SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and other Division 1 Specification sections apply to this section.

1.2 WORK INCLUDED

A. This section includes Basic Electrical Requirements specifically applicable to Division 26 and 28 Sections.

B. Provide and install all equipment, labor, material and accessories, and mounting hardware for a complete and operating system as described within these Division 26 and 28 Specification Sections.

C. Furnish, perform, or provide all labor including planning, purchasing, transporting, storing, installing, testing, cutting and patching, trenching, excavating, backfilling, coordination, field verification, installation safety, supplies, and materials necessary for the installation of complete electrical systems (as described or implied by these specifications and the applicable drawings) in strict accordance with safety standards and applicable codes, which may not be repeated in these specifications, but are expected to be common knowledge of qualified Bidder.

D. All work shall comply with all applicable codes as a minimum and with the additional requirements called for in these Contract Documents.

E. Only trained and licensed personnel shall perform work. No Work shall be performed which violates applicable Codes, even if called for in the Contract Documents.

F. Coordinate and verify power company service requirements prior to installation and material procurement.

G. Coordinate all Work with the Owner prior to performing any work on this project.

H. Make connections to all items in the Work which require electric power. Connections will include wire, conduit, circuit protection, disconnects, and accessories. Securing of roughing-in drawings and connection information for equipment involved is included under this division. See other divisions for specifications for electrically operated equipment.

I. Secure and pay for all permits, fees, licenses, and inspections required to perform Division 26 and 28 work.

J. Provide temporary electrical service, power, and lighting for construction. Refer to Division 1 for requirements.

1.3 CODES

A. Unless specifically noted to the contrary, the Contractor shall furnish all equipment, materials, labor, and install in accordance with applicable sections of the following codes and standards:

1. Florida Building Code – 6th Edition – 2017

2. NFPA 70 – National Electrical Code – 2014 Edition

3. All applicable local, city, and state codes.

1.4 DEFINITIONS

A. Provide: Furnish, install, and connect complete.

B. Review of shop drawings: A service by the Engineer to reduce the possibility of materials being ordered which do not comply with Contract Documents. The Engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. When an error is not detected, this does not grant the Contractor permission to proceed in error.

C. Wiring: Wire and cable, installed in raceway with boxes, fittings, connectors, supports, accessories, overcurrent protection, and disconnects per applicable codes.

D. Work: Materials completely installed.

E. Connect: Provide all wiring and connections required for a properly operating system.

1.5 WORK SEQUENCE

A. Install Work in stages or phases to accommodate Owner/Architect and construction manager.

1.6 DESCRIPTION

A. Install Work in locations shown or described in the Contract Documents, unless prevented by Project conditions.

B. Install all equipment so that all Code and Manufacturer recommended working and servicing clearances are maintained. Properly arrange and install all equipment within designated spaces. If a departure from the Contract Documents is necessary, submit to the Engineer for approval, detailed drawings of the proposed changes with written

reasons for the changes. No change shall be implemented without approval as permitted by the General Conditions.

C. The Contractor shall verify finish dimensions at the project site in preference to using dimensions noted on Contract Documents.

1.7 INVESTIGATION OF SITE

A. Investigate the site and existing conditions thoroughly before bidding.

B. During his site visit, the electrical bidder shall become familiar with all aspects of the proposed work and existing field conditions of the work. No compensation or reimbursement for additional expenses for failure investigate the existing facilities will be authorized. This shall include rerouting around existing obstructions.

C. Submission of a proposal will be construed as evidence that such examination has been made and later claims for labor, equipment or materials required because of difficulties encountered will not be recognized.

D. Existing conditions and utilities indicated are taken from existing construction documents, surveys, and field investigations. Unforeseen conditions probably exist, and existing conditions shown on drawings may differ from the actual existing installation with the result being that new work may not be field located exactly as shown on the drawings.

1.8 CONTRACT DOCUMENTS SITE

A. The drawings are diagrammatic and are not intended to include every detail of construction, materials, methods, and equipment. They indicate the result to be achieved by an assemblage of various systems. Coordinate equipment locations with Civil, Architectural, Structural, HVAC, and Plumbing. Layout equipment before installation so that all trades may install equipment in spaces available. Coordinate installation in a neat and workmanlike manner.

B. Should conflicts exist between the Drawings and Specifications, the Contractor shall ask for clarification prior to doing and conflicting work.

C. Refer to the architectural, structural, plumbing, sprinkler and HVAC plans and details for dimensions, and fit the work to conform to the details of building construction. The right is reserved to shift any switch, receptacle, ceiling outlet or any special outlet a maximum of 10’-0” from its location as shown before it is permanently installed, without incurring additions to the contract.

D. Wiring arrangements for equipment shown on the drawings are intended to be diagrammatic and do not show all required conductors and functional connections. All such items incidental to a complete and operating system shall be provided.

E. Submit specific shop drawings which indicate the fabrication, assembly, installation, and erection of systems’ components. Drawings that are part of the Contract Documents

shall not be considered a substitute for required shop drawings, field installation drawings, code requirements, or applicable standards.

F. Locations indicated for outlets, switches, and equipment are approximate and shall be coordinated with the Contract Documents. Where instructions or notes are insufficient to locate the item, notify the Engineer.

1.9 MATERIALS AND EQUIPMENT

A. Unless otherwise noted, all material shall be new and U.L. listed or labeled. In lieu of UL listing or labeling, a statement or data demonstrating compliance with contract documents from a nationally recognized testing agency shall be submitted for approval.

B. Where Contract Documents list design selection or manufacturer, type, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to the Engineer's review and approval. Where Contract Documents list approved substitutions, these items shall comply with Division 1 requirements for substitutions.

C. When a product is specified to be in accordance with a trade association or government standard and at the request of the Engineer the Contractor shall furnish a certificate that the product complies with the referenced standard and supporting test data to substantiate compliance.

D. Where multiple items of the same equipment or materials are required, they shall be the product of the same Manufacturer.

E. Prior to placing equipment orders, verify the physical size of specified equipment to fit spaces allotted on the drawings and with NEC working clearances.

F. Electrical equipment shall be protected from the weather, during shipment, storage, and construction per manufacturer's recommendations. Should any apparatus be subjected to possible damage by water, it shall be thoroughly dried and put through a dielectric test, at the expense of the Contractor, to ascertain the suitability of the apparatus, or it shall be replaced without additional cost to the Owner.

G. Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service. Replace or repair and test damaged equipment in compliance with industry standards at no additional cost to the Owner. Equipment required for the test shall be provided by the Contractor.

H. Material and equipment shall be provided complete and shall function up to the specified capacity/function. Should any material or equipment as a part or fail to meet performance requirements, replacements shall be made to bring performance up to specified requirements. Damages to finish by such replacements, alterations, or repairs shall be restored to prior conditions, at no additional cost to the Owner.

I. Where tamperproof screws are specified or required, Phillips head or Allen head devices shall not be accepted. For each type used, provide the Owner with three tools. The

Owner will designate the specific hardware design to correspond with existing devices elsewhere in the building, to limit special tool requirements.

J. Communications backboards shall be 3/4" A/B grade, Class A, flame spread, painted with light gray fire-retardant paint. Neatly mask off a minimum of one (1) plywood Manufacturer's pre-printed certified fire rating stamp per section of board prior to application of paint. Remove masking after paint has cured.

1.10 SUPERVISION OF THE WORK

A. Reference the General Conditions for additional requirements.

B. A qualified and experienced electrical superintendent shall oversee the work in progress at all times. If, in the judgment of the Owner, the electrical superintendent is not performing his duties satisfactorily, the Contractor shall immediately replace him upon receipt of a letter of request from the Owner. Once a satisfactory electrical superintendent has been assigned to the work, he shall not be withdrawn by the Contractor without the written consent of the Owner.

C. Provide field superintendent who has had a minimum of four (4) years previous successful experience on projects of comparable sizes and complexity. Superintendent shall be present always that work under this Division is being installed or affected. All work performed by a non-licensed Journeyman shall be under the direct supervision (in the presence of) of a Licensed Journeyman as specified herein. Increase the quantity of licensed Journeymen as required for supervision of all areas where direct contact is not possible.

D. Superintendent shall be employed by a State Registered (Type "E.R." License) or State certified (Type "E.C." License) electrical contractor.

1.11 COORDINATION

A. Provide all required coordination and supervision where work connects to or is affected by work of others and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to the Owner including but not limited to electrical work required for:

1. Door hardware
2. Roll-up doors
3. Roll-up grilles
4. Mechanical Division of the Specifications
5. Landscape Architect drawings
6. Interior design drawings
7. Millwork design drawings and shop drawings

B. Installation studies shall be made to coordinate the electrical work with other trades. Work shall be preplanned. Unresolved conflicts shall be referred to the Department prior to installation of the equipment.

C. Coordination drawings shall be prepared prior to the start of work. Drawings shall show the actual physical dimension required for the installation to assure proper integration of equipment with building systems and NEC required clearances. Location of conduit racking, etc., shall be provided. Coordination drawings shall be provided for all areas. Comply with the requirements of Division 1.

D. Secure approved shop drawings from all required disciplines and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on approved shop drawings differs from that shown or called for in Construction Documents, adjust the wiring, disconnects, and branch circuit protection to match that required for the equipment installed.

E. Damage from interference caused by inadequate coordination shall be corrected at no additional cost to the Department.

F. Coordinate the exact location of floor outlets, floor ducts, floor stub-ups, etc. with the Owner/Architect and Engineer (and receive their approval) prior to rough-in. Locations indicated in Contract Documents are only approximate locations.

G. The Contract Documents describe specific sizes of switches, breakers, fuses, conduits, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Coordinate the requirements of each load with each load's respective circuitry shown and with each load's requirements as noted on its nameplate data and manufacturer's published electrical criteria. Adjust circuit breaker, fuse, conduit, and conductor sizes to meet the actual requirements of the equipment being provided and installed and change from single point to multiple points of connection (or vice versa) to meet equipment requirements. Changes shall be made at no additional cost to the Owner.

