

SECTION 260500

GENERAL ELECTRICAL



PART 1 GENERAL

Permit Documents For Review Only – 10/22/2020
All Divisions 26, 27 & 28

1.1 SCOPE OF WORK

- A. The Instructions to Bidders, General Conditions of the Contract, Supplementary General Conditions and Division 1 bound herewith are a component part of this Division of the specifications and shall apply to this Division with equal force and shall be consulted in detail for instructions pertaining to the work.
- B. Requirements in Divisions 26, 27 and 28 of the specifications and shall, as applicable, apply to all these Divisions.
- C. Furnish all labor, materials and equipment and incidentals required to make ready for use complete electrical systems as shown on the Drawings and specified herein.
- D. It is the intent of these Specifications that the electrical systems shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Division shall be furnished at no extra cost.
- E. The work shall include, but not be limited to, furnishing, coordinating, and installing the following:
 - 1. Electrical distribution system for power, lighting, receptacles and miscellaneous power as shown on the contract drawings.
 - 2. Electrical lighting systems as shown on the contract drawings, complete with indicated switching, circuiting, etc.
 - 3. Electrical receptacle systems as shown on the contract drawings.
 - 4. Exit and emergency lighting systems.
 - 5. Power supplies for equipment furnished by others as detailed in Specification Section 260580.
 - 6. Existing Fire Detection and Alarm System extension.
 - 7. Raceway and outlet systems, including cabling and terminations, and power for data systems.
 - 8. Empty raceway and outlet systems and power for low voltage and other special systems.
 - 9. Grounding.
 - 10. Seismic restraint systems.
 - 11. Other special requirements and/or systems where shown.
- F. Each bidder (or Representative) shall, before preparing a proposal, visit all areas of the existing site. If the work includes demolition, restoration, renovation and/or addition; then existing buildings and structures should be carefully inspected. The submission of the proposal by this Bidder shall be considered evidence that the Bidder (or Representative) has visited the site and noted the locations and conditions under which the work will be

performed and that the Bidder takes full responsibility for a complete knowledge of all factors governing the work.

- G. All power interruptions to existing equipment shall be at the Owner's convenience with 24 hours (minimum) written notice. Each interruption shall have prior approval.
- H. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for all the proper functioning of the system and equipment. All work shall be of the highest quality. Substandard work will be rejected.
- I. Field verify all existing underground electrical, plumbing, gas, mechanical, etc. piping.

1.2 SUBMITTALS

- A. Shop drawings shall be submitted for all equipment, apparatus, and other items as required by the Architect/Engineer. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submittals are required for all materials shown in the individual specifications sections.
- C. Submittals are required for materials used for penetrations of rated assemblies and for seismic restraints.
- D. All shop drawings and submittals shall be submitted at the same time. Partial shop drawing and submittals will be rejected and not processed. Materials and equipment with long lead times or other materials and equipment requiring special handling, if identified and requested by the contractor, will be processed separately.
- E. Proposed equipment and/or materials substitutions shall be clearly indicated in shop drawings. All deviations from the specified quality, functionality, appearance or performance of the proposed equipment and/or materials shall be clearly summarized in the preface of each submittal. If none are disclosed, and the deviation specifically approved, the Contractor is responsible for providing the specified materials regardless of submittal approval.
- F. The project shall be bid based on the equipment listed in these specifications and on the drawings. After award of the Electrical Contract the Contractor may wish to substitute equipment other than that specified, subject to approval. The Electrical Contractor shall bear the "burden of proof" for demonstrating substitute equipment equivalency and suitability.
- G. The Electrical Contractor shall be required to replace installed "equivalent" equipment if the operation of this equipment does not meet the full design intent of the specified system.
- H. Physical size of equipment used in the design layout are those of reputable equipment manufacturers. The Contractor is responsible for providing equipment which will fit the space provided. If the Contractor elects to use other manufacturer's equipment, any resulting conflicts with space clearance or codes shall be the responsibility of the Contractor to correct at the Contractor's expense.

- I. The Contractor assumes all responsibility for providing code clearances. Submit a scale drawing of each electrical equipment room showing exact size and location of all proposed electrical equipment with code clearances and working space clearly indicated.

1.3 COORDINATION OF WORK

- A. It is understood and agreed that the Contractor is, by careful examination, satisfied as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the general and local conditions and all other matters which can and may affect the work under this contract. The Contractor shall be held responsible for visiting the site and thoroughly familiarizing himself with the existing conditions and also any contractual requirements as may be set forth in the other Divisions of these Specifications. No extras will be considered because of additional work necessitated by obvious job conditions that are not indicated on the drawings.
- B. The Contractor shall compare the electrical drawings and specifications with the drawings and specifications for other trades, and shall report any discrepancies between them to the Architect/Engineer and obtain written instructions for changes necessary in the electrical work. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provisions to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor caused by neglect to do so shall be made at the expense of the Contractor.
- C. Location of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each electrical raceway prior to make up and assembly.
 1. Right of Way: Lines which pitch shall have the right of way over those which do not pitch. For example, steam, condensate and plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
 2. Offsets and changes in direction of electrical raceways shall be made as required to maintain proper headroom and to clear pitched lines whether or not indicated on the drawings. The Contractor shall furnish and install elbows, pull boxes, etc., as required to affect these offsets, transitions, and changes in directions. Conflicts between electrical raceways, fixtures, etc., and ductwork or piping which cannot be resolved otherwise, will be resolved by the Architect/Engineer.
- D. Installation and Arrangements: The Contractor shall install all electrical work to permit removal (without damage to other parts) of any equipment requiring periodic replacement or maintenance. The Contractor shall arrange electrical raceways and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging and overhead doors and of access panels.

1.4 EQUIPMENT AND MATERIALS (GENERAL)

- A. In compliance with North Carolina General Statute 133.3, the Architect/Engineer has, wherever possible, specified the required performance and design characteristics of all materials utilized in this construction. In some cases it is impossible to specify the required

performance and design characteristics and when this occurs the Architect/Engineer has specified three or more examples of equal design or equivalent design, establishing an acceptable range for items of equal or equivalent design. Cited examples are used only to denote the quality standard of product desired and do not restrict bidders to a specific brand, make, manufacturer or specific name and are used only to set forth and convey to bidders the general style, type, character and quality of product desired. Equivalent products will be acceptable.

- B. Substitution of materials, items, or equipment of equal or equivalent design shall be submitted to the Architect/Engineer for approval or disapproval. Equal or equivalent shall be interpreted to mean an item of material or equipment, similar to that named and which is suitable for the same use and capable of performing the same functions as that named, the Architect/Engineer being the judge of equality.
- C. The materials used in all systems shall be new, unused and as hereinafter specified and shall bear the manufacturer's name, trade name and a qualified third party testing agency label in every case where a standard has been established for the particular material. Equipment furnished under this specification shall be essentially the standard product of manufacturers regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for approval as required by the Architect/Engineer.
- D. Protection: Electrical equipment shall at all times during construction be adequately protected against damage. Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury and theft. Electrical equipment shall be stored in dry, and heated if required to reduce condensation, permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner. At the completion of the work, fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect/Engineer. Damage or defects, developing before acceptance of the work shall be made good at the Contractor's expense.
- E. Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted per the field painting specifications in Division 9, at no additional cost to the Owner.
- F. Where materials such as wiring devices and plates, fire alarm equipment, paging system components, etc. are specified to match existing, provide materials to match existing equipment in finish, color, capacity, ratings, operating characteristics, performance, etc.
- G. Delivery and Storage: Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, and heated if required to reduce condensation, but readily accessible for inspection by the Architect/Engineer until installed.
- H. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.

- I. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect/Engineer, in writing, of any conflicts between any requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect/Engineer's written instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's direction or such written instructions from the Architect/Engineer, the Contractor shall bear all costs arising in correcting the deficiencies.

1.5 OPERATION AND MAINTENANCE MANUALS

- A. Submit under relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. The Contractor shall provide three compilations of catalog data, bound in suitable loose leaf binders, for each manufactured item of equipment used in the electrical work. These shall be presented to the Architect/Engineer for transmittal to the Owner before the final inspection is made. Data shall include printed installation, operation and maintenance instructions for each item, indexed by product with heavy sheet dividers and tabs. All warranties shall be included with each item. Each manufacturer's name, address and telephone number shall be clearly indicated.
- C. Shop drawings with Architect/Engineer's "as noted" markings are not acceptable for the above. "Approved" shop drawings are acceptable if adequate information is contained therein. Generally, shop drawings alone are not adequate.
- D. Installation information packed with lighting fixtures, devices and equipment shall be retained for inclusion in the operations and maintenance manuals.

1.6 PAINTING

- A. All painting will be performed by the General Contractor for the project, unless specifically indicated otherwise.
- B. The Electrical Contractor shall clean all exposed electrical work for painting. Should the Electrical Contractor delay in installing exposed conduit and outlets until the General Contractor has begun painting, the Electrical Contractor shall be required to paint all exposed electrical work at the Electrical Contractor's own expense. Such painting will be accomplished in accordance with the detailed specifications for the Project.
- C. Conductors exposed in boxes and cabinets shall be protected against painting. Devices, cover plates, trims, etc., for panelboards and cabinets shall not be installed until painting has been completed.
- D. The Electrical Contractor shall be responsible for touch up painting that may be required for electrical material or apparatus furnished with factory applied finish.

1.7 LOCATIONS AND MEASUREMENTS

Outlets and appliances are shown and located on the drawings as accurately as possible. All measurements shall be verified on the project and in all cases the work shall suit the surrounding trim, finishes and/or construction. The locations of outlets for special appliances shall be installed so that when extended, they are flush with the finished wall or ceiling and permit the proper installation of fixtures and/or devices. Heights of all outlets shown on the drawings are approximate only. Slight relocations of outlets, devices and equipment shall be made by the Contractor as required or as directed by the Architect/Engineer at no additional cost to the Owner.

1.8 QUALITY OF WORK

All work shall be executed as required by this specification and the accompanying drawings and shall be done by skilled mechanics, and shall present a neat, trim, and mechanical appearance when completed. All work shall be performed as required by the progress of the job.

1.9 SUPERVISION

- A. The Contractor shall personally, or through an authorized and competent representative, constantly supervise the work from the beginning to completion and final acceptance. So far as possible, the Contractor shall keep the same foreman and mechanics throughout the project duration.
- B. During the progress of the work it shall be subject to inspection by representatives of the Architect/Engineer, the Owner, and local inspection authorities, at which time the Contractor shall furnish such required information and data on the project as requested.
- C. The Electrical Contractor shall coordinate the electrical work with other Contractors and cooperate in the preparation and maintenance of a master schedule for the completion of the project.

1.10 EXCAVATION, TRENCHING AND BACKFILLING

- A. The Electrical Contractor shall do all excavating, trenching and backfilling in connection with this contract. All such excavation shall be done in a manner as not to endanger or damage existing utility lines and other structures. If damage occurs, the Contractor shall pay for and repair damage to the satisfaction of the Architect/Engineer.
- B. It shall be the responsibility of the Contractor to investigate conditions before excavation and to exercise care during the excavation to avoid any utilities or other objects which may not be shown. Whether or not utilities, etc., are shown on the drawings shall not relieve the Contractor from the responsibility to repair any damage caused by this work. Location of all ditching shall be laid out at grade and shall be approved by the Architect/Engineer before excavating and no work shall be done until such approval has been obtained.
- C. All surplus earth shall be removed by the Contractor from the site and disposed of at the Contractor's expense.

- D. All excavation, trenching and shoring shall be in accordance with rules and regulations set forth in Article XXI, Bulletin 1 “Trenching” as published in a separate bulletin by the North Carolina Department of Labor, Division of Standards and Inspection Construction Bureau.
- E. Backfilling shall be in 6” layers with each layer tamped. No boulders or debris shall be used for backfill material. Where trenching passes through areas designated as streets, driveways, walkways, or parking areas, backfill shall be tamped with power tamps to 95 percent compaction.
- F. Excavation shall be bid unclassified with no extra payment for removal of rock.

1.11 CLOSING IN WORK

Work shall not be covered up or enclosed until it has been inspected, tested and approved by the Architect/Engineer and authorities having jurisdiction over this work. Should any of the work be enclosed or covered up before such inspection and test, the Contractor shall uncover the work at the Contractor’s expense; after it has been inspected, tested and approved, the Contractor shall restore the work to its original condition.

1.12 REFERENCE STANDARDS

- A. All electrical equipment, materials, and installation shall be in accordance with the latest edition of the following codes and standards:
 1. American Association of Edison Illuminating Companies (AEIC)
 2. American National Standards Institute (ANSI)
 3. American Society for Testing and Materials (ASTM)
 4. Building Officials Code Administrators (BOCA)
 5. Energy Code 90.1 (ASHRAE/IES)
 6. Institute of Electrical and Electronic Engineers (IEEE)
 7. Insulated Cable Engineers Association (ICEA)
 8. International Code Council (ICC)
 9. International Conference of Building Officials (ICBO)
 10. National Electrical Code (NEC) 2017 edition
 11. National Electrical Contractor’s Association (NECA)
 12. National Electrical Installation Standards (NEIS)
 13. National Electrical Manufacturer’s Association (NEMA)
 14. National Electrical Safety Code (NESC)
 15. National Fire Protection Association (NFPA)
 16. North Carolina State Building Code (NCSBC)
 17. Occupational Safety and Health Act (OSHA)
 18. Requirements of the Americans with Disabilities Act (ADA), latest edition.
 19. Underwriters Laboratories Inc (U.L.)
 20. Southern Building Code Congress International (SBCCI)
 21. Toxicity Characteristics Leaching Procedure (TCLP)
- B. All electrical equipment and material shall be listed by a qualified third party testing agency. Acceptable qualified third party testing laboratories/agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical and Mechanical Equipment. Equipment and materials shall bear the appropriate testing agency’s listing mark or classification marking. Equipment, materials, etc. utilized not bearing a third

party testing agency certification shall be field or factory third party testing agency certified prior to equipment acceptance and use.

- C. Where reference is made to one of the above standards, the revision in effect at the time of the bid opening shall apply.

1.13 ENCLOSURE TYPES

Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:

1. NEMA 1 for dry, indoor locations.
2. NEMA 3R for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP" and "WET" locations.
3. NEMA 4X for locations subject to corrosion when specifically noted.

1.14 CODES, INSPECTION AND FEES

- A. All equipment, materials and installation shall be in accordance with the requirements of the local authority having jurisdiction.
- B. The Electrical Contractor shall obtain all necessary permits and pay all fees required for permits and inspections of electrical work.
- C. The Electrical Contractor shall contact Code Officials to schedule any and all required inspections.

