

## SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. All drawings associated with the entire project, including the General Conditions of the Contract for Construction, General and Supplementary Conditions, and Division 01 specification sections shall apply to the Division 26 specifications and drawings. The Contractor shall be responsible for reviewing and becoming familiar with the aforementioned and all other Contract Documents associated with the project.
- B. Where contradictions occur between this section and Division 01, the more stringent requirement shall apply.
- C. Contractor shall be defined as any and all entities involved with the construction of the project.

#### 1.2 SUMMARY:

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26 and Division 28. It expands and supplements the requirements specified in sections of Division 01 through 23.

#### 1.3 ELECTRICAL INSTALLATIONS:

- A. Drawings are diagrammatic in character and do not necessarily indicate every required conduit, box, fitting, etc.
- B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. Report any discrepancies to the Engineer and obtain written instructions before proceeding. Where any discrepancies occur between the specifications and the drawings the more stringent requirement shall apply. The contractor shall include pricing for the more stringent and expensive requirements and actual work will be clarified during construction.
- C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, take the necessary measurements and prepare the drawings.
- D. The exact location for some items in this specification may not be shown on the drawings. The location of such items may be established by the Engineer during the progress of the work.
- E. The contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner. All equipment shall be installed so access is maintained for serviceability.

- F. Before any work is begun, determine that equipment will properly fit the space and that conduit can be run as contemplated without interferences between systems, with structural elements or with the work of other trades.
  - G. Verify all dimensions by field measurements.
  - H. Arrange for chases, slots, and openings in other building components to accommodate electrical installations.
  - I. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring an access path for positioning prior to closing-in the building or space.
  - J. Where mounting heights are not detailed or dimensioned, install electrical conduits, boxes, and overhead equipment to provide the maximum headroom possible. In general, keep installations tight to structure.
  - K. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting and removal with minimum of interference with other installations.
  - L. Make allowance for expansion and contraction for all building electrical components and conduit systems that are subject to such.
  - M. The ceiling space shall not be "layered". It is the contractor's responsibility to offset and coordinate any systems as required to allow installation within the identified ceiling cavity. The contractor shall include labor and material in the base bid to accommodate such offsets.
  - N. In general, all conduit systems shall be routed as high as possible. Keep all equipment in accessible areas such as corridors and coordinate with systems and equipment from other sections.
  - O. Coordinate the installation of electrical materials and equipment above and below ceilings with suspension system, luminaires and other building components. Ductwork and piping shall not be installed above electrical panelboards, switchboards, and transformers.
- 1.4 COORDINATION:
- A. Work out all installation conditions in advance of installation. The Contractor shall be responsible for preparing coordination drawings, showing all work, in all areas. The Contractor shall be responsible for providing all labor and material, including but not limited to all fittings, hangers, control devices, lighting, low voltage equipment, conduit, transformers, disconnects, etc., necessary to overcome congested conditions at no increase in contract sum. The Contractors base bid shall include any and all time and manpower necessary to develop such coordination efforts and drawings. Increases to contract sum or schedule shall not be considered for such effort.
  - B. Provide proper documentation of equipment, product data and shop drawings to all entities involved in the project. Refer to individual sections for requirements.

C. Coordination Drawings:

1. Coordination drawings shall be prepared by the Contractor for his utilization and are his responsibility to assure systems will be installed in a manner to allow all systems to function properly.
2. Prepare and submit required coordination drawings showing major elements, components, and systems of electrical equipment and materials in relationship with other building components. Prepare drawings to an accurate scale, large enough to indicate required detail, and showing the necessary dimensions. Indicate the locations of all equipment and materials, including clearances for servicing and maintaining equipment. Indicate movement and positioning of large equipment into the building during construction.
3. Coordination drawings are informational submittals. Submit coordination drawings to Engineer for information only to document proper coordination of all portions of work and that coordination issues have been identified and resolved prior to submitting to the Engineer and prior to commencing construction in each affected area. The review of the coordination drawings by the Engineer does not constitute a relief of responsibility of the Contractor or a change to the contract documents.
4. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work.
5. Clearly indicate solutions to space problems. Identification of space problems without solutions is not acceptable. Only areas clearly identified will be reviewed.
6. CADD Drawings: Electronic AutoCAD drawings are available for purchase by the Contractor from the Engineer. Contact Engineer for further information in acquiring CADD drawings. The Engineers Construction documents cannot be used directly for coordination drawings. They are for information and initial coordination only.

D. Existing Conditions:

1. Contractor shall carefully survey existing conditions prior to bidding work. In addition,
2. Provide proper coordination of electrical work with existing conditions.
3. Contactor shall report any issues or conflicts immediately to Engineer before commencing with work and prior to purchasing equipment and materials. Start of work indicates acceptance of conditions.

1.5 COORDINATION WITH OTHER DIVISIONS:

A. General:

1. Coordinate all work to conform to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit. No extras will be allowed for corrections of ill-timed work, when such corrections are required for proper installation of other work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electrical systems within the cavity space allocation in the following order of priority:

1. Equipment and required clearances
2. Plumbing waste, cooling coil drain piping and roof drain mains and leaders.
3. Ductwork mains.
4. Low pressure ductwork and air devices.

5. Electrical conduits, raceways and cable tray.
  6. DDC control wiring and other low voltage systems.
- C. Chases, Inserts and Openings:
1. Provide measurements, drawings and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
  2. Check sizes and locations of openings provided, including the access panels for equipment in hard lid ceilings and wall cavities.
  3. Any cutting and patching made necessary by failure to provide measurements, drawings and layouts at the proper time shall be done at no additional cost in contract sum.
- D. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other sections of the specifications can be built at the proper time.
- E. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
- F. Modifications required as result of failure to resolve interferences, provide correct coordination drawings or call attentions to changes required in other work as result of modifications shall be paid for by responsible Contractor/Subcontractor.
- 1.6 DESIGN WORK REQUIRED BY CONTRACTOR:
- A. The construction of this project requires the Contractor to include the detailing and design of select systems and/or subsystems. All such design work associated with the development of the coordination drawings shall be the complete responsibility of the Contractor.
- B. The Contractor shall take the full responsibility to develop and complete routing strategies which will allow fully coordinated system to be installed in a fully functional manner. The Engineers contract drawings shall be for system design intent and general configurations.
- C. Systems or subsystems which require design responsibility by the contractor include but are not limited to:
1. Temporary Facilities
  2. Fire alarm shop drawings
  3. Equipment supports, hangers, anchors and seismic systems not fully detailed nor specified in these documents, or catalogued by the manufacturer
  4. Seismic restraint systems
- 1.7 PROJECT CONDITIONS:
- A. The contractor shall attend a pre-bid walk-thru, when required under Division 01, and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for existing conditions.
- B. Provide field verification of all conditions prior to submitting bids.
- C. Report any damaged equipment or systems to the Owner prior to any work.

- D. Protect all work against theft, injury or damage from all causes until it has been tested and accepted.
  - E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the work which may show defect during one year from the final acceptance of all work, provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.
  - F. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections.
  - G. Provide temporary electrical connections where required to maintain existing areas operable.
  - H. Coordinate all services shut-down with the Owner; provide temporary services. Coordinate any required disruptions with Owner, at a minimum one week in advance.
  - I. Minimize disruptions to operation of electrical systems in occupied areas.
- 1.8 SAFETY:
- A. Refer to Division 01.
- 1.9 EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS:
- A. Refer to Division 01 and conform with the Owners requirements.
- 1.10 REQUIREMENTS OF REGULATORY AGENCIES:
- A. Refer to Division 01.
  - B. Execute and inspect all work in accordance with Underwriters Laboratories (UL), and all local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the more stringent requirement shall be followed. Follow application sections and requirements and testing procedures of NFPA, IEEE, NEMA, CBM, ANSI, NECA, ICEA and IETA.
  - C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
  - D. Energy Codes: All equipment and installations shall conform to Federal, State, and local Energy Conservation Standards.
  - E. The handling, removal and disposal of regulated liquids or other materials shall be in accordance with U.S. EPA, state and local regulations.
  - F. The handling, removal and disposal of lead based paint and other lead containing materials shall comply with EPA, OSHA, and any other Federal, State, or local regulations.

- G. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.
  - H. All material used on this project shall be UL listed and labeled and be acceptable to the authority having jurisdiction as suitable for the use intended.
- 1.11 PERMITS AND FEES:
- A. Refer to Division 01.
  - B. Contractor shall arrange for and pay for all permits, inspections, licenses and certificates required in connection with the work.
- 1.12 PROJECT SEISMIC REQUIREMENTS:
- A. Installation shall comply with the local seismic requirements for the area of installation. Provide restraints, bracing, anchors, vibration isolation, seismic snubbers, and all other components required for the installation.
  - B. All electrical and fire alarm systems shall be installed to meet NFPA and IBC Seismic requirements.
    - 1. Where any conflicts arise the more stringent requirements shall be applicable.
    - 2. The design of the seismic requirements shall be the responsibility of the contractor.
- 1.13 TEMPORARY FACILITIES:
- A. Light, Heat, Power, Etc. Responsibility for providing temporary electricity, heat and other facilities shall be as identified in these specifications, as shown on the drawings and as specified in Division 01.
  - B. Building distribution equipment and devices (existing or new) shall not be used without written permission of the Owner. If used for temporary power, the equipment shall be properly maintained and any damage resulting from use shall be repaired by the Contractor. The guarantee period for new equipment shall not begin until the equipment is turned over to the Owner.
  - C. If AC power systems or their backup systems serving telecommunications, computer equipment, or their associated HVAC equipment and controls are taken out of service, for any reason, the Contractor shall be responsible for providing temporary systems during the period when the AC power systems or their backup systems are out of service. The Contractor shall be responsible for providing temporary power to all loads being interrupted.
- 1.14 PRODUCT OPTIONS AND SUBSTITUTIONS:
- A. Refer to the Instructions to Bidders and Division 01.
  - B. The burden of proof that proposed equipment is equal in size, capacity, performance, and other pertinent criteria for this specific installation, or superior to that specified is up to the Contractor. Substituted equipment will only be allowed where specifically listed in a written addendum. If substitutions are not granted, the specified materials and equipment must be installed. Where substituted equipment is allowed, it shall be the Contractor's responsibility to notify all related

trades of the accepted substitution and to assume full responsibility for all costs caused as a result of the substitution.

- C. Materials and equipment of equivalent quality may be submitted for substituted prior to bidding. This may be done by submitting to the Architect/Engineer at least ten (10) working days prior to the bid date requesting prior review. This submittal shall include all data necessary for complete evaluation of the product.
  - 1. Substitutions shall be allowed only upon the written approval of the Architect/Engineer. NO EXCEPTIONS.
  - 2. The Contractor shall be responsible for removal, replacement and remedy of any system or equipment which has been installed which does not meet the specifications or which does not have prior approval.

1.15 SUBMITTALS:

A. General

- 1. Refer to the Conditions of the Contract (General and Supplementary), Division 01.
  - 2. Contractor shall provide a submittal schedule appropriate for the size and duration of the project. Limit the number of large submittals being reviewed at one time and coordinate timing of sections that are dependent on each other.
  - 3. The Contractor shall identify any "long lead time" items which may impact the overall project schedule. If these submittal requirements affect the schedule, the Contractor shall identify the impacts and confer with the Engineer within two weeks of entering into the contract.
  - 4. The front of each submittal package shall be identified with the specification section number, job name, Owner's project number, date, Prime Contractor and Subcontractor's names, addresses, and contact information, etc. Each Specification Section shall be submitted individually and shall adequate annotation to indicate the equipment/materials/etc. within the section. Submittals with incomplete information will not be reviewed and will be sent back to be corrected.
  - 5. Submittals shall be provided electronically. All electronic submittals need to be complete with all design information and stamped for conformity by the contractor. Submittals will be reviewed, marked appropriately and returned by the same means received.
  - 6. An index shall be provided which includes:
    - a. Product
    - b. Specification Section
    - c. Manufacturer and Model Number
  - 7. Submittal schedule shall be provided for review within four (4) working weeks from award of contract to successful bidder.
- B. Basis of Design: The manufacturer's material or equipment listed first in the specifications or on the drawings are the basis of design and are provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the first names, the cost of any changes in construction required by their use shall be borne by this Contractor.
- C. Contractor Review: Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Each submittal shall be reviewed by the contractor for general conformance with contract requirements and stamped by the respective contractor prior to submittal to the Architect/Engineer. Any submittal not stamped or complete will be sent back. Data

- submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed unless written prior approval is obtained by the Contractor.
- D. Submittal Review Process: Before starting work, prepare and submit to the Architect/Engineer shop drawings and descriptive product data required for the project. Continue to submit in the stated format after each Architect/Engineer's action until a "No Exception Taken" or "Make Correction Noted" action is received. When a "Make Corrections Noted" is received, make the required corrections for inclusion in the operation and maintenance manual (O&M). Submittals marked "Make Corrections Noted" shall not be resubmitted during the submittal process. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned "Revise and Resubmit". Where an entire submittal package is returned for action by the Contractor, the Engineer may summarize comments in letter format and return the entire set. Submittals shall be prepared per the requirements listed in each Division 26 and Division 28 Section.
- E. The Design Professional's review and appropriate action on all submittals and shop drawings is only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include:
1. Accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes
  2. Construction means or methods
  3. Coordination of the work with other trades
  4. Construction safety precautions
- F. The Design Professional's review shall be conducted with reasonable promptness while allowing sufficient time in the Design Professional's judgment to permit adequate review. Review of a specific item shall not indicate that the Design Professional has reviewed the entire assembly of which the item is a component.
- G. The Design Professional shall not be responsible for any deviations from the contract documents not brought specifically to the attention of the Design Professional in writing by the Contractor. This shall clearly identify the design and the specific element which vary from the Design. The Contractor shall be responsible for all remedy for lack of strict conformance associated with this criteria.
- H. The Design Professional shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- I. If more than two submittals (either for product data, shop drawings, record drawings, test reports, or O&M's) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants.
- J. The contractor shall cloud all changes made on submittals that are marked "Revise and Resubmit."
- K. Submit proposed changes to electrical room or other equipment room layouts when revised from contract documents prior to installation.



- L. Mark submittals with designations as shown on the drawings and identify as required by Specification Sections. Identification shall contain the information as required in details and each label shall be submitted in list form with disconnects, panelboards, switchboards, overcurrent protection devices and utilization equipment.

1.16 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS:

A. Product Listing:

1. Prepare listing of major electrical equipment and materials for the project, within (2) two weeks of signing the Contract Documents and transmit to the Engineer of Record.
2. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.
3. When two or more items of same material or equipment are required (lighting, wiring devices, switchgear, panelboards, protective devices, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials steel bar stock, welding rods, solder, fasteners, except as otherwise indicated.

