIES

- A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.
- B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work, and the availability of adequate labor and materials will ensure that the duration of the interruption will not exceed the time agreed upon.

- C. Removed Materials: Existing materials made unnecessary by the new installation shall be stored on site. They shall remain the property of the Owner and shall be stored at a location and in a manner as directed by the Owner. If classified by the Owner's authorized representative as unsuitable for further use, the material shall become the property of the Contractor and shall be removed from the site at no additional cost to the owner.
- D. Contractor shall review drawings for all trades for coordination with existing conditions. Contractor shall be responsible for routing of underground raceways and coordinate with GC and other trades for cutting and repairing of existing slabs, parking areas, sidewalks, sheetrock and/or plaster walls, etc.
- E. Contractor shall be responsible for coordinating with contract documents and other trades for routing of ducts, pipes, cable-tray and other components with existing conditions. Contractor shall be responsible for field verifying source of raceways and cabling that are in conflict regardless of whether they serve devices around work or not. The relocation of these raceways to assist in avoiding these conflicts shall also be included at no additional cost to the owner.
- F. Contractor shall protect all existing low-voltage cabling from damage. If conflicts arise, contact architect immediately to determine status of cabling. Existing cabling that is damaged during construction shall be replaced by the contractor.

## PART 2 - PRODUCTS

### 2.1 FIRESTOPPING:

- A. A firestop system shall be used to seal penetrations of electrical conduits and cables through fire-rated partitions per NEC 300.21, and NEC 800.26. The firestop system shall be qualified by formal performance testing in accordance with ASTM E-814, or UL 1479.
- B. The firestop system shall consist of a fire-rated caulk type substance and a high temperature fiber insulation. It shall be permanently flexible, waterproof, non-toxic, smoke and gas tight and have a high adhesion to all solids so damming is not required. Only metal conduit shall be used in conjunction with this system to penetrate fire rated partitions. Install in strict compliance with manufacturer's recommendations. 3M or approved equal.
- C. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- D. Comply with BICSI TDMM, "Firestopping Systems" Article.

## PART 3 - EXECUTION

### 3.1 PRODUCT INSTALLATION, GENERAL

- A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shutdown of operating equipment. Consult with manufacturer's technical experts, for specific

instructions on unique product conditions and unforeseen problems.

- B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.
- C. Permits and Tests: Provide labor, material and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or his representative. Notify the Architect five days in advance of any testing.
- D. Install temporary protective covers over equipment enclosures, outlet boxes and similar items after interiors, conductors, devices, etc. are installed, to prevent the entry of construction debris and to protect the installation during finish work performed by others. Do not install device plates, equipment covers or trims until finish work is complete.
- E. Clean all equipment, inside and out, upon completion of the work. Scratched or marred surfaces shall be touched up with touch-up paint furnished by the equipment manufacturer.
- F. Replace all equipment and materials that become damaged.
- G. No more than three phase conductors, each of opposite phases for a three phase WYE system, shall be combined in a single raceway unless written approval is granted by the engineer or noted otherwise on the construction documents. 120 volt and 277 volt receptacle and lighting circuits are excepted from this requirement, but must meet the requirements of the NEC.
- H. Shared neutrals shall not be utilized (including but not limited to homeruns) unless written permission is obtained from the Engineer for a specific application.

### 3.2 EQUIPMENT PROTECTION

- A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
- B. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to switchgear, switchboards, panelboards, transformers, motor control centers, motor controllers, uninterruptible power systems, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
- C. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
- D. Damaged equipment shall be, as determined by the Engineer, placed in first-class operating condition or be returned to the source of supply for repair or replacement.

- E. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
- F. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

3.3 UTILITY CONNECTIONS:

- A. Coordinate the connection of the electrical system with the local power company. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Pay all utility fees and charges.

3.4 ELECTRICAL WORK:

- A. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
  - 1. Electricians must use full protective equipment (i.e., certified and tested insulation material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
  - 2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
  - 3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the Contractor. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
  - 4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Owner/ Architect.

END OF SECTION 260500

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes building wire and cable; and wiring connectors and connections.

#### 1.2 REFERENCES

- A. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
- C. Underwriters Laboratories, Inc.:
  - 1. UL Standard 83 for Thermoplastic-Insulated Wires and Cables.

#### 1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
  - 1. Solid conductor for branch circuits 10 AWG and smaller.
  - 2. Stranded conductors for control circuits.
  - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
  - 4. Conductor not smaller than 14 AWG for control circuits.
  - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
  - 1. Use only building wire, Type THHN/THWN-2 insulation, in raceway unless specifically noted otherwise.
  - 2. Type MC Cable shall **not** be allowed.

#### 1.4 SUBMITTALS

- A. Product Data for the following:
  - 1. Wire and Cable
  - 2. Splice Kits
  - 3. Waterproof Wire Connectors
- B. Test Reports: Indicate procedures and values obtained.

## 1.5 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Conform to requirements of NFPA 70.

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

## 1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to work. Coordinate dimensions with architectural, structural, and civil drawings. Electrical Drawings are diagrammatic only and shall not be scaled.

## 1.8 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 ft of length shown.

## PART 2 PRODUCTS

### 2.1 BUILDING WIRE

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Southwire
  - 2. AETNA.
  - 3. American Insulated Wire Corp.
  - 4. Colonial Wire
  - 5. General Cable Co.
  - 6. Encore Wire
  - 7. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Single conductor insulated wire.

- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.

## 2.2 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

### 3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

### 3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes are abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections, remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

### 3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.

- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
  - 1. Pull conductors into raceway at same time.
  - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Wiring Connections:
  - 1. Clean conductor surfaces before installing lugs and connectors.
  - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
  - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
  - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
  - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
  - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
  - 7. Polaris type splice kits will not be accepted.
- F. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- G. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- H. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- I. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

### 3.5 WIRE COLOR

- A. General:
  - 1. For wire sizes 6 AWG and smaller, install wire with insulation colors as designated below.
  - 2. For wire sizes 4 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
- B. 277/480-volt systems:
  - Phase A - Orange
  - Phase B - Brown
  - Phase C - Yellow

Neutral - Gray  
Ground - Green

3.6 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Rod electrodes.
  - 2. Wire.
  - 3. Mechanical connectors.
  - 4. Exothermic connections.

