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SECTION 260500 – ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL SUPPLEMENTARY AND OTHER CONDITIONS OF THE CONTRACT

- A. The general, supplementary and other Conditions of the Contract and the General Requirements (Division 1) are hereby made a part of this section.

1.2 INTENT OF PLANS AND SPECIFICATIONS

- A. The plans and specifications contemplate the complete installation of the system described so that at the conclusion of the construction, the systems will be turned over to the owner complete and ready for safe, efficient operation. The plans and specifications cannot deal individually with the many minute items which may be required by the nature of the systems. The contractor shall be obliged to furnish and install all such items normally included on systems of this type, which while not mentioned directly herein, are obviously essential to the installation and operation of the system and which are normally furnished on quality installations of this type.
- B. The drawings are partly diagrammatic and do not necessarily show exact location of conduit unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining quantities or lineal runs of conduit.
- C. In receiving bids, it will be assumed that each bidder has made a thorough inspection of the conditions and is familiar with all conditions affecting the extent or cost of this work. Claims for extra payments as a result of failure to examine the conditions prior to submitting the bid will not be allowed.

1.3 ELECTRONIC COPIES OF DOCUMENTS

- A. Electronic drawing files are available for construction coordination upon written request to the architect or engineer for a cost of \$100 per drawing. A written release waver will be required to be signed by the entity requesting the drawing(s). Upon receipt of signed waver and payment of drawing fee, electronic files will be delivered. Regardless of files delivered, it is the responsibility of the recipient to field verify all conditions prior to the fabrication or installation of any work.

1.4 CODES, ORDINANCES, PERMITS, AND FEES

- A. Comply with all state and local codes and ordinances applying to the work specified herein. Attention is directed in particular to the NATIONAL ELECTRIC CODE (NEC), NATIONAL FIRE PROTECTION ASSOCIATION (NFPA), AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI), NATIONAL ELECTRICAL MANUFACTURERS INSTITUTE (NEMA), INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE), INTERNATIONAL BUILDING CODE (IBC), UNIFORM FEDERAL ACCESSIBILITY STANDARDS (UFAS), INTERNATIONAL ENERGY CONSERVATION CODE (IECC), MANUFACTURERS INSTRUCTIONS AND/OR ANY AUTHORITY HAVING JURISDICTION, and local regulations concerning the specified electrical, lighting and special systems equipment.
- B. Make application for, obtain and pay for all required permits and certificates of inspection for the work.

- C. In the event of conflict between this specification and a governing code or ordinance, the higher standard shall govern. Bidders shall familiarize themselves with local regulations which affect their work in any way. Extra payment will not be allowed for changes required by local regulations.

1.5 RESPONSIBILITY

- A. Be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.
- B. The drawings do not attempt to show complete details of the building construction which affect the electrical installation; and reference is therefore required to the Architectural, Structural, Landscape and Mechanical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.
- C. Location of electrical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at no additional expense to the Architect/Engineer or Owner.
- D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed. Roughing-in fixtures, etc., must be laid out accurately. Connections to equipment of the same class shall be equal heights, plumb, and at right angles to the wall, unless otherwise directed.
- E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.
- F. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.
- G. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury or loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.
- H. Circuiting and switching shall be exactly as shown on drawings. Combining of home runs is acceptable. Contractor shall refer to NEC Article 310.8 and adjust accordingly. Combining of wiring of various systems in conduit runs is not acceptable unless otherwise specified herein or noted on drawings.

1.6 INSPECTION

- A. Regular inspections shall be requested of duly authorized inspectors as required by codes and ordinances.

1.7 SUBSTITUTING

- A. Proposals to contractor for substitution of material and equipment listed on the drawings and/or these specifications shall be submitted after the architect/engineer's approval has been obtained. For such proposals, materials and equipment will have to conform in type, function, quality of material and assembly and meet the requirements indicated in drawings and specifications. REQUESTS FOR APPROVAL SHALL BE SUBMITTED TO THE ARCHITECT/ENGINEER AT LEAST 10 DAYS PRIOR TO THE BID DATE. Each request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, photometric IES files, performance and test data and any other information needed for an evaluation. A statement setting forth any changes in any other equipment or other work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. If these proposed substitutions are considered as acceptable equals for quotations and use, approval will be issued in an addendum.

1.8 SHOP DRAWINGS

- A. The contractor shall submit to the engineer for approval, prior to the placing of orders for any equipment, a complete schedule of electrical equipment and light fixtures to be installed. The schedule shall consist of at least six (6) sets each of catalogs, cuts, diagrams, shop drawings, photometric data or any other descriptive material necessary to fully describe the equipment proposed and its operating characteristics. The schedules shall list the operating conditions of the equipment at the conditions listed on the schedules. Provide shop drawings for the following equipment:
 - 1. Disconnect and Safety Switches.
 - 2. Lighting Contactors.
 - 3. Wiring Devices.
 - 4. Lighting Fixtures.
 - 5. Lighting Control Systems, Dimmer Systems and Switches.
 - 6. Timers and Time Switches.
 - 7. Raceway and Fittings.
 - 8. Cables, Wires and Terminations.
 - 9. Grounding Connections.
- B. All shop drawings shall be submitted by the contractor and shall have been signed, "approved" and initialed by the contractor prior to submittal to the engineer. The engineer will check the shop drawings to aid in interpreting the plans and specifications, and in so doing will assume that the shop drawings conform to all specified requirements set forth in this specification. The approval of the shop drawings by the engineer does not relieve the contractor of the responsibility of complying with all elements of the specification.
- C. The determination of quantities of material and equipment required shall be made by the contractor from the drawings. Schedules on the drawings and in the specification

are completed as an aid to the contractor, but where discrepancies arise, it shall not release the contractor from providing the proper number to complete this work.

1.9 ASBESTOS CONTAINING MATERIALS

- A. Coordinate all work with the asbestos abatement contractor for this project. Prior to the start of work the Contractor shall review all asbestos reports or sample analysis, that the Owner has had completed. The Contractor shall not cut into or in any other way disturb existing materials which contain asbestos. Asbestos abatement is not within the scope of Division 16 work. If the Contractor must disturb a material that has not been tested for asbestos, request in writing shall be made to the Owner that the material be tested for asbestos prior to the start of work.
- B. The Contractor shall provide materials and equipment which do not contain asbestos. At the completion of the project, the Contractor shall certify in writing that the materials and equipment installed do not contain asbestos.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fire barrier caulking system shall be 3M CP25 caulk. Fire barrier caulk shall be UL classified and Factory Mutual System approved.