B. Schedule of Values

1. Provide Preliminary Schedule of Values to Engineer with product data submittal within four (4) weeks from award of contract to successful bidder. Provide according to the following descriptions:
  - a. General Construction (total)
  - b. Mobilization/Demobilization
  - c. Demolition
  - d. Lighting - Interior
  - e. Lighting Controls
  - f. Basic Materials/Devices/Equipment Connections
  - g. Fire Alarm
2. Provide a final Schedule of Values at close-out of project including updated values based on actual installation.

C. Product Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy to indicate which of the variations is to be provided.
2. Delete or mark-out portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.

D. Shop Drawings:

1. Shop Drawings are defined as electrical system layout drawings prepared specifically for this project, or fabrication and assembly type drawings of system components to show more detail than typical pre-printed materials.
2. Prepare Electrical Shop Drawings, except diagrams, to accurate scale, min 1/8"-1'-0", unless otherwise noted.

- E. Coordination Drawings: See applicable paragraph in this specification section.
  - F. Test Reports:
    - 1. Submit test reports which have been signed and dated by the accredited firm or testing agency performing the test.
    - 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.
    - 3. Submit test reports as required for O & M manuals.
  - G. Operation and Maintenance Data: See applicable paragraph in this specification section.
  - H. Equipment Settings Report: Submit Equipment Settings Report for lighting controls indicating final configurations and settings.
    - 1. Provide report of settings, parameters, programing inputs and parameters, etc., installed at each piece of electrical equipment that allows adjustments to be made in the field and those set at the factory. The report shall be arranged by specification section and each piece of equipment broken out individually or by listing of equipment if the same settings are installed in multiple pieces of equipment.
    - 2. Report shall be submitted and received by the Engineer at least fifteen calendar days prior to the contractor's request for final observation. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.
  - I. Software Licenses: Provide documentation of ownership under the owner's corporate name (coordinate with owner's representative for exact ownership wording) for Software Licenses provided as part of the work. Include information for updates, subscription requirements if applicable, backup, support, login, passwords, date when purchased, expiration date if applicable, version, etc. Include in the O & M Manual after review and "No Exceptions Taken" has been accomplished.
  - J. Record Drawings: See applicable paragraph in this specification section.
- 1.17 DELIVERY, STORAGE AND HANDLING:
- A. Refer to the Division 01, Sections on Transportation and Handling and Storage and Protection.
  - B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
  - C. Check delivered equipment against contract documents and submittals.
  - D. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage and weather.
  - E. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.18 DEMOLITION/REMODEL WORK:

- A. Refer to Division 01 Section on Summary of work for requirements on working in Owner-occupied areas of the existing building and Division 02 section on selective demolition. The following are additions and modifications.
- B. During the demolition phase of this contract it is the responsibility of this Contractor to carefully remove existing equipment, conduits, boxes, and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage and stored as directed by the Owner. A list of all items stored shall be turned over to the Architect/Engineer. At the completion of the remodeling works or when directed by the Engineer, all stored items not reused or wanted by the Owner shall be removed from the premises.
- C. The project involves renovation and remodel of the existing building. On the drawings, work may be denoted by showing items as bold or light line weight. These annotations and terms are amplified as follows:
1. **Bold Print** (when used): Work included in this contract is denoted in bold print or darker line weight.
  2. **Light Print** (when used): Work shown lightly indicates existing conditions to remain.
  3. **"TO BE DEMOLISHED" [R]**: Contractor shall remove the existing item and the associated existing wiring. Where the raceway serving the equipment is accessible (via removal of suspended ceiling, crawl space, etc.) the raceway shall also be removed. Where the removal of a raceway leaves visible evidence on an existing surface which is not being repaired or replaced by the General Contractor, this contractor shall repair the surface. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover-plate installed. Where the concealed raceway is uncovered by demolition performed by the General Contractor, the raceway shall be removed (or extended to new location if appropriate).
  4. **"TO BE RELOCATED" [RL]**: Existing item to be relocated. Contractor shall remove the existing item, and store in a safe place. The existing item shall be relocated to the new position as called for on the drawings. At Contractor's option, the existing wiring may be extended, or new wiring may be run from the source. Based upon the item to be relocated, the Contractor shall perform the following function:

Luminaires	Clean and reinstall in new location.
Receptacles	Clean and reinstall in new location.
  5. **"TO BE REPLACED" [ER]**: Existing item to be removed and reinstalled to facilitate new work, maintain circuit continuity. Contractor shall perform the following function based upon the item to remain:

Luminaires	Install new device in existing location.
Switches	Install new device in existing location.
Receptacles	Install new device in existing location.
  6. **"TO REMAIN" [E]**: Existing item to be removed and reinstalled only as required to facilitate new work. Necessity to relocate shall be determined by Contactor during field investigations, prior to submitting bid.

- D. Existing equipment that is removed and not scheduled to be reused shall remain the property of the Owner and be delivered for disposition unless specifically indicated otherwise and shall be stored in a location designated by the Owner. Items which are removed and not wanted by the Owner shall become the property of the Contractor and shall be removed from the site.
- E. Existing equipment that is removed and is to be reused shall be cleaned, serviced and operable before being reinstalled.
- F. Revise panelboard schedules to reflect removal or relocation of equipment. Circuit integrity of equipment in adjacent areas shall be left intact.
- G. Where remodeling interferes with existing circuits and equipment which are not to be removed, such circuits and equipment shall be reworked and relocated as required to complete the project. Take care to avoid overloading the bus when circuits are moved to a different phase in an existing panel.
- H. The Contractor shall remove all distribution equipment, conductors, etc., which are indicated to be removed or which must be removed to accommodate demolition. Equipment to be removed may require reworking conduit and wiring in order to maintain service to other equipment.
- I. Where remodeling interferes with circuits serving areas outside of the project or phase limits or which are remodeled in later phases of the project, circuits shall be reworked or temporary circuits provided as required. Take care to avoid overloading the bus when circuits are moved to a different phase in an existing panel.
- J. Existing equipment and circuiting shown are based on field surveys and/or Owner furnished drawings. The Contractor shall verify conditions as they exist with necessary adjustments being made to the drawing information.
- K. Coordinate the routing of all conduits with the existing mechanical and plumbing systems in order to avoid conflicts with ducts, pipes, etc. Where existing electrical boxes, conduit, or equipment interfere with installation of new ducts, plumbing, walls, soffits, luminaires, outlets, etc., the Contractor shall resolve the conflict with the appropriate trade.
- L. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated on the drawings or allowed under the appropriate section of the specifications.
- M. Electrical Outages: Electrical outages must be held to a minimum. The Contractor shall submit a Method of Procedure (MOP) to the Owner for each outage, detailing the reasons for the outage, areas affected and the sequence of procedures to accomplish work. The Contractor shall meet with the Owner to set a schedule and date for the outage based on the MOP. Due to the critical implications of power outages, the Owner may direct the Contractor as to the time of day or night and date an outage may take place.
  - 1. The Contractor will be responsible for providing temporary power required for the duration of the outages. The required outages to connect and disconnect the temporary power will require a MOP as described above.

- N. PCB Ballasts: PCB type ballasts may be present in existing luminaires. If PCB ballasts are discovered by the Contractor, report such occurrence to the Owner immediately. The Contractor shall remove and dispose of PCB type ballasts at an E.P.A. (Environmental Protection Agency) approved site in the prescribed manner acceptable to the EPA. The Contractor shall pay all fees associated with this work.
  - O. Hazardous Material: If suspected hazardous material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Owner immediately. The Owner will determine the action to be taken. Hazardous material removed is not a part of the work to be done under this Division.
  - P. Lamp Disposal: Contractor is responsible for sending removed lamps to be recycled. The Contractor should ensure the recycling agency meets RCRA and CERCLA regulations. Provide certificate of compliance in O&M Manuals.
  - Q. On Site Metering: When called for in the specifications or on the drawings, the Contractor shall meter the points indicated for a period of 30 days prior to start of construction to verify existing load. Meter shall record voltage; amperage; KVA; and Power Factor for each phase and sum of the phases. The meter shall continually average the power demand over maximum 15 minute intervals as required by NEC 220.87. Compile a metering summary report and deliver results to engineer after 7 days and after 30 days. Verify existing loads at and downstream of the metering location and provide list to engineer of what loads are not on during the 30 day metering and the reason why. Organize list by equipment name. If any loads have been removed or permanently abandoned, Turn circuit breaker off and relabel as SPARE.
- 1.19 CUTTING AND PATCHING:
- A. This Article specifies the cutting and patching of electrical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
  - B. Refer to the Division 01 Section covering cutting and patching for general requirements.
  - C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
  - D. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.
  - E. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
  - F. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to removal of conductors, conduit, luminaires, boxes, devices and other electrical items made obsolete by the new Work.
  - G. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

- H. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- I. Locate, identify, and protect electrical services passing through remodel or demolition area and serving other areas required to be maintained operational.

1.20 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough in requirements.
- C. Work through all coordination before rough-in begins. See applicable Article above.

1.21 ACCESSIBILITY:

- A. Install equipment and materials to provide required code clearances and access for servicing and maintenance. Coordinate the final location with piping, ducts, and equipment of other trades to insure proper access for all trades. Coordinate locations of concealed equipment, disconnects, and boxes with access panels and doors. Allow ample space for removal of parts, fuses, lamps, etc. that require replacement or servicing.
- B. Extend all conduits so that junction and pull boxes are in accessible locations.
- C. Provide access panel or doors where equipment or boxes are concealed behind finished surfaces.
- D. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 01 for access door specification and requirements.
- E. The minimum size of any access door shall not be less than the size of the equipment to be removed or 12 inches x 12 inches if used for service only.
- F. Furnish doors to trades performing work in which they are to be built, in ample time for building in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.
- G. Access doors in fire rated walls and ceilings shall have equivalent U.L. label and fire rating.

1.22 TESTING:

- A. Submit test reports as outlined in Division 01 Sections on Quality Control Services and each Division 26 Section. Deliver to Engineer at least one week prior to calling for substantial completion observations.

- B. Testing as required by these specifications shall pertain to all equipment, wiring, devices, etc. installed under this contract and being reused.
  - C. General Scope:
    - 1. Perform all tests and operational checks to assure that all electrical equipment, both Contractor and Owner-supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
    - 2. The tests and operational checks shall determine the suitability for energization.
    - 3. Schedule tests and give a minimum of two weeks advance notice to the Engineer. Reschedule testing for Owner convenience if required.
  - D. Test Report: Submit electronic copy copies of the completed report to the Engineer no later than fifteen (15) days after completion of test unless directed otherwise. The test report shall be bound and its contents certified. A final compilation of all Test Reports shall be submitted with the Testing and Equipment Settings Report (Refer to Operation and Maintenance Data paragraphs).
  - E. Failure to Meet Test:
    - 1. Contractor shall replace the defective material or equipment as necessary, and have test repeated until test proves satisfactory without additional cost to the Owner.
  - F. The Contractor or testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:
    - 1. Field Instruments: 6 months
    - 2. Laboratory Instruments: 12 months
    - 3. Leased specialty equipment: 12 months. (Where accuracy is guaranteed by lessor)
    - 4. Dated calibration labels shall be visible on all test equipment.
- 1.23 NAMEPLATE DATA:
- A. Provide equipment with permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Install equipment so that nameplate is readily visible.
- 1.24 CLEANING:
- A. Refer to the Division 01 Section on project closeout or final cleaning for general requirements for final cleaning.
- 1.25 RECORD DOCUMENTS:
- A. Refer to the Division 01 Section on Project Closeout or Project Record Documents for requirements. The following paragraphs supplement the requirements of Division 01.

- B. Keep a complete set of record document prints in custody during entire period of construction at the construction site. Documents shall be updated on a weekly basis.
  - C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices, and any other relevant deviations from the Contract Documents.
  - D. Mark shop drawings to indicate approved substitutions; Change Orders; actual equipment and materials used.
  - E. Schedules:
    - 1. Mark luminaire schedule on drawings to indicate manufacturer and complete catalog numbers of installed equipment.
    - 2. Mark schedules including panelboard, switchboard, motor control center, mechanical, kitchen and similar equipment schedules on drawings to indicate installed equipment and materials used, and any deviations or revisions to electrical load data and calculations.
  - F. Revisions to the Contract Documents shall be legible and shall be prepared using the following color scheme.
    - 1. Red shall indicate new items, deviations and routing.
    - 2. Green shall indicate items removed or deleted.
    - 3. Blue shall be used for relevant notes and descriptions.
  - G. At the completion of the project, obtain from the Architect a complete set of the Contract Documents in a read-only electronic format (.pdf unless otherwise noted). This set will include all revisions officially documented through the proper channels. Using the above color scheme, transfer any undocumented revisions from the construction site record drawings to this complete set. Submit completed documents for review. This contract will not be considered completed until these record documents have been received and accepted.
  - H. Contractor may propose methods of maintaining record documents on electronic media. Obtain approval of Engineer and Owner prior to proceeding. Marked-up .pdf format readable by Bluebeam is preferred.
- 1.26 OPERATION AND MAINTENANCE DATA:
- A. Refer to the Division 01 Section on project closeout or operation and maintenance data for procedures and requirements for preparation and submittal of maintenance manuals.
  - B. No later than four (4) weeks prior to the completion of the project provide complete set of operating and maintenance manuals, or as specified in Sections of Division 01 (whichever is more stringent). Operation and Maintenance Data shall be submitted in electronic format.



- C. Operation and Maintenance Data: Submit operation and maintenance data in maintenance manual in accordance with requirements of applicable Division 26 and 28 Sections and Division 01. Provide Operating and Maintenance Instructions in electronic format covering all equipment furnished. Manuals shall include all information required below, as indicated in each Division 26 and 28 Section, and the following for each piece of equipment:
1. The job name and address, contractor's name, address, and phone number, and each subcontractor's name, address, and phone number shall be identified at the front of the electronic submittal.
  2. Name, address and telephone number to be contacted of the local authorized service organization/company and individual to be contacted for service and maintenance for each item of equipment.
  3. Submit operation and maintenance data, schedule of recommended service and parts lists for all materials and products specified and intended for installation. Include description of function, normal operating characteristics and limitations, fuse curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
  4. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
  5. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  6. Servicing instructions and lubrication charts and schedules.
  7. Manufacturer's service manuals for all electrical equipment provided under this contract.
  8. Complete equipment and protection wiring diagrams. All wiring diagrams shall show color coding of all connections and mounting dimensions of equipment.
  9. Equipment identification numbers and adjustment clearly indicated for each piece of equipment.
  10. Electrical System and Equipment Warranties.
  11. Provide manuals tabbed and divided into major sections and special equipment. Mark the individual equipment when more than one model or make is listed on a page. Provide detailed table of contents.
  12. Record Set of Shop Drawings: Shop drawings corrected to show as-built conditions. Transfer modifications from field set.
  13. Equipment Testing Report including all test reports and Equipment Settings Report indicating final configurations and settings.
- D. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, settings reports, and final Schedule of Values with all Electrical change order costs included and identified is provided and the manual is reviewed by the Architect/Engineer.