1.12 PROVISION FOR OPENINGS

A. Locate openings required for work. Provide sleeves, guards or other approved methods to allow passage of items installed.

B. Coordinate with roofing Contractor on installation of electrical items which penetrate the roof. Roof penetrations shall be installed so as to not void roof warranty.

C. Where work pierces waterproofing, it shall maintain the integrity of the waterproofing. Coordinate roofing materials which pierce roof for compatibility with membrane or other roof types with Contractor.

1.13 CONCRETE PADS

A. Furnish and install reinforced concrete housekeeping pads for transformers, switchgear, generators, motor control centers, and other free-standing equipment installed within the building. Unless otherwise noted, pads shall be four (4) inches high and shall exceed dimensions of equipment being set on them, including future sections, by six (6) inches each side, except when equipment if flush against a wall where the side against the wall shall be flush with the equipment. Pads shall be reinforced with W1.4 x 1.4 6 x 6 welded wire mesh. Chamfer top edges 1/2". Trowel all surfaces smooth. Provide 4000 psi concrete.

B. Refer to Civil plans and electrical plans for the requirements for concrete pads supporting transformers, switchgear, generators, motor control centers, and other free-standing equipment installed outside the building. Coordinate pad installation, dimensions, conduit windows, or stub-ups with approved equipment shop drawings.

1.14 SURFACE MOUNTED EQUIPMENT

A. Surface mounted fixtures, outlets, cabinets, conduit, panels, etc. shall have finish or shall be painted as directed by designer. Paint shall be in accordance with applicable sections and/or divisions of these specifications.

1.15 CUTTING AND PATCHING

A. Reference Division 1 - General Requirements.

1. Provide cutting and patching necessary for the installation of Division 26 and 28 work.
2. Cutting of work in place shall be cut, drilled, patched and refinished to match specified finish.
3. Backfill new grades to match adjacent undisturbed surface.
4. Schedule work to place Division 26 and 28 work to avoid as much cutting and patching as practical.

1.16 TRENCHING AND BACKFILLING

A. All trenching, backfilling and compaction requirements shall be in accordance with other sections of these specifications.

B. Trench excavation more than 5 feet deep shall comply with OSHA Standard 29 C.F.R.s. 1926. 650 Subpart P.

1.17 DELIVERY, HANDLING, PROTECTION OF MATERIALS, AND STORAGE

A. Ship, deliver, and store products in the manufacturer’s protective packing to prevent damaging.

B. Handle equipment carefully to prevent damage to components, breakage and denting or scoring of surfaces and finishes.

C. Store all equipment and products in clean, dry spaces. Protect all equipment from dirt, fumes, water, chemicals, construction debris and physical damage. Any equipment exposed directly to moisture will not be acceptable and shall be replaced.

D. Replace damaged products and equipment. Repair and repaint marred and damaged finishes to original factory finish as directed by manufacturer and as herein specified.

E. Keep all conduit and other openings protected against entry of foreign matter.

1.18 INSTALLATION

A. Erect equipment to minimize interference and delays with the execution of the Work.

B. Take care in erection and installation of equipment and materials to avoid marring finishes or surfaces. Any damage shall be repaired or replaced as determined by the Owner/Architect at no additional cost to the Owner.

C. Equipment requiring electrical service shall not be energized or placed in service until the Owner/Architect is notified and is present or have waived their right to be present. Where equipment to be placed in service involves service or connection from another Contractor, notify the Owner/Architect in writing as appropriate when the equipment will be ready.

D. Equipment supports shall be secured and supported from structural members unless written approval is granted by the Engineer.

E. Plywood material shall not be used as a backboard for mounting panel boards, disconnects, motor starters, and dry type transformers. Provide "cast in place" type inserts or install expansion type anchor bolts. Electrical equipment shall not be mounted directly to dry wall for support without additional channels as anchors. Channels shall be anchored to the floor and structure above. Panelboards and terminal cabinets shall be provided with structural framing located within drywall partitions.

F. Inserts, pipe sleeves, supports, and anchorage of electrical equipment shall be provided. Where items are to be set or embedded in concrete or masonry, the items shall be furnished, and layout made for setting or embedment thereof so as to cause no delay.

1.19 PRODUCT SUBSTITUTIONS

A. The Contract for construction shall be based upon products and standards established in the Contract Documents.

1. Product substitutions shall only be considered if:
   a. Substituted product meets the design intent and quality of the specified project.
   b. All requirements of Division 1 are met, and the substitution is approved by the Engineer.
2. Approval of substitutions is at the Engineer’s sole discretion. If substitutions are rejected by the Engineer, the Contractor shall submit specified products.

1.20 AS-BUILT DOCUMENTS

A. As-Built Documents: As-built Documents include Drawings, Shop Drawings, Specifications, Addenda, Change Orders, and other modifications permitted by the General Conditions.

B. Comply with all requirements of Division 1.

C. Verify aspects of redlined as-builts for accuracy. As-Built Documents shall show all components including but not limited to:

1. All raceways 1-1/4" and above, cable tray systems, and grouped raceway racking as installed, including dimensions from fixed building lines such as column lines.
2. All site underground raceways and duct banks indicating burial depths and distances from fixed building lines or global tracking coordinates.
3. Underground pull boxes and manholes including elevations. Detail manhole and pull boxes, conduit terminations (butterfly layout) including conduit sizes, designated systems and cabling description.
4. General conduit routing from receptacle to receptacle, fixture to fixture, device to device. (Exact routing is not required for raceways 1” and smaller.)
5. Lighting.
6. The first junction box within each homerun, regardless of size shall be shown in the installed location.
7. All junction boxes and pull boxes located above non-accessible ceilings shall be shown in exact location. All junction boxes 6”X6” and larger shall be shown in exact location.
8. Any combining of circuits (which is only allowed by specific permission) or change in homerun outlet box shall be indicated.
9. Any circuit number changes.
10. All conductors and cables, conductors and cable sizes, raceway sizes, etc not shown on contract documents and any changes from the documents.
11. Any switchboard, panelboard, motor control center, relay panel, or dimming control panel schedule changes, including load changes.
12. All access panels.
13. All existing conditions.
14. Location of lighting control devices such as photocell controls, space occupancy sensors, etc.
15. Exact quantity of conductors and cables shall be shown for all raceway systems.
16. All devices, wall outlet boxes, and control components.
17. All wireway and cable tray systems.
18. Exact location of all driven grounding electrodes including burial depths and dimensions from fixed building lines. Location of all grounding system busbars.
19. All building automation system (BAS) control panels and associated electrical devices, connections, power supplies, and dampers.
20. Riser diagrams exactly as installed.
21. Panelboards, motor control center, motor control devices, terminal cabinets, equipment racks, relays, disconnects and switches and surge protection devices.
22. Change the equipment schedules (i.e. symbol legends, light fixture schedule, etc) to agree with items furnished.

23. Change plan notes to agree with items furnished, actual installation methods, etc. respectfully.
24. Cross-out all items, circuitry, devices, etc. not applicable.

D. As-Built red line information shall not compromise the clarity of the Contract Documents and Shop Drawings. Major components such as grouped raceway assemblies, cable tray systems, larger conduits, duct banks, racking, elevations, dimensions, etc. shall be shown on a clean architectural base plan(s) separate from the Contract Electrical Documents, as required to clearly delineate work. Obtain electronic base plan file from the Owner.

1.21 SYSTEMS WARRANTY

A. Reference the General Conditions.

B. Warranty shall be by the Contractor to the Owner and shall cover for a period of one year from the date of the Substantial Completion. Warranty shall not include light bulbs in service after one month from date of substantial completion of the System.

1. Explain the provisions of warranty to the Owner at the "Demonstration of Completed System" meeting to be scheduled with the Owner upon project completion.

C. Where items of equipment or materials carry a manufacturer's warranty for any period more than twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material.

D. Where extended Guarantees are called for herein, furnish three copies to be inserted in Operation and Maintenance Manuals.

E. All preventative maintenance and normal service will be performed by the Owner maintenance personnel after final acceptance of the work which shall not alter the Contractor's warranty.

1.22 WASTE MATERIALS DISPOSAL

A. Include in base bid the transport and disposal or recycling of all waste materials generated by this project in accordance with all rules, regulations and guidelines applicable. Comply fully with Florida Statute 403.7186 regarding mercury containing devices and lamps. Lamps, ballasts and other materials shall be transported and disposed of in accordance with all DEP and EPA guidelines applicable at time of disposal. Provide the Owner with written certification of approved disposal.

1.23 PROHIBITION OF ASBESTOS AND PCB

A. Prior to the Final Review field visit the Contractor shall certify in writing that the equipment and materials installed in this Project under this Division 26 and 28 contain no asbestos or PCB. Additionally, all manufacturers shall provide a statement with their

submittal that indicates that their product contains no asbestos or PCB. This statement shall be signed by a duly authorized agent of the manufacturer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

1.3 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

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.

1.5 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 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:

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

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW and SO.

E. Aluminum (AL) conductors shall be utilized only as called for on the Panel Feeder Schedule on the drawings.

F. Metal Clad (Type “MC”) Cable:

1. Concealed locations in wall spaces only (not to be utilized in exposed and/or concealed locations in ceiling spaces).
2. All fittings to be approved for the purpose.
3. Installed per requirements of NEC and local AHJ.

2.2 CONNECTORS AND SPLICES

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

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:

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: Interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Aluminum. Stranded (#4 AWG and larger).

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW compact stranded aluminum.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type XHHW compact stranded aluminum, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW compact stranded aluminum, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN copper, single conductors in raceway.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN copper, single conductors in raceway.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

G. Class 1 Control Circuits: Type THHN-THWN, in raceway.

H. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Install all conductors and cables in raceways and wireways.

B. Install cable in accordance with the NECA "Standard of Installation".

C. Verify that interior of building has been protected from weather before installing conductors and cables.

D. Verify that mechanical work likely to damage wire and cable has been completed before installing conductors and cables.

E. Verify that raceway installation is complete and supported before installing conductors and cables.

F. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final approved submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).