PART 3 EXECUTION

3.1 INSTALLATION OF THE WORK

- A. The Contractor shall examine all the drawings before proceeding with the layout and installation of his work. General, mechanical, and plumbing contract drawings will be made available to this Contractor. SHOULD DISCREPANCIES AFFECTING THE WORK BE FOUND, THE CONTRACTOR SHALL IMMEDIATELY REPORT SAME TO THE ENGINEER FOR INSTRUCTIONS. Subsequent changes made necessary by the neglect of any Contractor to discover and report such discrepancies shall be made by and at the expense of the Contractor, under the direction of the Engineer.
- B. Furnish, provide, and/or install shall be considered as requiring the Contractor to both furnish the equipment and install it unless specific reference is made to the furnishing or installing of the equipment by others.
- C. The Contractor shall confer and cooperate with other Contractors on the job in the installation of his work so all work will be installed in proper relationship to the surrounding location and shape of any part to avoid conflicts. The Contractor shall be responsible for the correct size and location of any changes, slots, and openings required by him and shall be required to do, at his expense, any cutting or patching made necessary by his failure to make proper arrangements in this respect.
- D. The Contractor shall follow the equipment manufacturer's instructions and recommendations in the installation and connection of all equipment and materials furnished under this contract. In the event of conflict or discrepancy between manufacturer's instructions and the contract documents, the Contractor shall notify the Engineer before proceeding. No equipment installation shall be made in a manner that voids the manufacturer's warranty of the equipment.

3.2 SUPPLEMENTARY FRAMING AND HOUSEKEEPING PADS

- A. Provide the design, fabrication, and erection of supplementary structural framing required for the attachment of hangers or other devices supporting electrical equipment.
- B. Provide framing members of standard rolled steel shapes, A-36 steel, designed for their actual loads, with allowable stresses specified by AISC, without excessive deflection and with consideration for rigidity under vibration, in accordance with standard structural practices.
- C. When suspending transformers or similar vibrating equipment, provide vibration isolators to isolate vibration from structural members.
- D. Provide housekeeping pads where shown on plans. Size as noted or shown. Electrical contractor shall hire general contractor to install pads. This also includes the pad for the main pad mounted transformer.

3.3 CLEANING

- A. Labels, stickers, etc., shall be removed and the entire installation left in a clean, usable condition.

3.4 PAINTING

- A. Finishes of all electrical equipment shall be protected during storage, installation and until final acceptance. Any damage or imperfections shall be "touched up" or if extensive, the entire unit shall be repainted as directed by the Engineer.

3.5 FIRE BARRIER PENETRATIONS

- A. All cracks, voids, or holes for the passing of mechanical and electrical items through floors and fire rated walls, or ceilings with fire rating of 1 hour or more shall be sealed with a fire barrier caulk.
- B. Fire barrier caulking system shall be 3M CP 25 caulk.
- C. Fire barrier caulking system shall be installed in accordance with the manufacturer's recommendations to maintain a fire rating of 3 hours minimum.

3.6 SLEEVES

- A. The Electrical Contractor shall set and maintain all sleeves. Any conduit passing through building construction including walls, floors, roofs or masonry partitions shall be encompassed with sleeves in accordance with the following.
- B. All conduit sleeves through slabs, floors, masonry walls and partitions shall be 1/2 inch greater in inside diameter than the external diameter of pipe passing through. All sleeves shall be fabricated from new material cut square and reamed.
- C. Sleeves shall be provided in all masonry partition walls and floors. Sleeves shall be Schedule 40 steel pipe. Wall sleeves shall be flush with the wall surface. The top of floor sleeves shall extend 1" above the floor, the bottom of the sleeve shall be flush with the floor.

- D. The space between the pipe and the sleeves, through fire rated walls and floors shall be protected as designated below.
- E. Furnish and install chrome-plated wall, floor and ceiling plates on all exposed pipes where they pass through walls, floors, or ceilings in finished areas. The wall plates shall have set screws or spring locks for clamping to the pipe.
- F. All sleeves through floors shall be sealed watertight.

3.7 OPENINGS

- A. All openings required for the passage of multiple conduits and electrical equipment in the construction shall be provided by the Mechanical Contractor. The Mechanical Contractor shall be responsible for determining the correct location for all openings.
- B. The inside dimensions of all openings shall be 1/2 inch greater than the size of the ductwork or equipment passing through the opening. Openings for insulated ductwork shall be large enough to accommodate the insulation without harming the insulation or vapor barrier.
- C. All openings through fire rated walls and floors shall be protected as described above.

3.8 EXISTING SERVICES

- A. The Contractor shall verify the exact location of all existing building services extended and/or relocated for this project. The Contractor shall also verify the exact location and take proper precautions to protect all services which may be encountered during construction.
- B. All active services which are encountered shall be protected, braced and supported where required for proper execution of the work and without interruption of service if possible.
- C. All inactive services which are encountered shall be protected, or removed as directed by the Owner, Utility Company, or Municipal Agency having jurisdiction.
- D. When active services must be temporarily interrupted, arrangements shall be made to work continuously including overtime if required, to assure that services will be interrupted only as long as actually required to complete necessary work.

3.9 REMODELING WORK

- A. Wherever existing electrical wire, conduit, controls, circuits, etc., are cut into, removed, interrupted, as a result of the remodeling, all such items that serve areas or equipment that remain shall be re-routed, extended, relocated, etc., as necessary to maintain operation of equipment and services.
- B. Downtime shall be held to a minimum. Outages shall be scheduled at a time acceptable to and approved by the owner. Consult with the owner in sufficient time for him to make necessary preparations for the outage.

3.10 ACCESS TO EQUIPMENT

- A. Access shall be provided to all motors, junction boxes, relays, controls, specialties, etc., for maintenance purposes. All access doors, access panels, removable sections, etc., required for access shall be provided. The General Contractor will provide access panels and doors required in the building construction where shown on the plans. The location of the access openings relative to the electrical equipment shall be coordinated to assure proper access to the equipment.

3.11 PROTECTIVE DEVICES

- A. All sheaves, belts, drives, couplings, and moving parts shall be protected by approved permanent guards, shields, or railings, which shall be in place whenever the equipment is in operation and shall be in accordance with applicable safety standards.