1.27 PROJECT CLOSEOUT LIST:

- A. In addition to the requirements specified in Division 01, the contractor shall be responsible for providing the items listed within these specifications prior to applying for certification of substantial completion. Refer to individual specification sections for additional requirements.

1.28 WARRANTIES:

- A. Refer to the Division 01 Section on Warranties and Bonds for procedures and submittal requirements for warranties. Refer to individual equipment specifications

for warranty requirements. In no case shall the warranty for the total electrical system be less than one year from date of acceptance by the Owner.

- B. Compile and assemble the warranties specified in Division 26 and 28 into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item. Information to include product or equipment description, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.29 CONSTRUCTION REQUIREMENTS:

- A. The contractor shall maintain and have available at the jobsite current information on the following at all times:
  - 1. Up to date record drawings.
  - 2. Submittals
  - 3. Site observation reports with current status of all action items.
  - 4. Test results; including recorded values, procedures, and other findings.
  - 5. Outage information.

1.30 EQUIPMENT HOUSEKEEPING PADS:

- A. Provide 4" high concrete housekeeping pad for all floor mounted equipment including, but not limited to: switchgear, switchboards, motor control centers, floor mounted distribution panelboards, floor mounted branch panelboards, and floor mounted dry type transformers. Fabricate pads as follows:
  - 1. Coordinate size of equipment bases with actual unit sizes provided. Fabricate base 3" larger in both directions than the overall dimensions of the supported unit.
  - 2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
  - 3. Place concrete and allow proper curing before installation of units. Use Portland cement that conforms to ASTM C 150; 54,000-psi compressive strength, and normal weight aggregate.
  - 4. Anchor housekeeping pads to slab using #3 rebar bent in "L" or "Z" shape 12 inch on center on each side of slab.

END SECTION 260500

## SECTION 260519 – ELECTRICAL CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

#### 1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.
- C. Conform to applicable code regulations regarding toxicity of combustion products of insulating materials.

#### 1.3 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- C. Record Documents: Record actual installed circuiting arrangements for panel feeders and underground circuits.

#### 1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver wire and cable properly packaged in factory- fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

### PART 2 - PRODUCTS

#### 2.1 APPLICATIONS

- A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed. Wire shall be single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

B. Dry and Concealed Interior Locations

1. Provide single conductor building wire in suitable raceway system.
2. Metal Clad cable (MC), Refer to Additional Requirements Paragraph, this section.

C. Dry and Exposed Interior Locations

1. Provide single conductor building wire in suitable raceway system.

D. Damp or Wet Interior Locations

1. Provide single conductor building wire in suitable raceway system.

E. Cable types that will NOT be permitted are listed as follows:

1. Armored Cable assemblies (AC)
2. Flat Cable assemblies (FC / FCC)
3. Integrated Gas Spacer cables assemblies (IGS)
4. Medium Voltage cable assemblies (MV)
5. Mineral-Insulated, metal sheathed cable assemblies (MI)
6. Nonmetallic-Sheathed cable assemblies (NM / NMC / NMS)
7. Service-Entrance cable assemblies (SE / USE)
8. Underground Feeder and branch-circuit cable assemblies (UF)

## 2.2 CONDUCTOR AND CABLE REQUIREMENTS

A. General Requirements

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide copper conductors.
3. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
4. Tinned Copper Conductors: Comply with ASTM B33.

B. Single Conductor Building Wire

1. Description: Single conductor insulated wire.
2. Conductor Stranding:
  - a. Size 10 AWG and Smaller: Solid.
  - b. Size 8 AWG and Larger: Stranded.
3. Insulation: Type THHN/THWN or THHN/THWN-2.
4. Conductor: Copper.
5. Insulation Voltage Rating: 600 volt, 75 degrees C.

C. Metal Clad cable (MC)

1. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, aluminum interlocked metal type covering with integral, full-size equipment grounding conductor. Fitting shall be double grip saddle and locking nut.
2. Conductor Stranding:
  - a. Size 10 AWG and Smaller: Stranded.

- b. Size 8 AWG and Larger: Stranded.
- 3. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2
- 4. Conductor: Copper.
- 5. Insulation Voltage Rating: 600 volt, 75 degrees C.

D. Portable Equipment Power Cords

- 1. Use for flexible pendant leads to luminaires, outlets, and equipment where indicated and in compliance with codes.
  - a. Type SO: Sizes 12 AWG through 2 AWG, copper conductors with 600 volt thermoset insulation 0.1 resistant insulation.
  - b. Type G-GC: Sizes 1 AWG through 500 KCMIL, copper conductors with 600/2000 volt, 90 degrees C, ethylene-propylene insulation

2.3 CONNECTORS:

- A. Description: Provide UL-type factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperatures equal to or greater than those of the wires upon which used.
- B. Provide 2-hole compression lugs for all power feeder, neutral, and grounding connections when installed on bus bars. (Including phase, neutral and grounding conductors).
- C. Provide connectors that are designed to accept stranded conductors where stranded conductors are used.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES:

- A. General: Install electrical cables, wires and connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- B. Coordinate wire/cable installation work, including electrical raceway and equipment connection work, with other work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.
- D. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway. Do not use rope hitches for pulling attachment to wire or cable.
- E. Keep conductor splices to minimum. Splice only in accessible junction boxes. No splices are allowed in feeder, control or fire alarm wiring. Connect un-spliced wire to numbered terminal strips at each end.
- F. Install splices and taps which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

- G. Use splice and tap connectors which are compatible with conductor material.
- H. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A for copper.
- I. Support cables above accessible ceilings. Independent from the ceiling suspension system to support cables from structure, do not rest on ceiling tiles.
- J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled to individual circuits. Make terminations so there is no bare conductor at the terminal.
- K. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated screw on type spring wire connectors with plastic caps, push on type are not acceptable.
- L. Use copper compression connectors for copper wire splices and taps, 1/0 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.
- M. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- N. Thoroughly tape the ends of spare conductors in boxes and cabinets.
- O. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.
- P. Make all ground, neutral and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to individual ground terminal of devices.
- Q. Branch circuits whose length from panel to first outlet exceeds 75 feet for 120 volt circuits or 175 feet for 277 volt circuit shall be #10 or larger.
- R. Parallel conductors shall be cut to the same length.
- S. All splices in control panels, terminal junction boxes, low voltage control circuits, fire alarm, etc., conductors shall be on numbered terminal strips.
- T. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.
- U. Provide wire training, lacing, labeling, and terminal blocks as required in panelboards and all control cabinets including, but not limited to, lighting and fire alarm cabinets. All wiring shall be installed neat and be labeled to match wiring diagrams, control devices, etc.
  - 1. Make temporary connections to panelboard devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.

- V. Color coding of switch legs, travelers, etc. shall be different and distinct from phase and neutral conductors. Where systems utilize two (2) different voltages, the color coding of switch legs, travelers, etc. shall be different and distinct for each voltage system.

### 3.2 ADDITIONAL REQUIREMENTS FOR MC CABLE INSTALLATIONS

- A. The location of system components, including cable routing shown on the plans, is approximate. Use good judgment in their placement to eliminate all interference with ducts, piping, etc.
- B. All cable routing shall be done in a neat and workmanlike manner, consistent with recognized good practice and in accordance with the manufacturer's instructions.
- C. Route the cables along the grid system. Do not route cables diagonally or in any way which restricts removal of lay-in ceiling material.
- D. Support cable on ceiling wires adjacent to each luminaire and at four foot intervals using clamp supports manufactured specifically for that purpose.
- E. Maximum of 6 feet unsupported length for connecting luminaires in accessible ceilings to the local junction box.
- F. Maximum of 6 feet unsupported length for connecting luminaires in non-accessible ceilings to the local junction box.
- G. May be used in stud walls and casework for horizontal branch circuit runs between devices.
- H. For vertical branch circuit drops from a local junction box in each room above an accessible ceiling to the direct or single device in a stud wall or casework; including under counter lighting.
- I. May not be used for branch circuit home runs, feeders, motor feeder circuits or in emergency systems.
- J. Branch circuit conductors shall match color coding schedule within this specification section

### 3.3 FIELD QUALITY CONTROL:

- A. Test installed wires and cables with 1000 VDC megohm meter to determine insulation resistance levels to ensure requirements are fulfilled. Test shall be made on all feeders. The megger values obtained shall be compared to the minimum values listed in NETA. All phase conductors and cables shall be meggered after installation, and prior to termination.
- B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

### 3.4 COLOR CODING SCHEDULE:

- A. Color code secondary service, feeder, and branch circuit conductors as follows:

<u>120/208 Volts</u>	<u>Phase</u>	<u>277/480 Volts</u>
----------------------	--------------	----------------------

Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

- B. Conductors shall be solid color for entire length.
- C. If solid color conductor insulation is not available and specific acceptance is given by the engineer for use of black conductor insulation, provide the following:
  - 1. Conductors 6 AWG and smaller shall be solid color for the entire length.
  - 2. Conductors 4 AWG and larger shall have either solid color insulation as specified above for the entire length or be black with color coding at each termination and in each box or enclosure. For a distance of 6 inches use half-lapped 3/4 inch plastic tape in the above specified color. Do not cover cable identification markings. Adjust tape locations to prevent covering of markings.

END OF SECTION 260519



## SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

#### 1.2 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Provide manufacturer's catalog information showing dimensions and materials, for ground rods, connectors and connection materials, and grounding fittings.
- C. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.
- D. Record Documents: Record actual installed circuiting arrangements. Indicate layout of ground rings, location of system grounding electrode connection, routing of grounding electrode conductors, also include diagrams for circuits and equipment grounding connections.

#### 1.3 QUALITY ASSURANCE:

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.

### PART 2 - PRODUCTS

#### 2.1 GROUNDING AND BONDING PRODUCTS:

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.

#### 2.2 WIRE AND CABLE CONDUCTORS:

- A. General: Comply with Division 26 Section on Conductors and Cables. Conform to NEC, except as otherwise indicated, for conductor properties, including stranding.

- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors: Conform to the following:
  - 1. Solid Conductors: ASTM B-3
  - 2. Assembly of Stranded Conductors: ASTM B-8
  - 3. Tinned Conductors: ASTM B-33

#### 2.3 MISCELLANEOUS CONDUCTORS:

- A. Ground Bus: Bare annealed copper bars of rectangular cross section
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated

#### 2.4 CONNECTOR PRODUCTS:

- A. General: Listed and labeled as grounding connectors for the materials used
- B. Pressure Connectors: High-conductivity-plated units
- C. Bolted Clamps: Heavy-duty units listed for the application
- D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

#### 2.5 GROUNDING ELECTRODES:

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
  - 1. Size: 3/4 inch by 10 feet.

### PART 3 - EXECUTION

#### 3.1 APPLICATION:

- A. Equipment Grounding Conductor Application: Comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
  - 1. Install separate insulated equipment grounding conductors with circuit conductors for all feeders and branch circuits, in addition to those locations where required by Code:
- B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.

- C. Signal and Communications: For data, telephone, alarm, and communication systems, provide a #6 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.
- D. All systems shall be grounded in accordance with the NEC.

### 3.2 INSTALLATION:

- A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.
- B. Electrical Room Ground Bus: Size and configurations as indicated in electrical plans. Space 1 inch from wall and support from wall 6 inches above finished floor, except as otherwise indicated.
- C. Ground Rods: Locate a minimum of two-rod lengths from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 24 inches below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.
- D. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.
- E. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- F. Labeling: Provide a phenolic tag for all grounding electrode conductors as described in section on Electrical Identification.
- G. Where grounding conductors, grounding electrode conductors, or bonding conductors are non-exposed, identify each with a 6-inch band of green tape at each end and at 10 foot intervals. When run in conduits, provide color banding on conduit per section on Electrical Identification.

### 3.3 CONNECTIONS:

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
  - 2. Make connections with clean bare metal at points of contact.
  - 3. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

- B. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
  - C. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors. Terminate each conductor on an individual ground lug terminal.
  - D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.
  - E. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
  - F. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.
- 3.4 FIELD QUALITY CONTROL:
- A. Provide all test results to Engineer in Substantial Completion Submittals, via Architect, prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.
  - B. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.
  - C. Ground Resistance Test:
    - 1. Grounding electrode resistance testing shall be accomplished with a ground resistance direct-reading single test meter utilizing the fall-of-potential method and two reference electrodes. Perform test prior to interconnection to other grounding systems. Orient the ground electrode to be tested and the two reference electrodes in a straight line spaced fifty (50) feet apart. Drive the two reference electrodes five (5) feet deep.
  - D. Correct Deficiencies, Retest and Report:

1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace conductors, units and rods as required to bring system into compliance.
2. Prepare a written report and show temperature, humidity and condition of soil at time of tests. Report shall be certified by testing agency that identifies components checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

3.5 CLEANING AND ADJUSTING:

- A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary top-soiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Restore vegetation and disturbed paving to original condition.

END OF SECTION 260526

PAGE INTENTIONALLY LEFT BLANK

## SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

#### 1.2 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Shop Drawings: Contractor shall indicate details of fabricated products and materials.
- C. Design Data: Indicate details and engineering analysis for any suspended transformers, cable trays, and trapeze hangers for multiple conduit runs.

### PART 2 - PRODUCTS

#### 2.1 COATINGS:

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

#### 2.2 MANUFACTURED SUPPORTING DEVICES:

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as follows:
  - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
  - 2. Toggle Bolts: All steel springhead type.
  - 3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.
- C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

- E. U-Channel Systems: 12-gage steel channels, with 9/16 inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
- F. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
  - 1. One-Hole Conduit Straps: For supporting 1 inch and smaller rigid metal conduit; galvanized steel.
  - 2. Two-Hole Conduit Straps: For supporting 1 inch and larger rigid metal conduit, galvanized steel; 3/4 inch strap width; and 2-1/8 inch between center of screw holes.

#### 2.3 FABRICATED SUPPORTING DEVICES:

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of either; Steel Pipe (fabricated from Schedule 40 galvanized steel pipe), or metallic conduit (EMT, IMC, or RMC).

#### 2.4 FIRE SEALS:

- A. Material: Fire stopping material shall be asbestos free, 100 percent intumescent, have code approval under BOCA, ICBO, SSBC, NFPA 101, NFPA 70, and be capable of maintaining an effective barrier against flame and gases in compliance with the following requirements.
- B. Flame Spread: 25 or less, ASTM E84
- C. Fire Resistance and Hose Stream Tests: Fire stopping materials shall be rated "F" and "T" in accordance with ASTM E 814 or UL 1479. Rating periods shall conform to the following:

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installation.
- C. Junction Box Supports: Comply with the NEC and the following requirement:
  - 1. Use 1/4 inch all-thread rod from structure to support junction boxes.
- D. Raceway Supports: Comply with the NEC and the following requirements:
  - 1. Conform to manufacturer's recommendations for selection and installation of supports.