1.15 TESTS AND SETTINGS

- A. Test all systems furnished under Division 26 and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.
- B. Make the following minimum tests and checks prior to energizing electrical equipment:
 1. Mechanical inspection, testing and settings of all circuit breakers, disconnect switches, motor starters, control equipment, etc., for proper operation. All overcurrent protective devices shall be set as recommended by the Selective Coordination Study, if applicable.
 2. Check all wire and cable terminations. Verify to the Architect/Engineer that connections meet the equipment torque requirements. Provide a tabular report of all terminations indicating the manufacturer recommended torque and the measured installed torque.
 3. Check rotation of motors, obtain permission from other contractors to start motor, and proceed to check for proper rotation. If the motor rotates in the wrong direction, correct it. Take all necessary precautions not to damage any equipment.
 4. Provide all instruments and equipment for the tests specified herein.
- C. All testing shall be scheduled and coordinated by the Contractor. Notify the Owner at least two (2) weeks in advance of conducting tests. The Contractor shall have qualified personnel present during all testing.

- D. All tests shall be completely documented with the time of day, date, temperature, and all other pertinent test information. All required documentation of readings indicated shall be submitted to the Architect/Engineer prior to, and as one of the prerequisites for, final acceptance of the project.
- E. Electrical Distribution System Tests: All current carrying phase conductors and neutrals shall be tested as installed, and before load connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt cable insulation tester. The following procedures shall be as follows:
 - 1. Minimum readings shall be one million (1,000,000) ohms or more for #6 AWG wire and smaller; 250,000 ohms or more for #4 AWG wire or larger. Measurement to be taken between conductors and between conductor and the grounded metal raceway.
 - 2. After all fixtures, devices and equipment are installed and all connections completed to each panel, the Contractor shall disconnect the neutral feeder conductor from the neutral bar and take a cable insulation tester reading between the neutral bar and grounded enclosure. If this reading is less than 250,000 ohms, the Contractor shall disconnect the branch circuit neutral wires from this neutral bar. The Contractor shall then test each one separately to the panel until the low reading ones are found. The Contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
 - 3. The Contractor shall send a letter to the Architect/Engineer certifying that the above has been done and tabulating the cable insulation tester readings for each panel. This shall be done at least four (4) days prior to final inspection.
 - 4. At inspection, the Contractor shall furnish a cable insulation tester and show Architect/Engineer's representative that the panels comply with the above requirements. The Contractor shall also furnish a clamp type ammeter and a voltmeter and take current and voltage readings as directed by the representatives.
 - 5. At inspection, the Contractor shall furnish ladders, required tools, and mechanics to open fixtures, boxes, panels, or any other equipment to enable the Architect/Engineer's representatives to see into any parts of the installation that may be requested.
- F. Electrical Grounding System Tests: Provide documentation showing values of earth ground impedance for the system ground. See Specifications Section 260526 for testing requirements.

1.16 SLEEVES AND FORMS FOR OPENINGS

- A. Anchor bolts, sleeves, inserts, supports, etc., that may be required for electrical work shall be furnished, located and installed by the Electrical Contractor. The Electrical Contractor shall give sufficient information (marked and located) to the General Contractor in time for proper placement in the construction schedule. Should the Electrical Contractor delay or fail to provide sufficient information in time, then the Electrical Contractor shall cut and patch construction as necessary and required to install electrical work. Such cutting and patching will be done by the General Contractor but paid for by the Electrical Contractor.
- B. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

- C. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, request shop drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured.
- D. Where such data is not available in time to avoid delay in scheduled floor slab pours, the Architect/Engineer may elect to allow the installations of such conduits to be exposed. No additional compensation for such change will be allowed and written approval must be obtained from the Architect/Engineer.
- E. Seal all openings, sleeves, penetration, and slots as specified and as shown on the Contract Drawings.

1.17 CUTTING AND PATCHING

- A. For the purposes of the Electrical Contract, “cutting and patching” shall be defined as that work required to introduce new electrical work into existing construction. Work required to install or fit electrical boxes, conduit, enclosures, equipment, etc. into new construction is not “cutting and patching”.
- B. The Electrical Contractor shall perform all cutting and patching necessary to install all equipment as required under his contract and shall re-establish all finishes to their original condition where cutting and patching occur.
- C. All cutting and patching shall be done in a thoroughly workmanlike manner.
- D. Core drill holes in existing concrete floors and walls as required.
- E. Install work at such time as to require the minimum amount of cutting and patching.
- F. Do not cut joists, beams, girders, columns or any other structural members without first obtaining written permission from the Architect/Engineer.
- G. Cut opening only large enough to allow easy installation of the conduit.
- H. Patching shall be of the same kind of material as was removed.
- I. The completed patching work shall restore the surface to its original appearance.
- J. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.
- K. Remove rubble and excess patching materials from the premises.
- L. Raceways and ducts penetrating rated floor, ceiling or wall assemblies shall be properly sealed in accordance with the corresponding Underwriters Laboratories approved method utilizing approved and listed materials.

1.18 INTERPRETATION OF DRAWINGS

- A. The Electrical drawings and specifications are complementary each to the other and what may be called for by one shall be as binding as if called for by both. The drawings are diagrammatic and indicate generally the location of outlets, devices, equipment, wiring, etc. Drawings shall be followed as closely as possible; however, all work shall suit the finished surroundings and/or trim.
- B. Do not scale electrical drawings. Refer to the architectural drawings for dimensions.
- C. Where the words “furnish and install” or “provide” are used, it is intended that this contractor shall purchase the equipment or material and install it completely with any and/or all material necessary and required for this particular item, system, equipment, etc.
- D. Where the words “the Contractor” or “this Contractor” appear in either the Electrical Drawings or Division 26 Specifications, it shall mean the Electrical Contractor.
- E. Any omission from either the drawings or these specifications are unintentional, and it shall be the responsibility of this Contractor to call to the attention of the Architect/Engineer any pertinent omissions before submitting a bid. Complete and working systems are required, whether every small item of material is shown and specified or not.
- F. Where no specific material or equipment type is mentioned, a high quality product of a reputable manufacturer may be used provided it conforms to the requirements of these specifications.
- G. The electrical drawings show the general arrangement of raceways, equipment, fixtures, and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Some adjustment of routings and installation of raceways, ducts, wireway, equipment, components and devices should be expected. The electrical work shall conform to the requirements shown on all of the Drawings. General and Structural drawings shall take precedence over Electrical Drawings. Because of small scale of the electrical drawings, it is not possible to indicate offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as may be required to meet such conditions, without additional cost to the Owner and as directed by the Architect/Engineer.
- H. Each 3-phase circuit shall be run in a separate conduit unless otherwise shown on the Drawings.
- I. Unless otherwise approved by the Architect/Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.
- J. Where circuits are shown as “home runs” all necessary fittings and boxes shall be provided for a complete raceway installation.
- K. Verify with the Architect/Engineer the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

- L. Any work installed contrary to or without approval by the Architect/Engineer shall be subject to change as directed by the Architect/Engineer, and no extra compensation will be allowed for making these changes.
- M. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Architect/Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Architect/Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- N. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.
- O. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of equipment.
- P. All connections to the equipment shall be made as required, and in accordance with the approved shop and setting drawings.
- Q. Redesign of electrical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at the Contractor's expense. Redesign and detailed plans shall be submitted to the Architect/Engineer for approval. No additional compensation will be provided for changes in the work, either the Electrical Contractor's or others, caused by such redesign.
- R. All floor mounted electrical equipment shall be placed on 4-inch thick concrete housekeeping pads. Edges shall be chamfered.

1.19 SIZE OF EQUIPMENT

- A. Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his materials in sections sized to permit passing through such restricted areas in the structure.
- B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to suitably brace the equipment, to insure that the tilting does not impair the functional integrity of the equipment.

1.20 EXISTING BUILDINGS AND CONSTRUCTION

- A. The Contractor is cautioned that some of the work to be performed under this contract is to be accomplished adjacent to and in an existing occupied building. All such work shall be scheduled and arranged to be done at the convenience of the Owner so as not to interfere with, disrupt, or disturb normal operations in the building. The Contractor shall obtain approval from the Owner before proceeding with work in existing buildings and shall work in existing buildings on schedule as agreed upon with the Owner. This is not to be necessarily construed to mean that the Contractor is expected to perform work on buildings on holidays,

weekends, etc., but that the Contractor must schedule work with the Owner for the Owner's beneficial and normal usage of the buildings, and that the Contractor will be required to maintain the schedule as approved by the Owner.

- B. The Contractor shall, at all times, provide safety barriers, protective devices, screening, dust barriers, etc., as required to maintain the safety and comfort of the building's personnel and/or occupants in or near the work area.
- C. The Contractor shall be responsible for cleanup in connection with work in existing buildings. At the end of each working day, all debris, boxes, waste, etc., shall be removed from the buildings and properly disposed of. Equipment, materials, etc., may be left inside the buildings, but such must be properly stored, stacked and located as approved by the Owner.
- D. The Contractor shall do all cutting, patching, finishing, repairing, painting, etc., necessary for electrical work to be installed in existing buildings. All finishes shall be left to equal finish and condition prior to cutting. No cutting of structural members will be allowed. All cutting of walls, floors, roofs, etc., shall be repaired and/or replaced to equal finish prior to cutting. The Contractor shall route conduits and locate equipment as approved by the Owner and Architect/Engineer. Routings and locations shall be firmly established and approved before proceeding with any phase of the work.
- E. The Contractor shall be responsible for any and all damage to the existing buildings, grounds, walkways, paving, etc., caused by the work, the Contractor and/or Contractor's personnel, and/or Contractor's equipment in the accomplishment of this work. Such damages shall be repaired and/or replaced by the Contractor at no additional cost to the Owner, to finish equal to that finish prior to damage. The Architect/Engineer shall be the judge as to equal finishes, etc.

1.21 RECORD DRAWINGS

- A. As the work progresses, legibly record all field changes on one set of project contract drawings, herein after called the "record drawings".
- B. Record drawings shall accurately show the installed condition of the following items:
 - 1. Power distribution one-line diagram(s).
 - 2. Panel schedule(s).
 - 3. Control wiring diagram(s).
 - 4. Lighting fixture schedule(s).
 - 5. Service, feeder, branch circuit conduit and conductor sizes.
 - 6. Lighting fixture, receptacle, and switch outlets, interconnections and homeruns with circuit identification.
 - 7. Underground raceway routing.
 - 8. Plan view, sizes and locations of panelboards, dry type transformers, etc.
 - 9. Fire alarm system.
 - 10. Telecommunications system.

1.22 CORROSION PROTECTION

All equipment, raceways, hardware, etc., furnished under the electrical contract shall be protected from corrosion by factory applied coatings, paint and galvanizing, or shall be fabricated of high quality

300 series stainless steel. All exposed hardware shall be hot dip galvanized. The requirements of preceding section entitled "Delivery and Storage" shall be strictly followed. Touch up any scratched metallic surfaces immediately to prevent corrosion. Apply cold galvanizing compound to all galvanized surfaces damaged during installation, i.e., cutting, etc. Rusted or corroded materials shall be replaced before final acceptance of the work.

1.23 SEISMIC REQUIREMENTS

- A. All equipment furnished under the electrical contract shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code (NCSBC). The Contractor shall provide any and all seismic restraint details and calculations that may be required by the NCSBC and/or the Authority Having Jurisdiction.
- B. Requirements for restraints are detailed in the NCSBC. All tables and references shall conform to building's location. Restraints shall be per Seismic Performance Category stated on Architectural Drawings.
- C. The Contractor shall retain the services of a Professional Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The Engineer's calculations, bearing his professional seal, shall accompany shop drawings and shall demonstrate Code compliance including certification that the seismic system components comply with the testing requirements of NCSBC Section 1708.5. Calculations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment, systems and assemblies. Internal seismic restraint elements of manufactured equipment shall be certified by a professional engineer retained by the manufacturer. Such certificate applies only to internal elements of the equipment. All equipment anchorage requirements shall be coordinated with the building structure and shall be compatible thereto. All such anchorages shall be subject to the review and approval of the project's structural engineer.
- D. The Professional Engineer retained for seismic restraint calculations shall visit the job site upon completion of the seismic restraint installation to comply with the Special Inspections requirement of the Code. This engineer shall provide written verification of compliance of the installation with the approved seismic submittal. This verification shall be submitted as a Special Inspections Report and shall bear the Engineer's professional seal. Job site inspections by other than this engineer are not acceptable.
- E. Review of the seismic design computations and shop drawings by the Architect/Engineer or his agent shall not relieve the Contractor of his responsibility to comply with the seismic or any other requirements of the North Carolina State Building Code.

1.24 GUARANTEE

The Contractor shall guarantee the materials and workmanship covered by these drawings and specifications for a period of one year from the date of acceptance by the Owner. The Contractor shall repair and/or replace any parts of any system that may prove to be defective at no additional cost to the Owner within the guarantee period. All equipment warranties shall be as specified and included in the Contract Documents.

1.25 PHASING OF THE WORK

The Electrical Contractor shall schedule his work as described in the relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

1.26 ALTERNATE BIDS

Alternate bid items are described in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

PART 2 PRODUCTS Not used.

PART 3 EXECUTION Not used.

END OF SECTION

SECTION 260519

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Metal clad cable.
- C. Lighting Control Cable.
- D. Wiring connectors and connections.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260526 - Grounding and Bonding.
- C. Section 260533 - Conduit.
- D. Section 260534 - Boxes.
- E. Section 260553 - Identification.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NECA Standard of Installation (National Electrical Contractors Association).

1.4 SUBMITTALS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, ratings, colors, and configurations.
- C. Test Reports: Indicate procedures and values obtained.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.5 QUALIFICATIONS

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.7 PROJECT CONDITIONS

- A. All wire and cable shall be installed in conduit, except where MC Cable and/or free run lighting control cable is specifically permitted. This includes all power wiring; fire alarm, emergency systems control conductors, sound and communications wire and cable (unless noted otherwise); lighting control cable; HVAC control cable; etc. and other electrical systems required by Codes to be installed raceways. Lighting control cable is permitted above accessible ceilings and in conduit to the switch location.
- B. Verify that field measurements are as shown on Drawings.
- C. Conductor sizes are based on 75° C. copper.
- D. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- E. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.8 COORDINATION

- A. Coordinate Work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated building wire.
- B. Conductor: Copper. Solid and stranded as specified below. Minimum #12 AWG, maximum 500 KCMil.
- C. Insulation/Voltage Rating: 600 volts.
- D. Insulation: Dual-rated THHN/THWN or XHHW.

E. Color Coding:

	<u>208/120 volts</u>	<u>480/277 volts</u>
Phase A -	Black	Brown
Phase B -	Red	Orange
Phase C -	Blue	Yellow
Neutral -	White*	Gray*
Ground -	Green	Green

*Provide branch circuit neutral conductors with factory color coded markings or stripes identified for their associated phase conductor (white-black, white-blue, white-red, gray-brown, gray-orange, gray-yellow) where individual neutral conductors are required.

