

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Access Panels
 - 3. Common electrical installation requirements.

1.3 DEFINITIONS

- A. Code. National, State and Local Electrical codes including OSHA requirements.
- B. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- E. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- F. Home Run: The portion of a branch circuit between the serving panelboard and the first electrical outlet, lighting fixture, or other electrical load connected to the circuit.
- G. Low voltage: 50 to 600 volts.
- H. Medium voltage: 601 to 35,000 volts.
- I. Provide. Furnish, install and wire ready for service.
- J. Signal voltage. NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.

1.4 SCOPE

- A. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work

may not be specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

- B. It is the intent that these Specifications and associated Drawings establish minimum requirements for products and equipment with the intent to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail that is not shown or specified, but necessary for proper installation and operation shall be included in the work and in these Contractor's estimates, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.
- C. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall be provided as if expressly required on both.
- D. It is the requirement of these Contract Documents to have the contractors provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall include in their bid the specific components or subsystems with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 20 deg F (minus 7 deg C) or exceeding 120 deg F (49 deg C).
 - 2. Humidity: Less than 95 percent (noncondensing).
 - 3. Altitude: Not exceeding 3300 feet (1000 m).

1.6 MODIFICATIONS IN LAYOUT

- A. Drawings are intended to outline the scope of work required and are not intended to be installation drawings. Drawings are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component nor do they show the exact routings. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational, nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. Unless specifically stated to the contrary, no measurement of an electric drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the electric drawings are subject to measurements of adjacent and previously completed work. Measurements shall be performed prior to the actual installation of equipment.

- C. Prior to installation of visible material and equipment (including access panels) in finished spaces, review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- D. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21 through 28 will be installed.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades. Systems shall be run parallel with or perpendicular to major architectural and structural building elements.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of equipment and raceways:
 - 1. To maintain maximum headroom; all piping, duct, conduit and associated components to be as tight as possible to underside of structure to provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 2. To allow right of way for piping installed at required slope.
 - 3. To allow connecting raceways, cables, wireways, cable trays, and busways to be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

1.8 COORDINATION DRAWINGS

- A. When included as part of the Contract Documents, there shall be full cooperation and coordination of all specialty trades.
- B. This Division's contractors shall comply fully with the requirements set forth in the Division 23 Section "Coordination Drawings" specification section.

1.9 RECORD DOCUMENTS

- A. Record Drawings are specified in Division 01 Section "Project Record Documents."
- B. The Contractor shall keep a detailed up-to-date record, of the manner and location in which installations are actually made, indexing each feeder, pull box and protective device. Record documents are to reflect all changes in work including change orders, field directives, addenda from bid set of Contract Documents, request for information responses, etc. Upon completion of the project, the contractor shall modify the project electronic drawing and specification files to incorporate this information. Modified documents shall be turned over to the Owner in both electronic and hard paper copy formats. Record drawings shall also include:

1. Locations of buried conduit or similar items. Include buried depth.
2. Field changes of dimension or detail.
3. Details not on original contract drawings.
4. Changes to circuit numbers.
5. Junction box locations and conduit runs, with trade sizes indicated, for lighting, power, and electrical systems installed.
6. Final panel schedules on drawings matching construction document drawing size.

1.10 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

- A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in a coordinated manual using loose leaf sheets in a three ring binder(s). Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment.
- B. The manuals shall include the following and shall have an index of contents and tabs for each Specification Section and each piece of equipment specified in that Section and be provided in the order listed below, per Specification Section.
 1. Copies of all approved submittals/shop drawings.
 2. Manufacturer's operating and maintenance instructions and parts lists of all items or equipment. Where manufacturer's data includes several types or models, the applicable type or model shall be clearly designated.
 3. Startup and shutdown procedures.
 4. Test records.
 5. Wiring diagrams.
 6. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment.
 7. Owner's written acknowledgement of satisfactory completion of instruction period.
- C. Furnish three copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- D. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of all systems. Factory-trained personnel shall perform instructions.
- E. Submittal Procedure and Format
 1. This Paragraph supplements Division 01.
 2. Submittal Cover Sheet
 - a. Submittal data for each product shall include a copy of the following cover sheet completely filled out. Incomplete or incorrect cover sheet submittal shall constitute reason for rejection.
 - b. Shop drawings/submittals shall be submitted according to applicable specification section's requirements with a separate cover sheet completed for each product, rather than one cover sheet for multiple products, whether or not supplied by one manufacturer or vendor.

SHOP DRAWING COVER SHEET				
PROJECT:		CONTRACTOR:		
DIVISION NO.:		SECTION NO.:		
DESCRIPTION:				
CONTRACT DRAWING REFERENCE NO:				
EQUIPMENT TAG:				
SUBMISSION (CIRCLE ONE): FIRST, SECOND, THIRD, FOURTH				
DATE:				
INFORMATION AND CHECKLIST				
1.	Contractor's Log #ID			
2.	Name, address, and phone number of supplier.			
3.	Are all specified or scheduled items included and exactly match scheduled/specified items?	Yes	No	
4.	Is this item a substitution?	Yes	No	
5.	Are deviations clearly identified?	Yes	No	
6.	Does equipment fit space shown on construction documents, coordination drawings, and actual field conditions?	Yes	No	
7.	Has support, erection, weights, and installation been coordinated with all trades?	Yes	No	
8.	Does the proposed installation void warranties and/or violate UL or code requirements?	Yes	No	
9.	Does this material/equipment add expense to any other trade or project costs?	Yes	No	
10.	Does equipment require interface with other trades? List divisions and specifics requiring coordination?	Yes	No	
11.	Is control interface coordinated?	Yes	No	
12.	List electrical characteristics (V/Ph/A)			

3. Multiple Re-submittals: The Engineer will review the first submittal from the contractor and respond with comments, and will review one re-submittal for the same item(s) from the contractor and respond with comments. If the contractor is required to make

subsequent submittals for the same item(s) the Engineer shall be compensated by the contractor for the time to review each subsequent re-submittal. The contractor shall agree to compensate the Engineer a minimum of \$500 per each re-submittal item.

4. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4 inches = 1 foot 0 inch scale unless specified otherwise.
5. Shop drawings and submittals showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
6. Provide shop drawing submittals showing details of piping connections to ALL equipment. If connection details are not submitted and connections are found to be installed incorrectly in the field, this contractor shall reinstall them within the original contract price.
7. Shop drawings for different systems and equipment shall be bound separately by specification section as indicated above and not bound by manufacturer. Each separate submittal shall have its own transmittal and cover letter. Submittals which contain different specification section systems bound together shall be returned un-reviewed for re-submittal.
8. Lighting Fixture shop drawings shall have all associated light fixtures included. Separate submittals grouped by manufacturer or supplier shall not be accepted. The contractor shall be responsible for coordinating drawings from his various suppliers in order to comply with this requirement.

1.11 QUALITY ASSURANCE

A. Acceptable Manufacturers

1. The Engineer's design for each product is based on the manufacturer listed in the schedule or shown on the drawings. In Part 2 of some technical specifications, other manufacturers are listed as being acceptable. The listing of a manufacturer as acceptable does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. These are acceptable only if, as a minimum, they:
 - a. Meet all performance criteria listed in the schedules and outlined in the specification.
 - b. Have identical operating characteristics to those called for in the specification. For example, a two-stroke diesel generator will not be acceptable if a four-stroke model is specified.
 - c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the contractor.
 - d. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.

- B. All equipment shall be labeled or listed by the National Board of Underwriters Laboratories (U.L.) or other recognized listing/testing agency where such labeling or listing exists for such material.
- C. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Skid-mounted or packaged assemblies shall be listed and labeled as an assembly, not just the individual components.

1.12 UTILITY CHARGES

- A. The contractor shall be responsible for costs from electric utility company that are assessed the Owner for the installation of the permanent electric service. It is the responsibility of the contractor to obtain those costs from the utility company and include them in their bid.

1.13 TEMPORARY CONSTRUCTION POWER

- A. Provide temporary lighting and construction power for the project. Pay the usage charges to the serving utility for electric service associated with temporary lighting and power for construction.

B. CONTINUITY OF UTILITY SERVICES

1. In the absence of specific requirements in Division 01, comply with the following procedures for shut-downs.
 - a. Provide temporary services where project construction schedule requires extended shut downs of existing equipment and/or systems. Temporary services include the necessary equipment and/or systems to maintain continuity of services. Extended shut downs are interruptions of existing services for a period of time longer than that acceptable to the Owner.
 - b. Contractor shall coordinate any shutdowns of existing systems as follows:
 - c. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days is required.
 - d. Minimize timeline of shutdowns of any system.
 - e. Provide temporary services where required and perform shutdowns and tie-ins at a time convenient to Owner.
2. Contractor shall be responsible for completing and filing the Owner's shutdown notice questionnaire.
3. Perform required survey and inspection work required by the notice for shutdown.
4. All life safety systems shall be returned to service at the end of each work day, when work is being performed on the systems. It is the responsibility of the Contractor to provide all associated appurtenances necessary to ensure that the systems are in proper working condition at all times.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment/materials from damage during shipping, storage, handling and installation. Delivery equipment/materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

- B. The Contractor shall provide for enclosed storage, when equipment/materials are stored on-site and prior to building "dry-in", to prevent any damage resulting from inclement weather or construction traffic. Specialties shall not be stored outdoors.
- C. Equipment/materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional expense. Do not store equipment with PVC material with exposure to direct sunlight.

PART 2 - PRODUCTS

2.1 CEILING ACCESS AND ACCESS PANELS

- A. Access panels are generally not shown on the drawings, but they are required to be provided by Contractor.
- B. Access panels shall be of size required to provide adequate access to equipment. Minimum size shall be 12" X 12" for hand access or 24" X 24" for body access. Minimum 16 gauge frame, not less than 18 gauge hinged door panel. Door locks shall be screwdriver operated for panels in general location applications and shall be key locked for public area applications.
- C. Furnish access panels for installation under other Sections valves or other items installed under this Division require access and are concealed in floor, wall, furred space or above ceiling. Access panels shall be by Milcor, Knapp, Nystorm or Inland Steel; coordinate selection with other Sections supplying similar access panels. Color of panel shall be selected by the Architect.
- D. Panels shall include concealed hinges, cam type locking devices, and shall have a frame border type necessary for the particular wall or ceiling construction in which they are installed. Access panels shall be flush mounted, recessed frame type units. Access panels shall be prime coated steel, for field painting for general applications and stainless steel for use in toilet rooms, shower rooms, and similar wet locations.
- E. Access panels shall have same fire rating classification as surface penetrated. Rated access panels must have UL Label.

PART 3 - EXECUTION

3.1 PRE-BID SITE VISIT

- A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this division. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.
- B. Contractor shall visit job site to familiarize himself with the specific location of the new equipment installations in existing areas, to ensure there is adequate access for the installation of equipment. All entries, pathways, corridors, stairwells, etc., that may be used to install equipment shall be investigated. All existing conditions and potential obstructions that may impede access and installation shall be addressed prior to equipment purchasing/ordering.

- C. The documentation of existing conditions was derived from As-Built documents and are in part unverified. Actual existing conditions shall be verified prior to commencement of work.

3.2 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.3 PAINTING

- A. Furnish one can of aerosol-free touch-up paint for each different color factory finish which is to be the final finished surface of the product.

3.4 CLEANING

- A. Cleaning shall be performed prior to equipment being energized.
- B. Raceways:
 - 1. General:
 - a. Cover all raceway openings prior to the installation of conductors to prevent dirt, moisture, and other debris from entering the raceways.
 - b. Before pulling conductors, swab out all raceways to remove any debris that may have entered raceways during construction or during storage.
 - c. When external surfaces of raceways or enclosures are rusted, clean and restore surfaces to original condition.
 - 2. Equipment:
 - a. After completion of work but prior to turning equipment over to the Owner, clean the exterior surfaces to be free from concrete residue, dirt, paint residue, etc.
 - b. All dirt, drywall dust, and all other foreign matter shall be blown from, wiped away, or vacuumed from transformer coils, terminal devices, panelboard interiors, switchboard interiors, junction boxes, pullboxes, and other similar equipment enclosures.

- c. Thoroughly clean equipment of all stains, paint spots, dirt, and dust. Remove all temporary labels not used for instruction or operation and remove all visible trade labels.

END OF SECTION 260500

SECTION 260510 - SELECTIVE ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Disconnection of power to selected portions of building or structure.
 - 2. Demolition and removal of selected electrical components.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Division 01 Section "Cutting and Patching."
 - 2. Division 02 Section "Selective Structure Demolition" for sequencing and scheduling procedures and requirements for demolition activities.

1.3 JOB CONDITIONS

- A. Perform all demolition as needed to accomplish new work.
- B. Do not rely solely on electrical drawings to determine extent of general construction demolition. Refer to architectural demolition plans for the exact extent of general construction demolition required by this contract.
- C. This Contractor is responsible for all charges, fees etc. incurred as a result of the electrical portion of the demolition.
- D. Prior to demolition or alteration of structures, the following shall be accomplished:
 - 1. Review available record documents of the existing construction. Owner does not guarantee that existing conditions are same as those indicated in record documents.
 - 2. Coordinate sequencing with Owner and other Contractors.
 - 3. Coordinate means to separate construction zones from non-renovated zones to prevent the spread of dust, fumes and debris.
 - 4. Coordinate means to provide exhaust and makeup air to maintain the construction zone at an adequate negative pressure to contain all construction dust and fumes.
 - 5. Except as noted otherwise, remove from the premises, all materials and equipment removed in the demolition work.
 - 6. Equipment noted to be removed and turned over to the Owner, shall be delivered to the Owner at a place and time he so designates.
 - 7. Where the materials are to be turned over to the Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain the condition of the

- materials and equipment equal to that existing before work began. Damaged materials or equipment shall be repaired or replaced at no additional cost to the Owner.
8. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore existing facilities to their pre-demolition condition, at no additional cost to Owner.
 9. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.1 PREPARATION

- A. Survey existing conditions and correlate with requirements indicated to determine the extent of selective demolition required.
- B. Refer to demolition drawings of other trades. Where motors, control panels, and other loads that have an electrical connection are being removed, include the disconnection and removal of associated electrical feeds, circuits, and loose control equipment in this contract.
- C. Protect existing work to remain in place, to be reused, or to remain property of Owner.
- D. Protect existing services and utilities.
- E. Disconnect electrical systems in walls floors and ceilings scheduled for removal.
- F. Coordinate utility service outages with serving utility company.
- G. Provide temporary wiring and connections to maintain existing circuits in service during construction.

3.2 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Beginning of demolition means installer accepts existing conditions.
- B. Existing electrical equipment in conflict with new construction shall be removed and/or relocated as indicated on the drawings, as directed or needed. This Contractor shall remove all electrical equipment released from service as a result of construction, and no equipment removed shall be reused, except as specifically directed on the drawings or elsewhere herein. All mechanical components shall be stored on site for Owner assessment. Any components not retained by the Owner shall be removed by the contractor. Properly dispose or remove from site any items not retained by Owner.
- C. Any existing services or equipment not shown on the drawings and which are logically expected to be continued in service and which may be interrupted or disturbed during construction, shall be reconnected in an approved manner. Provide temporary power connections, lighting, controls, etc., as needed to prevent interruption of service to occupied areas caused by

demolition operations. In addition, any conduit, wiring, fixtures, or equipment which may require relocation or rerouting as a result of construction, shall be considered a part of the work of this section and shall be done by this Contractor with no additional compensation, provided that the referenced relocation is discernable from the pre-bid review of the site, and associated documents.