2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
  3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
  4. Use #9 ceiling wire to support individual conduits up to 3/4 inch with spring steel fasteners. Use of ceiling support wires is unacceptable.
  5. Support parallel runs of horizontal raceways together on trapeze-type hangers. Use 3/8 inch diameter or larger threaded steel rods for support.
  6. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing. For hanger rods supporting 1-1/2 inch or larger conduits provide 3/8 inch minimum threaded steel rods with pipe hangers.
  7. Space supports for raceways in accordance with NEC. When four (4) or more 2 inch conduits are installed in a trapeze system, supports shall be spaced 5 feet O.C.
  8. In all runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
  9. Threaded rod supports to have bottoms cut off at a maximum length equal to rod diameter below bottom nut.
- E. Conductor or Cable Supports: Comply with the NEC and the following requirements:
1. Support individual conductors or cables by separate clamps with rubber or plastic grommet, fasten using a non-metallic bolt and nut, and secure clamps to channel supports anchored to structure (multiple clamps may be secured to a single channel support). Individual conductors or cables may be served utilizing a vinyl or fiberglass clamp which shall be anchored to the structure.
  2. Install simultaneously with installation of conductors.
  3. MC Cable shall be supported by UL listed clip or clamp. Cable tie support is not acceptable.
- F. Miscellaneous Supports: Support miscellaneous electrical components separately and as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- G. In overhead spaces, support metal boxes directly from the building structure via 1/4 inch minimum all-thread or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box. Supporting metal boxes utilizing ceiling type wire is not acceptable.
- H. Sleeves: Install in walls and all other fire-rated partitions for cable installations as needed. Apply UL-listed fire stopping sealant in gaps between sleeves and cables in accordance with "Fire Resistant Joint Sealers" requirement of Division 07 Section "Joint Sealers." See Architectural plans for location and extent of fire rated assemblies.

- I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
    1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws, where authorized by the Owner and structural engineer. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
    2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
    3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.
  
  - J. Communication and Telephone Cable Supports: Refer to Division 27.
- 3.2 PERSONNEL PROTECTION:
- A. Where U-channel systems, angles, brackets or other standard structural metal shapes are readily accessible and exposed to personnel, provide plastic or rubber end caps.
  - B. Where threaded rod supports are readily accessible and exposed to personnel, provide plastic or rubber end caps.
- 3.3 FIRE STOPPING LOCATIONS:
- A. Preparation:
    1. Coordination: Coordinate the work with other trades. Fire stopping materials at penetrations of insulated pipes and ducts can be applied after insulation is in place. If insulation is composed of combustible material, the thickness of fire stopping materials must be equivalent to that of the insulation. If the insulation is composed of non-combustible material, it may be considered as part of the penetrating item.
    2. Surface Preparation: Surface Preparation to be in contact with fire stopping materials shall be free of dirt, grease, oil, loose material or other substances that may affect proper fitting or the required fire resistance.
  - B. Installation: Install fire stopping materials in accordance with the manufacturer's instructions.
  - C. Cleaning: After completion of fire stopping work in any area, equipment shall be reviewed and walls, ceilings and all other surfaces shall be cleaned of deposits of firestop materials.

END OF SECTION 260529

## SECTION 260533 – RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. Extent of raceway work is indicated by drawings and schedules. Provide complete conduit systems for all conductors unless otherwise specified.
- B. Types of raceways specified in this section include the following:
  - 1. Flexible Metallic Tubing (FMT)
  - 2. Liquidtight Flexible Metal Conduit (LFMC)
  - 3. Electrical Metallic Tubing (EMT)
  - 4. Surface Raceway
- C. The following raceway systems are either specified in other sections or not anticipated to be provided by this Contractor.
  - 1. High Density Polyethylene (HDPE)
  - 2. Nonmetallic Underground Conduit with Conductors (NUCC)
  - 3. Reinforced Thermosetting Resin Conduit (RTRC)
  - 4. Liquidtight Flexible Nonmetallic Conduit (LFNC)
  - 5. Flexible Metal Conduit (FMC)
  - 6. Electrical Nonmetallic Tubing (ENT)
  - 7. Rigid Polyvinyl Chloride (PVC)
  - 8. Intermediate Metallic Conduit (IMC)
  - 9. Rigid Metal Conduit (RMC)
  - 10. Busways and/or Cablebus
  - 11. Cellular Concrete Floor Raceways
  - 12. Underfloor Raceways
  - 13. Cable Trays
  - 14. Auxiliary Gutters / Wireways

#### 1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

#### 1.3 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Record Documents: Record actual installed circuiting arrangements and routing for panel feeders and underground circuits.

## PART 2 - PRODUCTS

### 2.1 CONDUIT AND TUBING:

- A. General: Aluminum, Brass, and Stainless Steel tubing are not allowed unless specifically noted otherwise and/or for specialty systems such as use in corrosive or special condition environments. Provide galvanizing as indicated below. All fittings shall comply with NEMA FB 1.
- B. Flexible Metallic Conduits (FMC)
  - 1. Conduit: Continuous spiral wound, interlocked, zinc-coated steel, approved for grounding.
  - 2. Fittings: Zinc coated, malleable iron. Straight connector shall be one-piece body, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. Angle connectors shall be two piece body with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and threaded male end provided with a locknut. All fittings shall be terminated with threaded bushings having nylon insulated throats.
- C. Liquid-Tight Flexible Metal Conduit (LFMC)
  - 1. Conduit: Continuous spiral wound, interlocked zinc-coated steel with polyvinyl chloride (PVC) jacket, approved for grounding.
  - 2. Fittings: Zinc coated malleable iron. Straight and angle connectors shall be the same as used with flexible metal conduit but shall be provided with a compression type steel ferrule and neoprene gasket sealing rings.
- D. Electrical Metallic Tubing (EMT)
  - 1. Conduit: Thin-wall steel tubing, unthreaded, with zinc electroplating.
  - 2. Fittings: Steel compression fittings for all applications. Bushings shall be threaded and have nylon insulated throat or nylon bushing.
  - 3. Rain-tight Fittings: Steel compression fittings for rain-tight and concrete-tight applications. Steel set-screw for all other connections. Set-screw quick fit type for 2-1/2 inches and larger may be used. Bushings shall be threaded and have nylon insulated throat or nylon bushing.

### 2.2 SURFACE RACEWAYS:

- A. General: Sizes and channels as indicated. Provide fittings that match and mate with raceway. All circuits either factory or field installed shall have a separate neutral conductor. Verify color with Architect/Engineer prior to order.
  - 1. Multi-outlet assembly, divided for power and communication, nominal 4-3/4" x 1-3/4" with (2), 2-3/8" compartments and flush, Snap-on cover. Install devices and circuits as indicated on the drawings.
  - 2. Surface Metal Raceway: Galvanized steel with Snap-on cover. Finish in manufacturer's standard prime coating suitable for field painting. Provide raceways of suitable size based on fill for circuits indicated on the drawings. Provide all necessary boxes, covers, extensions, fittings, etc. to form a complete assembly.

- B. Boxes for Surface Raceways: Designed, manufactured and supplied by raceway manufacturer for use with specified raceway.

2.3 CONDUIT BODIES:

- A. General: Types, shapes and sizes, as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.
- B. Metallic Conduit and Tubing: Use malleable iron conduit bodies. Use bodies with threaded hubs for threaded raceways and in hazardous locations.

2.4 CONDUIT SIZES:

- A. Conduit sizes shall be as shown on the drawings. If the conduit size is not given on the drawings, the conduit shall be sized in accordance with NEC based on the number of conductors enclosed plus parity sized equipment ground.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 CONDUIT SCHEDULE:

- A. General: Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- B. Concealed Within Hollow Stud Walls: EMT.
- C. Concealed Above Accessible Ceilings: EMT.
- D. Interior, Damp or Wet Locations: EMT.
- E. Exposed Interior in utility areas or areas with open ceilings: EMT
- F. Connections to Vibrating Equipment: (Such as Transformers and Motors)
  - 1. Dry, Damp or Wet Locations: LFMC.
  - 2. Maximum Length: 6 feet unless otherwise indicated.
- G. Raceways in all other areas shall be EMT unless otherwise noted.
- H. Use FMC inside movable partition wireways, from junction boxes to devices and between devices in casework, from outlet boxes to recessed luminaires, and for "fishing" of existing walls.

- I. Rework or extensions of existing conduit shall include the use of similar materials to the existing conduit type unless otherwise noted.

### 3.3 INSTALLATION OF CONDUITS:

- A. General: Install electrical raceways in accordance with manufacturer's written installation instruction, applicable requirements of NEC, and as follows:
  1. Conceal all conduits unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
  2. Elevation of Raceway:
    - a. Where horizontal raceway is installed near water and steam piping, route raceway above piping and as close to structure as possible and practical.
    - b. Route raceway as close to structure as possible.
  3. Complete installation of electrical raceways before starting installation of conductors within raceways.
  4. Provide supports for raceways as specified elsewhere in Division 26.
  5. Prevent foreign matter from entering raceways by using temporary closure protection.
  6. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bend is not visible above the finished slab.
  7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
  8. Use raceway fittings that are types compatible with the associated raceway and suitable for the use and location. Install expansion fittings across all structural construction joints and expansion/deflection couplings across all structural expansion joints.
  9. Run raceways parallel and perpendicular to building elements and other equipment with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
  10. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.
  11. Install vertical feeder conduits in exterior walls, core walls, or chase spaces. Do not install in interior wall partition areas.
  12. Run exposed and parallel raceways together. Make bends in parallel runs from the same center line so that the bends are parallel. Factory elbows may be used only where they can be installed parallel. In other cases provide field bends for parallel raceways.
  13. Make raceway joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight.
  14. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Joints in non-metallic conduits shall be made with solvent cement in strict accordance with manufacturer's recommendations.
  15. Tighten set screws of thread less fittings with suitable tool.
  16. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the

- box. RMC and IMC shall be secured with double locknuts and an insulated metallic bushing. EMT shall be secured with one locknut and shall have nylon insulated throats or threaded nylon bushings from 1/2" to 1". 1-1/4" and above shall be metal with nylon insulated throats. Use grounding type bushings for feeder conduits at switchboards, panelboards, pull boxes, transformers, motor control centers, VFD's, etc.
17. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
  18. Provide nylon pull string with printed footage indicators having not less than 200 pounds tensile strength. Leave not less than 12 inches of slack at each end of the pull string. Identify with tags at each end the origin and destination of each empty conduit and indicate same on all empty or spare conduits on the as-built drawings.
  19. Telephone and Signal System Raceways: Refer to Division 27 requirements.
  20. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate ground conductor across flexible connections. PVC externally coated rigid steel conduit: Patch all nicks and scrapes in PVC coating after installing conduit.
  21. Where conduits are to be installed through structural framing members, the Contractor shall provide sleeves. The Architect/Engineer's written approval must be obtained prior to cutting, notching or drilling of structural framing members.
  22. Ream the ends of all cut and/or threaded conduit. Ends shall be cut square.
  23. Use of running threads for rigid or intermediate metallic conduit are not permitted. When threaded couplings cannot be used, provide 3 piece union or solid coupling.
  24. Conduits shall not cross pipe shafts or ventilation duct openings. Where conduits must penetrate air-tight spaces or plenums, seal around the conduit with a mastic acceptable to the Architect/Engineer.
  25. Install an insulated ground conductor in all conduits.
  26. Where individual conduits penetrate existing fire-rated walls and floors, pack void around conduit with fire rated insulation and seal opening around conduit with UL listed foamed silicone elastomer compound. Where conduits penetrate exterior walls, new floors, or roof, provide pipe sleeve one size larger than conduit, pack void around conduit with fire rated insulation, and seal opening around conduit with UL listed foam silicone elastomer compound.
  27. Where conduit sleeves penetrate fire rated floors or walls for installation of system cables, AC or MC cables, or modular wiring cables pack void around cables or empty sleeve with fire rated insulation and fill ends with fire-resistive compound. Seal opening around sleeve with UL listed foam silicone elastomer compound.
  28. Provide separate raceway systems for each of the following:
    - a. Lighting
    - b. Power Distribution
    - c. Communications and Data
    - d. Fire Alarm
    - e. Temperature Control
  29. Paint new exposed conduits to match existing exposed conduits where installed in areas with existing painted conduits or where otherwise indicated.

- B. Install labeling as required in Division 26 section - "Electrical Identification".

#### 3.4 INSTALLATION OF SURFACE RACEWAYS AND WIREWAYS:

- A. Surface Raceways and Wireways: Mechanically assemble metal enclosures and raceways to form continuous electrical conductor and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.
  - 1. Where practicable, avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
  - 2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
  - 3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. Field bends of raceway sections are not permitted.
  - 4. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
  - 5. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc., are not permitted for use with surface raceway installations.
  - 6. Install an insulated grounding conductor in all wireways and surface raceways. Bond grounding conductor to all wireways and surface raceways.
  - 7. Paint new exposed surface metal raceway to match adjacent surfaces where raceway is installed in finished areas such as lobbies, corridors, and normally occupied spaces.
  - 8. Surface raceways and wireways are acceptable only where specifically indicated on the drawings. The proposed use of surface raceways and wireways shall be submitted for review by the Engineer prior to installation.
  - 9. Common wireways are not acceptable for convergence of multiple circuits unless specifically indicated on the drawings. The proposed use of a common wireway shall be submitted for review by the Engineer prior to installation.
  - 10. The proposed use of wireways above or below panelboards, switchboards, motor control centers, and other electrical equipment shall be submitted along with a layout drawing for review by the Engineer prior to installation.

#### 3.5 ADJUSTING AND CLEANING:

- A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt and construction debris.

END OF SECTION 260533



## SECTION 260534 – CABINETS, BOXES, AND FITTINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This section includes cabinets, boxes, and fittings for electrical installations and certain types of electrical fittings not covered in other sections. Types of products specified in this section include:
  - 1. Outlet and device boxes
  - 2. Pull and junction boxes
  - 3. Cabinets
  - 4. Hinged door enclosures for Control Boxes
- B. Conduit-body-type electrical enclosures and wiring fittings are specified in the Division 26 Section on Raceways.

#### 1.2 DEFINITIONS:

- A. Cabinets: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.
- B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.
- C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.
- D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.
- E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.
- F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or switches for controlling electrical circuits.

#### 1.3 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations for any control enclosures.
- C. Shop Drawings: Provide computer generated drawings floor boxes and boxes, enclosures, and cabinets that are to be shop fabricated (non-stock items). For shop fabricated boxes, show accurately scaled views and spatial relationships to adjacent equipment as well as field wiring. Show box types, dimensions, and finishes. Control panels shall include, but not be limited to; lighting and specialized fan.

## PART 2 - PRODUCTS

### 2.1 CABINETS, BOXES, AND FITTINGS, GENERAL:

- A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

### 2.2 MATERIALS AND FINISHES:

- A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.
- B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.
- C. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
- D. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

### 2.3 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES:

- A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.
- B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

### 2.4 NONMETALLIC OUTLET, DEVICE, AND SMALL WIRING BOXES:

- A. General: Conform to NEMA OS 2, "Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports" and UL 514C, "Nonmetallic Outlet Boxes, Flush Device Boxes and Covers." Boxes shall be molded PVC units of type, shape, size, and depth to suit location and application.
- B. Boxes for Concealed Work: Mounting provisions and wiring entrances to suit installation conditions and wiring method used.