3.12 TESTS

- A. Test all wiring and connections for shorts between conductors, shorts to ground, and for continuity prior to installation of fixtures and equipment.
- B. Perform insulation resistance test on all feeder conductors installed under this contract, including neutrals, using a megohmmeter. Minimum value shall be 100 megohm at 60 degrees F.
- C. Correct and retest any defects and submit data to engineer.
- D. Test all low-voltage cabling, installed within the contract, per industry standards and submit test results to engineer.

3.13 ALL EQUIPMENT FURNISHED UNDER DIVISION 16000:

- A. At a time set by the contractor and agreed to by the owner, arrange to place equipment in operation and have available at that time, if required, representatives of the manufacturer of equipment to assist in starting equipment, to make necessary adjustments to equipment, and to prove satisfactory operation prior to turning facility over to the owner.
- B. Any irregularities, faulty equipment, etc., shall be repaired or replaced as required prior to acceptance.

3.14 OPERATION AND MAINTENANCE MANUALS

- A. Prepare two portfolios with two complete sets of shop drawings of the equipment used in the erection of the electrical systems and equipment testings, cleaning and maintenance instructions, operation and maintenance manuals, list of materials for the maintenance, parts list, wiring diagrams, and name and address of authorized service organization.
- B. Information shall be folded only if necessary, and bound in an 8-1/2" x 11" hard cover indexed, looseleaf binder. Multiple binders shall be used if required to contain material. All material shall be properly identified with job name, date, and the names and addresses of the contractor, architect, and engineer.
- C. The portfolios shall be submitted to the engineer for review of material and completeness prior to final inspection, and when approved by the engineer, the portfolios will be turned over to the owner at the time of the final inspection.

- D. Where indicated in the specification, provide the services of a factory trained representative to instruct the owner's authorized personnel in the operation, control, programming, and maintenance of equipment. Contractor shall instruct owner's personnel in the operation of all other equipment and systems.
- E. Include the following close-out documents in the manuals:
 - 1. Asbestos letter.
 - 2. Warranty letter.
 - 3. Low-voltage cabling test reports.

3.15 PROJECT CLOSE OUT

- A. The electrical contractor shall arrange for an inspection of all items installed in the ceiling before the ceiling or ceiling tile is installed. The engineer shall be informed at least one week before the planned installation of the ceiling to arrange the inspection. If the ceiling tile is installed before the inspection, the electrical contractor shall remove all the ceiling tiles prior to the inspection.
- B. General: Refer to Division 1 sections for general closeout requirements.
- C. Record Drawings: Give special attention to the complete and accurate recording of underground conduit and concealed and non-accessible work, and junction box location(s) of all conduit systems, location of lighting controls and remote ballasts in lighting systems, and work of change orders where not shown on contract documents.
- D. Operating Instructions: Conduct at least a full day walk-through instruction seminar for the Owner's personal to be involved in the operation and maintenance of the electrical equipment and systems. If more time is needed the contractor shall continue instruction until the owner's personal are familiar with the operation of the system. Explain the identification system, operational diagrams, emergency and alarm provisions, seasonal provisions, security, safety, efficiency and similar features of the system.
- E. Turn-Over of Operation: At the time of substantial completion, turn over the prime responsibility for the operation of the system to the owner's personal. However until the time of final acceptance, provide at least one full-time operating engineer, who is completely familiar with the work, to consult with and continue training the owner's personal.
- F. Final Completion: The following special requirements shall be provided in addition to those specified elsewhere:
 - 1. The contractor shall not call for final completion check until the electrical systems and equipment have been installed, adjusted, programmed, and are in full and complete satisfactory operation and the following certifications of inspection from equipment suppliers have been completed and submitted with the architect/engineer. Certifications of inspection are required for the following items of equipment:
 - a. Lighting Control System (Local Rep.)
 - 2. The certifications shall consist of letters signed by Factory Trained and Authorized service engineers stating the following:

- a. They have inspected all their equipment on the project.
 - b. They approve the condition of their equipment and its installation.
 - c. They have fully checked its operation and certify that it is operating properly.
 - d. They will note any problems, conditions or objections that could lead to future operating problems.
3. Exceptions may be permitted upon written request from the contractor listing any minor items that are uncompleted and beyond his reasonable control. Provide a full guarantee that they be completed at a named later date and the guarantee shall be extended as required to provide a full warranty.
- G. Final Payment will not be made until the contractor has satisfactorily completed all final inspection items.
- H. Guarantee: All equipment and work shall be fully guaranteed, parts and labor for one year from the date of substantial completion, unless noted otherwise. The contractor has the full responsibility to guarantee all equipment and work and shall assume full responsibility to repair any equipment at his cost which the manufacturer refuses to guarantee. The Owner has the right to order repairs to any equipment or work provided hereon and to charge the contractor for the same if repairs are not made during a reasonable period of time not to exceed 24 hours during an emergency or 72 hours on a non-critical item.

END OF SECTION 260500

SECTION 260513 - MEDIUM, LOW AND CONTROL VOLTAGE CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.
- B. Related Sections:
 - 1. Section 260526 - Grounding and Bonding for Electrical
 - 2. Section 260533 - Electrical Materials and Methods