- D. Verify circuiting arrangements are as shown on Drawings.
- E. Verify that abandoned wiring and equipment serve only abandoned facilities.
- F. Report discrepancies to Architect before disturbing existing installation.
- G. De-energize, disconnect, demolish, and remove electrical systems, equipment, raceways, wiring, and components indicated to be removed.
- H. Conduit to Be Removed: Remove portion of piping indicated or specified to be removed. In general, all empty raceways and associated supporting devices shall be removed back to nearest active junction box, panelboard, switchboard, panel cabinet, or other similar enclosure.
- I. Conductors to be Removed: Unless specifically stated elsewhere, all un-terminated conductors shall be de-energized, and all de-energized conductors shall be removed back to source.
- J. Equipment to be Removed, Including Panelboards and Distribution Equipment: De-energize, disconnect associated raceways and wiring, and remove equipment.
- K. Equipment to Be Removed and Reinstalled: De-energize, disconnect associated raceways and wiring, and remove equipment. Clean equipment and store where appropriate, reinstall, reconnect, and make equipment operational. Test equipment and associated components in accordance with the appropriate specification section.
- L. Equipment to Be Removed and Salvaged: De-energize, disconnect associated raceways and wiring, and move equipment to on site storage area as designated by the Owner.
- M. Any unused conduit openings in junction boxes, panelboards, switchboards, panel cabinets, pull boxes, or other similar enclosures shall be covered in a code approved manner.
- N. Update any electrical circuit directories or breaker identification nameplates to reflect changes in the status of overcurrent devices resulting from demolition.
- O. Disconnect and remove abandoned luminaires. Remove brackets, stands, hangers, and other accessories.
- P. Contractor shall check the ballasts of light fixtures removed from service. If any ballasts contain PCB's those ballasts shall be stored on site in containers and in a manner approved by local authorities and the Environmental Protection Agency. The contractor shall not be responsible for disposal of ballasts that contain PCB's
- Q. Notify Architect of location and extent of existing piping, conduit, OR equipment that interferes with new construction. In coordination with and with approval of Architect, relocate conduit and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned conduit and equipment as directed by Architect. Dispose of or store items as requested by Architect.
- R. Outlet boxes being abandoned in existing walls in remodeled areas shall have opening patched to match existing wall finish. Blank covers are not acceptable.

- S. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- T. Maintain continuity of circuits that remain in service.
- U. During the demolition and alterations, the fire alarm system, exit lighting and corridor life safety lighting shall remain active.
- V. Existing conduit and wiring in remodeled area that is not being removed, but which will be in conflict with new HVAC duct work being installed, shall be rerouted as required.
- W. This Contractor shall provide required additional support for existing conduit in remodeled area that is not being removed and is not properly supported in accordance with NEC requirements.
- X. When existing ductwork, piping, or related equipment in remodeled areas prevents the installation of other work, remove and reinstall existing materials, making necessary modifications and transitions to coordinate with other trades.

3.3 CLEANING AND REPAIR

- A. Clean existing materials and equipment which remain or are to be reused. Report damage or defects to Architect
- B. Existing Panelboards: Clean exposed surfaces and check tightness electrical connections. Provide closure plates for vacant positions.
- C. If equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. Repair adjacent construction and finishes damage during demolition and extension work.
- E. Luminaires: Clean existing luminaires shown to be reused. Use mild detergent to clean interior surfaces and visible exterior surfaces; rinse with clean water and wipe dry. Replace lamps. Energize fixtures. Notify Architect of fixtures with faulty components.

END OF SECTION 260510

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

SUMMARY

- B. This Section includes the following:
 - 1. Building wires and cables rated 600V and less.
 - 2. Connectors, splices, and terminations rated 600V and less.

ACTION SUBMITTALS

- C. Product Data: For each type of product indicated.

INFORMATIONAL SUBMITTALS

- D. Field quality-control test reports.

QUALITY ASSURANCE

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NFPA 70.

PROJECT CONDITIONS

- G. Wire and cable routing where shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- H. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. General Cable Corporation.
 - 2. Senator Wire & Cable Company.
 - 3. Southwire Company.
 - 4. AFC Cable Systems, Inc.
- B. Copper Conductors: Comply with NEMA WC 70. Aluminum not permitted.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN/THWN, XHHW-2 and SO.
- D. Multiconductor Cable: Comply with NEMA WC 70 for Type MC and Type SO with ground wire.

METAL CLAD CABLE

- E. Type MC.
- F. Conductor: Solid copper
- G. Jacket: Steel or Aluminum
- H. Minimum Conductor Size: 12 AWG for lighting and power circuits; #16 for fire alarm. Grounding conductor shall be same size as current carrying conductors contained in the cable assembly.
- I. Insulation: Type THHN.
- J. Armor: Interlocked, spiral-wound sheet tape.
- K. Cable terminators:
 - 1. Malleable iron or aluminum with red plastic, internal, anti-short bushings.

CONNECTORS AND SPLICES

- L. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
 - 6. Thomas & Betts.
- M. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

- N. Spring wire connectors: Corrosion-resistant, live-action spring in insulated shell, rated 105°C.
- O. Connectors and lugs: Circumferential compression (non-indenter) type.

PART 3 - EXECUTION

CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Conductor: Copper. Solid for #10 AWG and smaller; stranded for #8 AWG and larger.
 - 2. Insulation: Type XHHW-2 insulation for feeders larger than #2 AWG; Type THHN/THWN insulation for feeders #2 AWG and smaller.
- B. Branch Circuits:
 - 1. Conductor: Copper. Solid for #10 AWG and smaller; stranded for #8 AWG and larger.
 - 2. Insulation: Type XHHW-2 insulation for branch circuits larger than #2 AWG; Type THHN/THWN insulation for branch circuits #2 AWG and smaller.
- C. Motors and equipment connections subject to vibration: Copper. #12 AWG and larger, stranded conductor, single conductor.
- D. Use stranded conductor, single conductor, #14 minimum for control wiring.
- E. Metal Clad Cable – Type MC:
 - 1. MC Cable may be used at the contractor's option for branch circuits between devices and for switching circuits.
 - 2. Uses not permitted.
 - a. Home runs. Circuit home runs shall be individual wires in approved raceways.
 - b. Branch wiring in inaccessible ceilings.
 - c. Wiring runs exposed in unfinished spaces.
 - d. For circuits crossing smoke walls.
 - e. In exterior locations, or where exposed to view except in electrical rooms.
 - 3. MC Cable shall not terminate in Panelboards, Load Centers, Disconnects, Motor Controllers, Variable Speed Drives, Electrical Cabinets, Fire alarm panels, etc.
 - 4. Support metal clad cables above accessible ceilings using clips or cable ties. Do not rest cables on ceiling panels.
 - 5. Do not support metal clad cables from cable tray, from mechanical ducts or equipment, or from ceiling support wires.
 - 6. Install products in accordance with manufacturer's instructions.
 - 7. Other restrictions as listed in the NEC and other applicable codes.

CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- F. Service Entrance: Single conductors in raceway.
- G. Exposed Feeders: Single conductors in raceway.

- H. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Single conductors in raceway.
- I. Exposed Branch Circuits, Including in Crawlspace: Single conductors in raceway.
- J. Branch Circuits Concealed above Ceilings, in Walls, and Partitions: Single conductors in raceway, Metal-clad cable, Type MC.
- K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- L. Class 1 Control Circuits: Single conductors in raceway.
- M. Class 2 Control Circuits: Single conductors in raceway.

INSTALLATION OF CONDUCTORS AND CABLES

- N. Conceal cables in finished walls, above ceilings, and in floors, unless otherwise indicated.
- O. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- P. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- Q. Install exposed conduits parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- R. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- S. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- T. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

FEEDER REQUIREMENTS

- U. Contractor shall provide lugs, compression fittings, auxiliary wireways, etc., of adequate size for termination of feeder sizes as indicated on drawings. Feeder sizes indicated may be oversized for voltage drop in some cases. Contractor shall coordinate with equipment manufacturer for proper lug sizes.
- A. Extend feeders at full capacity from origin to termination.
- B. Feeders shall be continuous, without splices in so far as, practical. All feeder splices not specifically indicated on drawings must be prior approved by engineer in writing before splicing any cable.
- C. Each conduit raceway shall contain only those conductors constituting a single feeder circuit.
- D. Where multiple raceways are used for a single feeder, each raceway shall contain a conductor of each phase and neutral, if used, and a grounding conductor.

- E. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular-mil area, insulation type, and terminated in same manner.
- F. Where parallel feeder conductors are run in separate raceways, raceways shall have same physical characteristics.
- G. Feeders shall follow most accessible routes, concealed in construction in finished areas, exposed to the minimum temperature gradient and to minimum temperature fluctuation.
- H. Confine feeders to insulated portions of building, unless otherwise shown.
- I. Trapped runs without facilities for continuous drainage are not acceptable.
- J. Do not draw conductors into conduits until building is enclosed and watertight and until work which may cause cable damage has been completed.
- K. Feeders shall be sized for a maximum voltage drop of 2%.

BRANCH CIRCUIT REQUIREMENTS

- L. Do not use wire smaller than #12 AWG (unless otherwise noted) for branch circuit wiring, including motor circuits. All 20 amp, 120 volt and 277 volt branch circuit homeruns (to panelboard) serving receptacles, equipment, and lighting shall be #10 AWG minimum to first outlet or light fixture.
- M. Size home runs for 120V branch circuits based on the overall circuit length to the furthest outlet. The following requirements shall be followed:
 - 1. 0 to 100 ft. circuit length: Size home run at #10 AWG minimum to first outlet.
 - 2. 101 to 150 ft. circuit length: Size home run at #8 AWG minimum to first outlet.
 - 3. 151 to 250 ft. circuit length: Size home run at #6 AWG minimum to first outlet.
 - 4. For other branch circuits, size conductors so that voltage drop does not exceed 3%.
- N. All 120 volt and 277 volt branch circuits shall have a dedicated neutral conductor for each circuit.
- O. The plans show a circuit number for each device or light. This is done for clarity. No more than three 120V circuits shall be allowed in a single home run raceway.
- P. For isolated ground receptacle circuits, provide a dedicated neutral conductor and a dedicated isolated ground conductor for each circuit.
- Q. Any branch circuit protected by a GFCI circuit breaker shall be provided with a dedicated neutral conductor.

CONNECTIONS

- R. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- S. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

- T. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
- U. Clean conductor surfaces before installing lugs and connectors.
- V. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- W. Use compression connectors for conductor splices and taps, #6 AWG and larger. Use compression tool designed for the size and type of connector being compressed. Tape uninsulated conductors and connector with electrical tape to 150% of insulation rating of conductor.
- X. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, #8 AWG and smaller.
- Y. Where oversized conductors are called for (due to voltage drop, etc.) provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.

MOTOR AND EQUIPMENT WIRING

- Z. Furnish and install motor circuits in accordance with schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.
- AA. Conductor and conduit size for motor branch circuits, if shown on drawings, are sized for motor requirement only. Contractor may, at his option, include associated control conductors in same conduit providing the conduit size is adjusted to meet code requirements for percentage of fill.
- BB. Motors shall have proper size wire as per applicable codes and nameplate ratings. Verify ratings of motors before installing wiring.
- CC. Obtain manufacturer's wiring diagrams of electrical equipment furnished with equipment and do not proceed to wire equipment without this information.
- DD. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).
- EE. Make equipment connections with flexible conduit or liquid-tight flexible metallic conduit. Properly ground non-current carrying metal parts of equipment. Where cord connections or receptacles are required, provide type "S" rubber jacketed cord, 600 volt, heavy duty service of sizes and lengths required, and receptacle as applicable.
- FF. Coordinate work with the other trades such that the operation of mechanical equipment will be as described in mechanical specifications.
- GG. Unless otherwise indicated on drawings or in specifications, motors shall be furnished, set in place, and connected to driven equipment and prepared for operation as specified in other sections. Provide final connection and proper phase relationship to achieve proper motor rotation.

FIRESTOPPING

- HH. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

FIELD QUALITY CONTROL

- II. Perform tests and inspections and prepare test reports.

JJ. Tests and Inspections:

1. Visual and Mechanical Inspection:

- a. Compare cable data with drawing and specifications
- b. Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.
- c. Inspect bolted electrical connections for high resistance. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
- d. Inspect compression-applied connectors for correct cable match and indentation.
- e. Inspect for correct contractor identification and phase arrangements.
- f. Inspect jacket insulation and condition.

2. Electrical Tests:

- a. Perform insulation-resistance test on each feeder conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.
- b. Perform continuity tests to insure correct cable connection.

- KK. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Grounding Bus: Predrilled rectangular bars of 1/4 inches (6.3 mm) annealed copper, minimum 4 by 20 inches (102 by 508 mm) in main electrical rooms and minimum 4 by 10 inches (102 by 254 mm) in all other areas, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Panduit – Irreversible compression connectors.
 - 2. Erico – Welded connectors.

- B. Listed and labeled by a NRTL acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- C. Bolted Connectors for Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- D. Welded Connectors: Exothermic-welding kits, low-emission, electric-starting types and of types recommended by kit manufacturer for materials being joined and installation conditions.
- E. Compression Connectors: Irreversible type meeting IEEE standard 837-2002 and UL listed.
- F. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for #8 AWG and smaller; and stranded conductors for #6 AWG and larger, unless otherwise indicated.
- B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- C. Grounding Bus: Install in all electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus bar on insulated spacers 1 inch (25 mm), minimum, from wall 18 inches (450 mm) above finished floor, unless otherwise indicated.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors.
 - 3. Connections to Ground Rods at Test Wells: Welded connectors.
 - 4. Connections to Structural Steel: Welded connectors.
 - 5. Aboveground Accessible Connections: Irreversible compression or welded connectors.
 - 6. Connections in areas that may be a fire hazard to use welded connectors: Irreversible compression connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits. Terminate each end on suitable lug, bus or bushing.

- B. Bond equipment grounding terminal bars of the normal and emergency electrical system panelboards that serve the same patient area with an insulated continuous copper conductor not smaller than #8 AWG.
- C. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide insulated grounding conductor in raceway (minimum #4 AWG) from the main service copper bus bar to each service location(s), terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a copper grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 - 3. Bond all cable tray, metallic conduits, and equipment racks with minimum #6 AWG to copper bus bar.