G. 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.

H. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Pull all conductors into raceway at same time.

I. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

J. Neatly train and lace wiring inside boxes, equipment, switchboards and panelboards.

K. Conductor sizes indicated on circuit homeruns or in schedules shall be installed over the entire length of the circuit unless noted otherwise on the drawings.

L. Up to three phase conductors, corresponding switch-legs and a neutral are allowed in the same raceway unless indicated otherwise on the drawings. Do not combine homeruns.

3.4 CONNECTIONS

A. 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.

B. Clean conductor surfaces before installing lugs and connectors.

C. Make splices and taps that are compatible with conductor material and that possess equivalent or better ampacity, mechanical strength and insulation ratings than un-spliced conductors.

D. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

E. Conductors shall be continuous and unspliced where located within conduit. Splices shall occur within troughs, wireways, junction boxes, outlet boxes, or equipment enclosures where sufficient additional room is provided for all conductors, splices and devices.

F. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

G. Utilize anti-oxidant compound for all aluminum conductor terminations.

H. Exterior Locations:

1. All taps and splices shall be made with compression type connectors and covered with Raychem heavywall cable sleeves (type CRSM-CT, WCSM or MCK) with type “S” sealant coating with sleeve kits as per manufacturer’s installation instructions or be terminated/connected to terminal strips in above grade terminal boxes suitable for use.

I. Interior Locations:

1. All (non-electronic systems) copper taps and splices in No. 8 AWG and smaller shall be fastened together by means of spring type wire nut connectors. All copper taps and splices larger than No. 8 AWG shall be made with compression type connectors or split bolt connectors and provided with insulation equal to the conductor insulation.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. 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."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements;

    a. HVAC Equipment
    b. Motors 1HP and larger.
    c. UPS Systems

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. General: After installation of all conductors, and before final acceptance, make required tests to determine proper functioning of all circuits. Furnish all necessary instruments required to make tests, and correct any deficiencies found. Prior to energizing, circuits shall be “ringed-out” to verify opens, intentional and non-intentional grounds, continuity and detect short circuits by approved constant “megger”.

4. Procedure:

    a. Insulation resistance of all feeder conductors and all conductors AWG #1 and larger shall be tested. This is to include all new conductors. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps, and connections are made except connection to source and point of final termination at distribution or utilization equipment.
    b. Insulation resistance of conductors that are to operate at 600 volts or less shall be tested by using AVO biddle (or approved equal) Megger at not less than 1000 volts dc. Resistance shall be measured from conductor to conduit (ground). Testing methodology shall conform to short-time or spot-reading procedural recommendations of AVO Biddle Instruments for specific megger being used.

Acceptable insulation resistance of conductors rated at 600 volts shall not be less than on (1) megohm.

c. Conductors that do not satisfy test requirements (b.) above shall be removed, replaced, and testing repeated on new cable, at no additional costs to the Owner. All tests shall be performed by licensed electrician trained in the use of test instruments.

5. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

   a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. 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. Section includes grounding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.

1.3 SUBMITTALS

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

B. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For qualified testing agency and testing agency's field supervisor.

D. Field quality-control reports.

E. Operation and Maintenance Data: In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NFPA 70B.

a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

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 UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 2 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V. us length as required to accommodate all required connections plus 25% spare minimum except where indicated larger.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Bronze, Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8 inch by 30 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. 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.

D. Grounding Bus: Install in electrical, data and telephone equipment rooms and in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits and bond to equipment, raceway systems, devices and enclosures.

B. Bond the end of all conduit stubs with #8 CU to local ground bus or cable tray.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

F. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate Class 1 copper lightning protection down conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. 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.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 12 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods in a delta configuration spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Polymer-concrete

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. 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.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than the main grounding electrode conductor.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.4 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.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Distribution, Power and Lighting Equipment: 5 ohms.

G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS 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. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Hangers, straps, anchors and accessories.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
2. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.
7. Concrete Self Drilling Anchors: Heat treated carbon steel with Advanced Threadform Technology. Comply with ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements. For use in interior dry locations only.
8. All hangers and mounting hardware clamps shall be made of durable material suitable for the application involved. Excessive corrosive conditions, exterior and wet locations (i.e. kitchens, wash-down, etc.) conditions are encountered, hanger assemblies, supporting hardware and materials shall be made of malleable iron, hot dipped galvanizing steel, or stainless steel.
9. All hangers, clips and accessories for supporting shall be UL listed.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 5/16 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

D. Spring-steel clamps and clips are not acceptable.

E. Do not use powder-actuated anchors.

F. Do not use metal banding straps.

G. The use of tie-wire is only acceptable for support of conduit to reinforcing in poured concrete.

H. Obtain permission from Architect/Engineer before drilling or cutting structural members.

I. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

M. Concrete/insert anchors, thread rods, or similar fasteners installed on side or bottom of pre-stressed beams are not acceptable.

N. All items shall be supported directly from structural portion of the building. All above ceiling or ceiling mounted items shall be supported directly from building superstructure, except standard lay-in type ceiling lighting fixtures, and small outlet boxes for devices such as exit lights. Outlet boxes shall be attached to ceiling system by means of approved mounting brackets and shall also be provided with supplemental threaded rod hangers from super structure as specified elsewhere. No sagging of the ceiling will be permitted. Adjust supplemental supports accordingly.

O. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels. Support independent of ceiling per NEC-article 300-11(latest addition).

P. Hangers for PVC coated conduit shall be PVC coated galvanized steel.

Q. Free-air cable, where specified and permitted elsewhere, shall be supported directly from the structure with UL Listed devices intended for such use. Ty-Rap cable ties and support devices shall be UL Plenum rated within plenum air environments.

R. Attachment of cables to ceiling system or support wires, regardless if support wire is a dedicated wire, is prohibited. Support cables directly to building superstructure. Only a vertical cable drop down to a recessed lay-in luminaire can be supported to the fixture support wire with approved fasteners. Vertical cable drop attachment may be by means of Ty-Rap cable tie if approved by the Local Inspecting Authority having jurisdiction and UL plenum rated within plenum air environments.

S. Materials installed in environmental air plenums are required to be UL Listed for Plenum applications and bear the appropriate UL markings.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To New Concrete: Bolt to concrete inserts or anchor with self drilling anchors.
2. To Masonry: Approved toggle-type bolts or self drilling anchors on hollow masonry units and expansion anchor fasteners or self drilling anchors on solid masonry units.
3. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
4. To Light Steel: Sheet metal screws.
5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors and self drilling anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3500-psi, 28-day compressive-strength (minimum) concrete. Where pad construction is detailed on the drawings and in other sections of the specifications follow the most stringent requirements. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. LFMC: Liquidtight flexible metal conduit.

D. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

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

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

    a. Duct entry provisions, including locations and duct sizes.
    b. Frame and cover design.
    c. Grounding details.
    d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Qualification Data: For professional engineer and testing agency.

1.5 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 NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. EMT: ANSI C80.3.

C. FMC: Zinc-coated steel

D. LFMC: Flexible steel conduit with PVC jacket.

E. Fittings for Conduit (Including all Types and Flexible and Liquidtight and Conduit Bodies) and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Die-cast set-screw or die-cast compression type.

F. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Concealed locations only (below grade or in poured concrete).

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit type and material.

2.3 METAL WIREWAYS

A. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 in interior dry locations and Type 4 Stainless Steel in damp and wet locations, unless otherwise indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type, Flanged-and-gasketed type or as indicated.

D. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with Snap-On covers. Manufacturer's standard enamel finish in color selected by Architect.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: Die-cast aluminum boxes.

C. See Editing Instruction No. 2 in the Evaluations for a discussion of floor boxes.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, steel enclosure, finished inside and out with manufacturer's standard enamel in interior dry locations and Type 4 Stainless Steel in damp and wet locations, with continuous-hinge cover with flush latch, unless otherwise indicated.

F. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel in interior dry locations and Type 4 Stainless Steel in damp and wet locations.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open, closed or integral closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC." or as indicated for each service.

6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

2.7 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Underground Direct Buried Conduit: RNC, Type EPC-40-PVC or Rigid Steel Conduit coated with black mastic.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Cabinets and Enclosures, Aboveground: NEMA 250, Type 4X, stainless steel.
5. Cast Metal NEMA FB 1, Type 3R Outlet, pull and junction boxes, mounted aboveground.
6. Application of Handholes and Boxes for Underground Wiring:

    a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional Non-Deliberate Loading by Heavy Vehicles or Subject to Light-Duty Pedestrian Traffic Only: Polymer concrete, SCTE 77, Tier 22 structural load rating.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Underground Direct Buried Conduit: RNC, Type EPC-40-PVC or Rigid Steel Conduit coated with black mastic.
2. Embedded in concrete: RNC, Type EPC-40-PVC or Rigid Steel Conduit coated with black mastic.
3. Exposed, Not Subject to Physical Damage:

    a. EMT or Rigid Steel Conduit.
    b. Sheet Metal outlet, pull and junction boxes.

4. Exposed, Not Subject to Severe Physical Damage: Raceways and boxes installed within 1 foot of or above the overhead structure of a space is considered not subject to serve physical damage.

    a. EMT or Rigid Steel Conduit.
    b. Sheet Metal outlet, pull and junction boxes.

5. Exposed and Subject to Severe Physical Damage: Rigid Steel Conduit and Cast-Metal NEMA FB 1, Outlet, pull and junction boxes.

6. Concealed in Ceilings and Interior Walls and Partitions:

    a. EMT or Rigid Steel Conduit.
    b. Sheet Metal outlet, pull and junction boxes.

7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

8. Cabinets and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size. Home run raceways to be ¾ -inch.

D. Site Electrical Conduit: ¾" unless otherwise specified or noted.

E. Conduit size shall be increased as required for conductor fill, per NFPA 70 and when conductor size is increased due to voltage drop as specified in other sections of these specifications.

F. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings and conduit bodies, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NFPA 70 and NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes or surfaces with temperatures exceeding 104°F (40°C).