2.2 METAL CLAD (MC) CABLE

- A. Description: Metal clad (MC) cable with aluminum interlocked armor, copper conductors and an internal green insulated equipment grounding conductor may be used for branch circuits 30 amperes and less. Use cable with individual neutral conductors where specified and/or required. Cable with individual neutral per phase design neutral conductors shall be provided with factory color coded neutral markings or stripes identified for their associated phase conductor (white-black, white-red, white-blue, gray-brown, gray-orange, gray-yellow).
- B. Conductors: Copper. Solid and stranded as specified below. Minimum #12 AWG, maximum #10 AWG.
- C. Insulation/Voltage Rating: 600 volts.
- D. Insulation: Dual-rated THHN/THWN or XHHW.
- E. Conductor Color Coding: Same as Building Wire above.
- E. Interlocked armor color coding: Consistent with Section 260553 requirements for raceways.
- F. MC cable with integral power and low voltage cable for lighting control is permitted.
- G. Connectors shall be zinc plated malleable iron or steel body with locknut, dual cable gripping saddle design with set screw and insulated throat. Pressure cast (pot metal) connectors are not permitted.

2.3 LIGHTING CONTROL CABLE

Lighting control cable for dimming and occupancy sensor control shall be provided as required. Lighting control cable may be provided integral to MC cable, or discrete, as approved by the lighting controls manufacturer and as required by NEC Article 725. If discrete, cable shall be NEC Type CMP, in raceway from the switch outlet box to the accessible ceiling cavity, then free run to follow the lighting power system raceways to the fixtures controlled, be secured to the structure to the plane of the lighting power raceway system, then supported by the lighting power raceway system using NEC approved cable ties installed on no more than six foot intervals, or less if required by Codes and the AHJ. Lighting control cable shall be plenum rated and be approved by the lighting controls manufacturer. It shall consist of a 2#18 AWG solid, violet and

gray insulated conductors minimum with an outer jacket rating of 300V minimum. Cable outer jacket shall not be red. Cable shall be daisy chain connected to lighting fixtures or be taped in junction boxes installed at the same plane of the lighting power raceway system. Do not support cable with ceiling grid supports wires. Do not drape cable over ceilings, lighting fixtures, conduit, ductwork, piping or equipment. Daisy chaining cable at the ceiling level is not permitted.

2.4 WIRING CONNECTORS AND CONNECTIONS

- A. Conductors shall be installed continuous from outlet to outlet with no splicing except within outlet or junction boxes, troughs and gutters. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- B. Use mechanical connectors for copper conductor splices and taps, 8 AWG and larger, except main grounding conductors, which shall be terminated with compression lugs. Tape un-insulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor or use third party testing agency-approved insulating covers.
- C. Use insulated spring wire connectors with plastic caps for copper conductors, 10 AWG and smaller, splices and taps in junction boxes, outlet boxes and lighting fixtures, Ideal “Wire-Nut” or “Wing-Nut”, 3M Company “Scotchlock” series or NSI “Easy-Twist”. “Push wire” type connectors are not acceptable.
- D. “Sta-Kon” or other permanent type crimp connectors shall not be used for branch circuit connections.
- E. Joints in stranded conductors shall be spliced by approved mechanical connectors and insulated with vinyl mastic tape and covered with vinyl electrical tape, 3M Scotch Vinyl Mastic Tape 2210 and Scotch Vinyl Electrical Tape Super 88, respectively, or approved equal. Solderless mechanical connectors for splices and taps, provided with U.L. approved insulating covers, may be used instead of mechanical connectors plus tape.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 WIRING METHODS

- A. Panelboard and Equipment Feeders: Use building wire in metallic raceway.

- B. Exposed Branch Circuits in Unfinished Dry Interior Locations: Use only building wire in metallic raceway.
- C. Branch Circuits in Concealed Dry Interior Locations:
 1. Use building wire in metallic raceway or metal clad cable.
 2. MC cable may be used exposed in electrical equipment rooms where branch circuits originate at panelboards, but cable shall be supported and neatly arranged above panelboards on steel ladder rack, width as required. Cable shall be strapped to ladder rack using approved, UV resistant plastic cable ties. Alternately, MC cable shall be transitioned to building wire and metallic raceway outside of the electrical equipment rooms in a junction box or wiring trough concealed above an accessible ceiling. If this method is utilized to convert MC cable to building wire and metallic raceway, provide screw connection, feed-through, modular type DIN rail terminal blocks for termination and extension of circuit conductors. Terminal blocks shall be rated 30A, 300VAC minimum, and higher as required by circuit ampacity and voltage, quantity as required for phase, neutral and equipment ground conductors. Wirenut and similar terminations are not permitted in splice boxes or panelboard interiors. All splices shall be clearly labeled and neatly trained as judged acceptable by the Engineer.
- D. Branch Circuits in Wet or Damp Interior Locations: Use only building wire in metallic raceway.
- E. Underground Installations: Use only building wire in non-metallic raceway.
- F. Wet or Damp Interior Locations: Use only building wire in metallic raceway.
- G. Exterior Locations: Use only building wire in metallic raceway or Schedule 40 PVC where noted.

3.4 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Route wire and cable as required to meet Project Conditions.
- C. Install cable in accordance with the NECA "Standard of Installation".
- D. Use solid conductor for feeders and branch circuits 10 AWG and smaller, and Class B stranded for larger conductors.
- E. Use conductor not smaller than 12 AWG for power and lighting circuits.
- F. Use conductor not smaller than 14 AWG for fire alarm and control circuits.
- G. Pull all conductors into raceway at same time.
- H. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

- I. Neatly train and lace wiring inside boxes, equipment, and panelboards. Do not tightly bundle conductors.
- J. Clean conductor surfaces before installing lugs and connectors.
- K. Identify wire and cable under provisions of Section 260553.
- L. Identify each conductor with its circuit number or other designation indicated on Drawings.
- M. Common neutral lighting and receptacle branch circuits are not permitted. Provide separate, individual neutral conductors for branch circuits.
- N. Do not bundle metal clad cable in a manner that requires the conductors be derated.
- O. MC cable shall be supported in straight lines using approved supporting means and in compliance with the NEC. Dedicated support wires may be used above finished ceilings and shall be painted red prior to installation. Do not support cable with ceiling grid supports wires. Do not drape cable over ceilings, lighting fixtures, conduit, ductwork, piping or equipment. Do not “daisy-chain” connect lighting fixtures with MC cable.

3.5 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect wire for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer’s recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Prior to energizing, feeders, sub-feeders and service conductor cables shall be tested for electrical continuity and short circuits. A copy of these tests shall be sent to the Architect.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Grounding well components.
- D. Ground Bars.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260519 – Building Wire and Cable.
- C. Section 260533 - Conduit.
- D. Section 260534 - Boxes.
- E. Section 260553 – Electrical Identification.

1.3 REFERENCES

- A. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- C. NFPA 70 - National Electrical Code.

1.4 GROUNDING SYSTEM DESCRIPTION

- A. The earth electrode is existing and shall remain with modifications indicated.

1.5 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide for grounding electrodes and connections.

1.6 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Test Reports: Indicates overall resistance to ground and resistance of each electrode.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Procedures for submittals as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.
- C. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.8 QUALIFICATIONS

Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Material: Copper-clad steel.
- B. Diameter: 3/4 inch (19mm)
- C. Length: 10 feet (3000 mm).

2.2 MECHANICAL CONNECTORS

Material: Cast bronze, brass, or plain malleable iron. Ground clamps shall not be fabricated from aluminum or any aluminum alloy.

2.3 WIRE

- A. Material: Copper. Use solid conductor for 10 AWG and smaller, and Class B stranded for larger conductors, all sized per NEC requirements. Conductors shall be tinned bare copper for direct buried installations.

2.4 BONDING BUSHINGS

Bonding bushings shall be steel or malleable iron, insulated, threaded type, zinc plated for interior use and galvanized for exterior use. Provide with dual rated tin plated saddle for use with bonding conductors and resilient plastic insulation throat liner with 150°C rating molded on over the metallic stop. All bushings shall be third party testing agency approved and listed. Die cast zinc bushings are not acceptable.

2.5 GROUND ROD INSPECTION WELLS

- A. Pedestrian Traffic Rated
 - 1. Well Housing: 9 inch diameter High Density Polyethylene (HDPE), 10” minimum length. Static vertical load rating of 300 PSF minimum. Two knock out mouse holes for conductor entrance. Harger GAW910, nVent Erico T416B or approved equal.
 - 2. Well cover: HDPE twist lock with locking bolt and the legend “GROUND” embossed on cover.
- B. Vehicle Traffic Rated
 - 1. Well Housing: 10 inch diameter reinforced concrete, 12” minimum length. Static vertical load rating of 20,000 PSF minimum. Two knock out mouse holes for conductor entrance.
 - 2. Well cover: Bolt down cast iron with the legend “GROUND” embossed on cover.

2.6 GROUNDING BUSBARS

- A. Electrical Power Grounding Busbars: Third party testing agency listed and labelled. Grounding busbars shall be provided for single point termination of power distribution system grounding and bonding conductors as shown on the Drawings. Grounding busbars shall be tin plated solid copper factory drilled with a NEMA hole size and pattern for termination of two hole lugs, quantity as required with 25% spare, and be of the minimum dimensions shown on the Drawings. Provide with 600V standoff insulators, stainless steel mounting brackets and stainless steel hardware. Provide clear Lexan cover over connections.
- B. Telecommunications Grounding Busbars: Comply with TIA-607-C and BISCII Standards. Grounding busbars shall be provided for single point termination of telecommunications system grounding and bonding conductors as shown on the Drawings. Grounding busbars shall be tin plated solid copper factory drilled with a BISCII hole size and pattern for termination of two hole lugs, quantity as required with 25% spare, and be of the minimum dimensions shown on the Drawings. Provide with 600V standoff insulators, stainless steel mounting brackets and stainless steel hardware. Provide clear Lexan cover over connections.

PART 3 EXECUTION

3.1 EXAMINATION

Coordination and Meetings: Verify existing conditions prior to beginning work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

3.2 INSTALLATION

- A. Quality Control: Manufacturer's instructions shall be followed as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Provide bonding to meet Regulatory Requirements.
- C. Provide separate, insulated conductor within each feeder and branch circuit raceway.
- D. Equipment Grounding Conductor: The raceway system shall not be relied on for ground continuity. A green grounding conductor, properly sized per the NEC shall be run in all raceways. Terminate each end on suitable lug, bus, or bushing. Exceptions are as follows:
 - 1. Raceways for telecommunications.
 - 2. Raceways for data.
 - 3. Raceways for audio conductors.
 - 4. Services.
- E. Equipment grounding continuity shall be maintained through flexible conduit as required in previous sections.
- F. Grounding conductors shall be installed as to permit the shortest and most direct path from equipment to ground. All connections to ground conductors shall be accessible for inspection and made with approved solderless connectors, brazed or bolted to the equipment or structure to be grounded. All contact surfaces shall be thoroughly cleaned before connections are made to insure good metal to metal contact.
- G. All equipment housings and/or enclosures, and all non-current carrying metallic parts of electrical equipment, raceway systems, etc., shall be effectively and adequately bonded to ground.
- H. Grounding type insulated bonding bushings and jumpers shall be provided where concentric, eccentric or over-sized knockouts are encountered. The jumpers shall be sized per the NEC.
- I. All metallic raceways entering or leaving panelboards (branch circuits less than 30 amperes in lighting and appliance branch circuit panelboards excepted), switchboards, transfer switches, enclosed circuit breakers, safety switches, transformers, pull boxes, splice boxes, etc. shall be provided with insulated grounding and bonding bushings and each separate piece of raceway shall be individually bonded to the equipment ground bus or metallic enclosure, as applicable, by means of copper conductor sized in accordance with the NEC.

- J. Bond the above ground portion of the gas piping system upstream from equipment shutoff valve to the building electrical service ground. The bonding jumper shall be sized per the NEC.
- K. An equipment ground bus shall be installed in each panelboard for terminating equipment grounding conductors.
- L. All wiring devices equipped with grounding connections shall be permanently and securely connected to the enclosure in which they are mounted with a copper grounding jumper.
- M. The frame of all lighting fixtures shall be securely grounded to the equipment ground system with grounding conductors.
- N. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated. Bond reinforcing steel together.
- O. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- P. Provide ground rod inspection well with cover at each rod location. Install well top flush with finished grade.

3.3 EXISTING WORK

If the work includes renovation and/or addition to existing conditions:

1. Modify existing grounding system to maintain continuity and to accommodate renovations.
2. Extend existing grounding system using materials and methods specified.

3.4 FIELD QUALITY CONTROL

- A. Quality Assurance: Field inspection, testing and adjusting as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect and test in accordance with NETA ATS, except Section 4, or provide for qualified technicians to perform testing according to the manufacturer's recommendations.

END OF SECTION

SECTION 260529

SUPPORTING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Use expansion anchors.
 - 2. Steel Structural Elements: Use beam clamps.
 - 3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.

4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
5. Solid Masonry Walls: Use expansion anchors.
6. Sheet Metal: Use sheet metal screws or bolts
7. Wood Elements: Use wood screws.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- F. 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.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.
- I. Conduits installed on the interior of exterior building walls shall be spaced away from the wall surface a minimum of 1/4 inch (65mm) using "clamp-backs" or struts.
- J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION

SECTION 260533

CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Liquidtight flexible metal conduit.
- D. Electrical metallic tubing.
- E. Nonmetallic conduit.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 7: Fire Stopping.
- C. Division 7: Roofing penetrations.
- D. Section 260534 - Boxes.
- E. Section 260526 - Grounding and Bonding.
- F. Section 260529 - Supporting Devices.
- G. Section 260553 - Electrical Identification.

1.3 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. NECA "Standard of Installation".
- F. NEMA TC2 - Schedule 40 PVC

G. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 DESIGN REQUIREMENTS

Conduit Size: ANSI/NFPA 70.