3.3 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions and NECA 331.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts. Bond together metal siding not attached to grounded structure and bond to grounding electrode system.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.4 TERMINATIONS AND CONNECTIONS

- A. Equipment Grounding Conductor Terminations: For #8 AWG and larger, use pressure-type grounding lugs. #10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

- B. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.5 LABELING

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

END OF SECTION 260526

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Fire Stop Systems" for fire stopping materials and installation at penetration through walls, ceilings and other fire-rated elements.
 - 2. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. O-Z/Gedney; a brand of EGS Electrical Group.
 4. Robroy Industries.
 5. Southwire Company.
 6. Thomas & Betts Corporation.
- B. EMT: Comply with ANSI C80.3 and UL 797.
- C. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- D. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Indoor Wet Locations or Exterior: Steel insulated throat, compression, UL listed rain-tight.
 2. Fittings for EMT: Steel insulated throat, set-screw or compression type (Die-cast fittings will not be accepted).
 3. Expansion Fittings: Steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper Technologies Company; Cooper Crouse-Hinds.
 2. Hoffman; a Pentair company.
 3. Hubbell Incorporated; Killark Division.
 4. O-Z/Gedney; a brand of EGS Electrical Group.
 5. RACO; a Hubbell Company.
 6. Robroy Industries.
 7. Thomas & Betts Corporation.
 8. Wiremold / Legrand.
- B. General Requirements: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations. Weatherproof outlets shall utilize a use stainless steel or cadmium plated malleable iron box suitable for flush mounting.
- C. Sheet Metal Outlet and Device Boxes: Galvanized Steel. Comply with NEMA OS 1 and UL 514A.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- E. Cast-Metal Outlet and Device Boxes: Surface mount, NEMA FB 1, ferrous alloy, Type FD, with gasketed cover with stainless steel screws. Provide threaded hubs.
- F. Device Box Dimensions: Minimum 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- G. Sheet Metal Pull and Junction Boxes: NEMA OS 1.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Concealed above Ceilings, elevated underfloor, and in Interior Walls and Partitions: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 4. Connections to Lighting Fixtures in Accessible Ceilings: FMC – max 72 inches (1.8 m) in length.
 - 5. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 - 6. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 - 7. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 - 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R in damp or wet locations.
- B. Minimum Raceway Size:
 - 1. Minimum conduit size shall be 1/2 inch (16 mm) trade size except for conduit homeruns to panelboards, minimum size shall be 3/4 inch (21 mm).
 - 2. Minimum conduit size shall be 3/4 inch (21 mm) trade size except for switch legs and control circuits may be 1/2 inch (16 mm).
 - 3. Minimum FMC size shall be 1/2 inch (16 mm) except flexible connections to lighting fixtures may be 3/8 inch (12 mm), not to exceed 6 feet (1.5 m) in length
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 12 inches (300 mm) away from parallel runs of flues hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Conduit routing shown on drawings indicate approximate locations unless dimensioned. Route as required to complete wiring system.
- D. Complete raceway installation before starting conductor installation.
- E. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

- G. Conceal conduit within finished walls, above ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT.
 - 2. Use conduit bushings or insulated fitting at conduit ends not terminated in hubs or to an enclosure.
- K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- M. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- P. Conduit Routing:
 - 1. Arrange conduit to maintain headroom and present neat appearance.
 - 2. Route exposed conduit parallel with and perpendicular to walls and other building architectural and structural elements.
 - 3. Route conduits above accessible ceilings to clear access openings.
 - 4. Maintain adequate clearance between conduit and piping of other trades.
 - 5. Maintain 12 inches (306 mm) clearance between conduit and surfaces with temperatures exceeding 104 deg F (40 deg C).
- Q. Cut conduit square using saw or pipecutter; de-burr cut ends.
- R. Use conduit bodies to make sharp changes in direction, as around beams.

- S. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control joints.
- T. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- U. Termination of Conduit Stubs:
 - 1. Signal Systems: Use conduit bushing.

3.3 OUTLET BOX INSTALLATION

- A. Location of outlets and equipment as shown on drawings is approximate, and exact location shall be verified and shall be determined by:
 - 1. Construction or code requirements.
 - 2. Conflict with equipment of other trades.
 - 3. Equipment manufacturer's drawings.
 - 4. As dimensioned on interior or architectural elevations/plans as long as in compliance with all applicable codes.
- B. All outlet boxes shall be mounted flush with wall surface unless noted otherwise.
- C. Weatherproof outlet boxes specifically noted for surface mounting shall utilize a cast metal box complete with threaded conduit ends for surface outlets.
- D. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- E. Use plaster rings for all concealed work except for masonry boxes; depth of rings as required to reach finished surface.
- F. Do not fasten boxes to ceiling support wires and support boxes independently of conduit.
- G. Orient boxes to accommodate wiring devices oriented as specified in Division 26 Section "Wiring Devices".
- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- I. Conflict with millwork, tack boards, etc. Coordinate mounting heights and location of outlets mounted above counters, benches and backsplashes. Contractor shall review architectural elevations and millwork drawings before roughing-in boxes and conduit. Any conflicts shall be noted and addressed by an RFI requesting direction as to resolution. Adjusting box locations due to such conflicts shall be at no additional compensation.
- J. Minor modification in the location of outlets and equipment is considered incidental up to a distance of 10 feet with no additional compensation, providing necessary instructions are given prior to roughing in of outlet.
- K. Electrical outlet boxes may be installed in vertical fire resistive assemblies classified as fire/smoke and smoke partitions without affecting the fire classification, provided such openings do not exceed 16 square inches (100 square cm) and they are located per applicable UL assembly. All clearances between such outlet boxes and the gypsum board must be completely filled with joint compound or other approved materials. The wall must be built

around outlets of a larger size so as to not interfere with the integrity of the wall rating. The aggregate surface area of the boxes shall not exceed 100 square inches (645 square mm) per 100 square feet (9 m). Boxes located on opposite sides of walls or partitions shall be separated by a horizontal distance of 24 inches (609 mm) or by providing listed putty pads around both boxes. The metallic outlet or switch boxes shall be securely fastened to the studs and the opening in the wallboard facing shall be cut so that the clearance between the box and the wallboard does not exceed 1/8 inch (3mm).

- L. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall a minimum of 12 inches (306 mm) or on opposite sides of stud in partition walls. Where back to back boxes cannot be avoided, provide gypsum board between boxes.
- M. Where more than two switches or devices are located at one point, use ganged boxes and covers, unless devices do not allow for ganging or manufacturer recommends otherwise. Provide permanently installed barriers between adjacent switches as required to meet regulatory requirements.
- N. Align adjacent wall mounted outlet boxes for switches, thermostats and similar devices.

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Trough cable trays.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Mono-Systems, Inc.
3. Wiremold.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Drawings for specific requirements for types, materials, sizes, and configurations.

2.3 TROUGH CABLE TRAYS

- A. Description:
 1. Configuration: Two longitudinal members (side rails) with a solid sheet over rungs exposed on the interior of the trough, or corrugated sheet with both edges welded to the side rails.
 2. Rung Spacing: Rungs or corrugations shall be spaced a maximum of 6 inches (150 mm) o.c. and have a minimum flat bearing surface of 2 inches (50 mm).
 3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
 4. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
 5. Minimum Usable Load Depth: 5 inches (125 mm).
 6. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
 7. Width: 12 inches (300 mm) unless otherwise indicated on Drawings.
 8. Fitting Minimum Radius: 12 inches (300 mm).
 9. Splicing Assemblies: Bolted type using serrated flange locknuts.
 10. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 11. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.4 MATERIALS AND FINISHES

- A. Aluminum:
 1. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
 2. Hardware: Chromium-zinc-plated steel, ASTM F 1136.
 3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.5 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 WARNING SIGNS

- A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure[**and install seismic restraints**].
- G. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- I. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

- J. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- K. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- L. Make changes in direction and elevation using manufacturer's recommended fittings.
- M. Make cable tray connections using manufacturer's recommended fittings.
- N. Seal penetrations through fire and smoke barriers. Comply with requirements in Division 07 Section "Penetration Firestopping."
- O. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- P. Install cable trays with enough workspace to permit access for installing cables.
- Q. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Division Section "Grounding and Bonding for Electrical Systems."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on vertical runs to cable trays every 36 inches (450 mm).
- C. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.

2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

END OF SECTION 260536

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification of power and control cables.
 - 2. Identification for conductors.
 - 3. Warning labels and signs.
 - 4. Instruction signs.
 - 5. Equipment identification labels.
 - 6. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound or tubing type, with circuit identification legend machine printed by thermal transfer or equivalent process.
 - 1. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
 - 2. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings including neutral conductor.
 - 3. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.2 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 1/2 inch (13 mm).
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 1/2 inch (13 mm).

2.6 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black except where used for color-coding.
- B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 - 5. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping stainless steel screws, except contact type permanent commercial grade adhesive providing a permanent bond shall be used where screws cannot or should not penetrate substrate.
- B. Two-sided tape and dynamo type adhesives are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Indoors and Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION REQUIREMENTS

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in panelboards, switchboards, switchgear, vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors and neutral and ground conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White.
 - 5) Ground: Green.
 - 6) Isolated Ground: Green/Yellow Tracer.
 - c. If existing color coding is different than indicated above, match existing color coding.
 - 2. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Install instructional sign in the each main electrical room including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- D. At each junction box, the covers on junction boxes and pull boxes in areas that are not to be painted shall be marked with "Indelible Markers" to indicate the circuit number(s) of conductors in the box.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment.

- F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with design documents. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

- a. Panelboards.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Disconnects
- e. Switchgear.
- f. Switchboards.
- g. Variable-speed controllers.
- h. Contactors.

- G. Engraved laminate signs shall have white lettering in a black field.

- H. Panelboard identification shall indicate panelboard designation, voltage and where fed from, i.e., "PANEL 1LA - 120/208V, 3 PHASE, 4W".
FED FROM 1MDPHA"

- I. Panelboards located in storage rooms shall have floor space per NEC-110 permanently marked and shall be identified as "Electrical Access - Not For Storage."

- J. Identify each conductor with its circuit number or other designation indicated on Drawings.

- K. Identify neutrals with its associated circuit number(s).

- L. Install conductor markers at all new connections and terminations and existing connections and terminations, modified or altered.

3.3 ENGRAVED COVER PLATES

- A. All cover plates for control stations controlling remote equipment shall be engraved to identify the device being controlled.
- B. Engraved cover plates shall be supplied and installed on all switches serving lobbies, corridors, and other public locations.

- C. Wiring device coverplates shall be factory engraved to indicate panel designation and circuit number (i.e. "1HLA-7"). Letter height shall be 1/4" (7 mm), recessed and colored:
 - a. Black for normal power
- D. For receptacles other than 20A, 120V, engraving shall include receptacle voltage, phase and amperage at top of receptacle and panel designation and circuit numbers at bottom of receptacles.
- E. Adhesive labels and nameplates are not acceptable.

3.4 COVER PLATES

- A. All wiring device cover plates shall have panel designation and circuit number (i.e. "1HLA-7") serving device clearly marked on the back of each faceplate with indelible marker.

3.5 PANELBOARD CIRCUIT DIRECTORIES

- A. Install in each panelboard a typewritten directory accurately indicating rooms and equipment being served. Verify actual room names and numbers to be used. Also, provide a copy of typewritten panelboard directories in Owner's close-out manuals.
- B. Where new circuits are added to existing panelboards or existing circuits deleted, provide new typewritten panelboard circuit directory with added circuits identified and deleted circuits indicated as 'spare'. Circuit identification shall indicate room and equipment being served.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Time clocks.
 - 2. Photoelectric switches.
 - 3. Indoor occupancy sensors.
- B. Related Requirements:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 SYSTEM DESCRIPTION

- A. Occupancy Sensors
 - 1. Occupancy sensors shown on drawings are intended to show control intent. Quantities and locations are approximate and may not include all devices required for 100% coverage to meet energy code requirements. It shall be the contractor's responsibility to provide a complete Occupancy Sensor system based on the performance requirements of this specification and energy code requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lightolier as indicated on drawings or comparable product by one of the following:
 - 1. Leviton Mfg. Company Inc.
 - 2. Watt Stopper.

- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lightolier as specified on drawings or comparable product by one of the following:
1. Leviton Mfg. Company Inc.
 2. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V.
- C. Wall-Switch Sensor :

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: Dual technology.
3. Switch Type: SP and dual circuit, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: 120 V.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Operational Test: After installing switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 3 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Disconnecting and Overcurrent Protective Devices

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective devices, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and electrical ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Field quality control test results
 - 8. Operating and Maintenance data.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Copies of all panelboard typewritten directories.
- B. Record Drawings: Create and submit record drawings including the final version of each panel schedule after load balancing. Create drawings matching the record set and incorporate final panel schedules on drawing and add panel schedule sheets to drawing index.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with National Electrical Manufacturer's Association (NEMA) Standards Publication Number PB1.1 and PB 1.2.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Do not store panelboards exposed to weather.
- C. Handle and prepare panelboards for installation according to NEMA PB 1.
- D. Protect panelboards against damage from work of other trades.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with freestanding panelboards with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: spares for each panelboard as shown on one the Panel Schedules.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated. Provide circuit directory in clear plastic cover. Provide panelboards with lugs suitable for termination of feeder sizes indicated on drawings.
- B. Each panelboard, as complete unit, shall have a short circuit current rating equal to or great than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage. All panelboards shall be fully rated, series rated panels are not approved.
- C. Enclosures: Surface mounted cabinets. Refer to panel schedule and floor plans for types of panel cabinets required.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, type 1.
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions. Provide full height hinged trim integrated into front cover to allow access to wire gutters without the removal of cover. Provide hinged door for access to overcurrent devices.
 3. Back Boxes: Galvanized steel.
 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- D. Incoming Mains Location: Top or bottom. Mains location is at the contactor's option as project conditions dictate, unless specifically indicated otherwise on the drawings.
- E. Phase, Neutral, and Ground Buses:
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type. Lugs shall be of sizes as required to accept feeders as indicated on the drawings.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series rated panels are not approved.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D NQOD series panelboards or comparable product by one of the following. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or main lugs only as indicated on the on the Panel Schedules.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Buses:
1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs. Provide on panels where specifically noted on the panel schedules or one line diagram.
 2. Copper equipment and isolated ground buses. Provide on panels where specifically noted on the panel schedules or one line diagram.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.

- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Where required to achieve system coordination with upstream and downstream overcurrent devices, solid-state, electronic trip, circuit breakers shall be provided and where noted on drawings and schedules.
 - 2. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 3. Provide the following where noted on the drawings or schedules:
 - a. Handle Clamp: Loose attachment, for holding circuit breaker handle in the on position.
 - b. Lockable: Fixed attachment for padlocking circuit breaker handle in the on or off position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to manufacturer's written instructions, according to NEMA PB 1.1, and in accordance with recognized industry standards.
- B. Mount panelboards surface mounted as indicated on drawings and schedules.
- C. Support panel cabinets independently to structure with no weight bearing on conduits.
- D. Mount so that top breaker is not higher than 6'-0" (1800 mm) AFF, unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush and tight with wall finish and mating with back box.
- F. Adjacent panel cabinets shall be of same physical size and mounted in horizontal alignment.
- G. Provide lugs in panelboards of adequate size to accept feeders as indicated on drawings.
- H. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.