### 2.5 PULL AND JUNCTION BOXES:

- A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.
- B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

- C. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.

## 2.6 CABINETS:

- A. Comply with UL 50, "Electrical Cabinets and Boxes."
- B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.
- C. Doors: Double doors for cabinets wider than 24 inches.
- D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

## 2.7 STEEL ENCLOSURES WITH HINGED DOORS:

- A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6, "Enclosures for Industrial Controls and Systems."
- B. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams. NEMA class as indicated; arranged for surface mounting.
- C. Doors: Hinged directly to cabinet and removable, with approximately 3/4 inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.
- D. Mounting Panel: Provide painted removable internal mounting panel for component installation.
- E. Enclosure: NEMA 1 except as indicated. Where door gaskets are required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use appropriate weatherproof raceway entrances.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL:

- A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.

- B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
- C. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
- D. Remove sharp edges where they may come in contact with wiring or personnel.

### 3.2 APPLICATIONS:

- A. Cabinets: Flush mounted, NEMA enclosure type 1 except as otherwise indicated.
- B. Hinged Door Enclosures Indoor: NEMA type 1 enclosure except as indicated.
- C. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
  - 1. Interior Dry Locations: NEMA Type 1.
  - 2. Locations Exposed to Weather or Dampness: NEMA type 3R.
- D. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

### 3.3 INSTALLATION OF OUTLET BOXES:

- A. Outlets at Windows and Doors: Locate close to window trim. For outlets indicated above doors center outlets above the door opening except as otherwise indicated.
- B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
- C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.
- D. Gasketed Boxes: At the following locations use malleable or cast metal, threaded hub type boxes with gasketed weatherproof covers:
  - 1. Where exposed to moisture laden atmosphere.
  - 2. At food preparation equipment within four ft. of steam connections.
  - 3. Where indicated.
- E. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles vertically, except above counter receptacles to be mounted horizontally. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side. Provide far side box supports, for electrical switch

boxes installed on metal studs and provide stud to stud support for electrical receptacle boxes installed on metal studs.

- F. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4 inches square by 1-1/2 inches deep, minimum.
- G. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.
- H. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.
- I. Existing Outlet Boxes: Where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.
- J. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6 inches in standard walls and 24 inches in acoustical walls.

#### 3.4 INSTALLATION OF PULL AND JUNCTION BOXES:

- A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8 inches square by 4 inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box. Quantities of conductors (including equipment grounding conductors) in pull or junction box shall not exceed the allowable limits of the NEC.
- B. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.
- C. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.

#### 3.5 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES:

- A. Mount with fronts straight and plumb.
- B. Install with tops 78 inches above floor.
- C. Set cabinets in finished spaces flush with walls.

#### 3.6 GROUNDING:

- A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.

#### 3.7 CLEANING AND FINISH REPAIR:

- A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, abrasions and weld marks.

- B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.
- C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 260534

## SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:
  1. Identification labeling for raceways, cables, and conductors.
  2. Operational instruction signs.
  3. Warning and caution signs.
  4. Equipment labels and signs.

#### 1.2 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.

#### 1.3 QUALITY ASSURANCE:

- A. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

### PART 2 - PRODUCTS

#### 2.1 ELECTRICAL IDENTIFICATION PRODUCTS:

- A. Identify System Raceways with Painted Couplings & Connectors: Provide painted couplings & connectors for all concealed raceways. Install painted couplings at all conduit connecting couplings including end couplings at stub outs. Apply the following colors:
  1. Normal Power: Unpainted
  2. Fire Alarm: OSHA Red
  3. BMS/Temperature Control: Blue
- B. Adhesive Marking Labels: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Power D.C., HVAC, Control, Fire).
  1. Label Size for Raceways: 1 inch high by 12 inches long (minimum) with 5/8 inch minimum height letters.
  2. Label Size for Boxes, Enclosures, and Utilization Equipment: See detail on electrical plans.
  3. 600 Volt and Below Normal: White letters on black background indicating source equipment designation, circuit number(s), and voltage.
  4. Fire Alarm: White letters on red background indicating "FIRE ALARM".
  5. Temperature Control: White or black letters on blue background indicating "TEMP. CONTROL."
  6. Ground: White or black letters on green background indicating "GROUND" and equipment and designation.

- C. Adhesive Marking Tape for banding Wires and Cables: Self-adhesive vinyl tape, not less than 3 mils thick by 1 inch to 2 inches in width. Make each color band completely encircling cables, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.
- D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- E. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engraved legend in white letters on black face for normal and white letters on red face for emergency, black letters on yellow face for UPS and punched for mechanical fasteners. Where required for ground connections, provide engraved legend in white letters on green face.
- F. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.
- G. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50 lb minimum tensile strength, and suitable for a temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color coding.
- H. Adhesive Marking Tape for Device Cover Plates: 3/8 inch Kroy tape or Brother labels with 3/16 inch minimum height letters. Tape shall have black letters on clear background for normal and red letters on clear background for emergency. Embossed Dymo-Tape labels are not acceptable.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
- B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- D. Conduit Identification: Label conduits with painted couplings and connectors concealed or with labels at 10 foot intervals (medium voltage or exposed) to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible. Labels for multiple conduits shall be aligned and read the same direction. Where conduits enter or exit a panelboard, pull or junction box, switchboard, or other distribution equipment, conduit labels shall include circuit number in addition to feeder identification and voltage. Use the colors as identified above:
- E. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system voltage and identity of contained circuits on outside of box cover.



Color code shall be same as conduits for pressure sensitive labels. Use self-adhesive marking tape labels at exposed locations and indelible black marker at concealed boxes. All fire alarm boxes shall have covers painted red. All temperature control boxes shall have covers painted blue.

- F. Circuit Identification: Tag or label conductors as follows:
1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
  2. Multiple Circuits: Where multiple branch circuits, control wiring or communications/signal conductors are terminated or spliced in a box or enclosure, label each conductor or cable with circuit number. For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
  3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- G. Apply warning, caution and instruction signs and stencils as follows:
1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
- H. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
    - a. Panelboards, electrical cabinets and enclosures
    - b. Access doors and panels for concealed electrical items
    - c. Motor Controllers
    - d. Control devices
    - e. Transformers
    - f. Fire alarm control panel
- I. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.
- J. For panelboards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.

- K. Tag all grounding electrode conductors, associated bonding conductors, and grounding conductors at their point of attachment to any ground bus and grounding electrode (where possible) with a 2 inch diameter round green phenolic nameplate. Lettering shall be 1/4 inch high with 1/5 inch between lines centered on the tag stating "DO NOT DISCONNECT," "MAIN GROUND." Nameplate shall attach to conductor with a short length of small chain.
- L. Install labels at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- M. Adhesive Marking Tape for Exposed Cables in Cable Tray: Make each color band completely encircling cables, at penetrations of walls and floors, at each junction box and at 20-foot maximum intervals in straight runs.
- N. Provide tape labels for identification of individual receptacles including receptacles in furniture systems and light switch wall-plates. Locate tape on front of plate and identify panel/branch circuit serving the receptacle. Provide tape labels for identification of individual switches or thermal overload switches which serve as equipment disconnects. Locate the tape on the front of the cover-plate and identify panel/branch circuit serving the equipment.

END OF SECTION 260553

## SECTION 260583 – WIRING CONNECTIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.
- B. Applications of electrical power connections specified in this section include the following:
  - 1. From electrical source to safety/control equipment
  - 2. From safety/control equipment to motors
  - 3. From motors to secondary controllers (if applicable)
  - 4. To ancillary devices and appurtenances (converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment)
  - 5. To grounding system
  - 6. Other connections as shown within the electrical drawings

#### 1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

#### 1.3 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials. As a minimum, information shall include: Operating Voltage; MCA (Min. circuit amperes); FLA (Full load amperes); MFS (Max. fuse size) or MOP (Max. overcurrent protection); and SCCR (Short Circuit Current Rating) and shall match electrical equipment and protection/distribution sizes and be rated for available short circuit currents as shown on the drawings.
- C. Shop Drawings: Provide wiring diagrams where specialized control is details on the plans. Indicate all devices and final enclosure sizes.
- D. Coordination Drawings: All mechanical and plumbing equipment shall be coordinated with unit nameplate information per the actual nameplate to be included on the equipment.
- E. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.

#### 1.4 DEFINITIONS:

- A. Load voltage wiring shall be defined as:

1. Conduit and wiring required to carry power to motors and other equipment or devices. Wiring from control devices to equipment that carry power to drive that equipment such as line voltage thermostats, etc., shall be included as load voltage wiring. Wiring that provides power to control panels, control transformers, control relays, time clocks, etc., shall also be included as load voltage wiring.

## PART 2 - PRODUCTS

### 2.1 GENERAL:

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Low Voltage Circuit Protective Devices, with OCPDs adapted to equipment connection installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.
- B. Provide motor controllers that are horsepower rated to suit the motor controlled.
- C. Contacts shall open each ungrounded connection to the motor. Contacts shall be NEMA rated, 75 degrees C.
- D. Overload relays shall be ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full load current of the specific motor to which connected with appropriate adjustment for duty cycle and power factor correction supplied with the motor.

### 2.2 MATERIALS AND COMPONENTS:

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, disconnect, starter, contactor, relays, etc., and other items and accessories as needed to complete splices and terminations of types indicated.
- B. Metal Conduit, Tubing and Fittings:
  1. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division 26 section on Raceways.
- C. Wires, Cables, and Connectors:
  1. General: Provide wires, cables, and connectors complying with Division 26 section on Wires and Cables.
  2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes, ratings, and material of wires/cables which are supplying electrical power.
  3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.
  4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, electrical solder, electrical soldering

flux, wire-nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

2.3 MANUAL MOTOR STARTERS:

- A. Manual starters shall be flush-mounting type except where conduits are run exposed or as otherwise noted. Manual starters shall be complete with properly sized overload protection and neon pilot light. Manual starters shall be Square D Class 2510 or Allen-Bradley Bulletin 600 with stainless steel plates.
- B. Heater units in all manual motor starters shall be sized for approximately 115 percent of full load motor current. Check and coordinate all thermal protective devices with the equipment they protect.

2.4 CIRCUIT AND MOTOR DISCONNECT SWITCHES:

- A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated. All equipment with maximum fuse size listed in nameplate shall have fusible disconnect switch provided. Provide NEMA 1 enclosure. For outdoor switches and switches indicated as weatherproof, provide NEMA 3R enclosures with rain-tight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.
- B. Fusible Switches: Provide UL type "HD" 100 percent duty rated switches, with fuses of classes and current ratings indicated. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses. All disconnect switches shall be fusible unless otherwise noted.
- C. Non-fusible Disconnects: Provide UL type "HD" 100 percent duty rated switches of classes and current ratings as indicated.
- D. Accessories:
  - 1. Handles shall be lockable in open and closed position without modification.
  - 2. Disconnect switches provided in the motor feeders between a VFD and the motor shall be provided with auxiliary contacts at the disconnect that de-energizes power to the VFD.

2.5 MOTOR STARTERS:

- A. See Division 23 for Requirements

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and provide notification in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Start of work constitutes acceptance of conditions.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS:

- A. Furnish, set in place, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, plumbing and fire protection, elevator, etc., motors and controls in accordance with the following schedule and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Mechanical Division of these Specifications.
- B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Maintain existing electrical service and feeders to equipment serving occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.
- E. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
- F. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torqueing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torqueing requirements are not available, tighten connectors and terminals to comply with NEC.
- I. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- J. Provide suitable strain relief clamps for cord connection to outlet boxes and equipment connection boxes.
- K. Make wiring connections in control panel or in wiring compartment of pre-wired equipment and interconnecting wiring in accordance with manufacturer's instructions.

- L. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated or per manufacturer's instructions.
- M. Provide each motor with a fused disconnect switch for 3 phase motors and horsepower rated and/or thermal rated disconnect switch for single phase motors as shown on schedules or required. Coordinate with manufacturers of standalone, packaged and other equipment for factory installed and field installed motors and controllers.
- N. Provide circuit and motor disconnect switches as indicated and where required by Code. Comply with switch manufacturers printed installation instructions. Install within sight of motors.
- O. All splices in control panels, terminal junction boxes, low voltage control circuits and fire alarm conductors shall be on numbered terminal strips.
- P. Each branch circuit serving dedicated, isolated or emergency receptacles, multi-outlet assemblies or equipment connections shall be furnished with a dedicated neutral conductor. Neutrals common to more than one circuit shall only be permitted where specifically noted.
- Q. Where conduit is not required, plenum rated cable shall be provided in ceiling, floor or other air plenum spaces.

### 3.3 FIELD QUALITY CONTROL:

- A. Provide all test results to Engineer in Substantial Completion Submittals, via Architect, prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.
- B. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

### 3.4 EQUIPMENT CONNECTION SCHEDULES:

- A. Mechanical Equipment:
  - 1. Refer to Mechanical Equipment Schedule on the drawings.
  - 2. It is suggested that all load voltage wiring shall be provided under Division 26.
  - 3. The exact furnishing and installation of the equipment is left to the Contractors involved. Comply with the applicable requirements of Division 26 for all electrical work which is not otherwise specified. Contractor shall refer to the Division 26 and Division 23 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.
- B. For factory pre-wired equipment specified under other Divisions, all wiring within the equipment shall be by the manufacturer. All required field wiring between sections or other field connection details for power and/or control shall be clearly identified on shop drawings for contractor installation. Division 26 drawings show the provided electrical characteristics for equipment.

- C. Manufacturer's equipment provided under other divisions which varies from what is shown on Division 26 drawings shall be the responsibility of the Contractor to complete and pay for any costs for those variations.
  - 1. Fire alarm system control modules and wiring from fire alarm contacts to fire alarm system shall be installed by Fire Alarm system installer and match other components of the system. Refer to Division 28.
- D. Refer to Schedule on drawings for information on Owner Furnished Equipment.

END OF SECTION 260583



## SECTION 260923 – LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. Lighting Controls shall be priced as part of Add Alternate #3. If alternate is not selected as a part of the Contract, Contractor shall provide local switches at all room entrances. Switch at primary room entrance shall have a 0-10V dimmer.
- B. Extent of lighting control equipment work is indicated by drawings and schedules, and is hereby defined to include, but not by way of limitation, dimming devices, programmable controllers, data equipment, relays, switches, control wiring, and ancillary equipment.
- C. Types of lighting control equipment specified in this section include the following:
  - 1. Digital Programmable Lighting Controls
  - 2. Sensors
  - 3. Manual Modular Dimming Systems
  - 4. Time controlled switches
  - 5. Emergency Shunt Relays
- D. Refer to other Division 26 sections for wires/cables, electrical boxes and fittings and wiring devices which are required in conjunction with lighting control equipment work.