1.5 SUBMITTALS

A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, fittings and conduit bodies.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.9 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Size: Conduit shall be sized in accordance with the latest edition of the NEC unless shown otherwise, with minimum conduit size of ½ inch, except homeruns minimum size shall be ¾". Flexible metal and watertight ("sealtite") conduit in size ½ inch and larger are acceptable for motor, appliance and fixture connections provided green ground wire is installed (see Section 260526) and NEC is followed.
- B. Underground Installations:
 - 1. More than Five Feet from Foundation Wall: Use rigid steel conduit, intermediate metal conduit, plastic coated conduit, thickwall nonmetallic conduit and thinwall nonmetallic conduit.
 - 2. Within Five Feet from Foundation Wall: Use rigid steel conduit.
 - 3. In or Under Slab on Grade: Use rigid steel conduit, intermediate metal conduit, plastic coated conduit, thickwall nonmetallic conduit and thinwall nonmetallic conduit.
 - 4. Minimum Size: 1 inch (25 mm).
- C. Outdoor Locations, Above Grade: Use rigid steel conduit.
- D. In Slab Above Grade:
 - 1. Use rigid steel conduit.
 - 2. Maximum Size Conduit in Slab: ¾ inch (19 mm).
- E. Wet and Damp Locations: Use rigid steel conduit.
- F. Dry Locations:
 - 1. Concealed: Use rigid steel conduit, intermediate metal conduit or electrical metallic tubing. EMT may be utilized as permitted by the NEC, with the following restrictions. EMT shall not be installed:
 - a. where tubing, couplings, elbows and fittings would be in direct contact with the earth.
 - b. underground (in/below slab-on-grade or in earth).
 - c. any location outdoors where the tubing, etc., would be subjected to the elements.
 - d. where subject to severe corrosive influence.
 - e. where subject to severe physical damage.

2.2 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Plastic-Coated Rigid Steel Conduit: ANSI C80.1, 40 mil PVC coating.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit with zinc-plated steel or malleable iron fittings.

2.3 FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction.
- B. Fittings: ANSI/NEMA FB 1, steel.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction with PVC jacket.
- B. Fittings: ANSI/NEMA FB 1, steel or nonmetallic type.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression type, insulated throat.

2.6 NONMETALLIC CONDUIT

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

PART 3 EXECUTION

3.1 INSTALLATION

- A. Circuiting is shown schematically. Exact routing of branch circuits may be varied to suit building construction; however, the combination of circuits within raceways and panelboard connections shall not be changed from those shown on the drawings.
- B. Raceways shall be installed concealed in finished areas. Where construction does not permit concealed raceways and where indicated on the drawings, raceways shall be run exposed. Exposed raceways shall be run parallel to, or at a right angle with the building walls. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- C. Where any run of rigid conduit may change to a run of EMT or vice-versa, each change shall be made in a junction or outlet box with each conduit terminated separately therein. Rigid conduit to EMT (or vice-versa) adapters shall not be permitted.
- D. Install conduit in accordance with NECA "Standard of Installation".
- E. Arrange conduit to maintain headroom and present neat appearance.
- F. Maintain adequate clearance between conduit and piping.
- G. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

- H. Cut conduit square using saw or pipecutter and de-burr cut ends.
- I. Bring conduit to shoulder of fittings; fasten securely.
- J. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- K. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows, or hydraulic one-shot bender, to fabricate bends in metal conduit larger than 2 inch size.
- L. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- M. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
- N. Provide suitable pull string in each empty conduit except sleeves and nipples.
- O. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- P. The raceway system shall not be relied on for grounding continuity. Ground and bond conduit under provisions of Section 260526.
- Q. Identify conduit under provisions of Section 260553.
- R. The use of "LB's" shall be limited where possible. Where necessary to use "LB's" sized above 2 inch, mogul units shall be installed.
- S. Grounding type insulated bonding bushings and jumpers shall be provided where concentric, eccentric or over-sized knockouts are encountered. The jumpers shall be sized per the NEC.
- T. Fasten conduit supports to building structure and surfaces under provisions of Section 260529.
- U. Arrange supports to prevent misalignment during wiring installation.
- V. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- W. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- X. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- Y. Do not attach conduit to ceiling support wires.

- Z. All metallic raceways entering or leaving panelboards (branch circuits less than 30 amperes in lighting and appliance branch circuit panelboards excepted), switchboards, transfer switches, enclosed circuit breakers, safety switches, transformers, pull boxes, splice boxes, etc. shall be provided with insulated grounding and bonding bushings and each separate piece of raceway shall be individually bonded to the equipment ground bus or metallic enclosure, as applicable, by means of copper conductor sized in accordance with the National Electrical Code.
- AA. The term “fittings” includes couplings, connectors, offsets, LBs, conduit bodies, hubs, bushings, bonding bushings, etc.
- BB. No pressure cast (pot metal) fittings or conduit bodies shall be allowed.
- CC. Outlets, junction, taps, etc., on exposed rigid metal conduit shall be cast malleable iron conduit fittings or cast malleable metal boxes of the type and size appropriate for the location. Sheet steel outlet boxes shall not be permitted on exposed raceway runs except at or near a ceiling for interior construction.
1. Interior exposed raceway junction, switch, receptacle and outlet boxes installed at or below 8 feet AFF/AFG shall be cast malleable type with hubs and cast, gasketed plates.
 2. Exterior exposed raceway junction, switch, receptacle and outlet boxes shall be cast malleable type with hubs and cast, gasketed plates.
- DD. EMT couplings and terminations shall be made utilizing zinc-plated, steel hexagonal compression connectors. No set screw or indented type fittings shall be utilized.
- EE. EMT couplings and terminations shall be “concrete tight” where buried in masonry or concrete. EMT fittings, where installed in damp locations, shall be of the “raintight” type.
- FF. Install nonmetallic conduit in accordance with manufacturer’s instructions.
- GG. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- HH. PVC schedule 40 shall not be used exposed or concealed in gypsum walls, but may be used in CMU walls.
- II. IMC and GRC shall terminate with either a double locknut / bushing set, or in a threaded hub.
- JJ. Conduit couplings for IMC, GRC and PVC shall be in accordance with the NEC.
- KK. The placement of conduit in floor slabs shall be thoroughly coordinated with the General Contractor to avoid conflicts with steel reinforcing bars, reductions in net concrete sections and floor penetrations.
- LL. Route conduit in and under slab from point-to-point.
- MM. Do not cross conduits in slab.

- NN. Schedule 40 PVC may be used in elevated floor slabs and in foundation slabs. Minimum concrete cover shall be 3/4 inch at finished or formed surface and shall be 3 inches at concrete surface cast against earth or for slabs placed on-grade. Greater amounts of concrete cover shall be used in areas subject to damage.
- OO. Where underground or underslab raceways are required to turn up into cabinets, equipment, etc., and on to poles, the elbow required and the stub-up out of the slab or earth shall be of 40 mil plastic-coated rigid steel. Alternately, field applied corrosion protection wrap systems utilizing a primer, putty tape and all-weather corrosion protection tape may be used, in equivalent thickness to factory applied materials, with the specific approval of the Architect/Engineer.
- PP. Raceways run external to building foundation walls, with the exception of branch circuit raceways, shall be encased with a minimum of three (3) inches of concrete on all sides.
- QQ. Service entrance raceways run inside building foundation walls shall be buried at least eighteen (18) inches below grade or encased with a minimum of three (3) inches of concrete on all sides. Concrete encasement shall extend to the service equipment for raceways exposed above grade in crawl spaces.
- RR. Encased raceways shall be of a type approved by the NEC as “suitable for concrete encasement”.
- SS. Encased raceways shall have a minimum cover of eighteen (18) inches, except for raceways containing circuits with voltages above 600 volts, which shall have a minimum cover of thirty (30) inches.
- TT. Branch circuit raceways run underground external to building foundation walls shall be run in raceways installed in accordance with the NEC, and shall be of a type approved by the NEC as “suitable for direct burial.” Minimum raceway size shall be 1 inch.
- UU. Raceways run underground, internal to building foundation walls shall be of a type, and installed by a method approved by the NEC.
- VV. Raceways that penetrate outside walls, ceilings from conditioned space or other similar condition shall be effectively sealed to prevent condensation from infiltrating humid air.
- WW. Where raceways pass through a below grade wall, from a conditioned interior building space, the raceway shall be sealed utilizing fittings similar and equal to OZ/GEDNEY type “FSK” thru-wall fitting with “FSKA” membrane clamp adapter if required.
- XX. All underground raceways shall be identified by underground line marking tape within the provisions of Section 260553. The tape to be located directly above the raceway and 6 to 8 inches below finished grade.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified under Division 7.

END OF SECTION

SECTION 260534

BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.
- C. Floor boxes.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 7: Firestopping.
- C. Division 8: Access Doors.
- D. Section 260526 - Grounding and Bonding.
- E. Section 260553 - Electrical Identification.
- F. Section 262726 - Wiring Devices.
- G. Section 260529 – Supporting Devices.

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

- B. Product Data: Provide manufacturer's catalog information showing dimensions and configurations.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for Project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Junction, switch, receptacle and outlet boxes for interior use in dry locations shall be zinc coated or cadmium plated sheet steel, 4" square and 2-1/8" deep, unless otherwise indicated on the contract drawings. Smaller and shallower outlet boxes will be permitted only by special permission of the Architect/Engineer where such boxes are necessary due to structural conditions encountered. Where larger junction boxes are required, they shall be fabricated from No. 10, 12, 14 or 16 gauge sheet steel as required by the Underwriters Laboratories, Inc., and galvanized after fabrication. All junction boxes shall have screw fastened covers. Outlet boxes shall be provided with extension plaster rings where required by structural and finish conditions. Sheet steel boxes shall be as manufactured by Appleton, Raco, Steel City or Spring City.
 - 2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 2 inch (13 mm) male fixture studs where required.
 - 3. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs. Cast boxes shall be by Crouse-Hinds, Appleton, O. Z. Gedney or Killark.
- C. Wall Plates for Finished Areas: As specified in Section 262726.

2.2 FLOOR BOXES

- A. Floor Boxes: NEMA OS 1, fully adjustable, oversize, reach-in, concealed service, multi-compartment, two and three gang type (one and two duplex receptacles and one telecommunications outlet as shown), 3-3/4 inches deep, minimum. See Drawings for additional details and raceway connection requirements.

- B. Material: Cast metal or non-metallic. Do not use plastic boxes in rated assemblies.
- C. Service Fittings Covers and Trims: As specified on the Drawings.

2.3 PULL AND JUNCTION BOXES

Sheet Metal Boxes: NEMA OS 1, galvanized steel.

PART 3 EXECUTION

3.1 EXAMINATION

Verify locations of outlets and floor boxes prior to rough-in.

3.2 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation".
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Set wall mounted boxes at elevations to accommodate mounting heights indicated and specified in section for outlet device. Boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes. Use flush mounting outlet box in finished areas. Use Erico Caddy RBS series, Raco 9001 or Cooper B-Line BB8-16 box mounting brackets to support flush mounting outlet boxes between studs.

3.3 ADJUSTING

- A. Contract Closeout: Adjust installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Adjust floor box flush with finish flooring material.
- C. Adjust flush-mounting outlets to make front flush with finished wall material.
- D. Install knockout closures in unused box openings.

3.4 CLEANING

- A. Contract Closeout: Clean installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 260553

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.
- D. Wiring device plates marking.
- E. Underground warning tape.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 9: Painting.

1.3 REFERENCES

ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic as follows:

Furnish and install engraved laminated phenolic nameplates for all electrical equipment supplied under this contract for identification of system, equipment controlled or served, phase, voltage, ampacity, etc. Nameplates shall be securely attached to equipment with stainless steel screws, and shall identify by name the equipment controlled, attached, etc. Embossed, self adhesive plastic tape is not acceptable for marking equipment. Nameplate material colors shall match existing.

- B. Locations:

1. Each electrical distribution and control equipment enclosure (safety switches, panelboards, transformers, etc.)
2. Communication cabinets.
3. Pull and splice boxes.

- C. See details on the Drawings for additional requirements.

- D. Provide nameplates as specified above for all existing electrical equipment to remain.

2.2 WIRE MARKERS

- A. Description: Split sleeve type wire markers or approved equivalent.

- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

- C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings.
2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams on drawings.

2.3 CONDUIT, RACEWAY AND BOX MARKING

Paint visible surfaces of exposed junction and outlet boxes and covers of raceway systems above lay-in and other accessible ceilings. Paint all boxes and covers before installation. Paint conduit and raceways above accessible ceilings at ten foot minimum intervals with a 6 inch wide band in accordance with the color scheme outlined above. Legibly mark conduits at junction boxes above accessible ceilings with the panelboard and circuit numbers of the circuits contained in the raceway using a permanent black, bold marking pen.

2.4 WIRING DEVICE PLATES MARKING

- A. Description: Adhesive backed, laminated plastic receptacle device plate labels identifying the circuit feeding the device. Labels shall be label machine printed, **black lettering on a clear background**, to indicate panel and circuit number and shall be Casio, Brother, T&B or

approved equal.

- B. Locations: Each receptacle device plate. Apply centered on the lower portion below the receptacle, parallel to the lower surface.
- C. Legend: Typed labels to indicate panel and circuit number feeding the device (i.e., RPA-24).

2.5 UNDERGROUND WARNING TAPE

6 inch wide, 4 mils thick, minimum, permanent plastic tape compounded for direct burial, detectable type, colored bright yellow with suitable continuous warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 PREPARATION

Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

- A. Install nameplate parallel to equipment lines.
- B. Secure nameplate to equipment front using rivets or stainless steel machine screws, lockwashers and acorn nuts as shown on the Drawings. Stainless steel screws and nylon locknuts may be used in lieu of lockwashers and acorn nuts if the screw threads are not exposed.
- C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- D. Install receptacle circuit identification labels.
- E. Identify conduit using field painting under provisions of Division 9.
- F. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.
- G. Update all existing panelboard directories where changes are made. Provide new panel schedule cards as required to maintain legibility.
- H. Identify underground conduits using one underground warning tape per trench at 6 - 8 inches below finished grade.
- I. Install adhesive backed labels only when ambient temperature and humidity conditions for adhesive use are within range recommended by manufacturer.

END OF SECTION

SECTION 260580

EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

Electrical supply for, and connections to, equipment specified under other Divisions.

1.2 RELATED DIVISIONS AND SECTIONS

NOTE: Work specified to be accomplished by the Electrical Contractor in Related Divisions and Sections shall be as binding as work specified in Division 26.

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 1: Owner-furnished equipment.
- C. Division 11: Equipment.
- D. Division 21: Fire Suppression.
- E. Division 22: Plumbing.
- F. Division 23: Heating Ventilating and Air Conditioning.
- G. Section 260533 – Conduit.
- H. Section 260519 - Building Wire and Cable.
- I. Section 260534 – Boxes.
- J. Section 260526 - Grounding and Bonding.

1.3 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.
- C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.
- C. Where electrical wiring is required by trades other than covered by Division 26, specifications for that section shall refer to same wiring materials and methods as specified under Division 26.