#### 1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.

#### 1.3 DESIGN REQUIREMENTS

- A. Construct and test grounding systems for access flooring systems on conductive floors accordance with IEEE 1100. Refer to Section 09 69 00.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms maximum.

#### 1.5 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

- B. Installer: Company specializing in performing work of this section with minimum three years experience.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

### PART 2 PRODUCTS

#### 2.1 ROD ELECTRODES

- A. Product Description:
  - 1. Material: Copper-clad steel.
  - 2. Diameter: 3/4 inch (19 mm).
  - 3. Length: 10 feet (3.0 m).
- B. Connector: Connector for exothermic welded connection.

#### 2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 4 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor insulated.

#### 2.3 MECHANICAL CONNECTORS

- A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.
  - 1. Bonding Jumpers: Compression type connectors, using zinc-plated fasteners and external tooth lock washers.
  - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
  - 3. Rack and cabinet ground bars: One-hole compression type lugs using zinc-plated or copper alloy fasteners.

## 2.4 EXOTHERMIC CONNECTIONS

- A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

### 3.2 PREPARATION

- A. Remove paint, rust, mill oils, and other surface contaminants at connection points.

### 3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

### 3.4 INSTALLATION

- A. Install in accordance with IEEE 142.
- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond steel together. If it is determined that the reinforcing steel cannot be made electrically continuously, install a 4 AWG bare copper conductor in foundation footing around the perimeter of the building.
- E. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- F. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- G. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.

- H. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- I. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- J. Permanently attach equipment and grounding conductors prior to energizing equipment.

### 3.5 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground resistance testing in accordance with IEEE 142.
- D. Perform continuity testing in accordance with IEEE 142.
- E. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Conduit and equipment supports.
  - 2. Anchors and fasteners.

#### 1.2 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

### PART 2 PRODUCTS

#### 2.1 CONDUIT SUPPORTS

- A. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- B. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- C. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

#### 2.2 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

#### 2.3 SPRING STEEL CLIPS

- A. Product Description: Mounting hole and screw closure.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. The use of powder-actuated anchors is not allowed.
- B. Do not drill or cut structural members.

### 3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
  - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors and preset inserts.
  - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, and steel ramset fasteners.
  - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
  - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
  - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
  - 6. Sheet Metal: Provide sheet metal screws.
  - 7. Wood Elements: Provide wood screws.
  
- B. Inserts:
  - 1. Install inserts for placement in concrete forms.
  - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
  
- C. Install conduit and raceway support and spacing in accordance with NEC.
  
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
  
- E. Install multiple conduit runs on common hangers.
  
- F. Supports:
  - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
  - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
  - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
  - 4. Support vertical conduit at every other floor.

### 3.3 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Section 03 30 00.
  
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.4 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 260529

## SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

#### 1.2 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
  - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
  - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

#### 1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground Raceways: All underground raceways shall be as defined below unless noted otherwise on plans.
  - 1. Service Entrance: Provide nonmetallic conduit (schedule 40 PVC) with galvanized rigid steel long-sweep 90-degree elbows.
  - 2. Feeders: Provide nonmetallic conduit (schedule 40 PVC) with galvanized rigid steel long-sweep 90-degree elbows unless specifically noted otherwise. Where conduits go vertical, they shall be galvanized rigid steel or IMC to above grade or slab. Provide cast metal boxes or nonmetallic handhole.
  - 3. Branch circuits outside building footprint: Provide nonmetallic conduit

(schedule 40 PVC) with galvanized rigid steel long-sweep 90-degree elbows. Where conduits go vertical, they shall be galvanized rigid steel or IMC to above grade. Provide cast metal boxes or nonmetallic handhole.

- C. Outdoor Locations, Above Grade: Provide galvanized rigid steel or rigid aluminum conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes. Provide liquid-tight flexible metal conduit (maximum 6'-0" in length) for connection to vibrating equipment.
- D. Interior Wet and Damp Locations: Provide galvanized rigid steel or aluminum conduit. Provide cast metal outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- E. All raceways shall be hard-piped as described above. Flexible raceways shall be used for the following applications and shall be limited to 6'-0" in length:
  - 1. Whips to light fixtures.

#### 1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch (19 mm) unless otherwise specified.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
  - 1. Record actual routing of conduits larger than 2 inch (DN50).
  - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers listed below are basis of design or can provide products equal to basis of design.
  - 1. Carlon Electrical Products.
  - 2. Hubbell Wiring Devices.
  - 3. Thomas & Betts Corp.
  - 4. Walker Systems Inc.
  - 5. The Wiremold Co.
  - 6. Substitutions: Division 01 Specifications - Product Requirements.

## 2.2 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

## 2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked aluminum construction with PVC jacket.
- B. Fittings: NEMA FB 1.

## 2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel compression type.

## 2.5 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

## 2.6 WIREWAY

- A. Product Description: General purpose for interior locations, and Raintight type for exterior locations wireway.
- B. Cover: Hinged cover with full gaskets.
- C. Finish: Rust inhibiting primer coating with gray enamel finish.

## 2.7 OUTLET BOXES

- A. Cast Boxes: NEMA FB 1, Type FD. Furnish gasketed cover by box manufacturer.
- B. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- C. Wall Plates for Unfinished Areas: Furnish gasketed cover.

## 2.8 PULL AND JUNCTION BOXES

- A. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
  2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- B. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:
1. See details on plans.
  2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

#### 3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

#### 3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceways and boxes to maintain headroom and present neat appearance.

- E. Do not install raceways or boxes within 1-1/2" of roof decking to prevent damage from roof installation or repair.

### 3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch (19 mm). Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12-inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to cast boxes.