#### 1.2 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Submit manufacturer's data on lighting control equipment and components.
- C. Shop Drawings: Submit layout drawings of lighting control equipment and components including, but not necessarily limited to, programmable controllers, dimming modules, switch packs, sensors, relays, and switches. In addition, show spatial relationship of lighting control equipment to other electrical equipment in proximity. Submit lists of compatible electronic drivers, by manufacturer and catalog number.
- D. Wiring Diagrams: Submit wiring diagrams for lighting control equipment and components showing control and interconnection wiring, including connections to equipment components and electrical power feeders. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed. Provide a voltage drop calculation for network cabling to verify EOL voltage compliance.
- E. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
- F. Operation and Maintenance Data: Furnish maintenance manuals which contain equipment cuts, operating instructions, troubleshooting procedures, and spare parts list

for equipment. Ensure manual includes operating instructions in addition to instructions for maintenance of the system's software package.

- G. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- H. Extra Materials: Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Relays / Power Packs: Equal to 5% of amount installed.
  - 2. Sensors: Equal to 5% of the amount installed for each type.

### 1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with lighting control equipment work similar to that required for this project.
- C. FCC Compliance: Comply with Part 68 of Federal Communications Commission Rules pertaining to telephone equipment registration by manufacturer.
  - 1. Provide telephone equipment with FCC labels indicating applicable FCC registration and numbering of equipment.
- D. Codes and Standards:
  - 1. Energy Code Compliance: Meet the requirements of the current edition of the IECC-International Energy Conservation Code. In addition, meet any additional requirements of the Local AHJ-Authority Having Jurisdiction.
  - 2. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to construction, installation of lighting control and communications equipment.
  - 3. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.
  - 4. UL Compliance: Comply with applicable requirements of UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide lighting control equipment and components which are UL-listed and labeled. Lighting control panels shall be UL 916 and UL 924 Listed.
  - 5. NEMA Compliance: Comply with applicable requirements of NEMA's Std. Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)."
  - 6. EIA Compliance: Comply with applicable requirements of Electronic Industries Association standards pertaining to telephone and electronic systems.

### 1.4 DELIVERY, STORAGE AND HANDLING:

- A. Deliver lighting control equipment and components in factory-fabricated type containers or wrappings, which properly protect equipment from damage.

- B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.
- C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

## PART 2 - PRODUCTS

### 2.1 DIGITAL PROGRAMMABLE LIGHTING CONTROLS:

- A. General: Provide factory-fabricated lighting control equipment and ancillary components of sizes, types, ratings and electrical characteristics indicated; consisting of programmable controllers, data equipment, networking modules, relays, switches, control wiring, dimming modules and/or interfaces to dimming systems, and interfaces to building management systems which comply with manufacturer's standard design, materials and components; and constructed in accordance with published product information for duty indicated, and as required for a complete and functional installation.
- B. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- C. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a programmable, system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.
- D. Programmable Lighting Controller Description: Programmable, unit with graphic display and programming of system status and to override relay status; and to display status of local override controls and diagnostic information.
  - 1. Interoperability:
    - a. Controller shall be configured to connect to a BACnet compliant network, resulting in extending control to any network-compliant devices such as occupancy/vacancy switches.
  - 2. System Memory: Nonvolatile. System shall reboot program and reset time automatically without errors after power outages up to 90 days' duration.
  - 3. Software: Lighting control software shall be capable of linking switch inputs to relay outputs, retrieving links, viewing relay output status, controlling relay outputs, simulating switch inputs, setting device addresses, and assigning switch input and relay output modes.
  - 4. Automatic Time Adjustment: System shall synchronize to real time through internet protocol, shall automatically adjust for leap year with manual time and date of adjustment selection, shall automatically adjust for daylight saving time with manual ON/OFF for this feature, and shall provide Time Controls utilizing 7 Day clock with minimum 7 different day times per week, and programmable auto Holiday "shutoff".

5. Astronomic Control: Automatic adjustment of dawn and dusk switching based on exterior photoelectric sensor control.
6. Automatic battery backup shall provide power to maintain program and system clock operation for 3 days' minimum duration when power is off.
7. Flick Warning: Programmable momentary turnoff of lights shall warn that programmed shutoff will occur after a preset interval. Warning shall be repeated after a second preset interval before end of programmed override period.
8. Diagnostics: When system operates improperly, software shall initiate factory-programmed diagnosis of failure and display messages identifying problem and possible causes.
9. Automatic Control: System capable of activating building areas into user dictated pattern of ON-OFF array of relays, according to either weekly schedule divided into one-minute increments, or two one-day schedules.
10. Automatic Control of Local Override: Automatic control shall switch lighting off if lighting has been switched on by local override. Utilize "Flick Warning".
11. Manual Controls: System capable of activating each lighting zone or single groups of relays ON-OFF with a momentary switch; Provide prioritization of manual controls.
12. Manual Lockout: System capable of selecting, activating and locking-in any lighting pattern from central controller, and locking-out manual and automatic commands.

E. Manual Switches and Plates

1. Switches: Provide momentary toggle type ON-OFF switches with spring return to center position; and as recommended by lighting systems manufacturer for services indicated. An integral pilot light shall indicate the status of circuit.
2. Dimmer Switches: Slide control dimmer and separate ON/OFF switch as recommended by lighting systems manufacturer for services indicated. An integral LED status light shall indicate the dimmed range.
3. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug Tail device connections are acceptable.
4. ELV dimmers shall be provided with booster module to control a minimum of 1,000W per switch.
5. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

- F. Relays: Provide relays for control of inductive loads of 20 amperes at 120-volts, 50 to 60 Hz, as recommended by lighting systems manufacturer for services indicated.

2.2 OCCUPANCY/VACANCY SENSORS:

A. Wall or ceiling-mounting, solid-state units with a separate relay unit.

1. Passive Infrared, Ultrasonic, Microphonic, or Dual Technology. Provide Dual Technology Devices unless otherwise shown. Spacing and coverage per the manufacturer's recommendations.
2. Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
4. Relay Unit: Dry contacts rated for 20-A ballast/driver load at 120- and 277-V ac.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

2.3 MANUAL MODULAR DIMMING SYSTEMS:

1. Factory-fabricated equipment providing up to 4 channels of manual dimming control as indicated. Common on-off switching and components grouped into a 2- or 3-gang wall box under a single flush wall plate.
2. System shall be listed for control of the type of lighting unit used.
3. Dimmers shall control lights smoothly over a range of 100 percent to 10 percent of full brightness without flicker or humming.
4. System shall be microprocessor-based, solid-state, with low-voltage control signals. Control panels shall adjust dimmer channel settings and command changes from any one preset scene to another. Displays at the control panel indicate dimmer settings for each channel for each scene.

2.4 AUTOMATIC LOAD CONTROL RELAYS (ALCR)/ EMERGENCY SHUNT RELAY UNITS (ESR):

- A. Self-contained ALCR/ESR units shall comply with and be listed under UL 924.
1. Operation: Normally-closed electrically-held relay to be wired in parallel with control switch/relay. Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Unless otherwise indicated ALCR/ESR shall control as follows:
    - a. Emergency luminaires shown in rooms with other switched luminaires (Not indicated "NL" (night light) and/or connected to an always on emergency circuit) provide ALCR/ESR to allow indicated control of all luminaires in space. Provide room controller or other devices necessary to accommodate dimming and other control equipment and requirements. Emergency lights in space shall be brought to full brightness from emergency circuit whenever the normal circuit serving the room loses voltage. Sensing from panelboard feeders is not acceptable; sensing shall be accomplished at the branch circuit level. Normal lighting and controls shall be restored automatically when normal power is available.
    - b. Egress lighting shall meet requirements of NFPA 101.
  2. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  3. LED Indicator Light: Indicates status of normal and emergency power.

2.5 PHOTOELECTRIC SENSORS:

- A. Outdoor Photoelectric Switch: Solid-state, light-level sensor unit to detect changes in lighting levels that are perceived by the eye.
1. Light-Level Monitoring Range: 1.5 to 10 fc with an adjustment for turn-on and turn-off levels within that range.
  2. Time Delay: 30 second minimum to prevent cycling, with dead-band adjustment.
  3. Surge Protection: Metal-oxide varistor, complying with IEEE requirements for Category A1 locations.

4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

### PART 3 - EXECUTION

#### 3.1 INSPECTION:

- A. Examine areas and conditions under which lighting control equipment is to be installed and provide notification in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Start of work constitutes acceptance of conditions.

#### 3.2 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

- A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with intent of design. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.
- B. Low voltage control wiring terminations shall be made within electrical boxes on numbered terminal strips.
- C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.
- D. Interconnect lighting control equipment with building management system, after lighting equipment installation work has been completed and is operating properly. Define groups in the lighting control system to interface with the building management system as indicated on the temperature control matrix.
- E. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A and B.
- F. Co-locate equipment as much as practical for ease of maintenance.

#### 3.3 GROUNDING:

- A. Provide equipment grounding connections for lighting control equipment as indicated. Tighten connectors to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounding.

#### 3.4 FIELD QUALITY CONTROL:

- A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Testing and retesting at no cost to Owner.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust all field-assembled components and equipment installation, including connections, and assist in field testing. Report results in writing with commissioning report.
  - C. Perform the following field tests and inspections for each piece of equipment and each device and prepare test reports:
    - 1. Test for circuit continuity.
    - 2. Verify that the control module features are operational.
    - 3. Check operation of local override controls.
    - 4. Test system diagnostics by simulating improper operation of several components selected by facilities.
  - D. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values and submit settings list with Testing and Equipment Settings Report. Provide current licenses for software in O&M manuals.
  - E. Testing and training shall be provided at times scheduled with the owner and may need to be done off hours.
- 3.5 PERSONNEL TRAINING:
- A. Manufacturer's Field Service indicated above shall include Owner's maintenance personnel.
  - B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software.
  - C. Provide extra scheduled time with owner to make corrections to the system to meet the functionality/time control requirements desired by the owner. Record any changes in the Testing and Equipment Settings Report and submit final documents.

END OF SECTION 260923

PAGE INTENTIONALLY LEFT BLANK



## SECTION 262200 – LOW VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This section includes general purpose and specialty dry type transformers and voltage regulators with windings rated 600 V or less.

#### 1.2 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Submit manufacturer's technical product data including rated kVA, frequency, primary and secondary voltages, percent taps, polarity, impedance and certification of transformer performance efficiency at indicated loads, percentage regulation at 100% and 80% power factor, no-load and full-load losses in watts, % impedance at 75 deg. C, hot-spot and average temperature rise above 40 deg. C ambient temperature, and sound level in decibels.
- C. Coordination Drawings: Provide wiring diagrams from manufacturer differentiating between manufacturer-installed and field-installed wiring.
- D. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.

#### 1.3 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of transformers of types and ratings required for this project, whose products have been in satisfactory use in similar service for not less than 5 years.

### PART 2 - PRODUCTS

#### 2.1 TRANSFORMERS, GENERAL:

- A. Transformers: Factory assembled and tested air cooled units of types specified, having characteristics and ratings as indicated. Units shall be designed for 60-Hz service.
- B. Cores: Grain oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
- D. Internal Coil Connections: Brazed or pressure type.

#### 2.2 GENERAL PURPOSE, DRY-TYPE TRANSFORMERS:

- A. Comply with NEMA Standard ST 20 "Dry-Type Transformers for General Applications."
- B. Transformers shall have the following features and ratings:
  - 1. Enclosure: Indoor, ventilated, drip proof.
  - 2. Insulation Class: 220 deg. C class

3. Insulation Temperature Rise: 80 deg. C maximum rise above 40 deg. C. for transformers serving receptacles in telephone and data equipment rooms, receptacles in Laboratories, and where specifically shown or otherwise noted.
  4. Windings:
    - a. 2-winding type, three phase transformers shall use one coil per phase in primary and secondary. Conductors shall be individually insulated, as small in size as possible, and transposed when necessary to minimize eddy current losses. The primary winding shall be of sufficient size to limit temperature rise to its rated value even with circulating 3rd harmonic current.
    - b. Provide copper or aluminum windings.
    - c. Windings shall be delta-wye with 30° lagging phase shift to match ANSI standard, unless noted otherwise.
  5. Sound Level: Minimum of 3 dB less than NEMA ST 20 standard sound levels for transformer type and size indicated when factory tested in accordance with that standard.
  6. Taps: For transformers 3 kVA and larger, full capacity taps in high-voltage winding as follows:
    - a. Greater than 25 kVA through and including 500 kVA: Six 2-1/2 percent taps, 2 above and 4 below rated high-voltage.
  7. BIL: 10kV for all windings.
  8. Secondary Neutral: Twice the ampacity of the secondary phase conductors.
  9. Core Flux Density: Maintained below saturation point to prevent core saturation caused by harmonics even with a 10% primary overvoltage.
  10. Efficiency: Comply with NEMA standard TP-1 and DOE Energy Efficiency standards.
  11. K-Factor: Unit shall be specifically designed to supply 100% of the 60 hertz fundamental rated current and 33% of the fundamental current as third harmonic, 20% of the fundamental current as fifth harmonic, 14% of the fundamental current as seventh harmonic, 11% of the fundamental current as ninth harmonic, and lower proportional percentages of the fundamental current thru the 25th harmonic. The transformers shall be marked with a label stating "Suitable for Non-Sinusoidal Current Load with K factor not to exceed 13 per UL Guide Specifications.
- C. Accessories: The following accessory items are required where indicated:
1. Surge Arresters: Low-voltage type, factory-installed and connected to low-voltage terminals; complying with NEMA Standard LA 1.
  2. Electrostatic shielding (where indicated): Insulated metallic shield between primary and secondary windings. Connect to terminal marked "shield" for grounding connection.
  3. Wall mounting brackets: Manufacturers standard brackets for transformers sized up to 75 kVA where wall mounting is indicated.
  4. Fungus Proofing: Permanent fungicidal treatment for coil core.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. Arrange equipment to provide adequate spacing for cooling air circulation.

- B. Identify transformers in accordance with Division 26 Section on Electrical Identification.
- C. Tighten electrical connectors and terminals in accordance with manufacturers published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A for copper and UL 486B for aluminum.
- D. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NESC, NEMA, ANSI and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.
- E. Install units on vibration mounts; comply with manufacturer's indicated installation method, if any. Vibration Isolators shall be Double Deflection Neoprene Mounts (DDNM) type if no recommendation is provided.

### 3.2 GROUNDING:

- A. Ground transformers and tighten connections to comply with tightening torques specified in UL Standard 486A.