2. Install filler plates in unused spaces.
 3. Provide handle clamp accessory for any circuit breaker serving fire alarm control panels or fire alarm power supplies.
 4. Provide lockable handle padlock circuit breaker attachment where noted on panel schedules or plans as lockable option.
- I. Provide one 3/4" empty conduit for each three panel spaces between panelboard and accessible ceiling space or space designated to be ceiling space in the future, for future use.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Verify actual room names and numbers to be used, and include room name, room number and name of load being served for every circuit.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 2. Megger check and test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit. Do not megger check solid state components.
 3. Test continuity of each circuit.
 4. Energize each circuit and check for complete function.
 5. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - B. Panelboards will be considered defective if they do not pass tests and inspections.
 - C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - D. Touch up paint scratched or marred surfaces to match original finish.
- 3.5 ADJUSTING AND CLEANING
- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
 - B. Tighten lugs and bus connections.
 - C. Clean interior of panelboard.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI.
 - 2. Snap switches and wall-box dimmers.
 - 3. Device face plates.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RFI: Radio-frequency interference.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source unless noted otherwise.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 2. Leviton Mfg. Company Inc. (Leviton).
 - 3. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 DEVICE COLORS

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect.

2.3 STRAIGHT BLADE RECEPTACLES

- A. General:
 - 1. Convenience Receptacles, 125 V, 20 A, 5-20R configuration: Comply with NEMA WD 1, NEMA WD 6, UL 498, and FS W-C-596.
- B. Heavy-Duty, Simplex:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pass & Seymour – 5361
 - b. Hubbell –HBL5361
 - c. Leviton - 5361
- C. Heavy-Duty Duplex:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pass & Seymour – 5362
 - b. Hubbell – HBL5362
 - c. Leviton - 5362
- D. GFCI Receptacles:
 - 1. General Description: Feed-through type. Comply with UL 943, Class A, and include indicator light that is lighted when device is tripped.
 - 2. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - a. Receptacle shall be capable of being installed in a 2-1/2 inch deep outlet box without adapter.
 - b. Shall be grounding type with solid-state ground fault sensing and signaling; with 5 milliamperes ground fault trip level.
 - c. Test and reset buttons shall match color of face.
 - d. If critical components within receptacle are damaged and the ground fault protection is lost, power to receptacle shall be automatically disconnected within the device.

3. Products: Subject to compliance with requirements, provide one of the following:

a. Indoor – Dry Locations:

- 1) Pass & Seymour – 2095
- 2) Hubbell – GF20-LA
- 3) Leviton – 7899

2.4 SWITCHES

A. Switches shall be rated for 20 amperes, and rated 120/277 volts AC. Switch shall be manufacturer's specification grade toggle switch. Switches shall have quiet action mechanism with silver alloy contacts for longevity. Comply with NEMA WD 1, UL 20, and FS W-S-896.

1. Terminal screws shall allow back and side wiring and accept #14, 12, and 10 AWG stranded or solid wire.

B. Single Pole

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC1
- b. Hubbell – HBL1221
- c. Leviton – 1221-2

C. Double Pole Single Throw:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC2
- b. Hubbell – HBL1222
- c. Leviton – 1222-2

D. Three Way:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC3
- b. Hubbell – HBL1223
- c. Leviton – 1223-2

E. Four Way:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC4
- b. Hubbell – HBL1224
- c. Leviton – 1224-2

2.5 WIRING DEVICE ACCESSORIES

A. Wall Plates:

1. 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; wall plates colored to match wiring devices. Provide plates possessing the following additional construction features:
 - a. Material and Finish:
 - 1) Nylon, smooth – color to match device
2. Device plates for surface mounted Type FS or FD boxes: Type FSK galvanized steel covers.
3. Device plates for surface mounted, 4 in. square boxes: 1/2 in. raised galvanized steel covers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

B. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

C. Device Installation:

1. Clean debris from every outlet box; including excess drywall mud.
2. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
3. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
4. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment. Clean exposed surfaces to remove spatters and restore finish.
5. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

7. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
9. Tighten unused terminal screws on the device.
10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact. Provide extension rings to bring device flush with finished surface (do not use switch box extension rings/goof rings). Install devices plumb, level and rigidly in place.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

E. Device Plates:

1. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates where devices permit.

G. Ground receptacles with the insulated green ground wire from device ground screw to a bolted outlet box connection.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served on device.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Provide operational testing for devices.
3. Test receptacles with Hubbell 5200, Woodhead 1750, or equal, for correct polarity, proper ground connection, and wiring faults.

B. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior luminaires, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. CU: Coefficient of utilization.
- E. HID: High-intensity discharge.
- F. LED: Light Emitting Diode.
- G. LER: Luminaire efficacy rating.
- H. Luminaire: Complete luminaire, including ballast housing if provided.

1.4 ACTION SUBMITTALS

- A. Contractor shall provide submittals for luminaires as indicated in the "Lighting Fixture Schedule." Where an alternate manufacturer is indicated for a specific luminaire with no catalog number indicated for the alternate manufacturer, provide alternate luminaire that is equal in all characteristics as the cataloged luminaire. Luminaires without alternate manufacturers noted shall be provided with no substitutions and/or alternates.

- B. Excess delivery times shall not be an acceptable cause for substitution of specified luminaires. Notify Architect/Engineer of any long lead luminaires that may impact project schedule within two weeks of contract award. Beyond two weeks the contractor is responsible for any costs associated with expediting the manufacturing process of the specified luminaire and/or cost associated with an approved substitute luminaire is allowed by Architect/Engineer.
- C. Product Data: For each type of luminaire submit catalog literature for each luminaire specified in booklet form with index and a separate sheet for each luminaire, assembled in luminaire "type" alphabetical order, with specified luminaire data as required below.
- D. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. Ballast, including BF.
 - 4. Energy-efficiency data.
 - 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project.
 - a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - 7. LED compliance testing documentation in accordance with IESNA LM-80 and the DOE CALiPER testing documentation for all solid state luminaires.
- E. Shop Drawings: For nonstandard or custom luminaires. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- F. Samples: For each luminaire indicated in the "Lighting Fixture Schedule." Each Sample shall include the following:
 - 1. Lamps and ballasts, installed.
 - 2. Cords and plugs.
 - 3. Pendant support system.
- G. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified agencies providing photometric data for luminaires.
- B. Field quality-control reports.
- C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

- A. Equivalency of luminaires is determined by Engineer and includes the following data for comparative purposes.
 - 1. Efficiency.
 - 2. Efficacy.
 - 3. Distribution.
 - 4. Construction.
 - 5. Design compatibility.
 - 6. Manufacturer reliability based upon past performances.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- D. Comply with NFPA 70.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class, division, and group of hazard by FM Global.

1.8 COORDINATION

- A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.9 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: Five years from date of Substantial Completion. Full replacement warranty shall apply for the full five years.
 - 2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full replacement warranty shall apply for the full five years.

- B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. 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. Lamps: Furnish at least four of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Battery and Charger Data: 1 for each emergency lighting unit.
 - 4. Ballasts: 1 for each type and rating installed.
 - 5. Globes and Guards: Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings where only one manufacturer is listed, provide one of the products indicated on Drawings where multiple manufacturers are listed.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

- A. Provide luminaires of the size, type and rating indicated in "Lighting Fixture Schedule", complete with, but not necessarily limited to, lamps, lampholders, reflectors, ballasts, drivers, starters, wiring and any other accessories required for a complete working installation.
- B. Luminaire catalog numbers do not necessarily include all accessories and are intended to serve as a guide in defining types and manufacturers of luminaire only.
- C. The contractor shall ensure that the luminaire is UL listed for the ambient conditions where installed. Extra compensation will not be permitted for failure to coordinate luminaires with their ambient conditions.
 - 1. Luminaires located exterior to the building and/or in unconditioned damp spaces and under cover from direct weather exposure shall be UL listed as "Suitable for Damp Locations" unless noted otherwise.

2. Luminaires located exterior to the building and/or in unconditioned wet spaces and in direct contact with the weather or in washdown areas shall be UL listed as "Suitable for Wet Locations" unless noted otherwise.
- D. Luminaires installed with direct contact with insulation shall have an "IC" rating for direct contact with insulation. Verify if luminaires will be in contact with insulation prior to installation. Notify Architect/Engineer of any conflicts.
- E. Provide linear fluorescent ballast with quick disconnect in accordance with NFPA 70, Article 410.
- F. Gasketing material shall be vinyl or other non-aging type material as approved by Engineer.
- G. Provide proper trim for each luminaire as required for various types of ceiling being installed throughout the project; plaster rings, luminaire ends or caps, suspension units, mounting brackets and/or other accessory parts necessary for a complete luminaire.
- H. Recessed Luminaires: Comply with NEMA LE 4 for ceiling compatibility for recessed luminaires.
- I. Incandescent Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- J. Fluorescent Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- K. HID Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- L. Metal Parts: Free of burrs and sharp corners and edges.
- M. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- N. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- O. Diffusers, Covers, and Globes:
 1. Acrylic Luminaire Diffusers: Plastic for clear lenses and diffusers shall be formed of colorless 100% virgin acrylic, as manufactured by Atohaas, DuPont or equally acceptable manufacturer. The quality of the raw material must meet or exceed IES, SPI, and NEMA Specifications and shall not exceed a yellowness factor of 3 after 2,000 hours of exposure in the Fade-meter or as tested by an independent testing laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 10 years.
 - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
 - b. UV stabilized.

2. Glass: Glass used for lenses, refractors, and diffusers in incandescent luminaires shall be tempered for high impact and heat resistance; where clear glass has been specified, the glass shall be crystal clear in quality with a transmittance of not less than 88%. Where luminaire glass lenses are specified glass lenses shall be provided and plastic lenses shall not be substituted.
3. Provide clear tube guards over exposed fluorescent lamps in all strip and industrial luminaires in unfinished spaces. Equal to ALP Protect-A-Lamp.

P. Factory-Applied Labels: Comply with UL 1598.

1. All light fixtures shall factory-applied label near lamp socket stating maximum wattage of lamp allowed in fixture. Maximum wattage to be stated is wattage as shown on schedule of lighting equipment herein. Circuits are based on these wattages, circuitry, etc. Any failure to comply with this requirement shall be responsibility of contractor. Location of labels must meet acceptance of lighting designer, architect and engineer.
2. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
3. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter code (T-4, T-5, T-8, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. Start type (programmed start, etc.) for fluorescent and compact fluorescent luminaires.
 - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.

2.3 ACCEPTABLE BALLAST MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance
 2. General Electric
 3. Lutron
 4. Sylvania
 5. Universal Lighting Technologies
 6. Venture

2.4 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Description: Electronic Programmed-Start type, complying with ANSI C 82.11 and UL 935, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Sound Rating: Class A.
 2. Thermal Rating: Class P.
 3. Total Harmonic Distortion Rating: Less than 20 percent.
 4. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 5. Multi-voltage 120/277 volts.

6. Operating Frequency: 42-53 kHz.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.88 or higher.
9. Power Factor: 0.98 or higher.
10. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
11. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
12. Automatic lamp starting after lamp replacement.

2.5 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic Programmed-Start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz – 53kHz.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: Class P, 75 deg C, maximum.

2.6 EMERGENCY FLUORESCENT POWER UNIT

- A. Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast. Comply with UL 924.

1. Emergency Connection T8 Lamps: Operate one or two fluorescent lamp(s) continuously at an output of 1450-3500 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast. Shall be equivalent to Bodine B30 battery-inverter unit.
2. Emergency Connection T5 Lamps and T8 Lamps where required to be integral to pendant mounted, linear indirect luminaire: Operate one fluorescent lamp continuously at and output of 600-1325 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast. Shall be equivalent to Bodine LP600.
3. Emergency Connection Compact Fluorescent Lamps: Operate one compact fluorescent lamp continuously at and output up to 1250 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast. Shall be equivalent to Bodine B4CFG.
4. Test Push Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.7 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 2. AC/Battery Powered Exit Signs : Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.8 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or luminaires where noted on plans.
 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

2.9 LAMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Osram-Sylvania
2. General Electric
3. Philips Lighting Company
4. Venture
5. USHIO (Low-voltage lamps ONLY)

B. Fluorescent Lamps

1. All fluorescent lamps shall be of the same manufacturer.
2. Lamps in remodeled areas shall match color of existing lamps in area.
3. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
4. Minimum CRI of 85 for linear lamps and 82 for compact fluorescents.
5. Color Temperature of 3500 K.
6. T8 rapid-start lamps, rated 32 W maximum, nominal, 2950 initial lumens (minimum) and average rated life 20,000 hours unless otherwise indicated.
7. T8 rapid-start lamps, rated 17 W maximum and average rated life of 20,000 hours unless otherwise indicated.
8. Compact Fluorescent Lamps: 4-Pin, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
 - a. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - b. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - c. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - d. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - e. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - f. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
 - g. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Architect's and/or Interior Designer's reflected ceiling plans indicate actual location of all luminaires. Notify Architect/Engineer of any conflicts between these plans and electrical documents prior to rough-in and installation.
- B. Architect's and/or Interior Designer's elevation and/or section plans may show actual location of luminaires that are not documented on the reflected ceiling plans. If luminaires are not shown on elevation and/or section plans, install at height noted on the electrical documents. Notify Architect/Engineer of and conflicts between these plans and electrical documents prior to rough-in and installation.
- C. Temporary Lighting: If it is necessary, and approved by the Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps and reinstall.
- D. Verify adequacy of headroom and non-interference with other equipment such as ducts, pipes and openings. Report to Architect/Engineer any conflict between these plans and electrical documents.
- E. Adjustable luminaires shall be aimed as directed by Architect/Interior Designer/Engineer.

- F. Special care shall be taken to assure light-tight joints between recessed luminaires and ceiling systems.
- G. Recessed luminaires which are installed in rough textured ceiling surfaces whereby light may be emitted between luminaire frame and ceiling surface shall have black self-adhesive polyfoam gasketing installed around inside edges of frame to prevent light leaks.
- H. Install luminaires in a workmanlike manner. Care shall be taken in placement of luminaire outlets and surface-mounted luminaires to maintain alignment, spacing, layout, and general arrangement shown on drawings. Contractor may vary these dimensions slightly in order to clear obstructions. Any major changes in the arrangement must be approved by Engineer.
- I. Luminaires: Set level, plumb, and square with ceilings and walls. Install lamps in each luminaire.
- J. Coordinate with trades so luminaires are properly aligned with items such as diffusers, grilles, and speakers
- K. If necessary, relocate luminaires as directed by engineer so there will be no conflict with other equipment.
- L. Make luminaire holes for wire entrance with knock-out punches or hole saw, remove burrs. Do not cut holes with tinsnips.
- M. Clean luminaires of dirt and debris prior to acceptance.
- N. Maintain clearance as required in Section 410-66 of the NEC and other NFPA sections. Notify Engineer of any conflict, prior to rough-in.
- O. Comply with all relevant Federal, State, Local and Agency guidelines when disposing of lighting waste. Most fluorescent and HID lamps require special handling and disposal procedures.
- P. Electrical contractor shall remotely locate all transformers called for in the contract documents in a well ventilated and easily accessible space to comply with all codes.

3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. At time of Substantial Completion, replace lamps in luminaires which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Engineer.

3.4 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

- A. Provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. Adjust aimable luminaires in the presence of Architect.
- B. Adjust adjustable luminaires to satisfaction of Architect/Engineer.

END OF SECTION 265100

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Access Panels
 - 3. Common electrical installation requirements.