- R. Install no more than equivalent of three 90 degree bends between boxes for power systems. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireways, junction boxes, and pull boxes.

### 3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet (3 m) prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.
- P. Install junction boxes or pull boxes at locations that can be accessed through existing ceiling with a standard ladder. Maximum height of junction boxes above accessible ceiling or through an access panel in a non-accessible is 4' above top of ceiling frame.

### 3.6 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installer.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

### 3.7 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

### 3.8 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260533

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Nameplates.
  - 2. Labels.
  - 3. Wire markers.
  - 4. Panel Schedules
  - 5. Underground Warning Tape.

#### 1.2 DELIVERY, STORAGE, AND HANDLING

- A. Accept identification products on site in original containers. Inspect for damage.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.3 ENVIRONMENTAL REQUIREMENTS

- A. Install nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

### PART 2 PRODUCTS

#### 2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved letters on contrasting background color. See specification sections for specific equipment for nameplate color schemes. If no color scheme is specified for specific equipment, provide black letters on a white background.
- B. Letter Size:
  - 1. 1/8 inch (3 mm) high letters for identifying individual equipment and loads.
- C. Minimum nameplate thickness: 1/8 inch (3 mm).

#### 2.2 LABELS

- A. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) black letters on clear background.

## 2.3 WIRE MARKERS

- A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: -50 deg F to +284 deg F (-46 deg C to +140 deg C).
- B. Legend:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number.
  - 2. Control Circuits: Control wire number as indicated on shop drawings.

## 2.4 PANELBOARD SCHEDULES

- A. Provide complete panelboard schedule with all circuits identified and room numbers associated with each branch circuit included. Panel Schedules shall include Panelboard name, Voltage/Phase, Main Bus and/or Main Breaker rating, Date Schedule was completed, Contractor name and phone number.
- B. All panelboard schedules for existing panels where any branch circuit or feeder modification was included in the project scope shall have a completely new panelboard schedule created. Contractor is responsible for field verifying and circuit tracing of **all** existing branch circuits associated with the panelboard to ensure accurate descriptions.

## 2.5 SUPPORT WIRES

- A. Support wires above suspended ceilings for electrical system fixtures, devices, and cabling shall be painted red such that they are easily identified from below.

## 2.6 UNDERGROUND WARNING TAPE

- A. Description: 4 inch (100 mm) wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 EXISTING WORK

- A. Install identification on unmarked existing equipment.
- B. Replace lost nameplates.

### 3.3 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
  - 1. Install nameplate parallel to equipment lines.
  - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
  - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
  - 4. Secure nameplate to equipment front using screws, or adhesive.
  - 5. Install nameplates for the following:
    - a. Panelboards.
    - b. Lighting Control Panels.
- C. Label Installation:
  - 1. Install label parallel to equipment lines.
  - 2. Install label for identification of branch circuit and panelboard supporting each wiring devices.
  - 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
  - 1. Install wire marker for each conductor at each load connection.
  - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
  - 3. Install labels at data outlets identifying patch panel and port designation.
- E. Underground Warning Tape Installation:
  - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 260553

PANEL SCHEDULE DIRECTORY					
Panel: XXXXX			Location: XXXXXXXXXXX		
Voltage/Ph: XXX/XXX/XP			Room #: XXXX		
MAINS: XXXA			Date: XXXX X, XXXX		
MAIN CKT BKR: XXXXXXXXXXXXX			Contractor: XXXXXXX		
AIC: XXXXXA			Phone #: XXX-XXX-XXXX		
Panel Fed From: XXXXXXXXX					
Ckt	Amps/ #Poles	Load	Ckt	Amps/ #Poles	Load
1	xxA/xP	Circuit/Load Description	2	xxA/xP	Circuit/Load Description
3	xxA/xP	Circuit/Load Description	4	xxA/xP	Circuit/Load Description
5	xxA/xP	Circuit/Load Description	6	xxA/xP	Circuit/Load Description
7	xxA/xP	Circuit/Load Description	8	xxA/xP	Circuit/Load Description
9	xxA/xP	Circuit/Load Description	10	xxA/xP	Circuit/Load Description
11	xxA/xP	Circuit/Load Description	12	xxA/xP	Circuit/Load Description
13	xxA/xP	Circuit/Load Description	14	xxA/xP	Circuit/Load Description
15	xxA/xP	Circuit/Load Description	16	xxA/xP	Circuit/Load Description
17	xxA/xP	Circuit/Load Description	18	xxA/xP	Circuit/Load Description
19	xxA/xP	Circuit/Load Description	20	xxA/xP	Circuit/Load Description
21	xxA/xP	Circuit/Load Description	22	xxA/xP	Circuit/Load Description
23	xxA/xP	SPARE	24	xxA/xP	SPARE
25	xxA/xP	SPARE	26	xxA/xP	SPARE
27	xxA/xP	SPARE	28	xxA/xP	SPARE
29	xxA/xP	SPARE	30	xxA/xP	SPARE
31	xxA/xP	SPARE	32	xxA/xP	SPARE
33	xxA/xP	SPACE	34	xxA/xP	SPACE
35	xxA/xP	SPACE	36	xxA/xP	SPACE
37	xxA/xP	SPACE	38	xxA/xP	SPACE
39	xxA/xP	SPACE	40	xxA/xP	SPACE
41	xxA/xP	SPACE	42	xxA/xP	SPACE

Instructions for Completing Panel Schedules:

1. All Areas in Red are to be filled in, corrected or verified completely anytime a panel is installed, changed, or updated for any reason.
2. Each space in the panel should have a completed load description. If it is a spare breaker or an open space label it as such.
3. A digital copy of the panel schedule is to be submitted to Clemson's [Construction Shop](#) when complete.
4. See the notes below for guidance on completing individual sections of the schedule.