C. Maintain adequate clearance between conduit and ductwork, piping and equipment, 2" clearance minimum. Perform installation studies and coordinate installation to provide adequate clearance including required clearance for maintenance of equipment.

D. Conduits which contain communication, signal, data, control wiring and other cable sensitive to EMF and RF interference shall be routed at least 12 inches from power conduits and other EMF/RF generating equipment (i.e. light fixture ballast's, motors, capacitors etc.).

E. Complete raceway installation before starting conductor installation.

F. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

G. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

H. Route exposed conduit parallel and perpendicular to walls. Back straps or “stand-offs” shall be used to keep the conduit far enough away from supporting surfaces to allow painting and to prevent the accumulation of dirt and moisture.

I. Route conduit installed above ceilings parallel and perpendicular to walls.

J. Conduits in and under slabs may be routed from point-to-point.

K. Install no more than the equivalent of three 90-degree bends in any conduit run between boxes except for communications conduits, for which install no more than the equivalent of two 90-degree bends between boxes. Limit each bend to 90° or less. Radius of bends for communications conduits shall be 10 times the conduit diameter or greater. Size communication boxes to allow for large radius bend of cabling per cabling manufacturer requirements.

L. Conceal raceway systems within finished walls, ceilings, and floors, unless otherwise indicated.

M. Conduits installed within structural concrete i.e. columns, beams and suspended slabs shall meet all the following:

1. Conduit shall not be installed within structural concrete until specific written permission is given by the structural engineer. The contractor shall contact the structural engineer in writing within ten days of the award of contract and shall coordinate the installation of conduit within structural concrete. Installation shall meet the structural engineer’s requirements.
2. Conduit installation within structural concrete shall meet the requirements of applicable building codes.
3. Conduit & outlets which are not indicated on the drawings as being installed within the structural concrete shall be installed outside of the structural concrete (i.e. concealed below slab, above ceiling, within wall cavities or exposed) as indicated.
4. The contractor shall coordinate and install conduit and outlets within structural concrete where indicated on the drawings unless the requirements of items 1 & 2 above cannot be met. If conduit and outlets cannot be installed within the structural concrete, as shown then the contractor shall route the conduit outside of the structure at no additional cost. Coordinate routing of conduit outside of the structure with the architect and engineer prior to installation.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Rigid Metal Conduit Joints: All connections shall be threaded. The use of an Erickson type coupling is acceptable where two segments of a run must be joined, and neither can be rotated. Non-threaded type connectors shall not be allowed.

P. Threaded Conduit Terminations: Use insulating bushings where conduits penetrate metal enclosures.

Q. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

S. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

T. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.
2. Where liquids are present, form drip loops in liquid-tight flexible conduits to prevent liquid from running into connections.
3. Use angle connectors wherever necessary to relieve angle strain on flexible conduit.
4. Use strain relief type connectors for LFMC 2 inch and larger.

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

V. Provide bonding bushings at the end of all conduit stubs which do not terminate into a bonded metal enclosure or junction box (i.e. at terminal boards, cable trays, within open bottom enclosures etc.). Bond per Division 26 section Grounding and Bonding.

W. Seal all conduits with insulating electrical putty, which extend from the interior to the exterior of the building to prevent the circulation of air.

X. Use a Thruwall waterproof seal on each below grade conduit that penetrates a wall at or below grade level.

Y. Seal all site conduits entering building from below grade with insulating electrical putty where the conduit terminates in the building to prevent moisture from entering. Slope these conduits away from the building.

Z. All raceways shall be run from outlet to outlet as shown on the drawings, unless permission is granted, in writing from the Engineer, to alter arrangement shown. If permission is granted, arrangement shall be marked on field set of drawings as previously specified.

AA. Extend homeruns from outlets shown to panel designated, do not combine homeruns, and do not collect homeruns in pull or junction boxes.

BB. Spare underground conduit stubs shall be capped, and location marked with concrete marker set flush with finish grade. Marker shall be 6" round x 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.

CC. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction. Caps shall remain on conduits which remain empty after construction is complete.

DD. Ground and bond conduit under provisions of Division 26 section Grounding and Bonding.

EE. Conduit is not allowed to be installed on roofs except for stub-ups at equipment locations.

FF. Exposed exterior conduit shall be painted as directed by the Architect.

GG. The minimum headroom clearance for exposed conduits within a space shall meet all the following:

a. Install conduit as high as possible.
b. Install conduit above the bottom of all light fixtures.
c. Install conduit at least 6" above the tallest door height (including large doors i.e. roll-up and sliding doors) serving the space.
d. In no case shall headroom be less than 7'-0" above the finished floor.
e. If a through d above cannot be met the conduit does not serve the space, then conduit shall be routed around the space.
f. If a through e above cannot be met coordinate exact conduit routing with the architect and engineer prior to rough-in and route conduit around required means of egress and per owners required clearances for the use of the space.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit Outside of the Building:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. After installing conduit, backfill and compact (refer to general specifications).
3. Routing of conduits shall be coordinated with the utility, civil, hardscape and landscape construction documents and installers.

a. All conduit shall be installed in accordance with Article 300 of the NEC except the minimum cover for any conduit shall be 2 feet and the minimum cover for secondary or fiber optic conduit shall be 30 inches.
b. All conduit must maintain a minimum of 1ft. clearance with parallel utilities and at utility crossings.
c. All conduit must maintain a minimum of 1ft. clearance with footers, foundations and tree ball.
d. All conduits shall be routed around tree save areas and retention ponds.
e. Conduits shall not be routed within drainage ditches. Conduits crossing drainage ditches shall be provided with a 4" concrete cap (minimum 12" wide) extending a minimum of 5ft. beyond the limits of the ditch.
f. Conduit depth shall be increased as required to maintain the clearances noted above.

g. Provide underground warning tape: 4-inch-wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines. Install warning tape 12” below grade directly above each 1-1/2 inch or larger conduit.

B Conduit below building slab on grade:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. Install backfill as specified in "Earthwork” section of specifications.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

B. All penetrations through fire resistance rated partitions and other assemblies, including empty openings and openings containing cables, conduits and other penetrating items, shall be fire-stopped to preserve the fire resistance rating of the assembly. Fire-stopping shall comply with the following:

1. Compatibility: Provide fire-stopping composed of Components that are compatible with each other, the substrates forming openings, and the items if any, penetrating the fire-stopping under conditions of service and application, as demonstrated by fire-stopping manufacturer based on testing and field experience.

2. Fire stopping shall be listed in the underwriters laboratories fire resistance directory and installation shall be identical to that shown in the directory.
3. Fire-stopping details shall be submitted and approved by the Architect, Engineer and authority having jurisdiction prior to installation.

C. System Performance Requirements

1. General: Provide fire-stopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
2. F-Rated Through-Penetration Fire Stop Systems: Provide through-penetration fire-stop systems with F ratings equaling or exceeding the fire resistance rating of the constructions penetrated, as determined per ASTM E 814.
3. T-Rated Through Penetration Fire-Stop Systems: Provide through penetration fire-stop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where systems protect floor penetrating items exposed to contact with adjacent materials such as:

    a. Where fire-stop systems protect penetrations located outside of wall cavities.
    b. Where fire-stop systems protect penetrations located outside fire-resistive shaft enclosures.
    c. Where fire-stop systems protect penetrations located in construction containing doors required to have a temperature-rise rating, whether or not penetration is located within wall cavity.
    d. Where fire-stop systems protect penetrating items larger than a 4” diameter nominal pipe or 16 sq. in. in overall cross-sectional area, whether or not penetration is located within a wall cavity.

D. For fire-stopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 50, as determined per ASTM E 84.

E. Fire-stopping shall meet the requirements of applicable building codes as determined by the authority having jurisdiction.

F. Installer Qualifications: Engage an experienced Installer who is certified, licensed, or otherwise qualified by the fire-stopping manufacturer as having necessary experience, staff, and training to install manufacturer’s products per specified requirements.

G. Provide fire-stopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, “Polarized Light Microscopy.”

H. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that through-penetration fire-stop systems are installed per specified requirements.

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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. Section Includes:

1. Identification of power and control cables.
2. Identification for conductors.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

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.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, 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 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 FLOOR MARKING TAPE

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

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.
6. Printing on tape shall be permanent and shall not be damaged by burial operations.
7. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

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. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 42 INCHES." Adjust distance requirements per NFPA 70 for respective equipment voltage.
3. Flash Protection Warning: - “WARNING – ARC FLASH HAZARD – APPROPRIATE PPE REQUIRED – FAILURE TO COMPLY CAN RESULT IN DEATH OR INJURY – REFER TO NFPA 70E.”

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. inches and 1/8 inch 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.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background (Normal Power Equipment) on a red background (Emergency Power Equipment). Minimum letter height shall be 1/4 inch.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

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. Junction boxes and conduit located in public areas (i.e areas that can be seen by the public) shall be painted to match surface attached to. Provide written request to A/E for interpretation of those public areas which may be in question.

G. All junction boxes/cover plates for power, lighting and systems (except those installed in public areas) shall adequately describe it’s associated panel and circuit reference number(s) within, (i.e. ELRW-2, 4, 6) or systems within (i.e. fire alarm, intercom, etc.) Identification shall be by means of black permanent marker.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches below finished grade, unless noted otherwise. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Cables within Buildings: Identify conduits the covers of each junction and pull box.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in 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, grounded conductor and equipment grounding conductor.

a. Color shall be factory applied except for wiring sizes larger than No. 8 AWG may be field applied if approved by 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

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral: Gray
5) Ground: Green with yellow strips.
6) Note: Verify color code with GRU prior to starting work.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels at each panel.

D. 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. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to conduits 1-1/2 inch and larger.

F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

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.