1.3 DEFINITIONS

- A. Code. National, State and Local Electrical codes including OSHA requirements.
- B. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- E. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- F. Home Run: The portion of a branch circuit between the serving panelboard and the first electrical outlet, lighting fixture, or other electrical load connected to the circuit.
- G. Low voltage: 50 to 600 volts.
- H. Medium voltage: 601 to 35,000 volts.
- I. Provide. Furnish, install and wire ready for service.
- J. Signal voltage. NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.

1.4 SCOPE

- A. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work

may not be specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

- B. It is the intent that these Specifications and associated Drawings establish minimum requirements for products and equipment with the intent to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail that is not shown or specified, but necessary for proper installation and operation shall be included in the work and in these Contractor's estimates, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.
- C. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall be provided as if expressly required on both.
- D. It is the requirement of these Contract Documents to have the contractors provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall include in their bid the specific components or subsystems with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 20 deg F (minus 7 deg C) or exceeding 120 deg F (49 deg C).
 - 2. Humidity: Less than 95 percent (noncondensing).
 - 3. Altitude: Not exceeding 3300 feet (1000 m).

1.6 MODIFICATIONS IN LAYOUT

- A. Drawings are intended to outline the scope of work required and are not intended to be installation drawings. Drawings are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component nor do they show the exact routings. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational, nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. Unless specifically stated to the contrary, no measurement of an electric drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the electric drawings are subject to measurements of adjacent and previously completed work. Measurements shall be performed prior to the actual installation of equipment.

- C. Prior to installation of visible material and equipment (including access panels) in finished spaces, review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- D. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21 through 28 will be installed.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades. Systems shall be run parallel with or perpendicular to major architectural and structural building elements.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of equipment and raceways:
 - 1. To maintain maximum headroom; all piping, duct, conduit and associated components to be as tight as possible to underside of structure to provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 2. To allow right of way for piping installed at required slope.
 - 3. To allow connecting raceways, cables, wireways, cable trays, and busways to be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

1.8 COORDINATION DRAWINGS

- A. When included as part of the Contract Documents, there shall be full cooperation and coordination of all specialty trades.
- B. This Division's contractors shall comply fully with the requirements set forth in the Division 23 Section "Coordination Drawings" specification section.

1.9 RECORD DOCUMENTS

- A. Record Drawings are specified in Division 01 Section "Project Record Documents."
- B. The Contractor shall keep a detailed up-to-date record, of the manner and location in which installations are actually made, indexing each feeder, pull box and protective device. Record documents are to reflect all changes in work including change orders, field directives, addenda from bid set of Contract Documents, request for information responses, etc. Upon completion of the project, the contractor shall modify the project electronic drawing and specification files to incorporate this information. Modified documents shall be turned over to the Owner in both electronic and hard paper copy formats. Record drawings shall also include:

1. Locations of buried conduit or similar items. Include buried depth.
2. Field changes of dimension or detail.
3. Details not on original contract drawings.
4. Changes to circuit numbers.
5. Junction box locations and conduit runs, with trade sizes indicated, for lighting, power, and electrical systems installed.
6. Final panel schedules on drawings matching construction document drawing size.

1.10 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

- A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in a coordinated manual using loose leaf sheets in a three ring binder(s). Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment.
- B. The manuals shall include the following and shall have an index of contents and tabs for each Specification Section and each piece of equipment specified in that Section and be provided in the order listed below, per Specification Section.
 1. Copies of all approved submittals/shop drawings.
 2. Manufacturer's operating and maintenance instructions and parts lists of all items or equipment. Where manufacturer's data includes several types or models, the applicable type or model shall be clearly designated.
 3. Startup and shutdown procedures.
 4. Test records.
 5. Wiring diagrams.
 6. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment.
 7. Owner's written acknowledgement of satisfactory completion of instruction period.
- C. Furnish three copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- D. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of all systems. Factory-trained personnel shall perform instructions.
- E. Submittal Procedure and Format
 1. This Paragraph supplements Division 01.
 2. Submittal Cover Sheet
 - a. Submittal data for each product shall include a copy of the following cover sheet completely filled out. Incomplete or incorrect cover sheet submittal shall constitute reason for rejection.
 - b. Shop drawings/submittals shall be submitted according to applicable specification section's requirements with a separate cover sheet completed for each product, rather than one cover sheet for multiple products, whether or not supplied by one manufacturer or vendor.

SHOP DRAWING COVER SHEET				
PROJECT:		CONTRACTOR:		
DIVISION NO.:		SECTION NO.:		
DESCRIPTION:				
CONTRACT DRAWING REFERENCE NO:				
EQUIPMENT TAG:				
SUBMISSION (CIRCLE ONE): FIRST, SECOND, THIRD, FOURTH				
DATE:				
INFORMATION AND CHECKLIST				
1.	Contractor's Log #ID			
2.	Name, address, and phone number of supplier.			
3.	Are all specified or scheduled items included and exactly match scheduled/specified items?	Yes	No	
4.	Is this item a substitution?	Yes	No	
5.	Are deviations clearly identified?	Yes	No	
6.	Does equipment fit space shown on construction documents, coordination drawings, and actual field conditions?	Yes	No	
7.	Has support, erection, weights, and installation been coordinated with all trades?	Yes	No	
8.	Does the proposed installation void warranties and/or violate UL or code requirements?	Yes	No	
9.	Does this material/equipment add expense to any other trade or project costs?	Yes	No	
10.	Does equipment require interface with other trades? List divisions and specifics requiring coordination?	Yes	No	
11.	Is control interface coordinated?	Yes	No	
12.	List electrical characteristics (V/Ph/A)			

3. Multiple Re-submittals: The Engineer will review the first submittal from the contractor and respond with comments, and will review one re-submittal for the same item(s) from the contractor and respond with comments. If the contractor is required to make

subsequent submittals for the same item(s) the Engineer shall be compensated by the contractor for the time to review each subsequent re-submittal. The contractor shall agree to compensate the Engineer a minimum of \$500 per each re-submittal item.

4. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4 inches = 1 foot 0 inch scale unless specified otherwise.
5. Shop drawings and submittals showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
6. Provide shop drawing submittals showing details of piping connections to ALL equipment. If connection details are not submitted and connections are found to be installed incorrectly in the field, this contractor shall reinstall them within the original contract price.
7. Shop drawings for different systems and equipment shall be bound separately by specification section as indicated above and not bound by manufacturer. Each separate submittal shall have its own transmittal and cover letter. Submittals which contain different specification section systems bound together shall be returned un-reviewed for re-submittal.
8. Lighting Fixture shop drawings shall have all associated light fixtures included. Separate submittals grouped by manufacturer or supplier shall not be accepted. The contractor shall be responsible for coordinating drawings from his various suppliers in order to comply with this requirement.

1.11 QUALITY ASSURANCE

A. Acceptable Manufacturers

1. The Engineer's design for each product is based on the manufacturer listed in the schedule or shown on the drawings. In Part 2 of some technical specifications, other manufacturers are listed as being acceptable. The listing of a manufacturer as acceptable does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. These are acceptable only if, as a minimum, they:
 - a. Meet all performance criteria listed in the schedules and outlined in the specification.
 - b. Have identical operating characteristics to those called for in the specification. For example, a two-stroke diesel generator will not be acceptable if a four-stroke model is specified.
 - c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the contractor.
 - d. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.

- B. All equipment shall be labeled or listed by the National Board of Underwriters Laboratories (U.L.) or other recognized listing/testing agency where such labeling or listing exists for such material.
- C. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Skid-mounted or packaged assemblies shall be listed and labeled as an assembly, not just the individual components.

1.12 UTILITY CHARGES

- A. The contractor shall be responsible for costs from electric utility company that are assessed the Owner for the installation of the permanent electric service. It is the responsibility of the contractor to obtain those costs from the utility company and include them in their bid.

1.13 TEMPORARY CONSTRUCTION POWER

- A. Provide temporary lighting and construction power for the project. Pay the usage charges to the serving utility for electric service associated with temporary lighting and power for construction.

B. CONTINUITY OF UTILITY SERVICES

1. In the absence of specific requirements in Division 01, comply with the following procedures for shut-downs.
 - a. Provide temporary services where project construction schedule requires extended shut downs of existing equipment and/or systems. Temporary services include the necessary equipment and/or systems to maintain continuity of services. Extended shut downs are interruptions of existing services for a period of time longer than that acceptable to the Owner.
 - b. Contractor shall coordinate any shutdowns of existing systems as follows:
 - c. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days is required.
 - d. Minimize timeline of shutdowns of any system.
 - e. Provide temporary services where required and perform shutdowns and tie-ins at a time convenient to Owner.
2. Contractor shall be responsible for completing and filing the Owner's shutdown notice questionnaire.
3. Perform required survey and inspection work required by the notice for shutdown.
4. All life safety systems shall be returned to service at the end of each work day, when work is being performed on the systems. It is the responsibility of the Contractor to provide all associated appurtenances necessary to ensure that the systems are in proper working condition at all times.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment/materials from damage during shipping, storage, handling and installation. Delivery equipment/materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

- B. The Contractor shall provide for enclosed storage, when equipment/materials are stored on-site and prior to building "dry-in", to prevent any damage resulting from inclement weather or construction traffic. Specialties shall not be stored outdoors.
- C. Equipment/materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional expense. Do not store equipment with PVC material with exposure to direct sunlight.

PART 2 - PRODUCTS

2.1 CEILING ACCESS AND ACCESS PANELS

- A. Access panels are generally not shown on the drawings, but they are required to be provided by Contractor.
- B. Access panels shall be of size required to provide adequate access to equipment. Minimum size shall be 12" X 12" for hand access or 24" X 24" for body access. Minimum 16 gauge frame, not less than 18 gauge hinged door panel. Door locks shall be screwdriver operated for panels in general location applications and shall be key locked for public area applications.
- C. Furnish access panels for installation under other Sections valves or other items installed under this Division require access and are concealed in floor, wall, furred space or above ceiling. Access panels shall be by Milcor, Knapp, Nystorm or Inland Steel; coordinate selection with other Sections supplying similar access panels. Color of panel shall be selected by the Architect.
- D. Panels shall include concealed hinges, cam type locking devices, and shall have a frame border type necessary for the particular wall or ceiling construction in which they are installed. Access panels shall be flush mounted, recessed frame type units. Access panels shall be prime coated steel, for field painting for general applications and stainless steel for use in toilet rooms, shower rooms, and similar wet locations.
- E. Access panels shall have same fire rating classification as surface penetrated. Rated access panels must have UL Label.

PART 3 - EXECUTION

3.1 PRE-BID SITE VISIT

- A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this division. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.
- B. Contractor shall visit job site to familiarize himself with the specific location of the new equipment installations in existing areas, to ensure there is adequate access for the installation of equipment. All entries, pathways, corridors, stairwells, etc., that may be used to install equipment shall be investigated. All existing conditions and potential obstructions that may impede access and installation shall be addressed prior to equipment purchasing/ordering.

- C. The documentation of existing conditions was derived from As-Built documents and are in part unverified. Actual existing conditions shall be verified prior to commencement of work.

3.2 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.3 PAINTING

- A. Furnish one can of aerosol-free touch-up paint for each different color factory finish which is to be the final finished surface of the product.

3.4 CLEANING

- A. Cleaning shall be performed prior to equipment being energized.
- B. Raceways:
 - 1. General:
 - a. Cover all raceway openings prior to the installation of conductors to prevent dirt, moisture, and other debris from entering the raceways.
 - b. Before pulling conductors, swab out all raceways to remove any debris that may have entered raceways during construction or during storage.
 - c. When external surfaces of raceways or enclosures are rusted, clean and restore surfaces to original condition.
 - 2. Equipment:
 - a. After completion of work but prior to turning equipment over to the Owner, clean the exterior surfaces to be free from concrete residue, dirt, paint residue, etc.
 - b. All dirt, drywall dust, and all other foreign matter shall be blown from, wiped away, or vacuumed from transformer coils, terminal devices, panelboard interiors, switchboard interiors, junction boxes, pullboxes, and other similar equipment enclosures.

- c. Thoroughly clean equipment of all stains, paint spots, dirt, and dust. Remove all temporary labels not used for instruction or operation and remove all visible trade labels.

END OF SECTION 260500

SECTION 260510 - SELECTIVE ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Disconnection of power to selected portions of building or structure.
 - 2. Demolition and removal of selected electrical components.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Division 01 Section "Cutting and Patching."
 - 2. Division 02 Section "Selective Structure Demolition" for sequencing and scheduling procedures and requirements for demolition activities.

1.3 JOB CONDITIONS

- A. Perform all demolition as needed to accomplish new work.
- B. Do not rely solely on electrical drawings to determine extent of general construction demolition. Refer to architectural demolition plans for the exact extent of general construction demolition required by this contract.
- C. This Contractor is responsible for all charges, fees etc. incurred as a result of the electrical portion of the demolition.
- D. Prior to demolition or alteration of structures, the following shall be accomplished:
 - 1. Review available record documents of the existing construction. Owner does not guarantee that existing conditions are same as those indicated in record documents.
 - 2. Coordinate sequencing with Owner and other Contractors.
 - 3. Coordinate means to separate construction zones from non-renovated zones to prevent the spread of dust, fumes and debris.
 - 4. Coordinate means to provide exhaust and makeup air to maintain the construction zone at an adequate negative pressure to contain all construction dust and fumes.
 - 5. Except as noted otherwise, remove from the premises, all materials and equipment removed in the demolition work.
 - 6. Equipment noted to be removed and turned over to the Owner, shall be delivered to the Owner at a place and time he so designates.
 - 7. Where the materials are to be turned over to the Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain the condition of the

- materials and equipment equal to that existing before work began. Damaged materials or equipment shall be repaired or replaced at no additional cost to the Owner.
8. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore existing facilities to their pre-demolition condition, at no additional cost to Owner.
 9. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.1 PREPARATION

- A. Survey existing conditions and correlate with requirements indicated to determine the extent of selective demolition required.
- B. Refer to demolition drawings of other trades. Where motors, control panels, and other loads that have an electrical connection are being removed, include the disconnection and removal of associated electrical feeds, circuits, and loose control equipment in this contract.
- C. Protect existing work to remain in place, to be reused, or to remain property of Owner.
- D. Protect existing services and utilities.
- E. Disconnect electrical systems in walls floors and ceilings scheduled for removal.
- F. Coordinate utility service outages with serving utility company.
- G. Provide temporary wiring and connections to maintain existing circuits in service during construction.

3.2 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Beginning of demolition means installer accepts existing conditions.
- B. Existing electrical equipment in conflict with new construction shall be removed and/or relocated as indicated on the drawings, as directed or needed. This Contractor shall remove all electrical equipment released from service as a result of construction, and no equipment removed shall be reused, except as specifically directed on the drawings or elsewhere herein. All mechanical components shall be stored on site for Owner assessment. Any components not retained by the Owner shall be removed by the contractor. Properly dispose or remove from site any items not retained by Owner.
- C. Any existing services or equipment not shown on the drawings and which are logically expected to be continued in service and which may be interrupted or disturbed during construction, shall be reconnected in an approved manner. Provide temporary power connections, lighting, controls, etc., as needed to prevent interruption of service to occupied areas caused by

demolition operations. In addition, any conduit, wiring, fixtures, or equipment which may require relocation or rerouting as a result of construction, shall be considered a part of the work of this section and shall be done by this Contractor with no additional compensation, provided that the referenced relocation is discernable from the pre-bid review of the site, and associated documents.