Section Notes

- Panel: Insert panelboard name
- Voltage/Ph: Insert voltage and phase (208/120V/3ph or 240/120/1ph)
- MAINS: Insert panelboard main bus ampere rating as shown on manufacturers nameplate
- MAIN CKT BKR: Insert main circuit breaker ampere rating or if no main break, insert MLO for Main Lugs Only
- Location: Insert building Name and Room Number
- Room #: Insert Room number where panelboard is located
- Date: Insert date Panelboard schedule information is completed
- Contractor: Insert name of contractor or responsible party who gathered information for panelboard schedule
- Phone #: Insert above contractor or responsible party's primary business phone number. Do not include direct cellular numbers for company or University representatives.
- AMPS/#Poles: Insert breaker ampere trip rating and number of poles, 1, 2, or 3.
- LOAD: Insert load description and room number where load is located.

## SECTION 260583 - EQUIPMENT WIRING CONNECTIONS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes electrical connections to equipment.

#### 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA WD 1 - General Requirements for Wiring Devices.
  - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

### PART 2 PRODUCTS

#### 2.1 EQUIPMENT REQUIRING ELECTRICAL SERVICE

- A. Provide electrical connections for all electrically driven equipment. Final connections are electrical work, unless specifically noted otherwise. Obtain a copy of the shop drawings of equipment. Review shop drawings to verify electrical characteristics and to determine rough-in requirements, final connection requirements, location of disconnect switch, etc. Notify the General Contractor if the information received is ambiguous or incomplete. Keep a copy of these shop drawings at the project site throughout the course of construction.
- B. Equipment to be connected includes, but is not limited to the following:
  - 1. Site Lighting
  - 2. Control Systems
- C. The design of circuits for electrically driven equipment is based on the product of one manufacturer and may not be representative of all acceptable manufacturers. If equipment furnished has differing characteristics, make necessary adjustments to circuit components at no additional cost to the Owner, subject to the approval of the Architect/Engineer.
- D. Provide disconnects for all equipment and appliances unless specifically noted otherwise on the drawings.
- E. Provide motor starters for all mechanical equipment unless provided by the mechanical contractor.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

#### 3.2 EXISTING WORK

- A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.
- B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.
- C. Extend existing equipment connections using materials and methods as specified.

#### 3.3 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations. Flexible conduit shall be limited to 6' in length unless specifically noted otherwise.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.
- E. Install cord and cap for field-supplied attachment plug.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 260583

## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Remote control lighting relays.
  - 2. Lighting contactors.
  - 3. Time Clocks
  - 4. Switches.
  - 5. Switch plates.
  - 6. Occupancy sensors.
  - 7. Photocells.

#### 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
  - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
  - 3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
  - 4. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.
  - 5. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
  - 6. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
  - 7. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

#### 1.3 SYSTEM DESCRIPTION

- A. Exterior Lighting Controls shall be based on combination Time Clock, Photocells, and contactors as required to support astronomical time-based scheduling, measurement of daylight, and a combination of the two.

#### 1.4 SUBMITTALS

- A. Timeline for delivery, installation, and factory start-up. Lighting controls shall be completed, and factory commissioned prior to final walk-through.
- B. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
  - 1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.
  - 2. Include typical wiring diagrams for each component.
  - 3. Plans showing locations of all lighting control devices, and associated coverage patterns.

4. Relay Panel Schedules including circuit breaker origination, load description, and auxiliary control inputs.
  - C. Product Data: Submit manufacturer's standard product data for each system component.
  - D. Manufacturer's Installation Instructions: Submit for each system component.
  - E. Manufacturer's Certificate: Certify Products and system meet or exceed specified requirements.
- 1.5 CLOSEOUT SUBMITTALS
- A. Project Record Documents: Record the following information:
    1. Actual locations of components and record circuiting and switching arrangements.
    2. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.
  - B. Operation and Maintenance Data:
    1. Submit replacement parts numbers.
    2. Submit manufacturer's published installation instructions and operating instructions.
    3. Recommended renewal parts list.
    4. Product Components and System Warranty Information.
- 1.6 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Accept components on site in manufacturer's packaging. Inspect for damage.
  - B. Protect components by storing in manufacturer's containers indoor protected from weather.
- 1.8 WARRANTY
- A. Furnish five year manufacturer warranty for all control devices and panels.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Exterior Lighting Controls Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Musco Control-Link
  2. GeoSport Lighting Control Series
  3. Hylite Hylink Series
  4. Intermatic
  5. Paragon
  6. Tork

### 2.2 REMOTE CONTROL LIGHTING RELAYS

- A. Product Description: Heavy duty, single-coil momentary contact mechanically held remote control relays.
- B. Contacts: Rated 20 amperes at listed voltage. Rated for lighting applications with high intensity discharge (HID), fluorescent, and LED lamps.
- C. Line Voltage Connections: Clamp type screw terminals.
- D. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard enamel.
1. Interior Dry Locations: Type 1.
  2. Exterior Locations: Type 3R.

### 2.3 LIGHTING CONTACTORS

- A. Manufacturers:
1. GE
  2. Cutler-Hammer
  3. Square D
  4. Siemens
  5. Substitutions: Division 01 Specifications - Product Requirements.
- B. Product Description: NEMA ICS 2, magnetic lighting contactor.
- C. Configuration: Electrically held, 2 wire control.
- D. Coil Operating Voltage: 24 volts, 60 Hertz.
- E. Poles: To match circuit configuration and control function.
- F. Contact Rating: Conductor overcurrent protection, considering derating for continuous loads.

- G. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
  - 1. Interior Dry Locations: Type 1.
  - 2. Exterior Locations: Type 3R.

#### 2.4 MOTION SENSOR

- A. Sensors shall be integral with emergency egress floodlights with “hi-lo” drivers.
- B. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 30 seconds to 20 minutes.
- C. Furnish with manual override.
- D. Operation: Silent.

#### 2.5 PHOTOCELLS

- A. Exterior: Rated for exterior lighting voltage as indicated on plan and integral with emergency egress floodlights.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Provide electrical connections to relay panels, time clocks, or other controllers that require powered connections. Coordinate all connection points with system shop drawings.
- B. Mount devices to provide system control to match scheme indicated on drawings.
- C. Label each low voltage wire clearly indicating connecting relay panel.
- D. Mount relay as indicated on final shop drawings. Wire numbered relays in panel to control power to each load. Install relays to be accessible. Allow space around relays for ventilation and circulation of air.
- E. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.
- F. Label each low voltage wire with relay number at each switch or sensor.