H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification. Nameplates shall adequately describe the function of the equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 120/208V, 3-phase, 4-wire". In addition, describe where the panel is fed from. For example, "Fed from MDP-1:3:5". The name of the machine on the nameplates for a machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label.
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. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
e. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
e. Enclosed switches.
f. Enclosed circuit breakers.
g. Enclosed controllers.
h. Variable-speed controllers.
i. Push-button stations.
j. Power transfer equipment.
k. Contactors.
l. Remote-controlled switches, dimmer modules, and control devices.
m. Monitoring and control equipment.
n. UPS equipment.
o. Motors
p. HVAC Equipment
q. Power receptacles where the nominal voltage between any pair of contacts is greater than 150V.
r. Distribution circuit breakers.
s. Terminal Cabinets and Terminal Boards.
t. Wall switches controlling outlets that are not located within sight of the controlling switch.

END OF SECTION 260553

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, 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 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. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. 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. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. 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.

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; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

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.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
   b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

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 actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.10 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: Two spares for each panelboard.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Finishes:

a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: Top or bottom.

C. 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.

D. 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.
4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

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. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Multifunction Digital-Metering Monitor (where indicated on the plans): Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Megawatts: Plus or minus 2 percent.
e. Megavars: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.
k. Current and Voltage Total Harmonic Distortion per phase.

2. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, double secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; double secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
4. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
5. Provide appropriate space in the distribution board to allow installation of PT’s, CT’s and Control-Power Transformer or provide CT cabinet.
6. Meter to be installed in factory assembled enclosure.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 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. 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. 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.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

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 NEMA PB 1.1.

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges per manufacturer’s recommendations.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

G. Comply with NECA 1.

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.

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. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. 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.

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 262416

SECTION 262513 - BASWAYS

1 Summary

1.1 This specification covers the electrical characteristics and general requirements for a track busway system, hereafter referred to as Track Busway. The system shall be designed primarily for overhead power distribution of electrical power. Once installed, the Track Busway will provide simple, versatile, fast and economic means of distributing power. Loads fed from Track Busway plug-in units can be added or removed without shutting down the busway.

1.2 Specification includes:

1.2.1 Three-phase Track Busway system with the following features:

1.2.1.1 Extruded aluminum busway housing with conductors
1.2.1.2 Power Feed
1.2.1.3 Plug-in units for power distribution
1.2.1.4 Monitoring
1.2.1.5 Installation tool and joint kits
1.2.1.6 Optional accessories

2 Standards and Certification

2.1 The Track Busway shall be designed and manufactured to the following standards:

2.1.1 Electrical Testing Laboratories (ETL) (US/Canada) Certified to UL 857.

2.1.2 National Electric Code (NEC) – Article 368 – Busways

2.1.3 National Fire Protection Agency (NFPA) – 70, National Electric Code (NEC)

2.1.4 National Electrical Manufacturers Association (NEMA) - AB1, Molded Case Circuit Breakers and Molded Case Switches *(if applicable)*

2.1.5 National Electrical Manufacturers Association (NEMA) – KS-1, Enclosed and Miscellaneous Distribution Equipment Switches (600 VAC) *(if applicable)*

3 System Description

3.1 Electrical Requirements

3.1.1 System voltage: up to 600V

3.1.2 Frequency: 60 Hz.

3.1.3 Ampacity: 225

3.1.4 Neutral Ampacity: Minimum of 100% of rating

3.1.5 Short circuit rating must be: 22kAIC up to 600V; 50kAIC up to 240V, 65kAIC up to 480V

3.1.6 Conductors: 3 phase conductors, 1 neutral conductor solid copper, tin plated

3.1.7 Grounding: Aluminum casing

3.2 Operational Requirements

3.2.1 Environmental Conditions: The Track Busway shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage, degradation or derating of operating capability.

3.2.1.1 UL Operating temperature: busway shall operate with continuous load with no derating up to 40 degrees Celsius, 0.90 multiplier at 50 degrees Celsius, 0.85 at 55 degrees Celsius and 0.825 at 60 degrees Celsius

3.2.1.2 IEC Operating Temperature: busway shall operate with continuous load with no derating up to 55 degrees Celsius, 0.95 at 60 degrees Celsius, 0.925 at 65 degrees Celsius and 0.9 at 70 degrees Celsius

3.2.1.3 Relative humidity: 0 to 95 percent, noncondensing

3.2.1.4 Altitude: Sea level to 6,600 feet (2000m)

3.3 Manufacturers Qualification

3.3.1 A minimum of 10 years' experience in the manufacturing of the busway products.

3.4 Manufacturing Requirements

3.4.1 All Track Busway components and accessories shall be manufactured by Universal Electric Corporation.

Universal Electric Corporation
168 Georgetown Rd.
Canonsburg, PA 15317
(724) 597-7800

4 Submittals

4.1 Submittals shall be in accordance with specified procedures. Submit shop drawing and product data for record purposes prior to shipment. Shop drawings for Track Busway must include:

4.1.1 Detailed equipment assemblies and dimensions, weights, location and identification of each field connection

4.1.2 Wiring Connection: For power and monitoring wiring

4.1.3 Orientation of plug-in units face in final installation

4.1.4 Include plug-in schedule with detailed description

4.2 Provide electrical characteristics and connection requirements for the system and accessories.

4.3 Indicate special receiving and handling procedures.

5 Warranty

5.1 The Track Busway manufacturer shall guarantee the entire system against defective material and workmanship for a period of one (1) year from date of shipment.

5.2 Additional years of warranty and ability for start-up services must be an option if required per drawings.

5.3 Warranty shall only cover Track Busway product components manufactured by Universal Electric Corporation; use of any aftermarket components with Track Busway shall void warranty and any certifying listings completely

6 Product Components

6.1 Track Busway Housing

6.1.1 Extruded aluminum housing certified to serve as a 100% ground. Standard housing lengths are 5, 10 and 20 feet (1.5, 3 and 6 meters). 20 ft. (6 meter) maximum lengths can be cut in customizable lengths down to the inch or 3 centimeters. The housing should be properly extruded with a slot to receive rod mount hangers to hang from a ceiling. This housing should be open on the bottom to accept plug-in units anywhere along its length. This opening shall pass UL’s hypothetical finger probe test.

6.1.2 All conductors shall be made of copper and sized to handle 100% of its rating continuously up to the maximum ambient temperature. The conductors shall be electrically isolated from the housing. All insulators must be UL and IEC compliant.

6.1.3 Track Busway housing sections shall be joined together by a ‘press fit’ that requires no bolted connection and no future maintenance

6.1.4 Track Busway housing shall be available in standard silver, red, blue, black, white or custom RAL colors

6.2 Power Feed

6.2.1 The power feed shall provide the connections from the incoming cables to the Track Busway system. The power feed shall have internal connection to a section of busway conductors. End feeds, top feeds, center feeds and bottom feeds shall be available depending upon what Track Busway system is required. Feeds shall have the option to be designed with mechanical or compression type lugs.

6.3 Plug-In Units

6.3.1 Plug-in units shall be polarized to avoid incorrect installation

6.3.2 Plug-in units can be added, removed or repositioned without de-energizing the busway

6.3.3 Plug-in units shall use either a circuit breaker or a fuse for branch circuit protection as shown in the schedule on the project drawings

6.3.4 Plug-in units shall be capable of being built with customer-specified circuit protection, outlets and accessories

6.3.5 Plug-in units shall not require any tools to mount to the busway

6.3.6 Plug-in units shall not have a mechanism in order to engage the electrical connection to the busway conductors

6.3.7 Plug-in units shall have locking clips or bolt-on tabs to secure units to the busway

6.3.8 Plug-in units that include drop cords shall be manufactured with cord grips and receptacles as specified in the drawings

6.3.9 Plug-in units shall be configured by the manufacturer to balance the load based on quantity of plug-in unit types provided

6.3.10 Plug-in units shall have the ability to provide up to a 400amp load in certain plug-in unit configurations

6.3.11 Plug-in units shall have a minimum of 10kAIC and the ability to obtain a maximum of 200kAIC

6.3.12 Plug-in units shall be interchangeable within each Track Busway series

6.3.13 Plug-in units shall be available with optional, revenue grade metering devices

6.3.14 Plug-in units' authenticity shall be proven by the presence of a Starline ratings label

6.4 Accessories *(OPTIONAL)*

6.4.1 Closure strip and access panels shall be available for conductor access points to minimize accidental contact or build-up of debris

6.4.2 Universal Server Cabinet Mounting Brackets shall be available as an alternative hanging solution; meant for mission critical applications

7 Installation

7.1 The contractor shall install Track Busway in accordance with the manufacturer's instructions.

7.1.1 Track Busway runs shall consist of lengths as shown on the drawings.

7.1.2 The plug-in unit orientation shall be indicated on the drawings.

7.1.3 Hanging of the Busway: The Track Busway shall be hung from a structure above the busway, using the supplied busway hangers. The hangers shall connect to the busway, and to an all thread rod provided by the installing contractor. The spacing of the hangers along the busway is 10 feet (3 meters).

7.1.4 The busway shall be installed with the open access channel facing downward, or to the side for special applications. Special installation shall be agreed upon by the manufacturer.

7.1.5 Connecting Sections of Track Busway: At a junction of Track Busway sections, the installer will use a Joint Kit (includes Housing Couplers and Bus Connector) and an Installation Tool supplied by the manufacturer. Two sections are joined

together by a ‘press fit’ that requires no bolted connection and no future maintenance.

7.1.6 End of Runs: End caps will be provided to install at the end of each run.

7.1.7 Closure Strip: The closure strip is an optional accessory that can be cut and fitted to cover the bottom opening of the Track Busway housing to prevent dust and debris. Closure Strip can be field modified for fit.

7.2 All Track Busway joints are non-bolted, compression fit and shall require no maintenance after installation

8 Field Quality Control

8.1 Manufacturers Field Services: Track Busway shall be accompanied by optional services, such as on-site support and system startup, ongoing support, metering services and extended warranty programs. These services include:

8.1.1 On-site Training

8.1.2 Installation Inspection, Commissioning and Certification

8.1.2.1 Includes comprehensive visual inspection and certified report once results are satisfactory, which extends standard factory warranty from one to two years

8.1.3 Load Bank Testing

8.1.4 IR Scanning and other Ongoing Support

8.1.5 Extended Warranty Programs (Meter programming, commissioning and support)

8.1.6 24/7 Emergency Service and Phone Support

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, and associated device plates.
2. Twist-locking receptacles.
3. Wall-box motion sensors.
4. Snap switches and wall-box dimmers.
5. Pendant cord-connector devices.
6. Poke-through assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

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

1.5 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.