### 3.3 FIELD QUALITY CONTROL:

- A. Provide all test results to Engineer in Substantial Completion Submittals, via Architect, prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.
- B. Tests shall conform to National Electrical Testing Association (NETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems," and the following:
  - 1. Procedures: Upon satisfactory completion of tests, attach a label to tested components.
  - 2. Schedule tests and notify Engineer/Architect at least one week in advance of schedule and of test commencement.
  - 3. Testing for transformers shall include verification of switching, protection, or control devices, insulation resistance test, taps verification, excitation test, and audible sound level tests.
  - 4. Provide tap voltage readings and adjust tap connections for appropriate secondary voltage. Include tap settings and voltage readings in test report.

### 3.4 ADJUSTING AND CLEANING:

- A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

### 3.5 PROTECTION:

Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendations within enclosure of each transformer throughout periods during which

equipment is not in a space that is continuously under normal control of temperature and humidity.

END OF SECTION 262200

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY:

- A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V or less.

1.2 DEFINITIONS:

- A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.3 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories. Include information for all overcurrent devices of dedicated feeders to panelboards and motors 1/4 HP or larger, as well as any panelboard main breakers.
  - 1. Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- D. Coordination Drawings: Wiring diagrams detailing schematic diagram including control wiring, and differentiating between manufacturer-installed and field-installed wiring.
- E. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.
- F. Record Documents: Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- G. Extra Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Panelboard Keys: Two of each different key.
  - 2. Touch-up Paint: Furnish one (1) half-pint container.

1.4 QUALITY ASSURANCE:

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS, GENERAL REQUIREMENTS:

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section on Overcurrent Protective Devices, with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multiple breakers shall have common trip.
- B. Enclosures: Flush or surface mounted cabinets as indicated. NEMA Type 1 enclosure, except where the following enclosure requirements are indicated. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide baked gray enamel finish over a rust inhibitor coating. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.
- C. Front: Hinged trim type, secured to box with 1/4-20-large head slotted captive screws except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified. Provide fronts with hinged trim construction and door with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges on inner door, piano hinge on outer trim door, and door swings as indicated.
- D. Directory Frame: Metal, mounted inside each panel door with card and clear plastic cover. Directory shall match panelboard configuration, i.e. top to bottom, left to right. Provide permanent panelboard labels for each circuit number.
- E. Bus Material: Provide tin plated hard-drawn copper of 98 percent conductivity.
- F. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductor's bonded to box.
- G. Provide lugs for incoming feeders and grounds compatible with bus and feeder material.
- H. Provide minimum short circuit current ratings as indicated.
- I. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

### 2.2 LOAD CENTERS:

- A. Load Centers are NOT acceptable for use on this project.

### 2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS:

- A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Where OCPDs are indicated to be circuit breakers, use bolt-on breakers except circuit breakers.

2.4 IDENTIFICATION:

- A. General: Refer to Division 26 Section on electrical identification for labeling materials.
- B. UL nameplates shall be provided for all panelboards. Information shall include, but not be limited to, manufacturer, model number, serial number, plant or manufacturing location, ampere rating, voltage rating, wire and phase identification and bus short circuit bracing rating.
- C. Provide arc flash warning labels in accordance with NFPA 70.
- D. Provide floor markings to clearly indicate required working clearances where indicated or where required by the authority having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.
- B. Mounting: Plumb and rigid without distortion of box.
- C. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing.
- D. Install filler plates in unused spaces.
- E. Feeders to multiple section panelboards, from Sub-Feed Lugs or Feed-Through lugs shall match the feeders to the panelboard.

3.2 GROUNDING:

- A. Connections: Make equipment grounding connections for panelboards as indicated.
- B. Provide new ground bus in rooms and bond to main electrical ground bus for continuity.

3.3 CONNECTIONS:

- A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 LOAD BALANCING:

- A. For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

### 3.5 FIELD QUALITY CONTROL:

- A. Provide all test results to Engineer in Substantial Completion Submittals, via Architect, prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.
- B. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
- C. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.
- D. Visual and Mechanical Inspection: Include the following inspections and related work:
  - 1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
  - 2. Exercise and perform of operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
  - 3. Check panelboard mounting, area clearances, and alignment and fit of components.
  - 4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
  - 5. Verify that proper grounding bushings/bonding/ and panel enclosure bonding is complete.
  - 6. Verify isolated neutral bar and neutral connections.
- E. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:
  - 1. Insulation resistance test of buses. Insulation resistance less than 100 megohms is not acceptable.
  - 2. Ground resistance test on system and equipment ground connections.
  - 3. Test main and sub-feed overcurrent protective devices in accordance with Section "Overcurrent Protective Devices."

### 3.6 CLEANING:

- A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marks of finish to match original finish.

END OF SECTION 262416



## SECTION 262726 – WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.
- B. Types of electrical wiring devices in this section include the following:
  - 1. Receptacles
  - 2. Ground-fault circuit interrupters
  - 3. Switches
  - 4. Dimmers
  - 5. Wall-plates
  - 6. Electronic Sensors
  - 7. Plugs and connectors

#### 1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.
- C. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
  - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code", Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

#### 1.3 SUBMITTALS:

- A. See Section 26 05 00 – Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations. Samples of device plates for color selection and evaluation of technical features shall be submitted with product data.
- C. Field Quality Control Test Reports: Refer to Section 26 05 00 – Common Work Results for additional requirements.
- D. Operation and Maintenance Data: Include detailed information on system operation, device programming and setup, replacement parts and recommended maintenance procedures and intervals. Refer to Section 26 05 00 – Common Work Results for additional requirements.

1.4 COORDINATION:

- A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.
- B. Cord and Plug sets: Match cord and plug sets to equipment requirements.

PART 2 - PRODUCTS

2.1 WIRING DEVICES:

- A. Color selection shall be verified with Architect/Engineer prior to ordering. Devices shall be Ivory.
- B. Receptacles:
  - 1. All duplex, single, Isolated Ground, Tamper Resistant, Ground Fault Interrupter (GFCI), and other special receptacles shall be minimum, specification grade commercial series, listed by Underwriter's Laboratories, UL 498 and Federal Specification FS W-C-596, 20 amp, nylon face and have a metal mounting strap with self-grounding and have a hex-head green grounding screw and be side and back wired. Each device shall bear the UL/FS Label. Meet NEMA standards for wiring devices including NEMA WD 1 for general requirements and NEMA WD 6 for dimensional standards. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug-tail device connections are acceptable.
  - 2. Convenience Receptacle Configuration: Duplex or Single as indicated on the drawings, Type 5-20R.
  - 3. Tamper Resistant Receptacles: Where indicated or required provide Duplex receptacle with integral switch and contacts to prevent energization unless a plug is inserted. Provide receptacles that are UL listed and labeled "TR".
  - 4. Ground-Fault Interrupter Receptacles: Where indicated or required provide "local reset" auto monitoring "self test" ground-fault circuit interrupters. Provide unit capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943. Provide visual indication of lost protection.
- C. Switches:
  - 1. Wall Switches for Lighting Circuits: NEMA WD1 and WD-6; FS W-S-896E; AC quiet type specification grade commercial series listed by Underwriter's Laboratories with toggle handle, rated 20 amperes at 120-277 volts AC, unless noted otherwise. Mounting straps shall be metal and be equipped with a green hex-head ground screw. Each switch shall bear the UL/FS Label.
    - a. Each device shall have terminal screws and clamps listed for use with stranded wire. Plug Tail device connections are acceptable.
    - b. Pilot Light Type: Where indicated, provide Lighted handle lit when switch is "on."
    - c. Locator Type: Where indicated, provided continuously lighted handle.
- D. Combination Devices: Provide UL listed heavy-duty quiet type switch, 20-amperes, 120-277 volts AC, with toggle switch handle, and 3-wire grounding receptacle, 20-amperes, 120- volts, in a common 4 inch square box.

1. LED Lamp Dimmers: Provide UL listed single-pole, full-wave semi-conductor modular type AC dimmers; wattage and voltage as indicated, and with electromagnetic filters to reduce noise, RF and TV interference to minimum. Provide for use with 0-10V LED Drivers. Provide with power failure memory. Construct with continuously adjustable trim potentiometer for adjustment of low dimming; and with anodized heat sinks. Provide 5-inch wire connecting leads.

## 2.2 WIRING DEVICE ACCESSORIES:

- A. Verify color and type with Architect/Engineer prior to ordering. Device color to match Wiring Device Color identified above.
- B. Wall Plates: Provide wall plates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Identify all wall plates used for receptacles with branch circuit number per requirements of section on Electrical Identification. Provide blank wall plates for all cable, data, telephone and junction and outlet boxes. Where cables are routed through the plate, provide grommets in opening to protect cables. Provide plates possessing the following additional construction features:
  1. Material and Finish: 0.04" thick, Nylon, smooth.
  2. Material and Finish: 0.04" thick, type 302 satin finished stainless steel for use in unfinished areas, mechanical, and electrical rooms.
- C. Telephone/Power Poles: Provide factory-assembled telephone/power poles of types, sizes and ratings indicated; for use with data, and power systems installed above suspended ceilings. Construct with provisions for two (2), 20-amperes, 125-volts, 3-wire duplex receptacles and four (4) Cat 6 data cables. Isolate power section from low voltage compartment with separating steel enclosure. Extend wiring from receptacles to junction box at top of pole where connections are made above suspended ceiling. Provide pole foot with carpet pad; provide ceiling trim plate. Provide finish treatment and color as selected by Architect/Engineer. The Tele-Power Poles must be UL Listed for field modifications, changes and additions of receptacles, devices, and circuits.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF WIRING DEVICES:

- A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.
- C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
- D. Install wiring devices after wiring work is completed.
- E. Install wall plates after painting work is completed.

- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.
  - G. Install telephone/power service poles in accordance with final furnishing arrangement. Poles shall be plumb, true, and secure.
  - H. Provide GFCI type outlets as required in NEC 210, including but not limited to: each above counter duplex receptacle shown within 6'-0" of sinks/lavatories; Bathrooms; Kitchens; Roof Tops; Outdoors; Indoor Wet locations; Locker Rooms; Shower Facilities; Garages; Service Bays; vending machines; etc.
    - 1. For above counter multi-outlet assemblies which do not contain duplex receptacles that can be replaced with GFCI devices, install GFCI circuit breakers on the branch circuit(s) feeding the assembly.
    - 2. Where GFCI devices are required and/or shown but are not readily accessible when equipment is installed, i.e. vending machines, etc., provide GFCI circuit breakers on the branch circuit(s) feeding the assembly.
  - I. Provide Tamper Resistant (TR) devices for all 120V, 15A and 20A, non-locking receptacles in areas accessible to the general public.
- 3.2 PROTECTION OF WALLPLATES AND RECEPTACLES:
- A. Upon installation of wall plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.
- 3.3 GROUNDING:
- A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.
- 3.4 CLEANING:
- A. Internally clean devices, device outlet boxes and enclosures. Replace stained, cracked, damaged or improperly painted wall plates or devices. Remove temporary markings of labels.
- 3.5 TESTING:
- A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained and prepare test reports. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.
    - 1. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices or similar problems.
    - 2. Tests for Convenience Receptacles:

- a. Line Voltage: Acceptable range is 114 to 126 V.
  - b. Ground Impedance: Values of up to 2 ohms are acceptable.
  - c. Polarity: Test for correct neutral conduct to neutral terminal connection.
  - d. Using the test plug, verify that the device and its outlet box are securely mounted.
  - e. GFCI Receptacles: Test for tripping values specified in UL 1436 and UL 943. Test with both local and remote fault simulations in accordance with manufacturing recommendations.
  - f. SPD receptacle indicating lights for normal indication check.
3. Test Instruments:
    - a. Use instruments that comply with UL 1436.
    - b. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Correct Deficiencies and Report:
1. Correct unsatisfactory conditions and retest to demonstrate compliance; replace devices as required to bring system into compliance.
  2. Correct malfunctioning units on-site, where possible and retest to demonstrate compliance; otherwise, replace with new units and retest.
  3. Prepare a report that identifies enclosure, units, conductors and devices checked and describe results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.

END OF SECTION 262726

PAGE INTENTIONALLY LEFT BLANK

## SECTION 262800 – ELECTRICAL CIRCUIT PROTECTIVE DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This section includes overcurrent protective devices (OCPD's) rated 600 volts and below, as well as switching devices commonly used with them.
- B. Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment, such as Panelboards and Switchboards are specified in other Division 26 sections.

#### 1.2 DEFINITIONS:

- A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.
- B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

#### 1.3 SUBMITTALS:

- A. See Section 26 05 00 Common Work Results for Electrical for Submittal requirements. Supplemental information is listed within this section.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section.
- C. 3<sup>rd</sup> Party Study/Report: Provide coordination study in accordance with ANSI/IEEE Standards where required to show proper coordination to the AHJ. Study shall include all Utility systems, overcurrent devices, transformers, buses, generator systems, grounding systems. etc., which comprises the AC power system, Bill of materials for devices and settings proposed shall be coordinated per the applicable sections of the current edition of the NEC, as required by the Authority Having Jurisdiction. Study shall be commissioned and paid for by the Contractor.
- D. Field Quality Control Test Reports: Submit record of testing as described below. Refer to Section 26 05 00 – Common Work Results for additional requirements.
- E. Extra Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type.

#### 1.4 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS:

2.1 OVERCURRENT PROTECTIVE DEVICES (OCPDS), GENERAL:

- A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, motor control centers, and other related equipment; and also as individually enclosed and mounted single units.
- B. Manufacturers: When mounting overcurrent protective devices in switchboards, switchgear, panelboards, MCC's, etc., provide equipment of same manufacturer as equipment into which they are being mounted.
- C. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."
- D. Where OCPD's are to be installed in existing panelboards, they shall be of the same manufacture and type as those existing in the equipment. If this is not possible, provide devices which are compatible with the existing equipment and when installed will not void the U.L. label or reduce the short circuit rating of the equipment.
- E. All overcurrent devices shall be individually rated for the available fault current unless otherwise noted. Series ratings of equipment will only be allowed where specifically called out.
- F. Ground Fault Circuit Interrupters: Where indicated, provide 1 inch wide module bolt-on panelboard circuit breakers, with integral ground-fault circuit interrupters, UL-rated Class A, Group 1; 20-amperes ratings, 2-pole construction, 120/240-volts, 60 Hz, 10,000 AIC. Provide units with solid-state ground-fault sensing and signaling, with 5 mA ground-fault sensitivity trip level, with accuracy of plus or minus 1 mA. Equip with PUSH-TO-TEST capability. Provide modules which mate and match panelboards in which they are located.

2.2 CARTRIDGE FUSES:

- A. General: Comply with NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.
- B. All fuses used for branch-circuit protection shall be Underwriters Laboratories listed, current-limiting fuses with 200,000 ampere interrupting rating and shall be so labeled. Fuses used for supplementary protection (other than branch circuit protection) shall be as specified or shall be U.L. approved or component recognized for such purposes. All fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or size of fuse, the engineer shall be furnished sufficient data to ascertain that system function will not be adversely affected.
- C. In order to simplify fuse replacement, reduce spare fuse inventory and insure adequate thermal protection, all fuses 600 amperes and below shall be true dual-element time-delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees F or less when subjected to a non-load oven test.
- D. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or other alloy not subject to stress cracking.