#### 3.2 MANUFACTURERS' FIELD SERVICES

- A. Furnish services for check, test, and start-up. Perform the following services:
  - 1. Check installation of panelboards.

2. Test operation of remote-controlled devices.
  3. Repair or replace defective components.
  4. Manufacturer's factory authorized representative shall start-up and verify a complete fully functional system.
- B. Furnish 4 hours to instruct Owner's personnel in operation and maintenance of system. Schedule training with Owner, provide at least 7 days notice to Owner of training date.

### 3.3 ADJUSTING

- A. Test each system component after installation to verify proper operation.
- B. Confirm correct loads are recorded on directory card in each panel.

### 3.4 COMMISSIONING

- A. A commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturers should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available.
- B. The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent shall accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products.
- C. Commissioning must be completed prior to substantial completion. Punch lists will not be performed until lighting controls are in complete operation.

END OF SECTION 260923

## SECTION 262416 - PANELBOARDS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards.
- B. Related Sections:
  - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 2. Section 26 05 53 - Identification for Electrical Systems.

#### 1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
  - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
  - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
  - 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
  - 4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  - 5. NEMA PB 1 - Panelboards.
  - 6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
- E. Underwriters Laboratories Inc.:
  - 1. UL 67 - Safety for Panelboards.
  - 2. UL 1283 - Electromagnetic Interference Filters.

#### 1.3 SUBMITTALS

- A. Shop Drawings: Include all of the following information:
  - 1. Indicate outline and support point dimensions.
  - 2. Product data

3. Enclosure type
4. Circuit directory
5. Bussing Diagrams
6. Integrated short circuit ampere rating
7. Device Nameplate Data

B. Product Data: Submit catalog data showing specified features of standard products.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

#### 1.6 MAINTENANCE MATERIALS

- A. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following manufacturers:
  1. GE Electric
  2. Square D
  3. Eaton
  4. Siemens
  5. Substitutions: Division 01 Specifications - Product Requirements.

#### 2.2 DISTRIBUTION PANELBOARDS

- A. Product Description: NEMA PB 1, circuit breaker type panelboard. Furnish combination controllers as indicated on Drawings.
- B. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper and neutral ground bus in each panelboard.

- C. See circuit breaker section below for information on types of circuits required.
- D. Enclosure: NEMA PB 1
  - 1. Indoor Locations - Type 1, unless noted otherwise below.
  - 2. Outdoor Locations – Type 3R.
- E. Cabinet Front: Door-in-door type, fastened with concealed trim clamps, hinged door with flush lock all keyed alike, metal directory frame, finished in manufacturer's standard gray enamel.
- F. All panelboards shall be hinged "door in door" type with:
  - 1. Interior hinged door with hand operated latch or latches as required to provide access to circuit breaker operating handles only, not to energized parts.
  - 2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips or other fasteners requiring a tool for entry, hand operated latches are not acceptable.
  - 3. Both inner and outer doors shall open left to right.
- G. All panelboards shall have bolt-on style breakers.
- H. Provide labeling on panelboard such that each 1.5” space is numbered. This may imply that larger breakers may take up more than 3-spaces.
- I. Provisions for future breakers shall be fully bussed complete with all necessary mounting hardware.

### 2.3 BRANCH CIRCUIT PANELBOARDS

- A. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- B. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground and neutral bus in each panelboard.
- C. See circuit breaker section below for information on types of circuits required.
- D. Enclosure: NEMA PB 1
  - 1. Indoor Locations - Type 1, unless noted otherwise below.
  - 2. Outdoor Locations – Type 3R.
- E. Cabinet Box: 6 inches (153 mm) deep, 20 inches (508 mm) wide.
- F. Cabinet Front: Door-in-door type, fastened with concealed trim clamps, hinged door with flush lock all keyed alike, metal directory frame, finished in manufacturer's standard gray enamel.
- G. All panelboards shall be hinged "door in door" type with:

1. Interior hinged door with hand operated latch or latches as required to provide access to circuit breaker operating handles only, not to energized parts.
2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips or other fasteners requiring a tool for entry, hand operated latches are not acceptable.
3. Both inner and outer doors shall open left to right.

H. All panelboards shall have bolt-on style breakers.

I. Provisions for future breakers shall be fully bussed complete with all necessary mounting hardware.

## 2.4 CIRCUIT BREAKERS

- A. For Circuit breakers rated over 200 amps: Provide adjustable trip molded case, solid state adjustable trip type circuit breakers.
1. Ground-Fault Equipment Protection (GFEP) Circuit Breakers (where scheduled): Class B ground-fault protection (30-mA trip).
  2. Auxiliary Contacts: [One SPDT switch] [Two SPDT switches] with "a" and "b" contacts. "a" contacts mimic circuit breaker contacts and "b" contacts operate in reverse of circuit breaker contacts.
  3. Trip units shall have field adjustable tripping characteristics as follows:
    - a. Ampere Setting (Continuous)
    - b. Long time band.
    - c. Short time trip point.
    - d. Short time delay.
    - e. Instantaneous trip point.
- B. For all circuit breakers 200 amps and smaller: Provide Molded Case Thermal Magnetic Trip type Circuit Breakers.
1. Type SWD for lighting circuits.
  2. Ground-Fault Equipment Protection (GFEP) Circuit Breakers (where scheduled): Class B ground-fault protection (30-mA trip).
  3. Class A ground fault interrupter circuit breakers where scheduled.
  4. Do not use tandem circuit breakers.
  5. GFCI Circuit breakers: Single and two-pole configurations with Class A ground-fault protection (6-mA trip).