1.6 COORDINATION

- A. Coordinate work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- E. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 PRODUCTS

2.1 CORDS AND CAPS

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- C. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify conditions under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL WORK IN CONNECTION WITH OTHER CONTRACTS

- A. The Electrical Contractor shall provide a source of power for mechanical, plumbing, sprinkler, food service, low-voltage systems, General Contractor-furnished and Owner-furnished systems and equipment shown on the Drawings. Provide pigtails, flexible connections, conductors, raceways, circuit breakers, safety switches, receptacles, junction boxes, panelboards and/or wiring troughs as detailed in this section and/or as shown on the Drawings.
- B. The locations of safety switches and other electrical equipment and devices shown on the Electrical Drawings are approximate only and some adjustment of their locations should be anticipated. The locations of local disconnecting means furnished by other divisions are shown on the respective division's Drawings. Coordinate exact locations with the entity (contractor or Owner) providing the equipment. Coordinate and verify all electrical requirements, final connections, phasing and rotation, overcurrent and overload protective device sizes with the entity providing the equipment. Fuses, variable speed drives, magnetic motor starters, magnetic motor starter overload elements, control devices and sensors and control wiring and raceways for such equipment will be provided and installed by the entity providing the equipment. See other specifications divisions for further explanation of contractor responsibility. Do not apply power to equipment without the permission of the entity providing the equipment.
- C. The Electrical Contractor shall coordinate with the the plumbing, mechanical and general contractors, and the Owner, prior to ordering or installation of any equipment, to verify equipment requirements are provided in the electrical design. The contractor will not be compensated for costs associated with changing the electrical systems to match utilization equipment, even if the electrical work is installed per the electrical drawings.
- D. Safety switches, fuses, variable speed drives, magnetic motor starters, magnetic motor starter overload elements, control devices and sensors and control wiring and control raceways for such equipment will be provided and installed by the contractor providing the equipment. The locations of local disconnecting means furnished by other divisions are shown on the respective division's Drawings. Coordinate exact locations with the contractor providing the equipment. Coordinate and verify all electrical requirements, connections, phasing and rotation, overcurrent and overload protective device sizes with the Contractor providing the equipment or the Owner in the case of Owner-furnished equipment. See other specifications divisions for further explanation of contractor responsibility. Do not apply power to equipment without the permission of the contractor providing the equipment.
- E. Mechanical (Division 23) Equipment.
 - 1. The Electrical Contractor shall furnish and install power wiring up to a defined

termination point (see Contract Drawings) consisting of a junction box, trough, or a properly sized starter, variable frequency drive or fused safety disconnect switch for each item of equipment specified in the Mechanical Contract. The termination point shall be located adjacent to the associated equipment, unless equipment has built-in disconnects, in which case the Electrical Contractor shall bring his conductors to a junction box adjacent to the equipment, leaving sufficient marked conductor tails for extension by the Contractor providing the equipment. If shown on the Drawings, the Electrical Contractor shall provide circuit breakers in adjacent panelboards to serve local mechanical equipment. Circuit breaker ratings shall be coordinated with the Mechanical Contractor.

2. The Contractor providing the equipment shall make final connections from the junction box to the equipment.
3. HVAC Control Power:
 - a. The Electrical Contractor shall provide sufficient electrical circuits from the fire alarm control panel to allow all required mechanical equipment operations during fire mode. See Division 23 Specifications for further definition of the required fire alarm/mechanical control system interface and operation sequence.
 - b. HVAC Control and Miscellaneous Power: The Electrical Contractor shall provide branch circuit power sources (designated "HVAC Control Power" 20A circuit breakers in selected branch circuit panelboards) as indicated in the panel schedules on the Drawings. The HVAC Contractor shall extend power from these circuit breakers as required for control power, damper power, and power for unscheduled HVAC equipment. If additional circuits are required, the contractor may use circuit breakers designated as "Spare".
 - c. All equipment less than 120VAC, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and low voltage thermostats, thermals, remote selector switches, remote pushbutton stations, emergency break-glass stations, interlocking, safety switches beyond Electrical Contractor termination point and other appurtenances associated with equipment in Division 23, shall be furnished, installed and wired under Division 23. All wiring required for controls and instrumentation, not indicated on the Drawings, shall be furnished and installed by the Mechanical Contractor.
3. Duct Mounted Smoke Detectors: Duct mounted smoke detectors shall be provided and wired by the Electrical Contractor, but installed by the Mechanical Contractor. Fire Alarm Air Handling Units (AHU) shut down circuits shall be wired, by the Electrical Contractor, from the fire alarm control panel to a termination point, adjacent to the AHU control. The Electrical Contractor shall leave sufficient marked conductor tails in a junction box adjacent to each unit for final connection by the Mechanical Contractor to the equipment to be furnished and installed by the Mechanical Contractor. Duct mounted smoke detectors are shown on the mechanical floor plans only.
4. Smoke Dampers: Provide 120VAC power for smoke dampers provided by the Mechanical Contractor. Circuits are not shown on the Electrical Drawings. The Electrical Contractor shall extend power circuits to dampers from circuit breakers designated as "HVAC Control Power". Leave sufficient marked conductor tails in a junction box adjacent to each damper for final connection by the HVAC Contractor. Smoke dampers are shown on the mechanical floor plans only. The branch circuit breaker(s) supplying smoke dampers shall be physically protected

by a panelboard lock and circuit breaker handle lock and each circuit breaker shall be identified with a 1/4" permanent red dot applied to its handle.

5. Refer to Division 23 for additional detail concerning electrical connections to Division 23 equipment.

F. Plumbing (Division 22) Equipment:

1. The Electrical Contractor shall furnish and install a properly sized fused safety switch, and make final power connections for each item of equipment specified in the Plumbing Contract and as listed below.
2. All equipment less than 120VAC, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and low voltage thermostats, thermals, remote selector switches, remote pushbutton stations, emergency break-glass stations, interlocking, safety switches beyond Electrical Contractor termination point and other appurtenances associated with equipment in Division 22, shall be furnished, installed and wired under Division 22. All wiring required for controls and instrumentation, not indicated on the drawings, shall be furnished and installed by the Plumbing Contractor.
3. Electric and Gas-Fired Water Heaters: The Plumbing Contractor will furnish and install a disconnect switch adjacent to each water heater. The Electrical Contractor shall make power connections to the line side of the disconnect switch terminals. Wiring from the switch to the water heater will be accomplished by the Plumbing Contractor.
4. Hot Water Circulation Pump: The Plumbing Contractor will furnish and install a manual motor starter for circulator pump. The Electrical Contractor shall wire the system complete.
5. Electric Water Coolers: The Electrical Contractor shall provide grounding type 120VAC GFCI receptacle(s), quantity as required by the equipment, for 120VAC power supply at each electric water cooler and shall consult the Plumbing Contractor and determine the exact location and type service required for each type installed before roughing in. All outlets and cords shall be concealed within the cabinet.
6. Refer to Division 22 for additional detail concerning electrical connections to Division 22 equipment.

G. Fire Protection (Sprinkler) System: The Electrical Contractor shall connect fire alarm system conductors to sprinkler flow and tamper switches, provided and installed by the Sprinkler contractor. Connections shall be made under the direct supervision of the Fire Protection Contractor. See Fire Alarm System Drawings and Specifications Section 283111 for interface requirements and details.

H. Food Service Equipment: The Electrical Contractor shall provide a power source adjacent to equipment provided by the Food Service Equipment Contractor. See Food Service Equipment Electrical Notes on the Drawings for additional detail. See Food Service Equipment Schedule on the Drawings for electrical connection details.

I. General Contractor Provided Equipment: The Electrical Contractor shall provide a power source adjacent to equipment provided by the General Contractor. Final connections to this equipment shall be provided by the Electrical Contractor. Coordinate exact locations and requirements with the General Contractor.

1. Door Hold-Open Devices: The Electrical Contractor shall furnish and install electrical connections from the fire alarm system to each door hold-open device,

furnished by the General Contractor, at locations as shown and as directed by the General Contractor. Provide connections as required and coordinate exact locations and configurations with the General Contractor and the door hardware vendor. Final connections to the equipment shall be by the Electrical Contractor in cooperation with the General Contractor.

2. Electrically-Operated Doors: The Electrical Contractor shall furnish and install a power supply to each electrically-operated door at locations as shown and as directed by the General Contractor. The Electrical Contractor shall also install and wire door activation switches provided by the General Contractor. Provide connections as required and coordinate exact locations and configurations with the General Contractor and the door hardware vendor. Final connections to the equipment shall be by the Electrical Contractor in cooperation with the General Contractor.
3. Projection Screens: The Electrical Contractor shall furnish and install a junction box and disconnect switch adjacent to each projection screen and make power connections to the screen power terminals. The Electrical Contractor shall also install and wire screen position switches provided by the General Contractor. Provide connections as required and coordinate exact locations and configurations with the General Contractor and the projection screen vendor. Final connections to the equipment shall be by the Electrical Contractor in cooperation with the General Contractor.

- J. Low Voltage Systems Equipment: The Electrical Contractor shall provide boxes, raceways and power for LV equipment. Coordinate exact locations and requirements with the Owner's LV System Contractor. Final connection to the equipment will be provided by the Electrical Contractor in coordination with the LV Systems Contractor. Provide receptacle configurations as required and coordinate exact locations and configurations with the LV Systems Contractor. Do not apply power to equipment without the permission of the LV Systems Contractor.
- K. Owner Provided Equipment: The Electrical Contractor shall provide a power source adjacent to equipment provided by the Owner. Coordinate exact locations and requirements with the General Contractor. Final connection to the equipment will be provided by the Electrical Contractor. Provide receptacle configurations and/or provide direct connection as required by equipment and coordinate exact locations and configurations with the Owner. Do not apply power to equipment without the permission of the Owner.

3.3 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as indicated.
- G. Modify equipment control wiring with terminal block jumpers as indicated.
- H. Provide interconnecting conduit and wiring between devices and equipment where indicated.

END OF SECTION

SECTION 262200

DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Two-winding transformers.
- B. Two-winding transformers rated for nonlinear loads.
- C. Circuit Breaker Integrated Transformers

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260526 - Grounding and Bonding.
- C. Section 260529 Supporting Devices.
- D. Section 260533 – Conduit.
- E. Section 260553 - Electrical Identification.

1.3 REFERENCES

- A. NEMA ST 1 - Specialty Transformers (Except General-Purpose Type).
- B. NEMA ST 20 - Dry-Type Transformers for General Applications.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).
- D. NFPA 70 - National Electrical Code.
- E. IEEE C57.96 (Standard transformers) and C57.110 (K Rated transformers) - Transformer Overload Capability

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
- C. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Record actual locations of transformers in project record documents.

1.7 QUALIFICATIONS

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

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Material and Equipment: Transport, handle, store, and protect products as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

- A. Manufacturers:
 - 1. Eaton.
 - 2. General Electric/ABB.
 - 3. Siemens.
 - 4. Square D/Schneider.
 - 5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

- B. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated. Transformers shall be energy efficient with minimum efficiencies as set forth in the Department of Energy 1/1/16 Standards.

- C. Primary Voltage: 480 delta volts, 3 phase.

- D. Secondary Voltage: 208Y/120 volts, 3 phase.

- E. Core Flux Density: Below saturation at 10 percent primary overvoltage.

- F. Insulation and temperature rise: Class 220 insulation system with 115° C average winding temperature rise.

- G. Case temperature: Do not exceed 35° C rise above ambient at warmest point at full load.

- H. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.

- I. Sound Levels: NEMA ST 20.

- J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

- K. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

- L. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting. Provide manufacturers standard wall mounting brackets.
 - 2. 16-75 kVA: Suitable for wall or floor mounting. If wall mounted, provide manufacturers standard wall mounting brackets.
 - 3. Larger than 75 kVA: Suitable for floor mounting.

- M. Coil Conductors: Continuous windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses.

- N. Electrostatic Shield: Copper, between primary and secondary windings.
- O. Enclosure: NEMA ST 20, Type 1 ventilated. Provide lifting eyes or brackets.
- P. Isolate core and coil from enclosure using vibration-absorbing mounts.
- Q. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 TWO-WINDING TRANSFORMERS RATED FOR NONLINEAR LOADS

- A. Manufacturers:
 - 1. Eaton.
 - 2. General Electric/ABB.
 - 3. Siemens.
 - 4. Square D.
 - 5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated, designed to supply nonlinear load (K-rated). Transformers shall be energy efficient with minimum efficiencies as set forth in the Department of Energy 1/1/16 Standards.
- C. Primary Voltage: 480 delta volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.
- E. Core Flux Density: Below saturation at 10 percent primary overvoltage.
- F. Insulation and temperature rise: Class 220 insulation system with 115° C average winding temperature rise.
- G. Case temperature: Do not exceed 35° C rise above ambient at warmest point at full load.
- H. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.
- I. Sound Levels: NEMA ST 20.
- J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
- K. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

- L. Mounting:
 1. 1-15 kVA: Suitable for wall mounting. Provide manufacturers standard wall mounting brackets.
 2. 16-75 kVA: Suitable for wall or floor mounting. If wall mounted, provide manufacturers standard wall mounting brackets.
 3. Larger than 75 kVA: Suitable for floor mounting.
- M. Coil Conductors: Continuous windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.
- N. Electrostatic Shield: Copper, between primary and secondary windings.
- O. Enclosure: NEMA ST 20, Type 1 ventilated. Provide lifting eyes or brackets.
- P. Isolate core and coil from enclosure using vibration-absorbing mounts.
- Q. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.3 CIRCUIT BREAKER INTEGRATED TRANSFORMERS

Provide transformers with characteristics and ratings as specified above with factory assembled integrated primary and/or secondary molded case circuit breakers, as indicated on the Drawings.

2.4 SOURCE QUALITY CONTROL

- A. Quality Control: Manufacturer quality control as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Production test each unit according to NEMA ST20.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, under the provisions of Section 260533, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Provide grounding and bonding in accordance with Section 260526 and details on the Drawings.
- D. Install floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Use one ½" thick, 4" square, resilient waffle design, oil-resistant elastomeric pad at each corner of the transformer, between the concrete base and the transformer frame, each sized for load of 50 pounds per square inch minimum.

- E. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- F. Mount trapeze-mounted transformers as indicated utilizing minimum ½” galvanized all-thread rods and metal framing channels. Make double-nut connections between rids and channels. Locate transformers to provide adequate ventilation and accessibility.
- G. Transformer Stacking Frame: Transformer stacking frames shall be constructed from 1⁵/₈” x 1⁵/₈” by 12 gage P1000 Unistrut channel, or approved equivalent, for the horizontal and vertical members. The maximum span for the horizontal members shall be 48 inches. The maximum height of vertical members shall be 60 inches. All connections shall be made with 1⁵/₈” general fittings and post bases. Provide P2484W - 7 hole, 90° gusseted fittings at all horizontal to vertical connections. All connections shall follow requirements and recommendations of manufacturer.
- H. For wall hung transformer installations, use spring type Korfund Series CE, sized for the transformer load. Provide sound pads at each corner of the transformer sized for ½” deflections. Securely anchor wall mounting brackets to wall to provide adequate support.
- I. For floor and trapeze transformer installations, use one pad type Korfund Elasto-Grip waffle at each corner of the transformer, sized for load of 50 pounds per square inch.
- J. Secure transformer to concrete base according to manufacturer's written instructions.
- K. Transformers shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Section 260500, Paragraph 1.23 for additional requirements.