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.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

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 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Straight Blade, Side Wired with Ground Screw Terminal, Commercial Specification Grade, Comply with NEMA WD 1–Heavy Duty, NEMA WD 6 configuration 5-20R, and UL 498.

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

a. Hubbell
b. Leviton.
c. Pass & Seymour.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, 20A Feed-through type, Side Wired with Ground Screw Terminal, Heavy Duty Commercial Grade, Comply with NEMA WD 1–Heavy Duty, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Use “Weather-Resistant” rated GFCI type receptacles in all damp and wet locations.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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

a. Hubbell
b. Leviton.
c. Pass & Seymour.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Side Wired with Ground Screw Terminal, Heavy Duty, Specification Grade, Comply with NEMA WD 1–Heavy Duty, NEMA WD 6 configuration 5-20R, and UL 498.

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

a. Hubbell
b. Leviton.
c. Pass & Seymour.

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Single pole, Double Pole, Three-way or Four-way as indicated on the drawings.

C. Switches, 120/277 V, 20 A, AC only, Commercial Specification Grade, Side Wired with Ground Screw Terminal.

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

a. Hubbell
b. Leviton.
c. Pass & Seymour.

D. Pilot Light Switches, 120/277V, 20 A: Commercial Specification Grade, Side Wired with Ground Screw Terminal.

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

a. Hubbell
b. Leviton.
c. Pass & Seymour.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

E. Key-Operated Switches, 120/277 V, 20 A: Commercial Specification Grade, Side Wired with Ground Screw Terminal.

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

a. Hubbell
b. Leviton.
c. Pass & Seymour.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

F. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors. Specification Grade, Side Wired with Ground Screw Terminal.

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

a. Hubbell
b. Leviton.
c. Pass & Seymour.

G. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle. Specification Grade, Side Wired with Ground Screw Terminal.

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

a. Hubbell
b. Leviton.
c. Pass & Seymour

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices: Comply with UL 514D.

1. Material for Finished Spaces: #302 smooth stainless steel.
2. Material for Unfinished Spaces: #302 smooth stainless steel.
3. Material for Damp and Wet locations:

    a. Use weather proof heavy duty copper free cast aluminum “In-use rated cover.”

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: White or as selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure 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.

C. 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.
4. Connect wiring device grounding terminal to outlet box and branch circuit equipment grounding conductor.
5. Existing Conductors:

    a. Cut back and pigtail or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.

D. Device Installation:

1. 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.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. 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.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Install devices plumb and level.
11. Where walls have wainscot or chair rail finish, switch height shall be adjusted as required, so switch is either below chair rail all in wainscot or all in wall above wainscot or chair rail. Switch centerline shall be no higher than 46" AFF.
12. Prior to roughing-in outlet boxes, Contractor shall verify from general construction drawings; door swings, type of wall finishes and locations for counters, millwork and other equipment.

    a. Do not rough-in switches behind door swing. Where possible rough-in on knob side of door frame.
    b. Coordinate outlet box rough-in with millwork.

E. Receptacle Orientation:

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

F. 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.
2. Install blank cover plates on blank boxes.

G. Dimmers:

1. Install dimmers within terms of their listing.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

J. Provide extension rings to extend outlet boxes flush with finished surface.

K. Use “Weather-Resistant” rated GFCI type receptacles in all damp and wet locations.

1. Wet and Damp Locations: Use covers listed and labeled for use in "wet locations" when closed except for receptacles in wet locations use heavy duty copper free cast aluminum weather proof “In-use rated cover.”

3.2 IDENTIFICATION

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

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

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. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Ground Impedance: Values of up to 2 ohms are acceptable.
3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
4. Using the test plug, verify that the device and its outlet box are securely mounted.
5. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

3.4 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers 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 enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. 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.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provide rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

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

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.
4. Square D

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120VAC; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
2. Form C alarm contacts that change state when switch is tripped.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 4X SS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

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

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. 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 enclosed switch and

circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Description of Systems: A lightning protection system shall be placed on the structure as described herein, by experienced installers in compliance with provisions of NFPA 780, National Fire Protection Association, and Underwriters' Laboratories. All equipment to protect the structure against damage by lightning shall be included whether specifically called for herein. An U.L. Master Label (UL-96A) for the system and a witness of grounding form shall be required.

1.2 QUALITY ASSURANCE

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

1. Thompson Lightning Protection, Inc.
2. Heary Brothers Lightning Protection
3. Harger Lightning and Grounding

B. Installer: Firms with at least five (5) years of successful installation experience on projects with electrical installation work similar to that required for the project.

1. Maxwell Lightning Protection of Florida
2. Other qualified installers.

1.3 SUBMITTALS

A. Shop Drawings and Product Data:

1. Shop Drawings:

a. Shop drawings shall be submitted and reviewed before work is started. Drawings shall include full layout of cabling and points, and connections.
b. Submit shop drawings marked with roofing manufacturer's stamp of approval. Failure to do so will result in rejection of submittal.

2. Product Data: Product data shall be submitted on all equipment to show compliance with this Section of the Specifications and shall include manufacturer's written recommendations for installation.

PART 2 - PRODUCTS

2.1 AIR TERMINALS

A. Air terminals shall be solid aluminum and shall have proper base support for surface on which they are attached and shall be securely anchored to this surface. Terminals shall project a minimum of 10" above top of object to which attached.

2.2 CONDUCTORS

A. Roof conductors shall be aluminum and shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90° and shall provide an approximately horizontal or downward course. Down conductors shall be copper and shall be installed in PVC conduit and hidden within the structure. Radius of bends shall not be less than 8 inches. Ground loop conductors and counterpoise conductors shall be cooper.

2.3 FASTENER

A. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry's or structural work, they shall be furnished to the Masonry or Structural Contractor, so they may be installed during construction of the project.

2.4 GROUND CONNECTIONS

A. Ground connections shall be made in accordance with requirements of all applicable codes. Ground rods shall be placed a minimum of two (2) feet from building foundations. In addition to above artificial grounds, one down conductor of each two-path system shall be connected to water piping system with approved water pipe type strap connector. All ground rods shall be sectional, 5/8" x 20' minimum copper-weld type.

2.5 MATERIALS

A. Materials shall be new and shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the NFPA 780 relating to this type of installation and shall be U.L. Labeled.

B. All materials other than air terminal and conductors shall be heavy duty cast type. (No stamped metal materials are acceptable.)

C. Class I materials shall be used on structures that do not exceed 75 feet in height and Class II materials shall be used on structures that are 75 feet or higher above average grade.

D. Materials shall be selected to avoid deterioration due to environmental conditions or connection of dissimilar metals.

1. Aluminum materials shall not come into contact with earth or where rapid deterioration is possible. Aluminum materials shall not come into contact with copper surfaces.

2. Copper materials shall not be mounted on aluminum surfaces or galvanized steel surfaces including Galvalume, galvanized steel and zinc; this includes these materials that have been painted. Aluminum materials shall be used for these applications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within structure and shall be run in 1" PVC conduit. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor.

B. Bond to main service electrical ground.

C. Bond to incoming metallic telephone and communications surge protectors.

D. Provide access boxes at ground rods to permit inspection of connections. Boxes may be reinforced plastic body and cover in landscape areas and shall be concrete with cast iron covers in paved areas.

E. Make all connections and fastening and mounting of equipment using similar metals. Use bi-metal connectors where dissimilar metals are joined.

F. Provide a U.L. Master Label (UL-96A) for the system and witness of grounding forms.

3.2 TESTING

A. All ground rods shall be tested individually to ensure the maximum resistance to ground shall not exceed 5 ohms, and every rod that fails the test shall be driven deeper, using additional lengths of ground rod if necessary until the required resistance is achieved.

B. Upon completion of installation of the grounding and bonding systems, test ground resistance of the system with a ground resistance tester. The resistance of the grounding system shall not exceed five ohms. Where tests show resistance to ground exceeds five ohms, take appropriate action to reduce resistance to three ohms or less by driving additional ground rods; then retest to demonstrate compliance. Install additional rods at least eight feet apart.

C. Method for testing individual ground rods and the complete grounding and lightning protection system shall be by the three-point method. Test probes shall be placed a minimum of 30 feet and 60 feet from the rod being tested. Furnish a written report of all test results for all ground rods and the grounding system, witnessed by the Department's representative.

D. All underground connections shall be made using exothermic welds. All ground rod connections shall be welded.

E. All ground wires shall be terminated with compression lugs and bolted with ½ inch stainless steel nuts and bolts to the 1/4 inch by 2 inches by 12 inch (minimum, refer to plans) wall mounted copper ground bus near the main service equipment.

END OF SECTION 264113

SECTION 264313 - SURGE PROTECTIVE 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. Provide and install all materials, labor and auxiliaries required to furnish and install complete surge suppression for the protection of building electrical and electronics systems from the effects of line induced transient voltage surge and lightning discharge as indicated on drawings or specified in this section for power systems with voltages between 120VAC to 480VAC (single phase or three phase) and for all control, communications and alarm systems.

B. Provide surge suppression equipment for the following equipment:

1. On each main electrical service panel as call for on the drawings.
2. On distribution and branch panels as called for on drawings.
3. All electronic control, communications and alarm equipment provided under Divisions 26, 27 and 28 of the specifications including but not limited to: lighting control, security, telephone, data, CCTV and fire alarm systems.
4. Additional locations as required by NFPA 780.
5. On all A.T.S. (automatic transfer switches).
6. On each control, communication and alarm conductor pair and/or cable sheath entering or leaving a building provided under Divisions 26, 27 and 28 of the specifications including but not limited to: fire protection, fuel control, building management, lighting, security, telephone, data, CCTV and fire alarm systems.
7. On each exterior light pole, locate in the hand hole.