PART 2 PRODUCTS

2.1 CABLE AND WIRE (600 VOLTS AND BELOW)

- A. Secondary distribution and power cable shall be single conductor stranded copper, No. 12 AWG minimum; with NEC Type THHN insulation rated 90 degrees C, 600 volts. Alan Wire, American Insulated Wire, General, Cerro Wire, Encore, Republic Wire, Rockbestos, Service Wire, or United Copper Industries.
- B. Lighting wire for above ground use shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type THHN insulation rated 90 degrees C, 600 volts. Alan Wire, American Insulated Wire, General, Cerro Wire, Encore, Republic Wire, Rockbestos, Service Wire, or United Copper Industries.
- C. Lighting wire for underground use in conduit shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type XHHW insulation rated 90 degrees C in dry locations and 75 degrees C in wet locations, 600 volts. American Insulated Wire, General, Cerro Wire, Encore, Republic Wire, Rockbestos, Service Wire, or United Copper Industries.
- D. Control cable shall be single conductor stranded copper No. 14 AWG minimum; with NEC Type THHN insulation rated 90 degrees C, 600 volts.
- E. Instrumentation and special systems wire shall be in accordance with manufacturers' recommendations, but shall not be less than 20 AWG.
- F. Type MC cable shall be made up of individual conductors as noted above, be color coded, include a separate ground conductor, and shall have a corrugated metal armor over its entire length.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Install all cables and wires (including telecommunications, low voltage control and power limited circuits) in raceways. Telecommunications raceways shall be continuous from outlet boxes to telecommunications rooms or cable trays.
- B. Use cable lubricant when pulling primary cables and secondary feeder cables. Avoid exceeding manufacturer's recommendations on pulling tensions; sidewall pressures and cable bend radii.
- C. Segregate wiring of different voltage levels. Except as follows, circuits operating at different voltages shall not share raceways.
 - 1. Power wiring to rooftop motors and rooftop receptacles may be routed together.
 - 2. Power and control wiring between variable speed drives and motor disconnect switches may be routed together.
- D. Splice power cables with solderless compression butt splices or ring lugs. Terminate power cables including motor leads with solderless compression ring lugs. Splice branch circuit wiring, lighting wiring, and control and instrumentation wiring with wire nut connectors. Terminate control and instrumentation wiring with solderless compression ring or spade lugs. Compression connectors and lugs shall be crimped with tools specifically designed for the terminations being crimped.
- E. If no color coding system exists for each indicated system function and voltage, color code circuits as follows:
 - 1. Three Phase Power 208/120 Volts:
 - Phase X (A): Black
 - Phase Y (B): Red
 - Phase Z (C): Blue
 - Neutral: White
 - Ground: Green
 - 2. Control wires to light fixtures for light dimming shall be:
 - a. 'Hot control wire' - Black with white stripe
 - b. 'Neutral control wire' - White with Black stripe
 - 3. Less Than 120 Volts: Use Industry Standard Methods
- F. Provide home runs of No. 10 AWG wire for 20 amp branch circuits that exceed 150' in length.
- G. Ground the shields of shielded instrumentation and control cables at one end only. The shields at the other end shall be insulated from ground.
- H. Provide identification tags on all cables and conductors terminated in panels.

END OF SECTION 260513

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.
- B. Related Sections:
 - 1. Section 260513 - Medium, Low & Control Voltage Cables
 - 2. Section 260533 - Electrical Materials and Methods

1.2 SUMMARY

- A. Provide grounding for all systems and equipment.

1.3 GROUNDING SYSTEM REQUIREMENTS

- A. Each ground rod shall have a maximum resistance to ground of 10 ohms before connection to the other ground rods. If reading is above 10-ohms, drive one extension. Further testing of that individual rod is not needed
- B. The total grounding system with all connections completed shall have a maximum resistance to ground of 5 ohms.

1.4 CONNECTION REQUIREMENTS

- A. Provide exothermic weld type, or Burndy Hyground, ground connections for concealed, underground, and concrete encased ground connections, for ground connections to structural steel, connections between sections of the main ground bus and all connections to the substation room ground bus bars.
- B. Exposed ground connections (except connections to structural steel and substation room ground bus bars) may be made with copper or bronze compression ground fittings or bolted compression ring lugs.
- C. Provide exothermic weld type, or Burndy Hyground ground connections for splices and taps of grounding conductors No. 8 AWG and larger. Exposed splices and taps shall be taped.

PART 2 PRODUCTS

2.1 GROUND RODS

- A. Unless shown otherwise, ground rods shall be 3/4" diameter by 10' long, copper clad steel. Ground rods shall be capable of being extended when additional length is required.

2.2 GROUNDING CONDUCTORS

- A. Grounding conductors for direct burial underground, for encasement in concrete, and for grounding of unit substations shall be No. 4/0 AWG minimum, bare, stranded copper.
- B. Grounding conductors for general use shall be stranded, copper conductor, sized in accordance with the NEC unless shown otherwise on the drawings, and insulated with green NEC Type THHN insulation rated 90 degrees C, 600 volts.

2.3 GROUND CONNECTIONS

- A. Ground connections shall be Burndy Hyground, Cadweld, Thermo-weld or Thomas & Betts Blackburn only.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Provide green insulated equipment grounding conductors in all service, feeder, and branch circuits for connection of load devices to the power source ground. Raceways shall not be used as equipment grounding conductors.
 - 1. Equipment grounding conductors shall not be daisy-chained.
 - 2. Bond equipment-grounding conductors in boxes and enclosures where the grounding conductors are terminated or spliced.
- B. Bond conduits, cable trays, wireways, surface raceways, boxes, and enclosures together, and to the building grounding system. Provide bonding bushings and bonding jumpers to bond conduits where they enter a box or enclosure.
- C. Protect separately routed grounding conductors subject to damage or physical abuse by Schedule 40 PVC nonmetallic conduits. Grounding conductors shall not be routed in metallic conduits except when routed with phase conductors.

END OF SECTION 260526

SECTION 260533 - ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.
- B. Related Sections:
 - 1. Section 260513 - Medium, Low & Control Voltage Cables
 - 2. Section 260526 - Grounding and Bonding for Electrical

1.2 SUMMARY

- A. Provide conduits, cable trays, surface raceways, boxes, fittings and supports to form a complete, coordinated, and continuously grounded raceway system.

1.3 CONDUIT REQUIREMENTS

- A. Conduits indoors in general areas shall be electrical metallic tubing (EMT) with steel set screw fittings.
- B. Conduits indoors in hazardous areas, encased in concrete floor slabs or subjected to water, physical damage or abuse shall be galvanized rigid steel (RS) or intermediate metal conduit (IMC) with cast or malleable iron threaded fittings and bushings.
- C. Conduits outdoors shall be galvanized rigid steel or intermediate metal conduit with cast or malleable iron threaded fittings and bushings.
- D. Conduits encased in concrete underground shall be Type DB PVC with matching fittings.
- E. Conduits direct buried underground shall be Schedule 40 PVC with matching fittings.
- F. Conduits in parking structures, steam tunnels and near or in cooling towers shall be fiberglass-reinforced epoxy, or Schedule 80 PVC, with matching fittings. Exceptions to this requirement are tunnel segments inside building (i.e., mechanical rooms), or in heated rooms of parking structures. In these cases EMT may be used
- G. Final connections to recessed lighting fixtures and under-counter lights shall be 1/2" minimum flexible metallic conduit, manufactured wiring systems, or galvanized steel Type MC cable, all with steel fittings.
 - 1. Manufactured wiring systems shall
 - a. Only be used above accessible ceilings.
 - b. Shall not be used in walls or above permanent ceilings.
 - c. Shall contain a dedicated, separate, grounding conductor
 - 2. Type MC cable conductors shall be color coded to match the building color-coding scheme. Type MC cable shall be terminated with steel setscrew

connectors that have integral insulating bushings. Self-locking, twist-in type fittings are not acceptable.