3.2 FIELD QUALITY CONTROL

- A. Quality Assurance: Field inspection, testing, adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect and test in accordance with NETA ATS, except Section 4, or provide for qualified technicians to perform testing according to the manufacturer’s recommendations.

3.3 ADJUSTING

- A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.
- C. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- D. Output Settings Report: Prepare a written report recording output voltage and tap settings.

3.4 CLEANING

Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 262416

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Distribution panelboards.
- B. Lighting and appliance branch circuit panelboards.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 3: Concrete for supporting foundations and pads.
- C. Section 260526 - Grounding and Bonding.
- D. Section 260553 - Electrical Identification.
- E. Section 260573 - Short Circuit, Arc Flash and Coordination Study.
- F. Section 262421 - Utility Service Entrance.
- G. Section 262813 - Fuses.
- H. Section 264313 – Surge Protection Devices for Low-Voltage Electrical Power Circuits.
- I. Section 265650 – Electrical Systems Commissioning.

1.3 REFERENCES

- A. NECA Standard of Installation (published by the National Electrical Contractors Association).
- B. NEMA AB1 - Molded Case Circuit Breakers.
- C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
- D. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- H. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, ratings, features, colors, and configurations.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- D. Arrange panelboard branch circuit breakers as shown on the Drawings. Agreement of circuit breaker (pole) numbers with the Drawings panel schedules and floor plans is required in order to avoid confusion during construction, redrawing the circuitry for record drawing purposes and accurate documentation of the as-built conditions.

1.5 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
- C. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALIFICATIONS

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

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 MAINTENANCE MATERIALS

- A. Contract Closeout. As required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
 - 1. Eaton.
 - 2. General Electric/ABB.
 - 3. Siemens.
 - 4. Square D Schneider.
 - 5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA PB 1, circuit breaker type.
- C. Service Conditions:
 - 1. Temperature: 104° F. (40° C.).
 - 2. Altitude: N/A.
 - 3. Terminal Rating: 75° C. minimum.
- D. Panelboard Bus: Copper, ratings as indicated. Provide 100% copper ground and neutrals buses in each panelboard. Provide insulated ground bus where scheduled. Provide 200% copper neutral bus in each panelboard fed by a K rated transformer.
- E. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 208 volt panelboards; 30,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.
- F. Circuit Breakers: NEMA AB 1, bolt-on or plug-on (Square D I-Line and similar only) type.
 - 1. Circuit breakers in distribution panelboards shall be fully rated.
 - 2. Solid-state Trip Molded Case Main and Branch Circuit Breakers (100 amperes and larger): Panel mounted, NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings. Electronic trip units shall be provided with external, permanently-mounted power supplies in the gear where required to program trip units while the breakers are deenergized. Trip units shall be field-programmable with an internal display for programming and display and have:
 - a. Adjustable instantaneous trip.
 - b. Adjustable long time pickup and delay.

- c. Adjustable short time pickup and delay.
 - d. Ground fault pickup and delay.
 - e. Arc flash reduction mode with external switch and indicator for main circuit breakers.
 - f. Include shunt trip, undervoltage release, and other accessories where indicated.
 - g. Display line currents and cause of trip.
 - 3. Molded Case Circuit Breakers: Circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
 - 4. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- G. Enclosure: NEMA PB 1, Type 1 or Type 3R, cabinet box.
- H. Cabinet Front: Flush and Surface cabinet front door-in-door type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel. Distribution panelboards larger than 400 amperes are not required to have door-in-door trims.

2.2 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
- 1. Eaton.
 - 2. General Electric/ABB.
 - 3. Siemens.
 - 4. Square D Schneider.
 - 5. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Service Conditions:
- 1. Temperature: 104° F. (40° C.).
 - 2. Altitude: N/A.
 - 3. Terminal Rating: 75° C. minimum.
- D. Panelboard Bus: Copper, ratings as indicated. Provide 100% copper ground and neutrals buses in each panelboard. Provide 200% copper neutral bus where indicated. Provide insulated ground bus where scheduled. Provide 200% copper neutral bus in each panelboard fed by a K rated transformer.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.
- F. Circuit Breakers: NEMA AB 1, bolt-on type.
- 1. Circuit breakers in appliance and branch circuit panelboards may be series rated.
 - 2. Solid-state Trip Molded Case Main Circuit Breakers: Panel mounted, NEMA AB 1, with electronic sensing, timing and tripping circuits for adjustable current settings. Electronic trip units shall be provided with external, permanently-mounted power supplies in the gear where required to program trip units while the breakers are

deenergized. Trip units shall be field-programmable with an internal display for programming and display and have:

- a. Adjustable instantaneous trip.
- b. Adjustable long time pickup and delay.
- c. Adjustable short time pickup and delay.
- d. Ground fault pickup and delay.
- e. Arc flash reduction mode with external switch and indicator.
- f. Include shunt trip, undervoltage release, and other accessories where indicated.
- g. Display line currents and cause of trip.

3. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1 or Type 3R.

H. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 24 inches wide for 480 volt panelboards.

I. Cabinet Front: Flush and Surface cabinet front door-in-door type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

C. Panelboards shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Section 260500, Paragraph 1.23 for additional requirements.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Provide filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Final typed panelboard directories installed in the panelboard door pocket shall include final actual room names and numbers in addition to the general description shown on the panel schedules on the drawings. Revise directory to reflect circuiting changes required to balance phase loads.

G. Provide engraved plastic nameplates under the provisions of Section 260553.

- H. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling and below floor. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 260526.

3.2 FIELD QUALITY CONTROL

- A. Quality Control: Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect and test in accordance with NETA ATS, except Section 4, or provide for qualified technicians to perform testing according to the manufacturer's recommendations.

3.3 ADJUSTING

- A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Cleaning: Vacuum dirt and debris from panelboard tubs; do not use compressed air to assist in cleaning.
- C. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall box dimmers.
- C. Receptacles.
- D. Wall plates.

1.2 DESCRIPTION

Provide wiring devices in types, characteristics, grades, colors and electrical ratings for applications indicated which are third party testing agency listed and which comply with NEMA WD 1 and other applicable third party testing agency, NEMA and DSCC (Fed Spec) standards. All devices shall be produced by the same manufacturer.

1.3 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260526 - Grounding and Bonding.
- C. Section 260534 - Boxes.
- D. Section 260553 - Electrical Identification.

1.4 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device - Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.
- E. Underwriters Laboratories (UL) 498.
- F. DSCC (Fed Spec) W-C-596G

1.5 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.6 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submit manufacturer's installation instructions.

1.7 QUALIFICATIONS

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

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Model 1221/2/3/4 Series.
 - 2. Leviton 1221/2/3/4.
 - 3. Pass and Seymour PS20AC1/2/3/4.
 - 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA WD 1, third party testing agency listed, DSCC, heavy-duty, AC only, general-use, grounding type, back and side wired, single pole, three-way and four-way as indicated, snap switch with hex-head equipment grounding screw. Switches shall have a steel, nickel plated bridge with integral ground, one piece rivetless copper alloy spring contact arm and terminal plate and large silver cadmium oxide contacts. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be approved by a third party agency, approved for the voltage and current indicated.
- C. Body and Handle: Gray plastic with toggle handle.
- D. Indicator Light: Neon lighted handle type switch; red color handle. Voltage per system rating.

- E. Locator Light: Neon lighted handle type switch; green color handle. Voltage per system rating.
- F. Ratings:
 - 1. Voltage: 120-277 volts AC.
 - 2. Current: 20 amperes.

2.2 WALL BOX LINE VOLTAGE LED DIMMERS

- A. Manufacturers:
 - 1. Lutron.
 - 2. Leviton.
 - 3. Arrow Hart.
 - 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA WD 1, third party testing agency, DSCC, Type I semiconductor dimmer for incandescent lamps.
- C. Body and Handle: Rocker/decorator (Decora) style white plastic rocker switch with preset slider.
- D. Voltage: 120-277 VAC.
- E. Power Rating: Match load shown on drawings; 600 watts minimum at 80% maximum load.

2.3 WALL BOX LED 0-10V DIMMERS

- A. Manufacturers:
 - 1. Lutron DVSTV and DDTV.
 - 2. Sensor Switch.
 - 3. Wattstopper.
 - 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: Wall box type rocker/decorator (Decora) style white plastic rocker switch with 0-10V dimmer preset slider for LED loads.
- C. Body and Handle: Decora style white plastic with preset slider.
- D. Ratings:
 - 1. Voltage: 120-277 volts AC.
 - 2. Current: 8A minimum. Provide with 16A power pack for loads greater than 8A.
- E. Voltage: 120 or 277 volts as required.

2.4 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Model HBL 5362.

2. Leviton 5362.
 3. Pass and Seymour 5362A.
 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA WD 1, third party testing agency, DSCC, heavy-duty, 20 ampere, 120 volt, general use, duplex, straight blade, grounding type receptacle arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall have a full wrap around brass bridge with integral ground and standup double wipe contacts. Self grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- C. Device Face and Body: White nylon or reinforced thermoplastic.
- D. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacle: Type 5-20R.

2.5 USB RECEPTACLES

- A. Manufacturers:
1. Hubbell Model USB20AC5.
 2. Leviton T5833.
 3. Pass and Seymour TR20USBAC6.
 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA WD 1, third party testing agency, DSCC, heavy-duty, 20 ampere, 120 volt, general use, duplex, straight blade, grounding type receptacle with Type A and C, 5A, 5V USB charging ports, arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall have a full wrap around brass bridge with integral ground and standup double wipe contacts. Self grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- C. Device Face and Body: Decora style white nylon or reinforced thermoplastic. Provide red devices and plates where noted.
- D. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacle: Type 5-20R.

2.6 GROUND FAULT CIRCUIT INTERRUPTERS (GFI)

- A. Manufacturers:
1. Hubbell Model GFRWRST20.
 2. Leviton GFWT2.
 3. Pass and Seymour 2097TRWR.

4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Description: NEMA WD 1, third party testing agency, DSCC, heavy-duty, 20 ampere, 120 volt, general use, duplex, straight blade, grounding type receptacle arranged for back and side wiring, with separate single or double grounding terminals. Receptacles shall have a full wrap around brass bridge with integral ground and standup double wipe contacts. Self grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- C. Device Face and Body: White nylon or reinforced thermoplastic.
- D. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacle: Type 5-20R.

2.7 WALL PLATES

- A. Manufacturers:
 1. Hubbell.
 2. Leviton.
 3. Pass and Seymour.
 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Decorative Cover Plate: Single and combination, of types, sizes and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Material shall be white smooth nylon as manufactured by the device vendor.
- C. Weatherproof Cover Plate: Exterior mounted receptacles, and those noted to be weatherproof, shall be provided with weatherproof PVC transparent cover plates, standard size, and shall be single or ganged as indicated on the contract drawings. Weatherproof plates shall be "approved" third party listed as "raintight while in use".

PART 3 EXECUTION

3.1 EXAMINATION

- A. Ensure that outlet boxes are installed at proper height.
- B. Ensure that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.

- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA “Standard of Installation”.
- B. Install devices vertically, plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top. Install horizontally oriented receptacles with the grounding pole on the left.
- E. Receptacles installed over counters, backsplashes, etc., shall be mounted horizontally.
- F. Install line voltage wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- G. Do not share neutral conductor on load side of line voltage dimmers.
- H. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- I. Install decorative plates on switch, receptacle, and blank outlets in finished areas. Schedule installation of finish plates after the surface upon which they are installed has received final finish.
- J. Connect switches by wrapping conductor around screw terminal.
- K. Connect receptacles by utilizing back wiring provisions only. Do not use side wire terminals.
- L. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets. Use cast box covers and plates on cast boxes.
- M. Install protective rings on active flush cover service fittings.
- N. Provide adhesive backed, laminated plastic receptacle device plate labels identifying the circuit feeding the device. Labels shall be label machine printed to indicate panel and circuit number and shall be Casio, Brother, T&B or approved equal. See Section 260553 for additional requirements

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260534 to obtain mounting heights specified and indicated on drawings.
- B. All wiring devices shall be installed at heights as required by the ADA
- C. Install wall switch 48 inches above finished floor, measured to top of device plate.

- D. Install convenience receptacle 18 inches above finished floor, measured to bottom of device plate, unless noted otherwise on the Drawings.
- E. Install convenience receptacle horizontally 6 inches above backsplash of counter, unless noted otherwise on the Drawings.
- F. Install dimmer 48 inches (1.2 m) above finished floor, measured to top of device of plate.
- G. Install telecommunications jack 18 inches (450 mm) above finished floor, measured to bottom of device plate, unless noted otherwise on the Drawings.
- H. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches (1.4 m) above finished floor, unless noted otherwise on the Drawings.
- I. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 (1.2 m) above finished floor, unless noted otherwise on the Drawings.

3.5 FIELD QUALITY CONTROL

- A. Quality Control. As required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify that each receptacle device is energized.
- E. Test each receptacle device for correct polarity and for ground continuity.
- F. Test each GFCI receptacle device for correct operation.

3.6 ADJUSTING

- A. Contract Closeout: Adjust installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Contract Closeout: Clean installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 262727

OCCUPANCY SENSORS

PART 1 GENERAL

1.1 SECTION INCLUDES

Wall box and ceiling type occupancy sensors and accessories.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260534 - Boxes.
- C. Section 260553 - Electrical Identification.
- D. Section 262726 - Wiring Devices.
- E. Section 260526 - Grounding.

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, ratings and configurations.

1.5 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submit manufacturer's installation instructions.

1.6 QUALIFICATIONS

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

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Occupancy Sensor system shall sense the presence of human activity within the spaces indicated and fully control the “On” / “Off” function of the lighting loads automatically. Sensors shall turn “On” the load upon entrance into the room and shall not initiate “On” outside of entrance.
- B. Acceptable technology is Passive Infrared (PIR), Ultrasonic and Microphonic. Dual Technology is required utilizing PIR and one of the other technologies.
- C. Sensors shall automatically adjust time delays and sensitivity based on the activity level in the space.
- D. All line voltage devices shall be approved third party testing agency listed under Energy Management Equipment, or Industrial Control Equipment. Listing under Appliance Control shall not be accepted.
- E. Product shall be manufactured in the USA and be warranted for 5 years.