C. It is understood that each manufacturer or the electronic equipment being protected has different circuit requirements; therefore this specification is a modified performance specification. Contractor must provide the best type suppressor that matches these specifications and matches the equipment being protected.

1.2 REFERENCES

A. UL 1449 3rd Edition listed

B. UL 1283 listed

C. ANSI/IEEE C62.41.1-2002, C62.41.2-2002, C62.45-2002

D. NEMA LS-1 1992 Section 2.2.7

E. IEEE Std. 1100-1999 Section 8.6.1

F. ANSI C84.1, American National Standard for Electric Power Systems and Equipment, Voltage Ratings (60 Hertz).

G. NFPA 780 - Lightning Protection Code, latest edition.

H. NFPA 70 - National Electrical Code (NEC), current adopted year. Article 285

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications

B. SPD: Surge Protection Device

C. SCCR: Short Circuit Current Rating

D. VPRs: Voltage Protection Ratings

E. MCOV: Maximum Continuous Operating Voltage

F. I-n: I-nominal rating

1.4 SUBMITTALS

A. Submit under provisions of the General Requirements of the Contract Documents and Section 16012.

B. Product Data: For each type of product indicated. Include rated capacities; bill of materials of number of MOV's installed per phase with MOV part number and surge current rating, operating weights, operating characteristics, furnished specialties, and accessories.

C. Product Certificates: For Surge Protective Devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283
2. UL 1449 3rd Edition certification listing and classification page
3. UL 1449 3rd Edition fault current test report
4. NFPA 70, National Electrical Code - NEC 285 latest edition

D. Field quality-control test reports, including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

E. Operation and Maintenance Data: For transient voltage suppression devices to include in emergency, operation, and maintenance manuals.

F. Warranties: Special warranties specified in this Section. Submit Product Data for each type of suppressor:

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance (O&M) data as called for in Section 16098.

B. O&M data to include:

1. All approved shop drawings, product data, and/or cutsheets.
2. Installation, connection, and maintenance information on each type of surge suppression.
3. Procedure and/or timetable for recommended periodic inspection of devices to determine continued usefulness, as applicable.

1.6 QUALITY ASSURANCE

A. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment.

B. Manufacturing facility shall operate a Quality System Certified as ISO 9001:2000 (or latest version) Compliant.

C. CE Low Voltage Directive Compliant

D. The surge suppressor manufacturer shall provide requested technical assistance through support (including on-site as needed) by a factory-trained representative.

E. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

F. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated. Refer to Division 1 Section “Product Requirements”.

G. 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.

H. Product Standards:

1. Comply with IEEE C62.41.1, “IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits”, IEEE C62.41.2, “IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits”, and test devices according to IEEE C62.45, “IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits”.
2. Comply with NEMA LS 1, “Low Voltage Surge Protective Devices”.

3. Comply with UL 1283, “Electromagnetic Interference Filters,” and UL 1449 3rd Edition, “Surge Protective Devices”.
4. NFPA 70, National Electrical Code article 285 latest edition

1.7 REGULATORY REQUIREMENTS

A. Equipment Certification: Surge suppression equipment shall be listed by Underwriter Laboratories, shall bear the U.L. seal and be marked in accordance with referenced standard. Surge suppression equipment shall be U.L. listed and labeled for intended use.

B. Surge suppression devices shall be installed and located in accordance with requirements of all applicable National Fire Protection Association (NFPA) codes (including NFPA 780 and NFPA 70).

C. Comply with all standards and guides as listed under “References” above.

1.8 COORDINATION/PROJECT CONDITIONS

A. Verify proper grounding is in place.

B. Verify proper clearances, space, etc. is available for surge suppressor.

C. Coordinate so that proper overcurrent device, as recommended by manufacturer, is installed to feed each surge suppression device.

D. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
3. Humidity: 0 to 95 percent, no condensing.
4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.9 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.

B. For Data line Suppressors, Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within two years from date of Substantial Completion.

C. Any suppressor, that shows evidence of failure or incorrect operation during the warranty period (to include failure of visual failure indicators) shall be replaced or repaired by the manufacturer during the warranty period. The manufacturer shall provide replacement units to the owner for installation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Advanced Protection Technologies
2. Atlantic Scientific Corporation
3. Siemens
4. EDCO

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:

1. Install external SPD to distribution equipment with installation leads short as possible.
2. SPD marked with a 200kA short-circuit current rating. Ratings achieved in conjunction with external fuse protection shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.
3. Fabrication using bolted compression lugs for internal wiring.
4. Integral disconnect switch
5. Replaceable modules
6. Modes of Protection: Line to Neutral, Line to Ground, Line to Line, and Neutral to Ground
7. Arrangement with wire connections to OCP, neutral bus, and ground bus.
8. LED indicator lights for power and protection status.
9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. One set of dry contacts rated at 5A and 250-V ac, for remote monitoring of protection status.
11. Surge-event operations counter.
12. UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100KHz.

B. Minimum surge current (single pulse) rating: 200 kA per phase.

C. Connection Means: Permanently wired, connected on the load side of the service entrance overcurrent protection, and meet the SPD manufacturer’s instructions for overcurrent protection (breaker or fuse size).

D. Minimum I-nominal rating: 20KA

E. UL 1449 VPR shall not exceed the following:

1. Line to Neutral: 800V for 120/208V
   1200V for 277/480V
2. Line to Ground: 800V for 120/208V
   1200V for 277/480V
3. Neutral to Ground: 900V for 120/208V
   1200V for 277/480V
4. Line to Line: 1200V for 120/208V
   2000V for 277/480V

2.3 SUPPRESSOR FOR DISTRIBUTION PANELS AND PANELBOARDS

A. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:

1. Install external SPD to distribution equipment with installation leads short as possible.
2. SPD marked with a 200kA short-circuit current rating. Ratings achieved in conjunction with external fuse protection shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.
3. Fabrication using bolted compression lugs for internal wiring.
4. Integral disconnect switch
5. Replaceable modules
6. Modes of Protection: Line to Neutral, Line to Ground, Line to Line, and Neutral to Ground
7. Arrangement with wire connections to OCP, neutral bus, and ground bus.
8. LED indicator lights for power and protection status.
9. One set of dry contacts rated at 5A and 250-V ac, for remote monitoring of protection status.
10. UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100KHz.

B. Minimum surge current (single pulse) rating: 100 kA per phase.

C. Connection Means: Permanently wired, connected on the load side of the service entrance overcurrent protection, and meet the SPD manufacturer's instructions for overcurrent protection (breaker or fuse size).

D. UL 1449 VPR shall not exceed the following:

1. Line to Neutral: 600V for 120/208V
   1000V for 277/480V
2. Line to Ground: 700V for 120/208V
   1000V for 277/480V
3. Neutral to Ground: 600V for 120/208V
   1000V for 277/480V
4. Line to Line: 1000V for 120/208V
   1000V for 277/480V

2.4 SUPPRESSORS FOR POWER LINE CORD/DIRECT WIRED (120 VAC) SUPPRESSORS

A. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:

1. 15 & 30 Amp, 120 V rated. All continuous current bearing components must be either 15 or 30 Amp rated, minimum; depending on Location Load usage.
2. Suppressors shall provide three suppression modes: Line-to-neutral, line-to-ground, and neutral-to-ground.
3. Suppressor shall provide a pulse life rating of 3,000 amperes (8/20μs waveform) every thirty (30) seconds for 2,000 occurrences.
4. Peak Single-Impulse Surge Current Rating: 18 kA per phase

B. Protection modes and UL 1449 SVR for circuits with voltages of 120/240V, 1-Phase, 2-Wire shall be as follows:

1. Line to Neutral: 400V for 120V, 1PH, 2W
2. Line to Ground: 400V for 120V, 1PH, 2W
3. Neutral to Ground: 400V for 120V, 1PH, 2W

2.5 SUPPRESSORS FOR EXTERIOR LIGHT POLES

A. Surge Protection Device Description: Encapsulated fire retardant high impact waterproof, phenolic or plastic housing with the following features and accessories:

1. Suppressors shall provide suppression modes applicable to ballast configuration: Line-to-Line, Line-to-neutral, line-to-ground, and neutral-to-ground.
2. Peak Single-Impulse Surge Current Rating: 18 kA per phase

2.6 SIGNAL AND INICIATION CIRCUITS

A. Surge Protection Device Description:

1. Multi-stage hybrid protection circuit.
2. Plug-in replaceable modular design or individually mounted units.
3. Fail short/fail safe.
4. Surge capacity: 500 Amp with 10 x 700ms waveform.
5. Clamp voltage: 150% of circuit peak operating voltage with 100 amp 10 x 700ms waveform.
6. Maximum continuous operating voltage: 125% of peak operating voltage, minimum.
7. U.L. 497B listed and labeled.

2.7 DATA LINE SUPPRESSORS

A. Surge Protection Device Description: Modular DIN RAIL design.

1. Must be designed to U.L. 497B and/or UL-497B listed and labeled.
2. Plug-in replaceable DIN RAIL modules

3. Suppressor shall provide a pulse life rating of 3,000 amperes (8/20µs waveform) every thirty (30) seconds for 2,000 occurrences.

B. Peak Single-Impulse Surge Current Rating: 20 kA per phase.

C. Maximum clamping voltage at 10,000 amperes, 8/20µs current waveform, shall not exceed the peak of the normal applied signal voltage by 200%.

2.8 ENCLOSURES

A. NEMA Type 1 enclosures shall be used for all enclosures inside of the building and NEMA Type 3R enclosures for exterior applications.

2.9 ADDITIONAL SUPPRESSOR PERFORMANCE CRITERIA

A. Exterior Lighting Poles.

1. L-G, N-G, L-N and/or L-G, L-L Protection modes, (as applicable).
2. MOV shunt type protection.
3. Indicator lamps for each protected phase.
4. Modular solid state, fail-safe, 30 Ampere models.
5. Enclosures:

   a. Encapsulated, fire retardant, high impact, phenolic or plastic housing or metal enclosure.