- H. Final connections to motors, transformers and equipment subject to vibration or removal for maintenance shall be 1/2" minimum liquid tight flexible metallic conduit with steel liquid tight fittings. Transformer connections may be non-liquid tight flexible metallic conduit in electrical rooms only.
- I. Connections to other recessed devices, (including communication outlet boxes, junction or pull boxes, etc) shall be with standard conduit of the type appropriate for the wall construction.

1.4 SURFACE RACEWAY REQUIREMENTS

- A. When conduits in finished areas cannot be concealed in walls or above ceilings, surface raceways may be used where permitted. Boxes and fittings shall match and be from the same manufacturer as the raceways.

1.5 BOX REQUIREMENTS

- A. Provide sheet steel outlet boxes, extensions, and plaster rings for EMT, flexible metal conduit, and MC cable.
- B. Provide cast or malleable iron outlet boxes and covers for galvanized rigid steel conduits, intermediate metal conduits, and liquid tight flexible metal conduits.
- C. Boxes shall be sized for all conductors and devices to be contained within. Box extensions shall not be used to correct for undersized boxes. A single extension may be used as follows only if all free conductors extend at least 3 inches outside of the extension opening.
 - 1. On boxes being flush mounted in masonry walls.
 - 2. On existing boxes in walls that are being furred out.
 - 3. On existing boxes for connecting to an existing circuit.
 - 4. On fire alarm, security and clock system boxes where required by the system manufacturer's instructions.
- D. Plaster rings shall not be considered box extensions, but their capacities may be included in box fill calculations.

1.6 SUPPORT REQUIREMENTS

- A. Surface mounted equipment shall be secured to steel channels. The channels shall be attached with toggle bolts to hollow tile, block or similar surfaces, and attached with screws or bolts and expansion shields to solid masonry or concrete.

PART 2 PRODUCTS

2.1 CONDUITS

- A. Electrical metallic tubing shall be thin wall steel tubing, electro-galvanized or hot dipped galvanized inside and outside. Fittings and bushings shall be galvanized steel set screw type with two screws per connection for sizes over 2".
- B. Galvanized rigid steel conduit and intermediate metal conduit shall be hot dipped galvanized inside and outside, in 10' lengths and threaded on both ends. Fittings and bushings shall be cast or malleable iron, and hot dipped galvanized inside and outside.
- C. PVC conduit and fittings shall be Type DB for encasement in concrete, Schedule 40 for direct burial, concealed and exposed work, and schedule 80 in parking structures. Fittings shall be of the same type and from the same manufacturer as the conduit. PVC conduit shall be UL Labeled for 90 degrees C cables. Cantex, Carlon or National Pipe & Plastic.
- D. Fiberglass reinforced epoxy conduit shall be standard wall, iron pipe size, sunlight resistant, gray color, with matching push-fit fittings. FRE or Champion.
- E. Flexible metallic conduit shall be galvanized steel or aluminum. Fittings shall be of steel with cadmium or galvanized finish. Fittings shall be machine screw clamp type, single or two-piece. Self-locking, twist-in type fittings are not acceptable.
- F. Liquid tight flexible metallic conduit shall consist of a flexible, galvanized steel core, a continuous copper ground strip and a polyvinyl chloride jacket. Fittings shall be steel liquid tight grounding type from the same manufacturer as the conduit.

2.2 SURFACE RACEWAYS

- A. Where surface raceways are called for on the drawings, or when conduits in finished areas cannot be concealed in walls or above ceilings, surface raceways shall be used. Boxes and fittings shall match and be from the same manufacturer as the surface raceway.
- B. Surface raceways shall consist of a base and cover, sized for the number of conductors contained within, complete with all connectors, fittings, bushings, boxes, covers and mounting hardware.
- C. Raceways shall be 600 volt rated, and be in compliance with the applicable paragraphs of NEC Article 352.
- D. They shall be non-flammable, and UL labeled, under UL 5, or UL 5A (as applicable).
- E. The completed raceway system shall be vandal resistant.
- F. Shall accept receptacles, cover plates, telephone/data outlets and other standard wiring devices as specified elsewhere in these specifications.
- G. The cover plates used for wiring devices and telecommunication outlets shall be of the 'overlapping' type, and shall therefore cover the 'cut-end' of the raceway cover.
- H. The raceways shall have a select ivory (or white, or gray where noted) color, "scuff" resistant finish, and the raceways shall be paintable.
- I. All components of the raceway system exposed to view shall be of the same color and shade.

- J. Barriers shall be provided when necessary to separate conductors of different voltages, or services.
- K. Surface raceways shall be steel or plastic as noted below, and as noted on the drawings:
 - 1. Metallic
 - a. Metallic raceways shall be of .040" thick (minimum) zinc plated or galvanized steel.
 - b. The acceptable levels of quality are, generically,
 - 1) "Wiremold V500 and V700" for smaller single channel raceway applications,
 - 2) "Wiremold V3000" for larger single channel raceway applications, and
 - 3) "Wiremold V4000" for larger multi-channel raceway applications.
 - c. Manufacturers include Hubbell, Wiremold, Thomas and Betts, or Mono-System.

2.3 BOXES

- A. Boxes for fixtures, outlets, switches, equipment connections and wire pulling shall be
 - 1. Cast or formed from carbon steel sheets of commercial grade steel not less than 14-gauge,
 - 2. One-piece construction, zinc, or cadmium plated,
 - 3. Tapped for mounting plates and covers as required.
- B. Pull and junction boxes shall be
 - 1. Fabricated from galvanized or painted code gauge cold rolled carbon steel sheets.
 - 2. Welded construction with flat removable covers fastened to the box with machine screws.
 - 3. Seams and joints shall be closed and reinforced with flanges formed of the same material from which the box is constructed or by continuous welding which will provide equivalent strength to flange construction.
 - 4. Preferably not provided with 'knockouts'.
- C. Box covers shall be fastened in place by machine screws or hinges and latches. Self-tapping or sheet metal fasteners are not acceptable.

2.4 SUPPORTS

- A. Hangers and brackets shall be made of steel pipe, channel iron, angle iron or prefabricated steel channel. Prefabricated steel channel shall be by B-Line, Hilti, Powerstrut or Unistrut.
- B. Anchors shall be lead shield anchors or plastic expansion anchors for small loads, and expansion or epoxy anchors for large loads. Powder-driven anchors shall not be used.