2.2 WALL BOX LINE VOLTAGE SENSORS FOR SMALL AREAS

- A. Description: Line voltage, single gang, wall mounted occupancy sensor switch with one override or two (as shown) switch(es). Switch shall recess into single gang switch box and fit a standard GFI receptacle plate opening. Switches shall be compatible with standard three and four-way toggle switches. All switches shall be approved by a third party agency, approved for the voltage and current indicated. Provide hard lens switches in storage rooms and other location subject to abuse.
- B. Manufacturers
 - 1. Lutron.
 - 2. Sensor Switch.
 - 3. Wattstopper.
 - 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- C. Body and Handle: Match device colors specified in Section 262726.

- D. Ratings:
Voltage: 120-277 volts AC.
Minimum Load Rating: 800 watts at 120 VAC, 1200 watts at 277 VAC. Sensors shall be compatible with all load types, including electronic and compact fluorescent ballasts, incandescent or fluorescent and require no minimum load.

2.3 WALL BOX LOW VOLTAGE SENSOR/DIMMER SWITCHES FOR SMALL AREAS

- A. Description: Low voltage, single gang, wall mounted occupancy sensor switch 0-10v dimmer with one override or two (as shown) switch(es). Switch shall recess into single gang switch box and fit a standard GFI receptacle plate opening. Switches shall be compatible with standard three and four-way toggle switches. All switches shall be approved by a third party agency, approved for the voltage and current indicated. Provide hard lens switches in storage rooms and other location subject to abuse.
- B. Manufacturers
1. Lutron.
 2. Sensor Switch.
 3. Wattstopper.
 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- C. Body and Handle: Match device colors specified in Section 262726.

2.4 CEILING MOUNTED LOW VOLTAGE SENSORS FOR LARGE AREAS

- A. Sensor Switches: Low voltage, recess ceiling mounted occupancy sensor switch. Sensors shall be adjustable to accommodate the room geometry as shown or the contractor shall provide multiple sensors as required for complete coverage. The device shall operate in conjunction with a line voltage power pack to control the connected lighting loads. Sensors shall operate on a Class 2, three-conductor system. Multiple sensors shall be connectable to a single power pack. Sensor shall recess into a two gang outlet box. All devices shall be approved by a third party agency, approved for the voltage and current indicated.
- Manufacturers:
1. Lutron.
 2. Sensor Switch.
 3. Wattstopper.
 4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Control units/Power packs: Devices shall be rated 20A at 120-277 volts and shall be compatible with all load types, including LED. They shall have the capacity to power additional remote heads or additional relays. Control relays may be paralleled to accommodate extra load or more than three heads or additional relays. Additional relay shall be used where there is more than one circuit being controlled or where there is a need to control multiple voltages.
- Manufacturers:
1. Lutron.

2. Sensor Switch.
3. Wattstopper.
4. Substitutions: Refer to provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

C. Sensor Body: White plastic, or match device colors specified in Section 262726.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Ensure that outlet boxes are installed at the proper location.
- B. Ensure that ceiling openings are neatly cut and will be completely covered by devices.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install in locations in accordance with manufacturers recommendation.
- C. Install devices vertically, plumb and level.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260534 to obtain mounting heights specified and indicated on drawings.
- B. All wiring devices shall be installed at heights as required by the A.D.A.
- C. Install wall switch 48 inches (1.2 m) above finished floor, measured to bottom of outlet box.

3.5 FIELD QUALITY CONTROL

- A. Quality Control. As required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect each wiring device for defects.

C. Operate each system with circuit energized and verify proper operation.

3.6 ADJUSTING

A. Contract Closeout: Adjust installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

A. Contract Closeout: Clean installed work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

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

END OF SECTION

SECTION 262813

FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 262816 – Enclosed Switches.

1.3 REFERENCES

- A. NFPA 70 - National Electric Code.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.4 SUBMITTALS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide data sheets showing electrical characteristics including time-current curves.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Record actual fuse sizes.

1.6 QUALIFICATIONS

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

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.

- B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.8 EXTRA MATERIALS

- A. Provide no less than 10% of each fuse size and type installed, with a minimum of at least one set of three of each.
- B. Provide one fuse puller.

PART 2 PRODUCTS

2.1 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Third party testing agency Listed.

	<u>Circuit Type</u>	<u>Fuse type</u>
1.	Service Entrance and Feeder Circuits over 600Amp 200K Amp interrupting rating.	Class L
2.	Service Entrance and Feeder Circuits 600Amp or less 200K Amp interrupting rating.	Class RK1 or J
3.	Motor, Motor Controller and Transformer Circuits 200K Amp interrupting rating.	RK5

- D. For individual equipment where fault current does not exceed 50KA use Class K5 fuses with 50KA interrupting rating.
- E. Fusible safety switches with short-circuit withstand ratings of 100KA or 200KA require Class R or Class J rejection fuse block feature.

2.2 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse puller specified.
- B. Doors: Hinged, with hasp for Owner's padlock.
- C. Finish: Beige enamel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

- C. Install spare fuse cabinet in main electrical equipment room or adjacent to the main service equipment.

END OF SECTION

SECTION 262816
ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches.
- B. Nonfusible switches.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260526 - Grounding and Bonding.
- C. Section 260529 – Supporting Devices.
- D. Section 260553 – Electrical Identification.
- E. Section 262813 – Fuses.

1.3 REFERENCES

- A. NECA - Standard of Installation (published by the National Electrical Contractors Association).
- B. NEMA FU1 - Low Voltage Cartridge Fuses.
- C. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (published by the International Electrical Testing Association).
- E. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide switch ratings and enclosure dimensions.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Record actual locations of enclosed switches in project record documents.

1.6 QUALIFICATIONS

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

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton.
- B. General Electric/ABB.
- C. Siemens.
- D. Square D Schneider.
- E. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

2.2 RATINGS

- A. Service Conditions:
 - 1. Temperature: 104°F. (40°C.).
 - 2. Altitude: N/A.
 - 3. Terminal Rating: 75°C. minimum.
- B. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical, or as indicated.

2.3 FUSIBLE SWITCH ASSEMBLIES

- A. Description: NEMA KS 1, heavy duty type with externally operable handle interlocked (defeatable) to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Mechanisms shall be non-teasible, positive, quick make-quick break type. Handle lockable in ON or OFF position. Switches shall have handles whose positions are easily recognizable in the ON or OFF position.
- B. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
- C. Provide accessories required by their installation. Provide auxiliary switch contacts as

required by other systems. Coordinate with other Divisions as required.

2.4 NONFUSIBLE SWITCH ASSEMBLIES

- A. Description: NEMA KS 1, heavy duty type with externally operable handle interlocked (defeatable) to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Mechanisms shall be non-teasible, positive, quick make-quick break type. Handle lockable in ON or OFF position. Switches shall have handles whose positions are easily recognizable in the ON or OFF position.
- B. Provide accessories required by their installation. Provide auxiliary switch contacts as required by other systems. Coordinate with other Divisions as required.

2.5 ACCESSORIES

- A. Provide neutral assemblies and equipment grounding kits as required.

2.6 ENCLOSURES

- A. Fabrication: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation".
- B. Switches shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Section 260500, Paragraph 1.23 for additional requirements.
- C. Install fuses in fusible disconnect switches serving Division 26 equipment.
- D. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

- A. Quality Control: Field inspection, testing and adjusting as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- E. Inspect and test in accordance with NETA ATS, except Section 4, or provide for qualified technicians to perform testing according to the manufacturer's recommendations.

END OF SECTION

SECTION 262817

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

Enclosed circuit breakers.

1.2 RELATED WORK

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260526 - Grounding and Bonding.
- C. Section 260529 Supporting Devices.
- D. Section 260553 - Electrical Identification.
- E. Section 262813 - Fuses.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation".
- B. NEMA AB 1 - Molded Case Circuit Breakers
- C. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

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

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

1.8 Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.9 EXTRA MATERIALS

A. Furnish under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.

B. Provide three of each size and type current limiter.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton.

B. General Electric/ABB.

C. Siemens.

D. Square D Schneider.

E. Substitutions: As permitted in relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.

2.2 MOLDED CASE CIRCUIT BREAKER

A. Circuit Breaker: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled.

B. Service Conditions:

1. Temperature: 104° F. (40° C.).

2. Altitude: N/A.

3. Terminal Rating: 75° C. minimum.

C. Minimum Integrated Short Circuit Rating: 30,000 amperes rms symmetrical, or as indicated.

2.3 PRODUCT OPTIONS AND FEATURES (as specified and as applicable)

A. Provide accessories as scheduled, to NEMA AB 1.

B. Shunt Trip Device: 120 volts AC.

- C. Undervoltage Trip Device: 120 volts AC.
- D. Auxiliary Switch: 120 volts AC.
- E. Alarm Switch: 120 volts AC.
- F. Electrical Operator: 120 volts AC.
- G. Handle Lock: Include provisions for padlocking.
- H. Provide mechanical trip device.
- I. Provide insulated grounding lug in each enclosure.

2.4 ENCLOSURE

- A. Enclosure: NEMA AB 1, Type 1 and 3R, as indicated.
- B. Fabricate enclosure from steel.
- C. Finish using manufacturer's standard enamel finish, gray color.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 260529.
- C. Equipment shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Section 260500, Paragraph 1.23 for additional requirements.
- D. Height: 5 feet AFF to operating handle.
- E. Provide engraved plastic nameplates under the provisions of Section 260553.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect and test each circuit breaker to NEMA AB 1.
- C. Inspect each circuit breaker visually.

- D. Perform several mechanical ON-OFF operations on each circuit breaker.
- E. Verify circuit continuity on each pole in closed position.
- F. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.
- G. Include description of testing and results in test report.

3.3 ADJUSTING

- A. Adjust work under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Adjust adjust circuit breaker trip and time delay settings to minimum values that do not cause false tripping.

END OF SECTION

SECTION 264313

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.1 SUMMARY

Section includes integral equipment and field installed surge protective devices (SPD) for low-voltage (120VAC to 480VAC) power distribution and control equipment.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260526 - Grounding and Bonding.
- C. Section 260529 Supporting Devices.
- D. Section 260553 - Electrical Identification.

1.2 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. SVR: Suppressed voltage rating.
- C. SPD: Surge Protective Device.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Qualification Data: For qualified testing agency.
- C. Product Certificates: For SPD, from manufacturer.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For SPD to include in operation and maintenance manuals.
- F. Warranties: Sample of actual warranty.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company 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 testing agency, and marked for intended location and application.
- C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- D. Comply with NEMA LS 1.
- E. Comply with UL 1283 and UL 1449, latest edition.
- F. Comply with NFPA 70 Article 285, 2017 edition.

1.6 PROJECT CONDITIONS

- A. Service Conditions: SPDs shall be rated 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.
 3. Humidity: 0 to 85 percent, noncondensing.
 4. Altitude: Less than 20,000 feet above sea level.

1.7 COORDINATION

Coordinate location of SPDs to allow adequate clearances for maintenance with shortest possible lead length.

1.8 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 specified warranty period.
- B. Warranty: Full replacement warranty for a period of Twenty (20) years from date of Substantial Completion. Owner pays shipping cost to return unit to the manufacturer, Manufacturer returns a replacement unit shipping prepaid. Contractor shall register unit with manufacturer for the Owner.

PART 2 PRODUCTS

2.1 SERVICE ENTRANCE SPDs

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Basis of Design: Eaton SPM Max Series.
 2. ABB/GE.
 3. Siemens.
 4. Square D Schneider.

- B. Surge Protection Devices:
 - 1. Comply with UL 1449, 4th Edition.
 - 2. Thermally protected MOVs.
 - 3. Two module design, allowing Owner replacement of modules.
 - 4. Integral circuit breaker disconnect.
 - 5. LED indicator lights for power and protection status of each phase and neutral.
 - 6. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 7. Form-C contacts rated 0.4A at 150VAC minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - 8. Six-digit transient event counter with reset button and nonvolatile memory to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating: 500 kA per phase/250 kA per mode.
- D. Short circuit current rating: 200 kA.

2.2 PANELBOARD SPDs

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - 1. Basis of Design: Eaton SPM Max Series.
 - 2. ABB/GE.
 - 3. Siemens.
 - 4. Square D/Schneider.
- B. Surge Protection Devices:
 - 1. Comply with UL 1449, 4th Edition.
 - 2. Thermally protected MOVs.
 - 3. Two module design, allowing Owner replacement of modules.
 - 4. Integral circuit breaker disconnect.
 - 5. LED indicator lights for power and protection status of each phase and neutral.
 - 6. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 7. Form-C contacts rated 0.4A at 150VAC minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - 8. Six-digit transient event counter with reset button and nonvolatile memory to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating: 320 kA per phase/160 kA per mode.

2.3 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 4, powder coated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install SPD at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install SPD with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- C. SPD circuit breaker and feeder conductors shall be as recommended by the device manufacturer, or #8 AWG copper, whichever is greater. Install in metallic raceway.
- D. Coordinate SPD circuit breaker rating with actual SPD provided.

3.2 FIELD QUALITY CONTROL

- A. Inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. 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.
 - 2. After installing SPDs, but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
- C. SPD will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Do not energize or connect electrical equipment to their sources until SPDs are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SDP installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

END OF SECTION

SECTION 265100

INTERIOR LUMINAIRES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories.
- B. Drivers.
- C. Lamps and LED Light Engines/Sources.
- D. Luminaire accessories.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260533 - Conduit.
- C. Section 260519 - Building Wire and Cable.
- D. Section 260534 - Boxes.
- E. Section 260526 - Grounding and Bonding.
- F. Section 260553 - Electrical Identification.

1.3 REFERENCES

- A. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- B. NFPA 70 - National Electrical Code.
- C. NFPA 101 - Life Safety Code.

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.5 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submit manufacturer's operation and maintenance instructions for each product.

1.7 QUALIFICATIONS

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

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 101.
- C. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 EXTRA PRODUCTS

Not used.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Furnish Products as scheduled. Refer to relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections for substitutions and product options.
- B. All lighting fixtures shall be approved by third party testing agencies and NFPA and shall bear their label.
- C. All fixtures shall be listed on one or more of the following websites: LED Lighting Facts website (www.lightingfacts.com), Energy Star website (www.energystar.gov), or the Design Light Consortium website www.designlights.org.