6. Peak Let-Through Voltage, ANSI/IEEE Std. C62.41-Category B3/C1, (L-N), 6 kV x 3 kA, (8 x 20µs):
   a. 120V, 1ι: < 300 V
   b. 208V, 1ι: < 600 V
   c. 240V, 1ι: < 600 V

2.10 TERMINATIONS

A. Provide terminals sized for circuits required on project.

B. Where surge suppression modules are intended for mounting on >M= block assembly, provide M block assembly complete with grounding system that mates with surge suppression equipment.

2.11 TERMINAL CABINETS

A. Provide terminal cabinets for all termination=s and surge suppression equipment serving communications and alarm equipment including 120VAC power surge suppressor. Size terminal cabinets as required facilitating installation of terminations and surge suppression in a neat and workmanlike manner.

B. Terminal cabinet to meet specifications in Section 16160 unless specifically manufactured for use.

C. Manufacturers:

1. Hoffman

PART 3 - EXECUTION

3.1 GENERAL

A. Provide, install and connect suppressor at first piece of electrical equipment (panel, switchboard, ATS, etc.) that the electrical service encounters as it enters the facility as indicated on the drawings.

B. Provide, install and connect suppressor at each branch panel as noted on drawings.

C. Provide, install and connect suppressor at each Automatic Transfer Switch (ATS) in project.

D. Provide, install and connect surge suppressor on each exterior light pole, locate in the hand hole.

E. Provide, install, and connect point of use surge suppression at location where Divisions 21, 22, 23, 26, 27 and 28 control panels are connected to line voltage (120V). Provide cords and receptacles as required to connect SPD equipment to equipment being protected and maintain U.L. listing.

F. Provide, install and connect surge protective device on each communication and alarm conductor pair and cable sheath entering or leaving a building provided under Divisions 21, 22, 23, 26, 27 and 28 of the specifications including but not limited to: fire protection, fuel control, building management, lighting, security, telephone, data, CCTV and fire alarm systems. Provide terminal box in accessible location to house SPD's. Locate terminal box outside of finished areas.

G. Extreme care shall be taken by contractor to assure a properly surge protected system.

H. Surge protection equipment must be selected by contractor to match the equipment being protected including wire sizes, operating volts, amps, and circuit impedance.

I. Installation of surge protection equipment and its grounding must be per manufacturer's recommendations to assure short and proper ground paths.

3.2 EQUIPMENT SELECTION

A. Contractor to coordinate with suppliers and installers of all equipment being protected and provide surge suppression equipment that meets these specifications on respective equipment, wires, etc.

3.3 INSTALLATION OF SUPPRESSORS

A. Suppressors for 120V to 480V equipment shall be installed as close as practical to the electric panel or electronic equipment to be protected, consistent with available space.

B. Suppressors for equipment and conductors less than 120V shall be coordinated with respective equipment contractor. Locate in terminal cabinet with surge suppression equipment and bond together.

C. Suppressors shall be close-nippled to the device being protected in a position nearest the neutral bus (if present) to minimize wire lead length between suppressor and the buses or control breaker to which the suppressor connects. Suppressor leads shall not extend beyond the suppressor manufacturer's recommended maximum lead length without specific approval of the engineer. Gently twist SPD device leads to minimize impedance.

D. Location shown on drawings is diagrammatic only.

E. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be as short and as straight as possible and be consistent with recommended industry practices for the system on which these devices are installed.

F. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG core copper conductor and approved connections unless otherwise noted. Referenced to a common earth ground.

G. Suppressors shall be installed in a manner that allows simple replacement within short periods of downtime.

H. Suppressors other than point of use type and those for exterior lighting poles shall be installed with a means of disconnecting the suppressor at the panel. At the main service entrance location, provide a dedicated 30 amp, 3P-breaker for the SPD. At the distribution secondary and/or subpanels location, provide dedicated 30 amp, 3P-CB, for the SPD. Label disconnect or CB "Surge Protector". Contractor to change rating of CB's noted above as required to properly provide system as recommended by manufacturer.

I. Install surge suppression equipment per manufacturer's recommendation at each wire terminal as noted under Part 1.

J. Install in surge suppression equipment terminal cabinets, etc. as required to facilitate installation of surge protection equipment and terminal points. Increase size of terminal cabinets (from that shown on drawings) to size required to facilitate installation of surge suppression equipment and terminal blocks.

3.4 GROUND INSTALLATION

A. Ground Bus Connections:

1. Provide "local" ground bus in each terminal cabinet housing surge protection equipment (with lugs, etc. as required).

2. Bond "local" ground bus to terminal cabinet with minimum #6 copper wire.
3. Connect terminal cabinet "local" ground bus to "system" ground bus installed with minimum #6 copper insulated wire (unless otherwise noted) in conduit.

B. Surge Suppression Equipment Grounding:

1. Connect each surge suppressor to local ground bus in terminal cabinet with wire sized as recommended by manufacturer. Where "M" block type terminations/surge suppressors are used, bond ground rail to local ground bar with wire as recommended by manufacturer.
2. Assure that 120VAC power source/supply surge suppressor is also grounded to same local ground bus as surge suppressors provided in this section for same system (i.e. fire alarm, intercom, television, etc.).

C. Conductors:

1. Conductors shall meet requirements of Division 26. Minimum size to be #8 THWN and shall be twisted together a minimum of three turns per inch.
2. Bends in excess of 90 degrees in any grounding conductor shall not be permitted. A radius of 6 inches or greater shall be maintained on all bends.
3. Do not bundle unprotected conductors with protected conductors.
4. Conductors shall be kept as short and straight as possible.
5. Conductors shall be secured at 12" intervals with an approved copper clamp.
6. Grounding conductors shall be properly connected to the building service ground by approved clamps.

D. Grounding Connectors:

1. Connectors, splicers, and other fittings used to interconnect grounding conductors, bond to equipment or grounding bars, shall be approved by NEC or U.L. for the purpose.
2. All connectors and fittings shall be of the Nicopress crimp or compression set screw type.
3. Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electro-galvanic action.

3.6 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect service entrance equipment or panelboards to their sources until surge protection devices are installed and connected.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust equipment installation, including connections and to assist in field testing. Report results in writing.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with manufacturer’s instructions.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 264313

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. Section Includes:

1. Interior lighting fixtures.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
5. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers, and Grilles."
6. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.

7. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. 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.

B. Shop Drawings: For nonstandard or custom lighting fixtures. 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.

C. Installation instructions.

D. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

F. Field quality-control reports.

G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

H. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

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 NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.6 COORDINATION

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

1.7 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: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: 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. Self-Powered Exit Signs (Battery Type): 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.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by 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.

C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support rods to building structure.

E. Locate recessed ceiling luminaries as indicated on reflected ceiling plan.

F. Exposed Grid Ceilings: Support surface mounted luminaries on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid member to support surface mounted luminaries. Fasten surface mounted luminaries to ceiling grid members using bolts, screws, rivets, or suitable clips.

G. Install recessed luminaries to permit removal from below.

H. Install recessed luminaries using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Install wall mounted luminaries, emergency lighting units and exit signs at height as indicated on Drawings, as scheduled. Maintain ADA clearances.

J. Install accessories furnished with each luminaire.

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

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

M. Connect battery operated emergency light fixtures to local lighting circuit ahead of all swtches. Provide and install all wiring as required for proper operation.

N. Where ceiling mounted fixtures are called for in the Light Fixtures Schedule and on the drawings, this contractor shall provide fixture trims and supports as required to match type of ceiling system which will be furnished. No ceiling fixtures shall be ordered until the Ceiling System installer has given written approval of the method and location of the fixture hanging and fixture type. Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Clips identified for use with the type of ceiling framing member(s) and fixture(s) shall also be permitted.

O. All interior and exterior light fixtures shall not have any labels exposed to normal viewing angles. This includes manufacturer labels and U.L. labels. All labels shall be concealed within the body of the fixture and/or luminare. No manufacturers name or logo shall appear on the exterior of any light fixtures unless approved in writing by the engineer.

P. Ceiling surface mounted fluorescent fixtures installed in exposed ceiling structure with minimum 3/8” all-thread rods and 1-1/2” x 1-1/2” Kindorf channels, full length of fixture/row. Mount outlet box at structure with flexible connection to fixture.

Q. All light fixtures shall have label near lamp socket, out of view of public 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 approval of lighting designer, architect and engineer.

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

3.4 CLEANING

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

B. Remove dirt and debris from enclosures.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate luminare operation for minimum of eight hours.

3.6 PROTECTION OF FINISHED WORK

A. Replace luminaries that have failed as Substantial Completion.

END OF SECTION 265100

SECTION 265600 - EXTERIOR 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. Section Includes:

1. Exterior luminaires.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

E. Pole: Luminaire support structure, including tower used for large area illumination.

F. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.

1.5 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

    a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Materials, dimensions, and finishes of poles.
8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
9. Anchor bolts for poles.
10. Manufactured pole foundations.

B. Shop Drawings: 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. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
4. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For products designated for sample submission in the Exterior Lighting Device Schedule. Each Sample shall include lamps and ballasts.

D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

E. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

F. Field quality-control reports.

G. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

H. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. 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.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. 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.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

E. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

F. Exposed Hardware Material: Stainless steel.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

H. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

I. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

J. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.3 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated on Light Fixture Schedule on drawings.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.3 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Fasten luminaire to indicated structural supports.

B. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

C. Install level and plumb.

3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches.
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
3. Trees: 15 feet from tree trunk.

C. Raise and set poles using web fabric slings (not chain or cable).

D. Install plumb.

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 2 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

C. Install level and plumb.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.5 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.6 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Measure illumination levels to verify conformance with performance requirements.

1. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.
2. Aim and adjust poles and luminaries to provide illumination levels and distribution in conformance with performance requirements.

3.7 CLEANING

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

B. Remove dirt and debris from enclosures.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.8 PROTECTION OF FINISHED WORK

A. Replace luminaries that have failed at Substantial Completion.

END OF SECTION 265600