## 2.5 SHORT CIRCUIT CURRENT RATING

- A. Devices which achieve the level of fault protection indicated by means of "series" or "integrated" rating shall not be acceptable unless specifically indicated on the drawings. All panelboards shall be fully rated.
- B. For existing equipment, provide circuit breakers with short circuit current ratings that match ratings indicated on panel, if no markings indicate panelboard rating, then provide ratings that match highest rated circuit breaker in panelboard.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch (DN27). Identify each as SPARE.
- G. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.
- H. Provide a circuit breaker locking device for all circuit breakers that serve fire alarm system panels and power supplies. These circuit breakers shall be locked in the "closed" position. Identify these circuit breakers with a red marking.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- C. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

### 3.3 ADJUSTING

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Touch-up scratched or marred surfaces to match original finish.
- C. Clean all debris from panel interiors.

### 3.4 LABELING

- A. Install engraved plastic nameplates in accordance with Section 26 05 53.

- B. Provide nameplates on all new electrical panelboards. Indicate the following information on the nameplate:
  - 1. Panel Name
  - 2. Panel fed from
  - 3. Voltage, Phase, Wire, Short Circuit Current Rating
  - 4. Date Installed
  
- C. Use the following color coding for panelboard nameplates:
  - 1. Normal Power: White with Black Letters.
  - 2. Emergency Critical: Orange with Black Letters.
  - 3. Emergency Life Safety: Yellow with Black Letters.
  
- D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
  
- E. Identify load served and location by room names assigned by user, not by room numbers on floor plans. Note spares and spaces as such. Spare circuit breakers shall be left in the open position.

### 3.5 CLEARANCE AND WORKSPACE

- A. Maintain workspace and clearances as required by the NEC for voltages encountered. No pipes or ducts shall pass above the outline of the panelboard. It shall be the responsibility of this Contractor to make sure that other trades do not encroach on this space.

END OF SECTION 262416

## SECTION 264300 – SURGE PROTECTIVE DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Surge Protection Devices Type 1 and Type 2 Devices

#### 1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
1. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
  2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
  3. IEEE C62.45 - Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
- B. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.
  2. NFPA 780 - Standard for the Installation of Lightning Protection Systems.
- C. Underwriters Laboratories Inc.:
1. UL 1283 - Electromagnetic Interference Filters.
  2. UL 1449 Fifth Edition - Surge Protective Devices.

#### 1.3 SUBMITTALS

- A. Product Data: Submit the following
1. Unit Dimensions and Weights
  2. Wiring configuration.
  3. Warranty Statement
  4. Current Ratings
  5. Clamping Voltages
  6. Response Time
- B. Test Reports:
1. Indicate Let-Through voltage test data.
  2. Submit spectrum analysis of each unit.
  3. Submit test reports from nationally recognized independent testing laboratory verifying suppressors can survive published surge current rating.
- C. Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.
- D. Manufacturer's Certificate: Certify transient voltage surge suppression device complies with UL 1449 Fifth Edition Surge Voltage Ratings.

#### 1.4 QUALITY ASSURANCE

- A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
1. UL 1449 5th Edition 2021 Revision
  2. UL 1283.
  3. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
  4. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
  5. IEEE 1100 Emerald Book.
  6. National Fire Protective Association (NFPA 70: National Electrical Code).

## 1.5 WARRANTY

- A. Provide a 5 year product warranty.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following manufacturers:
1. ASCO
  2. Current Technologies
  3. Ditek
  4. ABB / GE
  5. Square D
  6. Eaton

### 2.2 ELECTRICAL REQUIREMENTS

- A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 5<sup>th</sup> Edition, section 37.7. MCOV values claimed based on the component's value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.
- B. Unit shall have not more than 10% deterioration or degradation of the UL1449 5<sup>th</sup> Edition Voltage Protective Rating (VPR) due to repeated surges. Unit shall have a monitoring option available to be able to test and determine the percentage of protective available at all times.
- C. Protection Modes: UL1449 5<sup>th</sup> Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347) 3-Phase/4 wire and (120/240) Split phase/3 wire circuits shall be as follows and comply with test procedures outlined in UL1449 5<sup>th</sup> Edition
1. 240/120V Single Phase 3-wire Service
    - a. Line to Line (L-L): 900V
    - b. Line to Neutral (L-N): 900V
    - c. Line to Ground (L-G): 800V

- d. Neutral to Ground (N-G): 700V
- 2. 208/120V Three Phase 4-wire Service
  - a. Line to Line (L-L): 900V
  - b. Line to Neutral (L-N): 900V
  - c. Line to Ground (L-G): 800V
  - d. Neutral to Ground (N-G): 700V
- 3. 480/277V Three Phase 4-wire Service
  - a. Line to Line (L-L): 1800V
  - b. Line to Neutral (L-N): 1500V
  - c. Line to Ground (L-G): 1200V
  - d. Neutral to Ground (N-G): 800V
- A. Electrical Noise Filter- each unit shall include a high performance EMI/RFI noise rejection filter. Noise attenuation for electric noise shall be as follows using the MIL-STD-220B insertion loss test method.
  - 1. 100 kHz at 44 db or better.
  - 2. All other frequencies should be 32 db or better.
- B. Each fuse shall be individually sealed in a manner that eliminates the potential for cross arcing.
- C. Each unit shall provide the following features:
  - 1. Phase Indicator lights, Form C dry contacts, surge counter and audible alarm.
  - 2. Field testable while installed.
  - 3. Measuring capability to indicate the percent protective available in SPD.

## PART 2 - EXECUTION

### 2.1 INSTALLATION

- A. Each unit shall be installed per Manufacturer's recommended installation and wiring practices.
- B. The UL 1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.
- C. The UL 1449 Nominal Discharge Surge Current Rating shall be a minimum of 20kA.
- D. Surge Current Rating of device shall be as noted on drawings.
- E. The SCCR rating of the SPD shall be 200kAIC without requiring an upstream protective device for safe operation.
- F. Locate SPDs and associated circuit breaker in panelboard or switchboard so as to minimize conductor lengths and bends.
  - 1. Conductors between SPD and circuit breaker shall be no more than 24" in length.
  - 2. There shall be no sharp bends or kinks in conductors.