2.5 LABELS AND DIRECTORIES

- A. Equipment nameplates shall be engraved .125 inch (1/8") thick laminated plastic, white, with black letters. The engraved letters shall be at least one quarter inch (1/4") high.
- B. Receptacles and lighting switches shall be labeled using clear adhesive backed nylon or Mylar tape with black text permanently laminated to the tape.
- C. Panel directories shall be typed on supplied card stock with panel, or card stock similar in thickness and material as those supplied with the panels. Install supplied clear plastic cover, or one of like material.

PART 3 EXECUTION

3.1 RACEWAYS

- A. Size conduits in accordance with the NEC, but not less than the sizes shown on the drawings. Minimum power and control conduit size shall be 1/2". Minimum telecommunications conduit size shall be 3/4".
- B. Install concealed and exposed conduits parallel to or at right angles to building lines. Conduits shall not be embedded in concrete slabs except where specifically shown. Install surface raceways as close to room corners or trim features as possible to make the surface raceways less obvious. Where conduits are routed over beams and under corrugated decking, conduits shall be offset 3" below the decking to avoid damage from future decking penetrations.
- C. Conceal conduits wherever possible and practical. When conduits cannot be concealed in finished areas, use surface raceways with matching boxes from the same manufacturer as the raceways.
- D. Metal conduits, fittings, enclosures and raceways shall be mechanically joined together in a firm assembly to form a continuous electrical conductor providing effective electrical grounding continuity.
- E. Provide expansion fittings at the intervals specified in the manufacturer's instructions.
- F. Conduits entering panels located outdoors, in parking structures, in steam tunnels and on cooling towers shall enter from the sides, back, or bottom. Conduits shall not enter from the top.
- G. Separate raceways from uninsulated steam pipes, hot water pipes, and other hot surfaces by a minimum of 4" horizontally or 12" vertically. Separate raceways from ventilation ducts and insulated pipes so that they do not come into contact with each other.
- H. Low voltage signal circuits shall be separated or shielded from power circuits to prevent the induction of noise into the signal circuits.
- I. EMT entering sheet metal enclosures and outlet boxes shall be secured in place by a connector with a locknut. Rigid conduit shall be secured with locknut inside and outside and a bushing. Sufficient thread on the connector or conduit shall extend into

the enclosure so that the bushing will butt tight into the connector or conduit. Bushings shall not be used as jamb nuts or in lieu of locknuts.

- J. Flexible metallic conduit to motors and similar equipment shall not exceed 3'-0" in length, and shall have adequate slack to absorb the maximum vibration. Flexible conduit connections to lighting fixtures shall not exceed 6'-0" in length.

3.2 MOUNTING HEIGHTS

- A. Except where shown otherwise, install equipment and devices at the following heights:
 1. Receptacles (Wall): 18" A.F.F. to center
 2. Receptacles (Above Counter): 48" A.F.F. to center
 3. Receptacles (Unfinished Area): 48" A.F.F. to center
 4. Surface Raceway Receptacle Strips: 42" A.F.F. to bottom
 5. Light Switches: 48" A.F.F. to center
 6. Telephone Outlets (Wall Phone): 54" A.F.F. to center
 7. Telephone/Data Outlets: 18" A.F.F. to center
 8. Clock Outlets: 88" A.F.F. to center
 9. Fire Alarm Pull Stations: 48" A.F.F. to center
 10. Fire Alarm Horn/Strobes: 80" A.F.F. to bottom
 11. Card Readers: 48" A.F.F. to card slot
 12. Security System Controls: 48" A.F.F. to center
 13. Thermostats/HVAC Controls: 48" A.F.F. to center
 14. Electrical Panels: 72" A.F.F. to top
 15. Safety Switches/Motor Starters/Variable Frequency Drives: 72" A.F.F. to top (except top of handle shall not exceed 78" A.F.F.)
 16. Motor Control Pushbuttons: 60" A.F.F. to center

3.3 SUPPORTS

- A. Provide 4" thick concrete housekeeping pads for floor-mounted equipment.
- B. Support all electrical items independently of supports provided by the other trades.
- C. Support conduits and boxes using steel conduit straps or 1/4-inch minimum diameter threaded rod hangers. Suspended ceiling hangers or hanger wire shall not be used (except to support flexible metallic conduit and manufactured wiring systems).
- D. Support cable trays with support brackets or 3/8" diameter minimum threaded rod hangers at intervals not exceeding 8'-0" for straight runs. Additional supports shall be provided at tray fittings.
- E. Hangers shall be of sufficient strength that their deflection at mid span does not exceed 1/240 of the hanger span length after the cables are installed.
- F. Route flexible metallic conduit, manufactured wiring systems and Type MC cable parallel to or perpendicular to building lines, and in a neat and workmanlike manner. Coil the excess manufactured wiring systems and Type MC cable, and support independently of the ceiling grid system at intervals not exceeding 3 feet.

3.4 PENETRATIONS, SLEEVES, AND FIRE SEALS

- A. Cut floor and wall penetrations neatly and to the minimum size required for installation of the equipment and raceways.
- B. Provide galvanized steel pipe sleeves for all conduits penetrating floors, exterior walls and roofs.
 - 1. Extend floor sleeves above the floor a minimum of 2 inches.
 - 2. Embed sleeves in new concrete or step-core concrete and grout sleeves into existing concrete with epoxy grout.
 - 3. Seal floor sleeves using fire-sealing systems approved by a Nationally Recognized Testing Laboratory.
 - 4. Seal exterior wall and roof penetrations water tight.
- C. Patch both sides of wall penetrations cut for electrical equipment and raceways to seal against the passage of air, sound and fire.
 - 1. Seal cable tray penetrations in fire rated walls using fire sealant bags approved by a Nationally Recognized Testing Laboratory.
 - 2. Seal conduit penetrations in fire rated walls using fire-sealing caulk approved by a Nationally Recognized Testing Laboratory.
 - 3. Seal conduit penetrations in non-rated walls using masonry materials that match the wall construction.
 - 4. Fire seal between recessed outlet boxes located on opposite sides of a fire rated wall if the box openings are over 16 square inches and the boxes are less than 24 inches apart.