- D. Verify circuiting arrangements are as shown on Drawings.
- E. Verify that abandoned wiring and equipment serve only abandoned facilities.
- F. Report discrepancies to Architect before disturbing existing installation.
- G. De-energize, disconnect, demolish, and remove electrical systems, equipment, raceways, wiring, and components indicated to be removed.
- H. Conduit to Be Removed: Remove portion of piping indicated or specified to be removed. In general, all empty raceways and associated supporting devices shall be removed back to nearest active junction box, panelboard, switchboard, panel cabinet, or other similar enclosure.
- I. Conductors to be Removed: Unless specifically stated elsewhere, all un-terminated conductors shall be de-energized, and all de-energized conductors shall be removed back to source.
- J. Equipment to be Removed, Including Panelboards and Distribution Equipment: De-energize, disconnect associated raceways and wiring, and remove equipment.
- K. Equipment to Be Removed and Reinstalled: De-energize, disconnect associated raceways and wiring, and remove equipment. Clean equipment and store where appropriate, reinstall, reconnect, and make equipment operational. Test equipment and associated components in accordance with the appropriate specification section.
- L. Equipment to Be Removed and Salvaged: De-energize, disconnect associated raceways and wiring, and move equipment to on site storage area as designated by the Owner.
- M. Any unused conduit openings in junction boxes, panelboards, switchboards, panel cabinets, pull boxes, or other similar enclosures shall be covered in a code approved manner.
- N. Update any electrical circuit directories or breaker identification nameplates to reflect changes in the status of overcurrent devices resulting from demolition.
- O. Disconnect and remove abandoned luminaires. Remove brackets, stands, hangers, and other accessories.
- P. Contractor shall check the ballasts of light fixtures removed from service. If any ballasts contain PCB's those ballasts shall be stored on site in containers and in a manner approved by local authorities and the Environmental Protection Agency. The contractor shall not be responsible for disposal of ballasts that contain PCB's
- Q. Notify Architect of location and extent of existing piping, conduit, OR equipment that interferes with new construction. In coordination with and with approval of Architect, relocate conduit and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned conduit and equipment as directed by Architect. Dispose of or store items as requested by Architect.
- R. Outlet boxes being abandoned in existing walls in remodeled areas shall have opening patched to match existing wall finish. Blank covers are not acceptable.

- S. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- T. Maintain continuity of circuits that remain in service.
- U. During the demolition and alterations, the fire alarm system, exit lighting and corridor life safety lighting shall remain active.
- V. Existing conduit and wiring in remodeled area that is not being removed, but which will be in conflict with new HVAC duct work being installed, shall be rerouted as required.
- W. This Contractor shall provide required additional support for existing conduit in remodeled area that is not being removed and is not properly supported in accordance with NEC requirements.
- X. When existing ductwork, piping, or related equipment in remodeled areas prevents the installation of other work, remove and reinstall existing materials, making necessary modifications and transitions to coordinate with other trades.

3.3 CLEANING AND REPAIR

- A. Clean existing materials and equipment which remain or are to be reused. Report damage or defects to Architect
- B. Existing Panelboards: Clean exposed surfaces and check tightness electrical connections. Provide closure plates for vacant positions.
- C. If equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- D. Repair adjacent construction and finishes damage during demolition and extension work.
- E. Luminaires: Clean existing luminaires shown to be reused. Use mild detergent to clean interior surfaces and visible exterior surfaces; rinse with clean water and wipe dry. Replace lamps. Energize fixtures. Notify Architect of fixtures with faulty components.

END OF SECTION 260510

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

SUMMARY

- B. This Section includes the following:
 - 1. Building wires and cables rated 600V and less.
 - 2. Connectors, splices, and terminations rated 600V and less.

ACTION SUBMITTALS

- C. Product Data: For each type of product indicated.

INFORMATIONAL SUBMITTALS

- D. Field quality-control test reports.

QUALITY ASSURANCE

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NFPA 70.

PROJECT CONDITIONS

- G. Wire and cable routing where shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- H. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. General Cable Corporation.
 - 2. Senator Wire & Cable Company.
 - 3. Southwire Company.
 - 4. AFC Cable Systems, Inc.
- B. Copper Conductors: Comply with NEMA WC 70. Aluminum not permitted.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN/THWN, XHHW-2 and SO.
- D. Multiconductor Cable: Comply with NEMA WC 70 for Type MC and Type SO with ground wire.

METAL CLAD CABLE

- E. Type MC.
- F. Conductor: Solid copper
- G. Jacket: Steel or Aluminum
- H. Minimum Conductor Size: 12 AWG for lighting and power circuits; #16 for fire alarm. Grounding conductor shall be same size as current carrying conductors contained in the cable assembly.
- I. Insulation: Type THHN.
- J. Armor: Interlocked, spiral-wound sheet tape.
- K. Cable terminators:
 - 1. Malleable iron or aluminum with red plastic, internal, anti-short bushings.

CONNECTORS AND SPLICES

- L. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
 - 6. Thomas & Betts.
- M. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

- N. Spring wire connectors: Corrosion-resistant, live-action spring in insulated shell, rated 105°C.
- O. Connectors and lugs: Circumferential compression (non-indenter) type.

PART 3 - EXECUTION

CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Conductor: Copper. Solid for #10 AWG and smaller; stranded for #8 AWG and larger.
 - 2. Insulation: Type XHHW-2 insulation for feeders larger than #2 AWG; Type THHN/THWN insulation for feeders #2 AWG and smaller.
- B. Branch Circuits:
 - 1. Conductor: Copper. Solid for #10 AWG and smaller; stranded for #8 AWG and larger.
 - 2. Insulation: Type XHHW-2 insulation for branch circuits larger than #2 AWG; Type THHN/THWN insulation for branch circuits #2 AWG and smaller.
- C. Motors and equipment connections subject to vibration: Copper. #12 AWG and larger, stranded conductor, single conductor.
- D. Use stranded conductor, single conductor, #14 minimum for control wiring.
- E. Metal Clad Cable – Type MC:
 - 1. MC Cable may be used at the contractor's option for branch circuits between devices and for switching circuits.
 - 2. Uses not permitted.
 - a. Home runs. Circuit home runs shall be individual wires in approved raceways.
 - b. Branch wiring in inaccessible ceilings.
 - c. Wiring runs exposed in unfinished spaces.
 - d. For circuits crossing smoke walls.
 - e. In exterior locations, or where exposed to view except in electrical rooms.
 - 3. MC Cable shall not terminate in Panelboards, Load Centers, Disconnects, Motor Controllers, Variable Speed Drives, Electrical Cabinets, Fire alarm panels, etc.
 - 4. Support metal clad cables above accessible ceilings using clips or cable ties. Do not rest cables on ceiling panels.
 - 5. Do not support metal clad cables from cable tray, from mechanical ducts or equipment, or from ceiling support wires.
 - 6. Install products in accordance with manufacturer's instructions.
 - 7. Other restrictions as listed in the NEC and other applicable codes.

CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- F. Service Entrance: Single conductors in raceway.
- G. Exposed Feeders: Single conductors in raceway.

- H. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Single conductors in raceway.
- I. Exposed Branch Circuits, Including in Crawlspace: Single conductors in raceway.
- J. Branch Circuits Concealed above Ceilings, in Walls, and Partitions: Single conductors in raceway, Metal-clad cable, Type MC.
- K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- L. Class 1 Control Circuits: Single conductors in raceway.
- M. Class 2 Control Circuits: Single conductors in raceway.

INSTALLATION OF CONDUCTORS AND CABLES

- N. Conceal cables in finished walls, above ceilings, and in floors, unless otherwise indicated.
- O. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- P. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- Q. Install exposed conduits parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- R. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- S. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- T. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

FEEDER REQUIREMENTS

- U. Contractor shall provide lugs, compression fittings, auxiliary wireways, etc., of adequate size for termination of feeder sizes as indicated on drawings. Feeder sizes indicated may be oversized for voltage drop in some cases. Contractor shall coordinate with equipment manufacturer for proper lug sizes.
- A. Extend feeders at full capacity from origin to termination.
- B. Feeders shall be continuous, without splices in so far as, practical. All feeder splices not specifically indicated on drawings must be prior approved by engineer in writing before splicing any cable.
- C. Each conduit raceway shall contain only those conductors constituting a single feeder circuit.
- D. Where multiple raceways are used for a single feeder, each raceway shall contain a conductor of each phase and neutral, if used, and a grounding conductor.

- E. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular-mil area, insulation type, and terminated in same manner.
- F. Where parallel feeder conductors are run in separate raceways, raceways shall have same physical characteristics.
- G. Feeders shall follow most accessible routes, concealed in construction in finished areas, exposed to the minimum temperature gradient and to minimum temperature fluctuation.
- H. Confine feeders to insulated portions of building, unless otherwise shown.
- I. Trapped runs without facilities for continuous drainage are not acceptable.
- J. Do not draw conductors into conduits until building is enclosed and watertight and until work which may cause cable damage has been completed.
- K. Feeders shall be sized for a maximum voltage drop of 2%.

BRANCH CIRCUIT REQUIREMENTS

- L. Do not use wire smaller than #12 AWG (unless otherwise noted) for branch circuit wiring, including motor circuits. All 20 amp, 120 volt and 277 volt branch circuit homeruns (to panelboard) serving receptacles, equipment, and lighting shall be #10 AWG minimum to first outlet or light fixture.
- M. Size home runs for 120V branch circuits based on the overall circuit length to the furthest outlet. The following requirements shall be followed:
 - 1. 0 to 100 ft. circuit length: Size home run at #10 AWG minimum to first outlet.
 - 2. 101 to 150 ft. circuit length: Size home run at #8 AWG minimum to first outlet.
 - 3. 151 to 250 ft. circuit length: Size home run at #6 AWG minimum to first outlet.
 - 4. For other branch circuits, size conductors so that voltage drop does not exceed 3%.
- N. All 120 volt and 277 volt branch circuits shall have a dedicated neutral conductor for each circuit.
- O. The plans show a circuit number for each device or light. This is done for clarity. No more than three 120V circuits shall be allowed in a single home run raceway.
- P. For isolated ground receptacle circuits, provide a dedicated neutral conductor and a dedicated isolated ground conductor for each circuit.
- Q. Any branch circuit protected by a GFCI circuit breaker shall be provided with a dedicated neutral conductor.

CONNECTIONS

- R. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- S. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

- T. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
- U. Clean conductor surfaces before installing lugs and connectors.
- V. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- W. Use compression connectors for conductor splices and taps, #6 AWG and larger. Use compression tool designed for the size and type of connector being compressed. Tape uninsulated conductors and connector with electrical tape to 150% of insulation rating of conductor.
- X. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, #8 AWG and smaller.
- Y. Where oversized conductors are called for (due to voltage drop, etc.) provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.

MOTOR AND EQUIPMENT WIRING

- Z. Furnish and install motor circuits in accordance with schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.
- AA. Conductor and conduit size for motor branch circuits, if shown on drawings, are sized for motor requirement only. Contractor may, at his option, include associated control conductors in same conduit providing the conduit size is adjusted to meet code requirements for percentage of fill.
- BB. Motors shall have proper size wire as per applicable codes and nameplate ratings. Verify ratings of motors before installing wiring.
- CC. Obtain manufacturer's wiring diagrams of electrical equipment furnished with equipment and do not proceed to wire equipment without this information.
- DD. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).
- EE. Make equipment connections with flexible conduit or liquid-tight flexible metallic conduit. Properly ground non-current carrying metal parts of equipment. Where cord connections or receptacles are required, provide type "S" rubber jacketed cord, 600 volt, heavy duty service of sizes and lengths required, and receptacle as applicable.
- FF. Coordinate work with the other trades such that the operation of mechanical equipment will be as described in mechanical specifications.
- GG. Unless otherwise indicated on drawings or in specifications, motors shall be furnished, set in place, and connected to driven equipment and prepared for operation as specified in other sections. Provide final connection and proper phase relationship to achieve proper motor rotation.

FIRESTOPPING

- HH. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

FIELD QUALITY CONTROL

- II. Perform tests and inspections and prepare test reports.

JJ. Tests and Inspections:

1. Visual and Mechanical Inspection:

- a. Compare cable data with drawing and specifications
- b. Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.
- c. Inspect bolted electrical connections for high resistance. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
- d. Inspect compression-applied connectors for correct cable match and indentation.
- e. Inspect for correct contractor identification and phase arrangements.
- f. Inspect jacket insulation and condition.

2. Electrical Tests:

- a. Perform insulation-resistance test on each feeder conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.
- b. Perform continuity tests to insure correct cable connection.

- KK. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Grounding Bus: Predrilled rectangular bars of 1/4 inches (6.3 mm) annealed copper, minimum 4 by 20 inches (102 by 508 mm) in main electrical rooms and minimum 4 by 10 inches (102 by 254 mm) in all other areas, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Panduit – Irreversible compression connectors.
 - 2. Erico – Welded connectors.

- B. Listed and labeled by a NRTL acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- C. Bolted Connectors for Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- D. Welded Connectors: Exothermic-welding kits, low-emission, electric-starting types and of types recommended by kit manufacturer for materials being joined and installation conditions.
- E. Compression Connectors: Irreversible type meeting IEEE standard 837-2002 and UL listed.
- F. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for #8 AWG and smaller; and stranded conductors for #6 AWG and larger, unless otherwise indicated.
- B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- C. Grounding Bus: Install in all electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus bar on insulated spacers 1 inch (25 mm), minimum, from wall 18 inches (450 mm) above finished floor, unless otherwise indicated.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors.
 - 3. Connections to Ground Rods at Test Wells: Welded connectors.
 - 4. Connections to Structural Steel: Welded connectors.
 - 5. Aboveground Accessible Connections: Irreversible compression or welded connectors.
 - 6. Connections in areas that may be a fire hazard to use welded connectors: Irreversible compression connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits. Terminate each end on suitable lug, bus or bushing.

- B. Bond equipment grounding terminal bars of the normal and emergency electrical system panelboards that serve the same patient area with an insulated continuous copper conductor not smaller than #8 AWG.
- C. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide insulated grounding conductor in raceway (minimum #4 AWG) from the main service copper bus bar to each service location(s), terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a copper grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 - 3. Bond all cable tray, metallic conduits, and equipment racks with minimum #6 AWG to copper bus bar.