3. Conductors shall be continuous from device to breaker.
4. Do not bundle or tie-wrap conductors together.
5. If conductor's must exceed 24" in length or contain multiple bends due to location constraints, contractor shall provide manufacturer's specialty cable for excessive lengths at no additional cost.

END OF SECTION 264300

## SECTION 265200 - EMERGENCY LIGHTING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes emergency lighting units and exit signs.

#### 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- B. National Fire Protection Association (NFPA)
  - 1. NFPA 70 - National Electrical Code (NEC)
- C. Underwriter Laboratories (UL)
  - 1. UL1008 – Transfer Switch Equipment

#### 1.3 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.

#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

### PART 2 PRODUCTS

#### 2.1 CENTRAL EMERGENCY LIGHTING INVERTERS (Greater than 1000-watts)

- A. Manufacturers:
  - 1. Crucial Power Products
  - 2. Perfect Power Systems
  - 3. Myers Power Products
- B. Product Description: The system shall utilize high frequency pulse width modulation and digital signal processing for control and monitoring.
  - 1. The system's automatic overload and short circuit protection of the inverter in normal and emergency operations shall have 150% momentary surge capability and withstand a 115% overload for 10 minutes.
  - 2. The system's protection shall also include a low battery voltage disconnect to prevent damage to the battery bank.
  - 3. The system shall supply a clean, computer grade, sinusoidal output waveform with less than 5% total harmonic distortion at full rated load.

4. Dynamic brownout protection must maintain the desired voltage without continuously switching to batteries in low voltage situations up to -15%.
  5. The system shall maintain output regulation of less than + 5% under all operating conditions except overload and short circuit.
  6. The system shall be able to protect itself from an internal over-temperature condition and issue an alarm under such conditions.
  7. During normal utility power operation, the design must provide power factor correction close to unity (1.0 pf).
  8. The system shall include the following additional features:
    - a. An automatic, multi-rate, software-controlled charger.
    - b. Self-diagnostic, programmable system testing capabilities.
    - c. A microprocessor controlled diagnostic display panel capable of audible alarms.
    - d. Visual displays of all alarms.
    - e. A DC to AC converter (inverter).
    - f. A battery charger that meets the UL 924 standard.
    - g. AC and DC input protection.
    - h. A battery bank sized for the system's runtime requirements
    - i. Full KW rating at unity power factor.
    - j. An RS232 communication interface.
- C. System Design Requirements
1. Input Voltage – As indicated on Drawings.
  2. Output Voltage – As indicated on Drawings.
  3. Output Load Capacity – 750 kW. As indicated on Drawings.
    - a. The unit shall be designed to have a minimum 20% of rated power capacity added without having to change the unit.
  4. Battery – The UPS shall be capable of operating at full load for a minimum of 90-minutes on battery power at a temperature of 25°C.
  5. Battery Type – Valve regulated sealed lead-acid (VRLA).
  6. Battery Protection – System shall utilize a Battery Circuit Breaker.
  7. Input Surge Protection – System shall utilize SPD on input side of system.
  8. Output Frequency – 60 Hz, +/- 0.5 hz.
  9. Output Voltage Regulation - =/- 3% no load to full load.
  10. Output Power Connections – Hard wired terminal block.
- D. Static Bypass: A continuous duty, 100% rated bypass serves as an alternate source of power for the critical load when an input line failure or abnormal condition prevents operation in inverter mode. It will consist of a fully rated, continuous duty static switch for high-speed transfers and feature two back-to-back SCRs to allow make before break transfer. The design shall include a manual bypass switch that is protected within the locked cabinet. It shall be accessible only to authorized personnel, allowing the unit to remain continually in bypass to allow a technician to safely work on the unit. Manual transfer to bypass shall not cause unit trip or transfer to the battery backup mode. To allow redundant input capabilities, the static switch shall be able to safely route power from an optional power source such as a generator or other power supply.
1. Transfer to Bypass – Initiate automatically under the following conditions:

- a. Critical bus voltage out of limits (greater than +/-10% of line voltage)
  - b. Total battery discharge
  - c. Over temperature period expired.
  - d. UPS problem
2. Automatic Re-transfer – Initiate whenever the inverter is capable of handling the critical load. It shall be inhibited for the following conditions:
- a. Transfer to bypass is activated manually or remotely.
  - b. UPS problem.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install wall-mounted emergency lighting units and exit signs at height as indicated on Drawings.
- B. Install accessories furnished with each emergency lighting unit and exit sign.
- C. Connect emergency lighting units and exit signs to branch circuits as indicated on Drawings.
- D. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- E. Install specified lamps in each emergency lighting unit and exit sign.
- F. Ground and bond emergency lighting units and exit signs in accordance with Section 26 05 26.

#### 3.2 FIELD QUALITY CONTROL

- A. Operate each unit after installation and connection. Inspect for proper connection and operation.

#### 3.3 ADJUSTING

- A. Aim and adjust lamp fixtures as indicated on Drawings and approved by A/E.

#### 3.4 PROTECTION OF FINISHED WORK

- A. Replace emergency lighting units having failed operation at Substantial Completion.

END OF SECTION 265200

## SECTION 265600 - EXTERIOR LIGHTING

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section includes exterior luminaires, poles, and accessories.

#### 1.2 REFERENCES

- A. Illuminating Engineering Society (IES)
1. LM-79 - Approved Method: Electrical and Photometric Testing of Solid-State Lighting Devices.
  2. LM-80 - Approved Method: Measuring Lumen Depreciation of LED Light Sources.
  3. TM-21 - Projecting Long Term Lumen Maintenance of LED Light Sources.
- B. National Electrical Manufacturers Association (NEMA)
1. ANSI/NEMA/ANSI C78.377 - American National Standard for the Chromaticity of Solid-State Lighting Products
  2. SSL-1 - Electronic Drivers for LED Devices, Arrays, or Systems.