3.5 EXPANSION FITTINGS

- A. Provide expansion fittings at all building expansion joints. Expansion fittings shall be bonded to the raceway on both sides.
- B. Provide expansion fittings, in accordance with manufacture recommendations, in all areas subject to swings in temperature of more than 15 degrees C.
- C. Install expansion fittings in all locations where expected expansion difference is ¼", or more, between boxes

3.6 IDENTIFICATION

- A. Provide nameplates and labels in accordance with Article 2.6.
 - 1. Laminated plastic labels shall be mechanically secured in place with sheet metal screws and/or bolts and nuts
 - 2. Labels shall be neatly centered. Place labels in like positions on similar equipment.
- B. Color code wiring as noted in Section 260513
- C. Color code junction boxes and box covers of emergency and fire alarm circuits with red paint. Color code junction boxes and box covers of temperature control circuits with blue paint.
- D. Mark junction box covers in indelible ink with the panel and breaker numbers of the circuits contained within.

- E. Provide a 3" by 5" yellow "Warning Arc Flash Hazard" label on the outside of panels in 'occupant areas' - Brady Type 99454 or equivalent from another manufacturer. Center the label horizontally and vertically on outside of door.

- F. Provide a 4" by 6" red "Danger Arc Flash and Shock Hazard" label on the outside of panels in areas open only to 'qualified personnel', and on the inside panel door of panels in 'occupant areas' - Brady Type 99459. Center label on gutter areas of distribution panels, centered above or below the directory of panels, and otherwise centered in other applications. In all cases, label will be no lower than 48" or above 84" AFF

END OF SECTION 260533

SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.
- B. Related Sections:
 - 1. Section 260513 - Medium, Low & Control Voltage Cables
 - 2. Section 260526 - Grounding and Bonding for Electrical
 - 3. Section 260533 - Electrical Materials and Methods

PART 2 PRODUCTS

2.1 TOGGLE SWITCHES

- A. Toggle switches shall be rated 120/277 volts, 20-amperes, single-pole, double-pole, 3-way or 4-way as shown, specification grade, extra-heavy duty, back and side wired, with ivory handles. Arrow Hart, Bryant, Hubbell, Leviton or Pass & Seymour.

2.2 DIMMER SWITCHES

- A. Dimmer switches shall be rated 1000 watts minimum, specification grade, heavy duty, with radio noise filter and suitable for use in a single gang box. Leviton, Lithonia or Lutron.

2.3 OCCUPANCY SENSORS

- A. Wall mounted occupancy sensors shall be rated 600 watts minimum, 180 degrees coverage, 300 sq. ft. minimum coverage, infrared type, heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, integral manual override switches, and suitable for mounting in single gang wall mounted boxes. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.
- B. Ceiling mounted occupancy sensors shall be rated 1000 watts minimum, 180 degrees coverage, 1000 sq. ft. minimum coverage, infrared type, heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, and suitable for mounting in ceiling mounted boxes. Sensors shall utilize low voltage control circuits and be interlocked with the switch circuit for local auto/off control. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.
- C. Dual technology occupancy sensors shall be rated 1000 watts minimum, 180 degrees coverage, 1000 sq. ft. minimum coverage, and combination ultrasonic/infrared type. The ultrasonic component shall be of a frequency compatible with hearing aids. The overall occupancy sensor shall be heavy duty, specification grade, with SCR power

switching devices, adjustable range or sensitivity, adjustable time delay, and suitable for mounting in ceiling mounted boxes. Sensors shall utilize low voltage control circuits and be interlocked with the switch circuit for local auto/off control. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.

2.4 COVER PLATES

- A. Except where unique cover plates are required (wall box dimmers, surface raceways, occupancy sensors, etc.), cover plates for switches and receptacles shall be of high quality Type 302 stainless steel, unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Except where necessary to match existing receptacles, install receptacles with their ground slots below, or to the left, of the line and neutral slots.
- B. Provide No. 10 AWG wire to NEMA Type 6-20R receptacles serving freezers, window air conditioners or other large appliances.
- C. Where shown on the drawings, provide a separate neutral conductor for each single-phase branch circuit. The neutrals of these single-phase circuits shall not be shared or daisy-chained.
- D. Receptacles installed in surface raceways being fed by multiple circuits, shall have adjacent receptacles from alternate circuits.
- E. Provide ground fault circuit interrupter (GFCI) receptacles for new and existing 120 volt duplex receptacles located outdoors, in toilet rooms and within 6 feet of water sources including sinks, cup sinks, fume hood sinks, faucets, hose bibs and water coolers. Standard receptacles protected by an upstream GFCI receptacle or a GFCI circuit breaker are not acceptable.
- F. Provide waterproof enclosures for receptacles located outdoors or when designated "waterproof" in special indoor applications. Enclosures shall remain watertight even while in use. Cantex, Carlon, Leviton or TayMac Corporation.
- G. Provide a nametag on each cover plate of new and existing light switches and receptacles identifying the panel and circuit number feeding the device. Trace the existing circuits using an electronic circuit tracer if necessary. Nametags shall consist of black text permanently laminated to adhesive backed clear nylon or Mylar tape. Brother P-Touch. Embossed plastic tape labels are not acceptable.
- H. Color code junction boxes and box covers of emergency circuits with red paint.
- I. Mark junction box covers in indelible ink with the panel and breaker numbers of the circuits contained within.

3.2 FIELD QUALITY CONTROL

- A. The contractor shall perform testing in accordance with Specification Section 260800, and shall submit a test report.

3.3 COMMISSIONING

- A. Perform commissioning activities in accordance with Related Sections.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.
- B. Related Sections:
 - 1. Section 260513 - Medium, Low & Control Voltage Cables
 - 2. Section 260526 - Grounding and Bonding for Electrical
 - 3. Section 260533 - Electrical Materials and Methods

PART 2 PRODUCTS

2.1 LIGHTING FIXTURES

- A. Lighting fixtures shall be of specification grade, and shall be listed or labeled by Underwriters Laboratories (UL) or other approved agency. Lighting fixtures shall be provided in accordance with the Fixture Schedule.
- B. Recessed lighting fixtures shall be thermally protected.