3.3 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions and NECA 331.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts. Bond together metal siding not attached to grounded structure and bond to grounding electrode system.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.4 TERMINATIONS AND CONNECTIONS

- A. Equipment Grounding Conductor Terminations: For #8 AWG and larger, use pressure-type grounding lugs. #10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

- B. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.5 LABELING

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

END OF SECTION 260526

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Fire Stop Systems" for fire stopping materials and installation at penetration through walls, ceilings and other fire-rated elements.
 - 2. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. O-Z/Gedney; a brand of EGS Electrical Group.
 4. Robroy Industries.
 5. Southwire Company.
 6. Thomas & Betts Corporation.
- B. EMT: Comply with ANSI C80.3 and UL 797.
- C. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- D. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Indoor Wet Locations or Exterior: Steel insulated throat, compression, UL listed rain-tight.
 2. Fittings for EMT: Steel insulated throat, set-screw or compression type (Die-cast fittings will not be accepted).
 3. Expansion Fittings: Steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper Technologies Company; Cooper Crouse-Hinds.
 2. Hoffman; a Pentair company.
 3. Hubbell Incorporated; Killark Division.
 4. O-Z/Gedney; a brand of EGS Electrical Group.
 5. RACO; a Hubbell Company.
 6. Robroy Industries.
 7. Thomas & Betts Corporation.
 8. Wiremold / Legrand.
- B. General Requirements: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations. Weatherproof outlets shall utilize a use stainless steel or cadmium plated malleable iron box suitable for flush mounting.
- C. Sheet Metal Outlet and Device Boxes: Galvanized Steel. Comply with NEMA OS 1 and UL 514A.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- E. Cast-Metal Outlet and Device Boxes: Surface mount, NEMA FB 1, ferrous alloy, Type FD, with gasketed cover with stainless steel screws. Provide threaded hubs.
- F. Device Box Dimensions: Minimum 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- G. Sheet Metal Pull and Junction Boxes: NEMA OS 1.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Concealed above Ceilings, elevated underfloor, and in Interior Walls and Partitions: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 4. Connections to Lighting Fixtures in Accessible Ceilings: FMC – max 72 inches (1.8 m) in length.
 - 5. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 - 6. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 - 7. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 - 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R in damp or wet locations.
- B. Minimum Raceway Size:
 - 1. Minimum conduit size shall be 1/2 inch (16 mm) trade size except for conduit homeruns to panelboards, minimum size shall be 3/4 inch (21 mm).
 - 2. Minimum conduit size shall be 3/4 inch (21 mm) trade size except for switch legs and control circuits may be 1/2 inch (16 mm).
 - 3. Minimum FMC size shall be 1/2 inch (16 mm) except flexible connections to lighting fixtures may be 3/8 inch (12 mm), not to exceed 6 feet (1.5 m) in length
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 12 inches (300 mm) away from parallel runs of flues hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Conduit routing shown on drawings indicate approximate locations unless dimensioned. Route as required to complete wiring system.
- D. Complete raceway installation before starting conductor installation.
- E. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

- G. Conceal conduit within finished walls, above ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT.
 - 2. Use conduit bushings or insulated fitting at conduit ends not terminated in hubs or to an enclosure.
- K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- M. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- P. Conduit Routing:
 - 1. Arrange conduit to maintain headroom and present neat appearance.
 - 2. Route exposed conduit parallel with and perpendicular to walls and other building architectural and structural elements.
 - 3. Route conduits above accessible ceilings to clear access openings.
 - 4. Maintain adequate clearance between conduit and piping of other trades.
 - 5. Maintain 12 inches (306 mm) clearance between conduit and surfaces with temperatures exceeding 104 deg F (40 deg C).
- Q. Cut conduit square using saw or pipecutter; de-burr cut ends.
- R. Use conduit bodies to make sharp changes in direction, as around beams.

- S. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control joints.
- T. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- U. Termination of Conduit Stubs:
 - 1. Signal Systems: Use conduit bushing.

3.3 OUTLET BOX INSTALLATION

- A. Location of outlets and equipment as shown on drawings is approximate, and exact location shall be verified and shall be determined by:
 - 1. Construction or code requirements.
 - 2. Conflict with equipment of other trades.
 - 3. Equipment manufacturer's drawings.
 - 4. As dimensioned on interior or architectural elevations/plans as long as in compliance with all applicable codes.
- B. All outlet boxes shall be mounted flush with wall surface unless noted otherwise.
- C. Weatherproof outlet boxes specifically noted for surface mounting shall utilize a cast metal box complete with threaded conduit ends for surface outlets.
- D. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- E. Use plaster rings for all concealed work except for masonry boxes; depth of rings as required to reach finished surface.
- F. Do not fasten boxes to ceiling support wires and support boxes independently of conduit.
- G. Orient boxes to accommodate wiring devices oriented as specified in Division 26 Section "Wiring Devices".
- H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- I. Conflict with millwork, tack boards, etc. Coordinate mounting heights and location of outlets mounted above counters, benches and backsplashes. Contractor shall review architectural elevations and millwork drawings before roughing-in boxes and conduit. Any conflicts shall be noted and addressed by an RFI requesting direction as to resolution. Adjusting box locations due to such conflicts shall be at no additional compensation.
- J. Minor modification in the location of outlets and equipment is considered incidental up to a distance of 10 feet with no additional compensation, providing necessary instructions are given prior to roughing in of outlet.
- K. Electrical outlet boxes may be installed in vertical fire resistive assemblies classified as fire/smoke and smoke partitions without affecting the fire classification, provided such openings do not exceed 16 square inches (100 square cm) and they are located per applicable UL assembly. All clearances between such outlet boxes and the gypsum board must be completely filled with joint compound or other approved materials. The wall must be built

around outlets of a larger size so as to not interfere with the integrity of the wall rating. The aggregate surface area of the boxes shall not exceed 100 square inches (645 square mm) per 100 square feet (9 m). Boxes located on opposite sides of walls or partitions shall be separated by a horizontal distance of 24 inches (609 mm) or by providing listed putty pads around both boxes. The metallic outlet or switch boxes shall be securely fastened to the studs and the opening in the wallboard facing shall be cut so that the clearance between the box and the wallboard does not exceed 1/8 inch (3mm).

- L. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall a minimum of 12 inches (306 mm) or on opposite sides of stud in partition walls. Where back to back boxes cannot be avoided, provide gypsum board between boxes.
- M. Where more than two switches or devices are located at one point, use ganged boxes and covers, unless devices do not allow for ganging or manufacturer recommends otherwise. Provide permanently installed barriers between adjacent switches as required to meet regulatory requirements.
- N. Align adjacent wall mounted outlet boxes for switches, thermostats and similar devices.

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Trough cable trays.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Mono-Systems, Inc.
3. Wiremold.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Drawings for specific requirements for types, materials, sizes, and configurations.

2.3 TROUGH CABLE TRAYS

- A. Description:
 1. Configuration: Two longitudinal members (side rails) with a solid sheet over rungs exposed on the interior of the trough, or corrugated sheet with both edges welded to the side rails.
 2. Rung Spacing: Rungs or corrugations shall be spaced a maximum of 6 inches (150 mm) o.c. and have a minimum flat bearing surface of 2 inches (50 mm).
 3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
 4. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
 5. Minimum Usable Load Depth: 5 inches (125 mm).
 6. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
 7. Width: 12 inches (300 mm) unless otherwise indicated on Drawings.
 8. Fitting Minimum Radius: 12 inches (300 mm).
 9. Splicing Assemblies: Bolted type using serrated flange locknuts.
 10. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 11. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.4 MATERIALS AND FINISHES

- A. Aluminum:
 1. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
 2. Hardware: Chromium-zinc-plated steel, ASTM F 1136.
 3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.5 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 WARNING SIGNS

- A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure[**and install seismic restraints**].
- G. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- I. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

- J. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- K. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- L. Make changes in direction and elevation using manufacturer's recommended fittings.
- M. Make cable tray connections using manufacturer's recommended fittings.
- N. Seal penetrations through fire and smoke barriers. Comply with requirements in Division 07 Section "Penetration Firestopping."
- O. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- P. Install cable trays with enough workspace to permit access for installing cables.
- Q. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Division Section "Grounding and Bonding for Electrical Systems."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on vertical runs to cable trays every 36 inches (450 mm).
- C. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.

2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorquing in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

END OF SECTION 260536

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification of power and control cables.
 - 2. Identification for conductors.
 - 3. Warning labels and signs.
 - 4. Instruction signs.
 - 5. Equipment identification labels.
 - 6. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound or tubing type, with circuit identification legend machine printed by thermal transfer or equivalent process.
 - 1. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
 - 2. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings including neutral conductor.
 - 3. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.2 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 1/2 inch (13 mm).
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 1/2 inch (13 mm).

2.6 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black except where used for color-coding.
- B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 - 5. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping stainless steel screws, except contact type permanent commercial grade adhesive providing a permanent bond shall be used where screws cannot or should not penetrate substrate.
- B. Two-sided tape and dynamo type adhesives are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Indoors and Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION REQUIREMENTS

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in panelboards, switchboards, switchgear, vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors and neutral and ground conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White.
 - 5) Ground: Green.
 - 6) Isolated Ground: Green/Yellow Tracer.
 - c. If existing color coding is different than indicated above, match existing color coding.
 - 2. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Install instructional sign in the each main electrical room including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- D. At each junction box, the covers on junction boxes and pull boxes in areas that are not to be painted shall be marked with "Indelible Markers" to indicate the circuit number(s) of conductors in the box.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment.

- F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with design documents. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

- a. Panelboards.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Disconnects
- e. Switchgear.
- f. Switchboards.
- g. Variable-speed controllers.
- h. Contactors.

- G. Engraved laminate signs shall have white lettering in a black field.

- H. Panelboard identification shall indicate panelboard designation, voltage and where fed from, i.e., "PANEL 1LA - 120/208V, 3 PHASE, 4W".
FED FROM 1MDPHA"

- I. Panelboards located in storage rooms shall have floor space per NEC-110 permanently marked and shall be identified as "Electrical Access - Not For Storage."

- J. Identify each conductor with its circuit number or other designation indicated on Drawings.

- K. Identify neutrals with its associated circuit number(s).

- L. Install conductor markers at all new connections and terminations and existing connections and terminations, modified or altered.

3.3 ENGRAVED COVER PLATES

- A. All cover plates for control stations controlling remote equipment shall be engraved to identify the device being controlled.
- B. Engraved cover plates shall be supplied and installed on all switches serving lobbies, corridors, and other public locations.

- C. Wiring device coverplates shall be factory engraved to indicate panel designation and circuit number (i.e. "1HLA-7"). Letter height shall be 1/4" (7 mm), recessed and colored:
 - a. Black for normal power
- D. For receptacles other than 20A, 120V, engraving shall include receptacle voltage, phase and amperage at top of receptacle and panel designation and circuit numbers at bottom of receptacles.
- E. Adhesive labels and nameplates are not acceptable.

3.4 COVER PLATES

- A. All wiring device cover plates shall have panel designation and circuit number (i.e. "1HLA-7") serving device clearly marked on the back of each faceplate with indelible marker.

3.5 PANELBOARD CIRCUIT DIRECTORIES

- A. Install in each panelboard a typewritten directory accurately indicating rooms and equipment being served. Verify actual room names and numbers to be used. Also, provide a copy of typewritten panelboard directories in Owner's close-out manuals.
- B. Where new circuits are added to existing panelboards or existing circuits deleted, provide new typewritten panelboard circuit directory with added circuits identified and deleted circuits indicated as 'spare'. Circuit identification shall indicate room and equipment being served.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Time clocks.
 - 2. Photoelectric switches.
 - 3. Indoor occupancy sensors.
- B. Related Requirements:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 SYSTEM DESCRIPTION

- A. Occupancy Sensors
 - 1. Occupancy sensors shown on drawings are intended to show control intent. Quantities and locations are approximate and may not include all devices required for 100% coverage to meet energy code requirements. It shall be the contractor's responsibility to provide a complete Occupancy Sensor system based on the performance requirements of this specification and energy code requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lightolier as indicated on drawings or comparable product by one of the following:
 - 1. Leviton Mfg. Company Inc.
 - 2. Watt Stopper.

- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Lightolier as specified on drawings or comparable product by one of the following:
1. Leviton Mfg. Company Inc.
 2. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V.
- C. Wall-Switch Sensor :

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: Dual technology.
3. Switch Type: SP and dual circuit, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: 120 V.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Operational Test: After installing switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 3 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Disconnecting and Overcurrent Protective Devices

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective devices, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and electrical ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Field quality control test results
 - 8. Operating and Maintenance data.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Copies of all panelboard typewritten directories.
- B. Record Drawings: Create and submit record drawings including the final version of each panel schedule after load balancing. Create drawings matching the record set and incorporate final panel schedules on drawing and add panel schedule sheets to drawing index.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with National Electrical Manufacturer's Association (NEMA) Standards Publication Number PB1.1 and PB 1.2.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Do not store panelboards exposed to weather.
- C. Handle and prepare panelboards for installation according to NEMA PB 1.
- D. Protect panelboards against damage from work of other trades.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with freestanding panelboards with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: spares for each panelboard as shown on one the Panel Schedules.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated. Provide circuit directory in clear plastic cover. Provide panelboards with lugs suitable for termination of feeder sizes indicated on drawings.
- B. Each panelboard, as complete unit, shall have a short circuit current rating equal to or great than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage. All panelboards shall be fully rated, series rated panels are not approved.
- C. Enclosures: Surface mounted cabinets. Refer to panel schedule and floor plans for types of panel cabinets required.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, type 1.
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions. Provide full height hinged trim integrated into front cover to allow access to wire gutters without the removal of cover. Provide hinged door for access to overcurrent devices.
 3. Back Boxes: Galvanized steel.
 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- D. Incoming Mains Location: Top or bottom. Mains location is at the contactor's option as project conditions dictate, unless specifically indicated otherwise on the drawings.
- E. Phase, Neutral, and Ground Buses:
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type. Lugs shall be of sizes as required to accept feeders as indicated on the drawings.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series rated panels are not approved.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D NQOD series panelboards or comparable product by one of the following. The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or main lugs only as indicated on the on the Panel Schedules.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Buses:
1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs. Provide on panels where specifically noted on the panel schedules or one line diagram.
 2. Copper equipment and isolated ground buses. Provide on panels where specifically noted on the panel schedules or one line diagram.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.

- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Where required to achieve system coordination with upstream and downstream overcurrent devices, solid-state, electronic trip, circuit breakers shall be provided and where noted on drawings and schedules.
 - 2. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 3. Provide the following where noted on the drawings or schedules:
 - a. Handle Clamp: Loose attachment, for holding circuit breaker handle in the on position.
 - b. Lockable: Fixed attachment for padlocking circuit breaker handle in the on or off position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to manufacturer's written instructions, according to NEMA PB 1.1, and in accordance with recognized industry standards.
- B. Mount panelboards surface mounted as indicated on drawings and schedules.
- C. Support panel cabinets independently to structure with no weight bearing on conduits.
- D. Mount so that top breaker is not higher than 6'-0" (1800 mm) AFF, unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush and tight with wall finish and mating with back box.
- F. Adjacent panel cabinets shall be of same physical size and mounted in horizontal alignment.
- G. Provide lugs in panelboards of adequate size to accept feeders as indicated on drawings.
- H. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.