#### 1.3 SUBMITTALS

- A. Reference Division 01 Specifications - Submittal Procedures: Submittal procedures and Specification 260500 – Common Work Results for Electrical: Submittal Requirements.
- B. Shop Drawings: Indicate dimensions and components for each luminaire.
- C. Performance Specification Lighting Calculations: Provide point-by-point calculations of each playing field and minimum, maximum, average foot-candle level statistics that meet project performance specifications.
- D. Product Data: Submit dimensions, ratings, and performance data.
- E. Submittal Data for LED Fixtures shall be based on specified "basis-of-design" fixture and shall include the following:
1. Wattage
  2. Color Temperature
  3. CRI
  4. Distribution Pattern
  5. Total Lumen Output for Fixture Assembly based on the data above.
  6. Submit US DOE LED Lighting Facts label, or other 3<sup>rd</sup> party testing reports that include the information above.

#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

#### 1.5 AIMING DRAWINGS

- A. Provide photometric aiming drawings for review.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle steel or concrete poles in accordance with manufacturer's recommendations.

### PART 2 PRODUCTS

#### 2.1 LUMINARIES

- A. See Lighting fixture schedule on plans for information on luminaires.
  - 1. Basis-of-Design Product: The design for each lighting fixture is based on the product named from the first manufacturer listed in the schedule. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified, or a prior approved manufacturer.
  - 2. A prior approved manufacturer does not except a product from review during the submittal process.
  - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Provide complete exterior luminaire assemblies, with features, options, and accessories as required to provide a complete working system mounted as described in contract documents.

#### 2.2 LED LUMINAIRES

- A. LED light fixtures shall be in accordance with IES, NFPA, UL standards as shown on the drawings and as specified.
- B. All electrical components shall be RoHS compliant.
- C. LED fixtures shall be complete assemblies. Fixtures designed around a different lamp source with an LED type replacement lamp shall not be accepted.
- D. LED modules shall include the following features unless otherwise indicated:
  - 1. Comply with LM-79 and LM-80 requirements.
  - 2. Minimum CRI of 70 unless otherwise specified in the Lighting Fixture Schedule.

3. Color Temperatures for each fixture shall be enclosed inside a 3-step MacAdam ellipse.
  4. Minimum Rated Life: 50,000 hours per IES L70.
  5. Total Fixture Light Output in lumens shall be no less than 95% of Lumens listed in Lighting Fixture Schedule.
  6. Total Fixture Efficacy in Lumens / Watt shall be no less than 95% of "Basis-of-Design" fixture.
- E. LED drivers, modules, and reflectors shall be accessible for servicing and replacement either integral to fixture or in enclosure mounted lower on pole.
- F. Indirect Fixtures – Each playing field pole shall have indirect type fixture mounted lower on pole to help baseball/softball application lighting.

### 2.3 LED DRIVERS

- A. LED drivers shall include the following features unless otherwise indicated:
1. Minimum efficiency: 85% at full load.
  2. Minimum operating Ambient Temperature: -20° C (-4° F)
  3. Include integral short circuit, open circuit, and overload protection.
  4. Power Factor:  $\geq 0.95$ .
  5. Total Harmonic Distortion:  $\leq 20\%$
- B. Provide LED drivers with step-dim configuration as noted on plans. Systems shall conform to the following:
1. Ballast circuit and leads provide for remote control of the light output of the associated lamp(s) between high- and low-level and off.
    - a. High-Level: 100%
    - b. Low-Level: 20%
  2. They distribute even light across all LEDs and boards in entire fixture. Fixture shall not accomplish steps by switching grouped LEDs or boards.
  3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

### 2.4 METAL POLES (Base Bid)

- A. Material: Structural Grade Steel; pole welded for single unit construction.
- B. Finish: Silver or gray finish to match existing concrete poles' color.
- C. Section Shape and Dimensions: 6" round straight pole, 0.188 wall thickness.
- D. Height: 60-0" (above grade; direct buried application).
- E. Tenon/Bracket: Type to accept multiple sports lighting fixtures.
- F. Accessories:
1. Access door (handhole) in base with stainless steel allen head screws.

2. Provide Bussman HEB or equal fuse holder and KTK (480v) or equal fuse for each phase conductor in each pole, accessible from handhole.

G. Backfill: Pole shall be mounted in grade with concrete backfill.

## 2.5 CONCRETE POLES (Bid Alternate)

A. Material: Spun-cast Prestressed Concrete.

B. Finish: Natural gray concrete color.

C. Section Shape and Dimensions: 20 to 30" round tapered pole.

D. Height: 60-0" (above grade; direct buried application).

E. Tenon/Bracket: Type to accept multiple sports lighting fixtures.

F. Accessories:

1. Access door (handhole) in base with stainless steel allen head screws.
2. Provide Bussman HEB or equal fuse holder and KTK (480v) or equal fuse for each phase conductor in each pole, accessible from handhole.

G. Backfill: Pole shall be mounted in grade with concrete backfill.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify foundations are ready to receive fixtures.

### 3.2 EXISTING WORK

A. Disconnect and remove abandoned exterior luminaries.

B. Extend existing exterior luminaire installations using materials and methods compatible with existing installations, or as specified.

### 3.3 INSTALLATION

A. Install lighting poles at locations as indicated on Drawings. Confirm locations of new poles with A/E before installation

B. Install poles plumb. Install double nuts to adjust plumb. Grout around each base.

C. Install luminaires per manufacturer's instructions.

- D. Bond and ground luminaries, metal accessories and metal poles in accordance with Section 26 05 26.

### 3.4 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- B. Measure illumination levels and submit to engineer for review.
  - 1. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

### 3.5 ADJUSTING

- A. Aim and adjust luminaries to provide illumination levels and distribution as directed by engineer in the field.

### 3.6 CLEANING

- A. Clean photometric control surfaces as recommended by manufacturers.
- B. Clean finishes and touch up damage.

### 3.7 PROTECTION OF FINISHED WORK

- A. Replace luminaries having failed lamping at Substantial Completion.

END OF SECTION 265600