- E. Comply with UL Standards for Safety Plug Fuses. UL 198F
  - 1. Class L Fuses: Dual Element, Time Delay, 0-30A 125V S
  - 2. Edison Base Fuses: Dual Element, Time Delay, 0-30A 125V T

### 2.3 FUSIBLE SWITCHES:

- A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
- B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.
- C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.
- D. Operation: By means of external handle.
- E. Interlock: Prevents access to switch interior except when in "off" position.
- F. Provide rejection type fuse clips.
- G. Contacts shall be NEMA rated 75 degrees C.
- H. Provide fuses for safety switches and other equipment of classes, types, and rating needed to fulfill electrical requirements for services indicated.

### 2.4 MOLDED-CASE CIRCUIT BREAKERS:

- A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
- B. Construction: Provide bolt-in type compatible with existing equipment.
- C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating as indicated or required to match existing devices or equipment.
- D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole. Trip unit to be interchangeable within frame sizes for breakers 200 amperes or larger. Breakers 250 amperes and above shall have adjustable trip selection for trip units. All 120/208 volt rated breakers shall be rated and labeled "High Magnetic".
- E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values. Provide adjustable instantaneous trip devices for each circuit breaker supplying individual motor loads and where indicated.
- F. Enclosure for Panelboard Mounting: Suitable for mounting in equipment indicated.

### 2.5 OCPD ACCESSORIES:

- A. Provide adjustable-time-delay under-voltage trip devices where indicated.

- B. Lock-Out Devices: Provide padlocking provisions on each overcurrent protective device, lockable in the open or closed position. Provide 3 sets of lockout/tagout devices for each type of breaker or switch provided. Include tags, locks and all accessories necessary.

### PART 3 - EXECUTION:

#### 3.1 INSTALLATION:

- A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions. Install OCPDs level and plumb.
- B. OCPDs in new distribution and branch circuit equipment shall be factory installed. OCPD's in existing distribution and branch circuit equipment shall match existing for type and be provided with features as listed herein.
- C. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.
- D. All fuses for new disconnect switches feeding motors or motor starters shall be provided with Class J fuses.
- E. OCPDs and mounting accessories installed in existing equipment shall match the existing manufacturer and be rated for the available fault current.
- F. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
  - 1. Fire detection and alarm circuits.

#### 3.2 IDENTIFICATION:

- A. Identify components in accordance with Division 26 Section on electrical identification.
- B. Provide computer-generated circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.
  - 1. Description included on electrical panel schedules are for design purposes only. Description printed on final panel schedules must have a sufficient degree of detail that allows each circuit to be distinguished from all others, as approved by the Authority Having Jurisdiction.

#### 3.3 CONTROL WIRING INSTALLATION:

- A. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- B. Install wiring between OCPDs and control/indication devices.

#### 3.4 CONNECTIONS:

- A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance

with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING:

- A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL:

- A. Provide all test results to Engineer in Substantial Completion Submittals, via Architect, prior to scheduling Substantial Completion observations. Test results shall be tabulated to show name of tested device, measured value, expected values, acceptable standard deviation, and test conditions, as well as any miscellaneous variables that may be applicable to test being performed.
- B. Upon completing installation of the system, perform the following tests on all new equipment and existing equipment as indicated on the drawings:
  - 1. Visual and mechanical inspection: Include the following inspections and related work.
    - a. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters.
    - b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
    - c. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
    - d. Check tightness of electrical connections of OCPD's with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
    - e. Clean OCPD's using manufacturer's approved methods and materials.
    - f. Verify installation of proper fuse types and ratings in fusible OCPD's.
  - 2. Electrical Tests: Perform the following tests in accordance with manufacturer's instructions:
    - a. Insulation resistance test of fused power circuit devices, insulated-case, and molded-case circuit breakers, 600-ampere frame size and over at 1000 degree V D.C. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
    - b. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
    - c. Make continuity tests of circuits.
- C. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

- D. Activate auxiliary protective devices such as ground fault or under-voltage relays, to verify operation of shunt-trip devices.
- E. Check stored-energy charging motors for proper operation of motor, mechanism, and limit switches.
- F. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.

3.7 CLEANING:

- A. Upon completion of installation, inspect OCPD's. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 262800

SECTION 265000 – LIGHTING

PART 1 - GENERAL

1.1 SUMMARY:

- A. Extent, location, and details of lighting work are indicated on drawings and in schedules.
- B. Types of lighting in this section include the following:
  - 1. Light Emitting Diode (LED)

1.2 SUBMITTALS:

- A. See Section 26 05 00 – Common Work Results for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations for each luminaire listed on the plan "LUMINAIRE SCHEDULE". Include estimated useful life, calculated based on IES LM-80 test data.
- C. Design Data: Submit lighting calculations identified below for all products not listed first in the luminaire schedule and where otherwise noted.
  - 1. Interior: Provide isofootcandle(isolux) plot diagram of footcandles on horizontal workplane surface which shows composite values of illuminance projected from the arrangement of light sources from indicated luminaire locations and heights. Show on the graphic plots the locations, spacings and heights of luminaires. Indicate values of maximum, average, minimum, max:min ratios, and Lumen Maintenance factor utilized.
- D. Shop Drawings: For specialized areas; submit layout drawings of lighting and their spatial relationship to each other. In addition, submit luminaire cut sheets from the manufacturer. For standard products submit shop drawings; for non-standard products submit in booklet form with separate sheet for each luminaire, assembled by "luminaire type" with proposed luminaire and accessories clearly indicated on each sheet. Submit details indicating compatibility with ceiling grid system. Shop drawings shall detail luminaire dimensions, weights, methods of field assembly, mounting components, features and accessories. All features and accessories shall be clearly defined.
- E. Field Quality Control Test Reports: Refer to Section 26 05 00 – Common Work Results for additional requirements.
- F. Extra Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Drivers: Furnish stock or replacement drivers amounting to 5%, but not less than 2 of each type used in each type luminaire.
  - 2. Lenses: Furnish stock or replacement lenses amounting to 3%, but not less than one, of each type and size used in each type luminaire.
  - 3. LED Modules: Furnish replacement modules amounting to 3% of each type.
  - 4. Deliver replacement stock as directed to Owner's storage space.
- G. Operation and Maintenance Data: Include detailed information on system operation, device programming and setup, replacement parts and recommended maintenance

procedures and intervals. Refer to Section 26 05 00 – Common Work Results for additional requirements.

- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in owner's name and registered with manufacturer. The statement of warrantee shall be provided on manufacturer's letterhead.

### 1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with lighting work similar to that required for this project.
- C. Residential grade luminaires and luminaires sold by discount construction outlet stores that do not provide data on the same parameters as the specified luminaries will not be considered.

### 1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver lighting in factory-fabricated containers or wrappings, which properly protect luminaires from damage.
- B. Store lighting in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.
- C. Handle lighting carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

### 1.5 SEQUENCING AND SCHEDULING:

- A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting with other work.
- B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Luminaire Manufacturers: Subject to compliance with requirements, provide luminaires as listed in the luminaire schedule or elsewhere on the drawings or specification.
- B. All other manufacturers shall request prior approval and supply test data from an independent testing laboratory and comparison report to substantiate compliance with specifications and specified equipment.

2.2 EQUIPMENT:

- A. General: Provide lighting of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient lamps, lamp holders, reflectors, energy efficient ballasts, starters and wiring. Ship luminaires factory-assembled, with those components required for a complete installation. Design luminaire with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise and as to disconnect ballast when door is opened for HQI lamps.
- B. LED Boards:
1. Provide LED's that retain 70% of lamp life after 50,000 hours. LED's shall be binned to NEMA standard SSL 3-2010. Indoor luminaires shall have remote phosphors. The LED light assembly shall be replaceable separate from the luminaire housing. The LED driver shall be dimming where indicated on the drawings. The dimmer switch shall be compatible with the driver, unless otherwise noted.
    - a. Indoor luminaires shall have remote phosphor technology for "white" LED's.
    - b. All LED products to be in accordance with IES Standards LM79 & LM80.
    - c. Provide color variation within a 3-Step McAdams Ellipse (MAE).
- C. Electronic Drivers for LED Boards
1. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
  2. Drive Technology: As required to match module operating characteristics.
  3. Total Harmonic Distortion: Not greater than 20 percent.
  4. Power Factor: Not less than 0.90.
  5. Provide thermal protection with automatic reset.
  6. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
  7. Module Current Crest Factor: Not greater than 1.5.
  8. Module Starting Temperature: Capable of starting LED modules at a minimum of -22 degrees F.
  9. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
  10. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 18, for Class A, non-consumer application.
- D. Dimmable LED Drivers
1. Continuous dimming from 100 percent to five percent relative light output without flicker, unless dimming capability to lower level is indicated on plan sets.
  2. Control Compatibility: Fully compatible with the dimming controls to be installed.

### PART 3 - EXECUTION

#### 3.1 INSPECTION:

- A. Examine areas and conditions under which electric lighting is to be installed and provide notification in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Start of work constitutes acceptance of conditions.

#### 3.2 INSTALLATION:

- A. Install lighting at locations and heights as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fulfills requirements.
- B. Provide luminaires and/or outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Architect.
  - 1. Luminaires shall be positively attached to the suspended ceiling system. The attachment device shall have a capacity of 100% of the luminaire weight acting in any direction.
  - 2. When intermediate systems are used, No. 12 gauge hangers shall be attached to the grid members within 3" of each corner of each luminaire.
  - 3. When heavy-duty systems are used, supplemental hangers are not required if a 48" modular hanger pattern is followed. When cross runners are used without supplemental hangers to support luminaires, these cross runners shall provide the same carrying capacity as the main runner.
  - 4. Luminaires weighing less than 56 pounds shall have, in addition to the requirements above, two No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.
  - 5. Luminaires weighing 56 pounds or more shall be supported directly from the structure above by four No. 12 gauge hangers connected from the luminaire housing to the structure above. These wires may be slack.
- C. Install flush mounted luminaires properly to eliminate light leakage between frame and finished surface.
- D. Provide plaster frames for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.
- E. Fasten luminaires securely to structural supports; and ensure that pendant luminaires are plumb and level. Provide individually mounted pendant luminaires longer than 2 feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum one inch vertical adjustment. Mount continuous rows of luminaires with an additional stem hanger greater than number of luminaires in the row.
  - 1. Pendant hung luminaires shall be supported directly from the structure above with No. 9 gauge wire or approved alternate support without using the ceiling suspension system for direct support.
  - 2. Luminaires mounted in areas of high seismic activity shall be mounted from a rigid stem to restrain sway. If mounted from a non-rigid stem, luminaires to be



mounted such that their sway under seismic conditions does not impact another luminaire within 45° swing from center line.

- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A and 486B, and the National Electrical Code.
- G. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box stud.
- H. Set units plumb, square, level and secure according to manufacturer's written instructions and shop drawings.

### 3.3 ADJUSTING AND CLEANING:

- A. Clean lighting of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses and reflectors.
- B. Protect installed luminaires from damage during remainder of construction period.

### 3.4 GROUNDING:

- A. Provide equipment grounding connections for lighting as indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.
- B. Ground luminaires according to Section 260526, "Grounding,".

### 3.5 WARRANTY

- A. The Contractor shall guarantee all equipment including drivers, light engines, luminaires, wiring, etc. free from inherent mechanical and electrical defects. Warranty period shall be from date of acceptance as set forth in the general conditions with periods as follows:
  - 1. LED and Driver – Five year manufacturer's warranty.

### 3.6 DEMONSTRATION:

- A. Upon completion of installation of lighting and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 265000

PAGE INTENTIONALLY LEFT BLANK

SECTION 265200 – EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY:

- A. Types of emergency luminaires in this section include the following:

1. Exit Signs

1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of emergency luminaires and equipment of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with emergency lighting work similar to that required for project.

1.3 SUBMITTALS:

- A. See Section 26 05 00 – Common Work Results for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, colors, and configurations.
- C. Shop Drawings: Submit shop drawings in booklet form with separate sheet for each luminaire, assembled in luminaire "type" alphabetical, or numerical order, with proposed luminaire and accessories clearly indicated on each sheet.
- D. Field Quality Control Test Reports: Refer to Section 26 05 00 – Common Work Results for additional requirements.
- E. Extra Materials: Furnish the following for Owner's use in maintenance of project.
1. Drivers: Furnish stock or replacement battery-backed drivers amounting to 3%, but not less than 2 of each type used in each type luminaire.
- F. Operation and Maintenance Data: Include detailed information on system operation, device programming and setup, replacement parts and recommended maintenance procedures and intervals. Refer to Section 26 05 00 – Common Work Results for additional requirements.

1.4 DELIVERY, STORAGE AND HANDLING:

- A. Handle emergency lighting carefully to prevent damage, breaking, and scoring. Do not install damaged luminaires or components; replace with new.
- B. Store in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

## PART 2 - PRODUCTS

### 2.1 EMERGENCY LIGHTING:

- A. General: Provide lighting of sizes, types and ratings indicated; complete with, but not limited to, housings, lamps, lamp holders, reflectors, drivers, starters and wiring.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid state control shall automatically switch light source to integral battery power. Upon restoration of power, units shall return to normal power and batteries shall automatically recharge.

### 2.2 EXITS SIGNS:

- A. General: Provide self-contained unit, internally illuminated with LEDs. Listed and labeled as complying with UL 924. Single or double face as indicated on the drawings with chevrons indicating the direction of egress according to architectural plans.
- B. Provide power status indicator light and accessible, integral test switch to manually activate emergency operation.

## PART 3 - EXECUTION

### 3.1 INSPECTION:

- A. Examine areas and conditions under which emergency lighting is to be installed and provide notification in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Start of work constitutes acceptance of conditions.

### 3.2 INSTALLATION OF EMERGENCY LIGHTING UNITS:

- A. Install emergency lighting units at locations and heights as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fulfills requirements.
- B. Coordinate with other electrical work as appropriate to properly interface installation of emergency lighting with other work.

### 3.3 ADJUSTING AND CLEANING:

- A. Clean emergency lighting of dirt and debris upon completion of installation.
- B. Protect installed units from damage during remainder of construction period.

### 3.4 GROUNDING:

- A. Provide equipment grounding connections for emergency lighting as indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.5 FIELD QUALITY CONTROL:

- A. Upon completion of installation of emergency lighting and after building circuitry has been energized with normal power source, apply electrical energy to demonstrate capability and compliance with requirements. Test emergency lighting to demonstrate operation under emergency conditions. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.6 WARRANTY:

- A. The Contractor shall guarantee all equipment including ballasts, lamps, luminaires, wiring, etc. free from inherent mechanical and electrical defects for three (3) years. Warranty period shall be from date of acceptance as set forth in the general conditions.

END OF SECTION 265200

PAGE INTENTIONALLY LEFT BLANK