- D. Power supplies/drivers/ballasts, LED arrays, boards or light engines shall be easily field replaceable using common hand tools (e.g., screwdrivers, pliers, etc.) and without uninstalling the luminaire
- E. All fixtures shall have a stock, or standard finish unless otherwise specified. Fixtures subject to corrosive or damp environments shall have corrosion resistant hardware and finishes.
- F. No visible welding, no plane-protruding screws, latches, springs, hooks, rivets or plastic supports viewed from the occupied (room) side are allowed.
- G. All fixtures shall be installed complete with lamps or LED sources as specified.
- H. Lighting fixture types shall be furnished as required by the Lighting Fixture Schedule as indicated on the drawings. Catalog numbers are provided as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers listed will be acceptable upon approval of the Architect/Engineer, unless noted otherwise. The Contractor shall verify from the contract drawings the type ceilings or walls the fixture is to be used with and shall provide compatible mounting attachments and trim. Provide all accessories or additional materials required to maintain the ceiling fire rating as required by regulatory authorities.
- I. Luminaires shall be designed to operate at an average operating temperature of 25°C. The operating temperature range shall be 0°C to 25°C.
- J. Manufacturers shall be firms regularly engaged in the manufacture of lighting fixtures of types and ratings required, who have a service organization in the continental US, and whose products have been satisfactorily used in similar service for not less than 5 years. Fixtures shall comply with the provisions of all applicable code and standards. All fixtures shall be tested before shipping.
- K. Warranty: 10 years from the date of Final Acceptance non-prorated on complete fixture including driver including premature failure, discoloration and defects. The contractor shall provide a written warranty against defects in material and workmanship, including replacement for ten years from the date of final acceptance.

2.2 LED SOURCES

- A. LED sources shall be high intensity white, single color or as noted. Provide white LEDs in the color temperature(s) specified. The color temperature in all lamps of the same type shall be consistent and remain so over the life of the lamp. Color consistency between lamps shall conform to ANSI NEMA ANSLG standard C78.377-2008. The contractor shall replace lamps/fixtures exhibiting inconsistent lamp color.
- B. The color or color temperature of replacement LED lamps shall match those of the same lamp types that remain in operation. The minimum color rendering index of white LEDs shall be 80. Electrical and photometric performance of LED assemblies and luminaires shall conform to IES LM 79-08.

- C. Minimum lumen maintenance shall be 70% of rated initial lumen output at 50,000 hours of operation. Measurement of lumen maintenance shall be in accordance with IES LM-80-08.
- D. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.
- E. LED screw base lamps replacing incandescent lamps in fixtures will be provided by the Owner and installed by the contractor.

2.3 LED DRIVERS

- A. Provide high frequency electronic type with secondary voltages matching those required by the led source they operate. Drivers shall operate within a 0°F – 140°F ambient temperature range. Minimum driver specifications:
 1. Power factor $\geq 90\%$ (at full luminaire output and across specified voltage range).
 2. Driver efficiency (at full load): $\geq 85\%$ for drivers capable of ≥ 50 watts and $\geq 80\%$ for drivers capable of < 50 watts
 3. Current crest factor – 1.5 minimum.
 4. Total harmonic distortion $< 20\%$ (at full luminaire output and across specified voltage range).
 5. Rated life – 50,000 hours.
 6. Transient and surge protection: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kv for interior fixtures.
 7. Sound: Class A not to exceed a measured value of 24dB.
 8. Maximum standby power: 1W.
 9. For indoor and building mounted fixtures, provide minimum 2-kv surge suppression integral with the driver (5-kv preferred if available).
 10. For outdoor fixtures, provide minimum 10.0-kv surge suppression integral with the driver.
 11. Thermal management
 - a. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
 - b. The LEDs manufacturer's maximum junction temperature for the expected life shall not be exceeded at the average operating ambient temperature.
 - c. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature.
 - d. The driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating temperature. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.
 12. Flicker: Comply with IESNA standards for flicker and IEEE PAR1789 Recommended Practice, including flicker at when fully powered and when dimmed.
 13. EMI/RFI: The luminaire and associated on-board circuitry shall meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI Emissions.
 14. Inrush Current: Comply with NEMA 410.

Manufacturers shall have been manufacturing LED drivers for at least ten years with a documentable low failure rate. The contractor shall provide a written warranty against defects in material and workmanship, including replacement for ten years from the date of final acceptance.

2.4 LENSES

Lenses shall be clear virgin acrylic material with uniform 3/16" square based female cone prisms aligned 45° to the length and width of the lens panel. Minimum prism depth shall be 0.080" with a nominal panel thickness of 0.156" and a minimum overall panel thickness of 0.150" to 0.160" inches.

2.5 CONTROLS

- A. Time Switch: Astronomic, two channel, electronic type with 48 hour capacitor or battery reserve, digital display, 30 ampere output contact rating, two, single pole output contacts, voltage compatible with load served, NEMA-1 enclosure.
- B. Photocell: Weatherproof, enclosed, single pole, 1800 VA, 120VAC, twist lock plug-in type with base.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- B. Lighting equipment shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Specifications Section 260500, Paragraph 1.23 for additional requirements.
- C. Where a recessed or downlight fixture replaces a section or part of an acoustical ceiling tile, or a section or part of a suspended gypsum board ceiling, the fixture shall be supported at two (2) diagonal corners to the steel frame of the building. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track or GWB ceiling system. Attach one end of the wire to one corner of the fixture and the other end to the building's structural system. The lay-in or flange fixture shall then be screwed to the main runners of the lay-in ceiling track or GWB ceiling system at all four (4) corners using sheet metal screws (parabolic type fixtures shall be attached to the ceiling grid with approved clips). The Electrical Contractor shall be responsible for coordination work with the ceiling contractor; however, the ceiling contractor will provide framed openings for reception of lighting fixtures. All recessed fixtures shall be furnished with all necessary mounting accessories.
- D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- F. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid members to support

surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts or screws.

- G. Install recessed luminaires to permit removal from below.
- H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings.
- J. Install accessories furnished with each luminaire.
- K. Connect luminaires, emergency lighting units and exit signs to branch circuit outlets provided under Section 260534 using flexible conduit.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Install/provide specified lamps/LEDs in each emergency lighting unit, exit sign, and luminaire.

3.2 FIELD QUALITY CONTROL

- A. Quality Assurance: Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Aim and adjust luminaires as directed.

3.4 CLEANING

- A. Contract Closeout: Clean installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.

- E. Clean finishes and touch up damage.

3.5 DEMONSTRATION AND INSTRUCTIONS

- A. Contract Closeout: Demonstrate installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Demonstrate luminaire operation for minimum of two hours.

3.6 PROTECTION OF FINISHED WORK

- A. Contract Closeout: Protect installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Relamp luminaires that have failed lamps at Substantial Completion. Replace LED modules in which more than 5% of the LEDs have failed lamps at Final Acceptance of the Work.

END OF SECTION

SECTION 265200

EMERGENCY AND EXIT LIGHTING

PART 1 GENERAL

1.1 SUMMARY

Section includes emergency exit lighting and emergency egress lighting units and transfer switching devices.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 260533 - Conduit.
- C. Section 260519 - Building Wire and Cable.
- D. Section 260534 - Boxes.
- E. Section 260526 - Grounding and Bonding.
- F. Section 260553 - Electrical Identification.

1.3 STANDARDS

- A. UL 924
- B. NFPA 101 - Life Safety Code.
- C. NFPA 70 - National Electrical Code.
- D. North Carolina State Building Code including Energy Code Volume X.
- E. NEMA - Standards

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Procedures for submittals. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.5 SUBMITTALS FOR INFORMATION

- A. Submittals: Submittals for information. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Contract Closeout: Submittals for project closeout. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Submit manufacturer's operation and maintenance instructions for each product.

1.7 QUALIFICATIONS

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

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 101.
- C. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated. Products shall also meet or exceed the standards listed in Part 2.

PART 2 PRODUCTS

2.1 GENERAL

- A. All lighting fixtures shall be listed as emergency lighting equipment and approved by third party testing agencies and NFPA and shall bear their label.
- B. All fixtures shall have a stock, or standard finish unless otherwise specified.
- C. All fixtures shall be completely self-contained, provided with maintenance free battery, automatic charger and other features. They shall be installed complete with lamps, batteries, etc. which shall be new and unused at time of final inspection of the project for acceptance.
- D. Lighting fixture types shall be furnished as required by the Lighting Fixture Schedule on the contract drawings and as herein specified. Catalog numbers are provided as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers listed will be acceptable upon approval of the Architect/Engineer. The Contractor shall verify from the contract drawings the type of ceilings or walls the fixture is to

be used with and shall provide compatible mounting attachments and trim. Provide all accessories or additional materials required to maintain the ceiling fire rating as required by regulatory authorities.

- E. Emergency lighting fixtures shall be as shown on the lighting fixture schedule on the contract drawings, and as herein specified.
- F. Warranty: The entire unit shall be warranted for three years. The battery shall have an additional two more years pro-rated warranty. Warranty shall date from the date of final project acceptance and be included in the contract document.

2.2 EMERGENCY LIGHTING (EGRESS) UNITS

- A. Product Description: Self-contained LED emergency lighting unit automatically activated when the line voltage drops below 80%.
- B. Battery: Ten year normal life expectancy, 6 or 12 volt, sealed, maintenance-free, lead calcium type, with 1.5 hour minimum capacity at full load. Battery shall be a high temperature type with an operating range of 0° C. to 60° C., contain a resealable pressure vent and sintered positive and negative terminals. A low voltage disconnect switch shall be included if a lead battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during an extended power outage.
- C. Battery Charger: Automatic, solid state, full wave rectification, surge protected, current-limiting, dual-rate type, with filtered output of sufficient capacity to recharge discharged battery to full charge within twelve hours. Provide fused output circuit, low voltage battery disconnect, brownout and short circuit protection. Thermal protection shall sense circuitry temperature and adjust charge current to prevent overheating and charger failure. Thermal compensation shall adjust charger output to provide optimum charge voltage relative to ambient temperature. Regulated charge voltage shall maintain constant charge voltage over a wide range of line voltages. AC lockout circuit shall allow battery connection before AC power is applied and prevent battery damage due to deep discharge.
- D. Lamps: LED. Heads shall rotate for aiming. Maximum LED failure rate shall be 25% within a seven (7) year period; otherwise, if exceeded, manufacturer shall replace the complete unit at no charge to the Owner.
- E. Mounting: Surface wall or recessed ceiling as indicated by the drawings.
- F. Housing: White polycarbonate, with steel backbox/housing or steel with white finish. Wall mount unit with hinged faceplate and adjustable mounting hardware. Ceiling mount unit with T bar hangar kit.
- G. Self-Diagnostics: Electronics shall automatically, or manually upon demand, conduct self test on battery condition (including actual discharge), charger, lamps and internal wiring integrity per NEC and NFPA at prescribed intervals. A pilot light shall indicate the unit is connect to AC power. Provide test switch and visual indicator(s) of unit operational condition including charger status, ready and service code. Test switch shall simulate operation of the unit upon loss of AC power by energizing lamps from the battery, and also exercise the transfer relay.

- H. Electrical Connection: Conduit connection.
- I. Input Voltage: Dual voltage input (120/277 volts).

2.3 EXIT LIGHTING UNITS

- A. Product Description: Exit lighting fixture.
- B. Lamps: LED, discrete or diffuse. Maximum failure rate shall be 25% within a seven year period, otherwise, if exceeded the manufacturer shall replace the entire unit at no cost to the Owner.
- C. Directional Arrows: As indicated or universal type for field adjustment.
- D. Mounting: Universal, surface wall, back or end mount, or ceiling, top or pendant mount.
- E. Housing: White polycarbonate for standard unit, metallic enclosure with clear plexiglass signage panel for architectural/edge lit unit.
- F. Electrical Connection: Conduit connection.
- G. Input Voltage: Dual voltage input (120/277 volts).

2.4 TRANSFER SWITCHING DEVICES

- A. Transfer switching devices shall be provided for circuits and/or fixtures where noted on the Drawings. Devices shall be capable of bypassing local switching of the circuit or fixture when the emergency generator or other emergency power source is supplying power to the facility or lighting circuit, energizing the circuit or fixture from the emergency power source regardless of local switch position.
- B. Fixture devices shall be UL 924 listed for field installation inside the ballast channel or on top of the fixture. It shall be rated for 3 amperes load at rated voltage and shall consist of relay switching circuitry and be contained in a NEMA-1 enclosure. The device shall be capable of overriding a 0-10V dimmer to full brightness. The device shall be multivoltage (120 or 277 V), or the proper single voltage device shall be provided.
- C. Circuit devices shall be UL 924 listed for field installation at a location shown or field directed. It shall be rated for up to 20 amperes load at rated voltage and shall consist of relay switching circuitry and be contained in a NEMA-1 enclosure. The device shall be capable of overriding a 0-10V dimmer to full brightness. The device shall be multivoltage (120 or 277 V), or the proper single voltage device shall be provided.
- D. Devices shall be warranted for a minimum of five (5) years by the manufacturer.
- E. Devices shall be Bodine GTD series, Dual Lite ATSD series, Functional Devices ESR series or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated.
- D. Install accessories furnished with each emergency lighting unit and exit sign.
- E. Emergency and exit lighting fixtures shall be installed in a manner to be fully compliant with the seismic restraint requirements of the North Carolina State Building Code. Provide mounting devices and hardware, bracing, fittings, etc. as required for seismic restraint. See Specifications Section 260500, Paragraph 1.23 for additional requirements.
- F. Connect emergency lighting units and exit signs to branch circuit outlets provided under this Division as indicated.
- G. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts or screws.
- H. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- I. Install specified lamps in each emergency lighting unit.
- J. Ground and bond emergency lighting units and exit signs under the provisions of Section 260526.
- K. Locate exit and emergency lighting fixtures as indicated on reflected ceiling plan.
- L. Install recessed luminaires to permit removal from below.
- M. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- N. Install screws to secure recessed grid-supported luminaires in place.
- O. Install accessories furnished with each luminaire.

3.2 FIELD QUALITY CONTROL

- A. Quality Assurance: Field inspection, testing and adjusting shall be as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications

Sections.

- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Contract Closeout: Adjust installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Aim and adjust emergency lighting fixture heads to illuminate paths of egress.

3.4 CLEANING

- A. Contract Closeout: Clean installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.5 DEMONSTRATION AND INSTRUCTIONS

- A. Contract Closeout: Demonstrate installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Demonstrate normal luminaire operation for minimum of ninety minutes after the unit has been permanently installed and charged for a minimum of 24 hours. The battery run time test shall be completed a minimum of 10 days prior to final inspection. Any unit which fails the test shall be repaired or replaced, and tested again. A copy of the test report shall be sent to the Architect. The Architect/Engineer will provide the testing form for contractor use.

3.6 PROTECTION OF FINISHED WORK

- A. Contract Closeout: Protect installed work as required under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Relamp emergency lighting units and exit signs that have failed lamps at Substantial Completion. Replace exit signs in which more than 5% of the LEDs have failed lamps at Substantial Completion.

END OF SECTION