2. Install filler plates in unused spaces.
 3. Provide handle clamp accessory for any circuit breaker serving fire alarm control panels or fire alarm power supplies.
 4. Provide lockable handle padlock circuit breaker attachment where noted on panel schedules or plans as lockable option.
- I. Provide one 3/4" empty conduit for each three panel spaces between panelboard and accessible ceiling space or space designated to be ceiling space in the future, for future use.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Verify actual room names and numbers to be used, and include room name, room number and name of load being served for every circuit.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 2. Megger check and test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit. Do not megger check solid state components.
 3. Test continuity of each circuit.
 4. Energize each circuit and check for complete function.
 5. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - B. Panelboards will be considered defective if they do not pass tests and inspections.
 - C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - D. Touch up paint scratched or marred surfaces to match original finish.
- 3.5 ADJUSTING AND CLEANING
- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
 - B. Tighten lugs and bus connections.
 - C. Clean interior of panelboard.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI.
 - 2. Snap switches and wall-box dimmers.
 - 3. Device face plates.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RFI: Radio-frequency interference.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source unless noted otherwise.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 2. Leviton Mfg. Company Inc. (Leviton).
 - 3. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 DEVICE COLORS

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect.

2.3 STRAIGHT BLADE RECEPTACLES

- A. General:
 - 1. Convenience Receptacles, 125 V, 20 A, 5-20R configuration: Comply with NEMA WD 1, NEMA WD 6, UL 498, and FS W-C-596.
- B. Heavy-Duty, Simplex:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pass & Seymour – 5361
 - b. Hubbell –HBL5361
 - c. Leviton - 5361
- C. Heavy-Duty Duplex:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pass & Seymour – 5362
 - b. Hubbell – HBL5362
 - c. Leviton - 5362
- D. GFCI Receptacles:
 - 1. General Description: Feed-through type. Comply with UL 943, Class A, and include indicator light that is lighted when device is tripped.
 - 2. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - a. Receptacle shall be capable of being installed in a 2-1/2 inch deep outlet box without adapter.
 - b. Shall be grounding type with solid-state ground fault sensing and signaling; with 5 milliamperes ground fault trip level.
 - c. Test and reset buttons shall match color of face.
 - d. If critical components within receptacle are damaged and the ground fault protection is lost, power to receptacle shall be automatically disconnected within the device.

3. Products: Subject to compliance with requirements, provide one of the following:

a. Indoor – Dry Locations:

- 1) Pass & Seymour – 2095
- 2) Hubbell – GF20-LA
- 3) Leviton – 7899

2.4 SWITCHES

A. Switches shall be rated for 20 amperes, and rated 120/277 volts AC. Switch shall be manufacturer's specification grade toggle switch. Switches shall have quiet action mechanism with silver alloy contacts for longevity. Comply with NEMA WD 1, UL 20, and FS W-S-896.

1. Terminal screws shall allow back and side wiring and accept #14, 12, and 10 AWG stranded or solid wire.

B. Single Pole

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC1
- b. Hubbell – HBL1221
- c. Leviton – 1221-2

C. Double Pole Single Throw:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC2
- b. Hubbell – HBL1222
- c. Leviton – 1222-2

D. Three Way:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC3
- b. Hubbell – HBL1223
- c. Leviton – 1223-2

E. Four Way:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Pass & Seymour – PS20AC4
- b. Hubbell – HBL1224
- c. Leviton – 1224-2

2.5 WIRING DEVICE ACCESSORIES

A. Wall Plates:

1. 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; wall plates colored to match wiring devices. Provide plates possessing the following additional construction features:
 - a. Material and Finish:
 - 1) Nylon, smooth – color to match device
2. Device plates for surface mounted Type FS or FD boxes: Type FSK galvanized steel covers.
3. Device plates for surface mounted, 4 in. square boxes: 1/2 in. raised galvanized steel covers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

B. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

C. Device Installation:

1. Clean debris from every outlet box; including excess drywall mud.
2. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
3. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
4. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment. Clean exposed surfaces to remove spatters and restore finish.
5. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

7. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
9. Tighten unused terminal screws on the device.
10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact. Provide extension rings to bring device flush with finished surface (do not use switch box extension rings/goof rings). Install devices plumb, level and rigidly in place.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

E. Device Plates:

1. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates where devices permit.

G. Ground receptacles with the insulated green ground wire from device ground screw to a bolted outlet box connection.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served on device.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Provide operational testing for devices.
3. Test receptacles with Hubbell 5200, Woodhead 1750, or equal, for correct polarity, proper ground connection, and wiring faults.

B. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior luminaires, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. CU: Coefficient of utilization.
- E. HID: High-intensity discharge.
- F. LED: Light Emitting Diode.
- G. LER: Luminaire efficacy rating.
- H. Luminaire: Complete luminaire, including ballast housing if provided.

1.4 ACTION SUBMITTALS

- A. Contractor shall provide submittals for luminaires as indicated in the "Lighting Fixture Schedule." Where an alternate manufacturer is indicated for a specific luminaire with no catalog number indicated for the alternate manufacturer, provide alternate luminaire that is equal in all characteristics as the cataloged luminaire. Luminaires without alternate manufacturers noted shall be provided with no substitutions and/or alternates.

- B. Excess delivery times shall not be an acceptable cause for substitution of specified luminaires. Notify Architect/Engineer of any long lead luminaires that may impact project schedule within two weeks of contract award. Beyond two weeks the contractor is responsible for any costs associated with expediting the manufacturing process of the specified luminaire and/or cost associated with an approved substitute luminaire is allowed by Architect/Engineer.
- C. Product Data: For each type of luminaire submit catalog literature for each luminaire specified in booklet form with index and a separate sheet for each luminaire, assembled in luminaire "type" alphabetical order, with specified luminaire data as required below.
- D. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. Ballast, including BF.
 - 4. Energy-efficiency data.
 - 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project.
 - a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - 7. LED compliance testing documentation in accordance with IESNA LM-80 and the DOE CALiPER testing documentation for all solid state luminaires.
- E. Shop Drawings: For nonstandard or custom luminaires. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- F. Samples: For each luminaire indicated in the "Lighting Fixture Schedule." Each Sample shall include the following:
 - 1. Lamps and ballasts, installed.
 - 2. Cords and plugs.
 - 3. Pendant support system.
- G. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified agencies providing photometric data for luminaires.
- B. Field quality-control reports.
- C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

- A. Equivalency of luminaires is determined by Engineer and includes the following data for comparative purposes.
 - 1. Efficiency.
 - 2. Efficacy.
 - 3. Distribution.
 - 4. Construction.
 - 5. Design compatibility.
 - 6. Manufacturer reliability based upon past performances.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- D. Comply with NFPA 70.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class, division, and group of hazard by FM Global.

1.8 COORDINATION

- A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.9 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: Five years from date of Substantial Completion. Full replacement warranty shall apply for the full five years.
 - 2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full replacement warranty shall apply for the full five years.

- B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. 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. Lamps: Furnish at least four of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Battery and Charger Data: 1 for each emergency lighting unit.
 - 4. Ballasts: 1 for each type and rating installed.
 - 5. Globes and Guards: Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings where only one manufacturer is listed, provide one of the products indicated on Drawings where multiple manufacturers are listed.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

- A. Provide luminaires of the size, type and rating indicated in "Lighting Fixture Schedule", complete with, but not necessarily limited to, lamps, lampholders, reflectors, ballasts, drivers, starters, wiring and any other accessories required for a complete working installation.
- B. Luminaire catalog numbers do not necessarily include all accessories and are intended to serve as a guide in defining types and manufacturers of luminaire only.
- C. The contractor shall ensure that the luminaire is UL listed for the ambient conditions where installed. Extra compensation will not be permitted for failure to coordinate luminaires with their ambient conditions.
 - 1. Luminaires located exterior to the building and/or in unconditioned damp spaces and under cover from direct weather exposure shall be UL listed as "Suitable for Damp Locations" unless noted otherwise.

2. Luminaires located exterior to the building and/or in unconditioned wet spaces and in direct contact with the weather or in washdown areas shall be UL listed as "Suitable for Wet Locations" unless noted otherwise.
- D. Luminaires installed with direct contact with insulation shall have an "IC" rating for direct contact with insulation. Verify if luminaires will be in contact with insulation prior to installation. Notify Architect/Engineer of any conflicts.
- E. Provide linear fluorescent ballast with quick disconnect in accordance with NFPA 70, Article 410.
- F. Gasketing material shall be vinyl or other non-aging type material as approved by Engineer.
- G. Provide proper trim for each luminaire as required for various types of ceiling being installed throughout the project; plaster rings, luminaire ends or caps, suspension units, mounting brackets and/or other accessory parts necessary for a complete luminaire.
- H. Recessed Luminaires: Comply with NEMA LE 4 for ceiling compatibility for recessed luminaires.
- I. Incandescent Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- J. Fluorescent Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- K. HID Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- L. Metal Parts: Free of burrs and sharp corners and edges.
- M. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- N. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- O. Diffusers, Covers, and Globes:
 1. Acrylic Luminaire Diffusers: Plastic for clear lenses and diffusers shall be formed of colorless 100% virgin acrylic, as manufactured by Atohaas, DuPont or equally acceptable manufacturer. The quality of the raw material must meet or exceed IES, SPI, and NEMA Specifications and shall not exceed a yellowness factor of 3 after 2,000 hours of exposure in the Fade-meter or as tested by an independent testing laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 10 years.
 - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
 - b. UV stabilized.

2. Glass: Glass used for lenses, refractors, and diffusers in incandescent luminaires shall be tempered for high impact and heat resistance; where clear glass has been specified, the glass shall be crystal clear in quality with a transmittance of not less than 88%. Where luminaire glass lenses are specified glass lenses shall be provided and plastic lenses shall not be substituted.
3. Provide clear tube guards over exposed fluorescent lamps in all strip and industrial luminaires in unfinished spaces. Equal to ALP Protect-A-Lamp.

P. Factory-Applied Labels: Comply with UL 1598.

1. All light fixtures shall factory-applied label near lamp socket stating maximum wattage of lamp allowed in fixture. Maximum wattage to be stated is wattage as shown on schedule of lighting equipment herein. Circuits are based on these wattages, circuitry, etc. Any failure to comply with this requirement shall be responsibility of contractor. Location of labels must meet acceptance of lighting designer, architect and engineer.
2. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
3. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter code (T-4, T-5, T-8, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. Start type (programmed start, etc.) for fluorescent and compact fluorescent luminaires.
 - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.

2.3 ACCEPTABLE BALLAST MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance
 2. General Electric
 3. Lutron
 4. Sylvania
 5. Universal Lighting Technologies
 6. Venture

2.4 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Description: Electronic Programmed-Start type, complying with ANSI C 82.11 and UL 935, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Sound Rating: Class A.
 2. Thermal Rating: Class P.
 3. Total Harmonic Distortion Rating: Less than 20 percent.
 4. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 5. Multi-voltage 120/277 volts.

6. Operating Frequency: 42-53 kHz.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.88 or higher.
9. Power Factor: 0.98 or higher.
10. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
11. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
12. Automatic lamp starting after lamp replacement.

2.5 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic Programmed-Start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz – 53kHz.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: Class P, 75 deg C, maximum.

2.6 EMERGENCY FLUORESCENT POWER UNIT

- A. Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast. Comply with UL 924.

1. Emergency Connection T8 Lamps: Operate one or two fluorescent lamp(s) continuously at an output of 1450-3500 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast. Shall be equivalent to Bodine B30 battery-inverter unit.
2. Emergency Connection T5 Lamps and T8 Lamps where required to be integral to pendant mounted, linear indirect luminaire: Operate one fluorescent lamp continuously at and output of 600-1325 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast. Shall be equivalent to Bodine LP600.
3. Emergency Connection Compact Fluorescent Lamps: Operate one compact fluorescent lamp continuously at and output up to 1250 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast. Shall be equivalent to Bodine B4CFG.
4. Test Push Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.7 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 2. AC/Battery Powered Exit Signs : Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.8 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or luminaires where noted on plans.
 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

2.9 LAMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Osram-Sylvania
2. General Electric
3. Philips Lighting Company
4. Venture
5. USHIO (Low-voltage lamps ONLY)

B. Fluorescent Lamps

1. All fluorescent lamps shall be of the same manufacturer.
2. Lamps in remodeled areas shall match color of existing lamps in area.
3. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
4. Minimum CRI of 85 for linear lamps and 82 for compact fluorescents.
5. Color Temperature of 3500 K.
6. T8 rapid-start lamps, rated 32 W maximum, nominal, 2950 initial lumens (minimum) and average rated life 20,000 hours unless otherwise indicated.
7. T8 rapid-start lamps, rated 17 W maximum and average rated life of 20,000 hours unless otherwise indicated.
8. Compact Fluorescent Lamps: 4-Pin, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
 - a. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - b. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - c. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - d. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - e. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - f. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
 - g. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Architect's and/or Interior Designer's reflected ceiling plans indicate actual location of all luminaires. Notify Architect/Engineer of any conflicts between these plans and electrical documents prior to rough-in and installation.
- B. Architect's and/or Interior Designer's elevation and/or section plans may show actual location of luminaires that are not documented on the reflected ceiling plans. If luminaires are not shown on elevation and/or section plans, install at height noted on the electrical documents. Notify Architect/Engineer of and conflicts between these plans and electrical documents prior to rough-in and installation.
- C. Temporary Lighting: If it is necessary, and approved by the Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps and reinstall.
- D. Verify adequacy of headroom and non-interference with other equipment such as ducts, pipes and openings. Report to Architect/Engineer any conflict between these plans and electrical documents.
- E. Adjustable luminaires shall be aimed as directed by Architect/Interior Designer/Engineer.

- F. Special care shall be taken to assure light-tight joints between recessed luminaires and ceiling systems.
- G. Recessed luminaires which are installed in rough textured ceiling surfaces whereby light may be emitted between luminaire frame and ceiling surface shall have black self-adhesive polyfoam gasketing installed around inside edges of frame to prevent light leaks.
- H. Install luminaires in a workmanlike manner. Care shall be taken in placement of luminaire outlets and surface-mounted luminaires to maintain alignment, spacing, layout, and general arrangement shown on drawings. Contractor may vary these dimensions slightly in order to clear obstructions. Any major changes in the arrangement must be approved by Engineer.
- I. Luminaires: Set level, plumb, and square with ceilings and walls. Install lamps in each luminaire.
- J. Coordinate with trades so luminaires are properly aligned with items such as diffusers, grilles, and speakers
- K. If necessary, relocate luminaires as directed by engineer so there will be no conflict with other equipment.
- L. Make luminaire holes for wire entrance with knock-out punches or hole saw, remove burrs. Do not cut holes with tinsnips.
- M. Clean luminaires of dirt and debris prior to acceptance.
- N. Maintain clearance as required in Section 410-66 of the NEC and other NFPA sections. Notify Engineer of any conflict, prior to rough-in.
- O. Comply with all relevant Federal, State, Local and Agency guidelines when disposing of lighting waste. Most fluorescent and HID lamps require special handling and disposal procedures.
- P. Electrical contractor shall remotely locate all transformers called for in the contract documents in a well ventilated and easily accessible space to comply with all codes.

3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. At time of Substantial Completion, replace lamps in luminaires which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Engineer.

3.4 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

- A. Provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. Adjust aimable luminaires in the presence of Architect.
- B. Adjust adjustable luminaires to satisfaction of Architect/Engineer.

END OF SECTION 265100