2.2 LAMPS

- A. Unless noted otherwise in the fixture schedule, fluorescent lamps shall be T-8, straight tube, rapid start, multi-phosphor type with a medium bi-pin base, average rated life of 24,000 hours, 3000 initial lumens, 2820 mean lumens, a correlated color temperature of 3500 degrees K and a CRI of 85 ("700" series lamps do not meet this requirement.). Lamps shall be designed to pass the Federal TCLP test in effect at the time of manufacture. U-tube lamps shall not be used. GE Ecolux, Osram/Sylvania Ecologic, or Philips Alto only.
- B. Compact fluorescent lamps shall be 4 pin, 13 watt minimum with a color temperature of 3500 degrees K, a CRI of 80 minimum, end-of-life protection, suitable for use with electronic ballasts. Self-ballasted compact fluorescent lamps are not acceptable except for retrofitting existing incandescent fixtures. Osram/Sylvania, GE or Philips only.
- C. High intensity discharge (H.I.D.) lamps shall conform to their applicable ANSI codes.
- D. Incandescent lamps shall be rated 120 volts and shall have a life of 2000 hours minimum. Standard "A" Type lamps shall be inside frosted.

2.3 BALLASTS

- A. Unless indicated otherwise, fluorescent fixtures with three or four T-8 lamps shall have two ballasts to accommodate dual switching. Fluorescent fixtures with multiple compact fluorescent lamps may have only one ballast.
- B. Fluorescent ballasts shall be of the electronic type, programmed rapid start, series circuited, and completely solid state. Ballasts shall be rated for the specific lamps they are supplying, shall have a maximum crest factor of 1.6, a maximum current total harmonic distortion of 10 percent, a minimum starting temperature of 0 degrees F, and a sound rating of "A". Ballasts, for T-8 lamps shall be Osram/Sylvania Quicktronic Professional, Advance Optanium, or Universal Accustart only. Ballasts for compact fluorescent lamps shall be the fixture manufacturer's standard electronic type.
- C. Fluorescent dimming ballasts shall be electronic, comply with the other requirements for electronic ballasts, be capable of smoothly and consistently dimming the lamps from full output to 10 percent or less output, and maintain a cathode voltage between 3 to 4 volts. A low voltage slide switch that is compatible with the ballast shall control light level. Osram/Sylvania Quicktronic, Lightolier or Lutron only.
- D. Ballasts shall conform to their applicable ANSI codes. H.I.D. ballasts for use in finished areas shall be of the quietest type available, or shall be mounted remote from the fixtures.
- E. Ballasts shall be rated for the ambient temperatures in which they are located. Outdoor fixtures shall be equipped with ballasts rated for reliable starting to -20 degrees F. Indoor fixtures located in areas with above normal ambient temperatures shall have ballasts rated at 65 degrees C minimum.
- F. Individually fused ballasts shall have their fuses accessible from outside of the fixture chassis.

2.4 EMERGENCY LIGHTING

- A. Emergency lighting shall consist of fluorescent emergency lighting fixtures or sealed beam emergency lighting units as shown. Chloride, Dual-Lite or Exide Lightguard.
 - 1. Fluorescent emergency lighting fixtures shall consist of normal fluorescent fixtures with one or two center lamps connected to a remotely mounted, maintenance free, nickel cadmium battery pack, and solid-state battery charger. Minimum light output shall be 1100 lumens. The battery pack shall be sized for a minimum of 90 minutes of battery operation. The battery charger shall provide overload, short circuit, brownout and low battery voltage protection. The unit shall include self-diagnostic and self-exercising circuitry to exercise and test itself for 5 minutes every month and for 30 minutes every 6 months. The unit shall include a test/monitor module with status indicating lights mounted on a device plate suitable for mounting remotely from the fixture and battery pack in a single gang outlet box.
 - 2. Sealed beam emergency lighting units shall consist of 6 volt, sealed beam, PAR36 lamps connected to a wall or ceiling mounted maintenance free nickel cadmium battery pack and solid state battery charger. The battery pack shall be sized for a minimum of 90 minutes of battery operation. The battery charger shall provide overload, short circuit, brownout and low battery voltage protection. The unit shall include self-diagnostic and self-exercising circuitry to exercise and test itself for 5 minutes every month and for 30 minutes every 6 months. The unit shall include a test/monitor module with status indicating lights.

2.5 EXIT SIGNS

- A. Exit signs shall be of the LED type. Fluorescent, electro luminescent light panel or self-powered luminous signs shall not be used. Chloride, Dual-Lite, Emergi-Lite, Exide Lightguard, Lightalarms, Lithonia or Sure-Lites.
 - 1. LED's shall be wired in parallel to prevent multi-lamp failure, and shall be concealed within the sign by a clear panel and red optical diffuser. Power consumption shall not exceed 2 watts per face.
 - 2. Exit signs shall have white die cast aluminum or polycarbonate housings with universal mounting brackets; brushed aluminum stencil faces with red letters and multi-directional knockout arrows.
 - 3. Exit signs shall be provided with emergency battery packs and battery chargers when required. Batteries shall be maintenance free nickel cadmium, and shall be mounted within the signs.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Support recessed fluorescent troffers independently of the ceiling grid system by using two, safety wires minimum on diagonally opposite corners of the fixtures. Support recessed downlights by using safety wires or by rigidly attaching the fixtures to the building structure or ceiling grid system. Removable T-bar clips shall not be used to attach fixtures to the ceiling grid system.
- B. Install fixtures level, with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Lenses, reflectors and trims of fixtures shall be properly and uniformly aligned.
- C. Where fluorescent fixtures are shown with dual switches, connect all inner lamps to one switch and all outer lamps to the other switch. Dim the inner lamps where a dimmer switch is shown unless indicated otherwise.
- D. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.
- E. Provide an individual feed with ground conductor from a junction box to each lighting fixture. Lighting fixtures shall not be daisy-chained.
- F. Drops to recessed fixtures may be flexible metallic conduit, or manufactured wiring systems may be used where accessible. Fixtures shall be provided with sufficient length to permit removal and lowering of the fixtures 12" below the ceiling.
- G. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.
- H. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Burned out lamps shall be replaced.
- I. Mount fluorescent emergency lighting battery packs in accordance with the manufacturer's instructions. Locate the remote test/monitor modules identically so that

they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

- J. Mount sealed beam emergency lighting units where shown and aim their lamps to light the egress path as uniformly as possible.

3.2 FIELD QUALITY CONTROL

- A. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures. Misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.
- B. An operational test shall be performed to verify that all fixtures light properly, and are switched according to the drawings.

3.3 TRAINING

- A. Provide a qualified service technician from the Manufacturer's staff to provide training.
- B. Train Owner's maintenance personnel on equipment operation, start-up and shutdown, trouble-shooting, servicing and preventative maintenance procedures. Review the data contained in the Operating and Maintenance Manuals with Owner's personnel. Training shall occur separate from startup activities.
 - 1. Provide 2 hours of training minimum.

END OF SECTION 265100