

SEALS PAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Professional Seals and administrative information for the firms involved in the project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF SEALS

A. Electrical Engineer

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Seal/Signature



END OF DOCUMENT

Sligo Creek Elementary School
Switchboard Replacement

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SECTION 26 0101

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General provisions and requirements for electrical work.

1.2 RELATED SECTIONS

- A. Requirements of this section generally supplement requirements of Division 01.

1.3 REFERENCES

- A. NFPA 10: Portable Fire Extinguishers.
- B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

- A. The full set of Contract Documents applies to work of Division 26.
- B. Visit the site and study aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.
- C. The work covered in technical sections includes the furnishing of labor, equipment and materials, and the performance of operations pertinent to the work described.
- D. Except as required otherwise in Division 01, promptly obtain and pay for necessary signatures and paperwork, permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.
- E. Electrical work of this project includes, as a brief general description, the following:
 - 1. Replace existing switchboard manufactured by Westinghouse with a new switchboard.
 - 2. Provide new feeder cables from the existing transformer to the new switchboard.
 - 3. Replace existing fluorescent strip light fixtures with new LED lighting fixtures.
- F. See Division 01 for requirements related to Owner's occupancy of the premises, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

- A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 26 specifications.
- B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for coordination and additional costs as specified in article "Substitutions" below for substitutions.

- C. Products specified by reference standards or by description only: Any product meeting those standards or description.
- D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.
 - 1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
 - 2. Where specification permits "equal" products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.
- E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

- A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 26 specifications.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.
- D. A request constitutes a representation that the Bidder or Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.
- B. Equipment, construction and installation must meet requirements of local, state and federal governing codes.

- C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.
- D. Terms have the following meanings:
 - 1. Furnish: Supply item
 - 2. Install: Mount and connect item
 - 3. Provide: Furnish and install
- E. Materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.
- F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.
- G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.
- H. In cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

- A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.
- B. Plan and coordinate work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate electrical work so that work of each trade is completed before other construction begins which would obstruct it.
- C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.
- D. Coordinate location and elevation of conduit, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.
- E. The Contractors' assistants shall include a competent electrical foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. Exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.
5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit the results of every test required under any section in this division.

D. After the work is completed, submit required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.10 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:
 - a. Contract Drawings.
 - b. Specifications.
 - c. Addenda.
 - d. Change Orders and other Modifications to the Contract.
 - e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
 3. Record information concurrent with construction progress.
 4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:
 - a. Manufacturer's name and product model and number.
 - b. Product options, substitutions, or alternates utilized.
 - c. Changes made by addenda and modifications.
 5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:
 - a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
 - b. Field changes of dimension and detail.
 - c. Details not on original Contract Drawings.
 6. Submit documents as specified in Division 01.
- B. Operation and maintenance data:
1. Submit data prior to final inspection as specified in Division 01. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
 2. Prepare covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project.
 3. Internally subdivide the contents with permanent page dividers, logically organized as described below.
 4. Contents: Prepare a Table of Contents, with each product or system description identified.
 5. Part 1: Directory, listing names, addresses, and telephone numbers of electrical engineers; contractor; electrical subcontractors; and major electrical equipment suppliers.
 6. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component, including recommended spare parts list.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
 7. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Photocopies of certificates.
 - c. Photocopies of warranties, guarantees, and bonds.
 - d. Test reports: Copies of the results of tests required under sections of specifications.
 8. Submit data in final form 15 days prior to final inspection. This data will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
 9. Submit final revised data within ten days after final inspection.
 10. Submit operation and maintenance data in electronic format.

1.11 REGULATORY REQUIREMENTS

- A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.
- B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.
- C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.
 - 1. The electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
 - 2. The National Electric Code, NFPA 70 (NEC).
 - 3. The National Fire Protection Association Code (NFPA).
 - 4. International Building Code (IBC).
 - 5. International Energy Conservation, Fire, and Electrical Codes (ICC).

1.12 REFERENCE STANDARDS

- A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.
 - 1. American National Standards Institute (ANSI)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. International Code Council (ICC)
 - 4. Institute of Electrical and Electronics Engineers (IEEE)
 - 5. National Electrical Code (NEC) (NFPA 70)
 - 6. National Electrical Manufacturer's Association (NEMA)
 - 7. National Fire Protection Association (NFPA)
 - 8. The Occupational Safety and Health Act (OSHA)
 - 9. Underwriters Laboratory Inc. (UL)
 - 10. American Association of State Highway and Transportation Officials (AASHTO)
 - 11. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
 - 12. Maryland Occupational Safety and Health Act (MOSHA)
 - 13. Illuminating Engineering Society of North America (IESNA)

1.13 TEMPORARY STORAGE

- A. Maintain upon premises, where directed, a storage area, and be responsible for contents within these areas. Provide security measures necessary for this area.
- B. Area shall be maintained and shall be returned to original condition at the completion of the project.
- C. Store electrical construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.
 - 1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.

2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.
 3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.
- D. Electrical equipment such as motor controllers, panelboards and circuit breakers stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.14 PROTECTION

- A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.
1. Do not use water to control dust. Use drop cloths or other suitable barriers.
 2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
 3. Provide walk-off mats at entries and replace them at regular intervals.
 4. Construct dust partitions, where indicated on the drawings or as required.
 5. Protect areas occupied by Owner's personnel or equipment.
- B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.
1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
 2. Protect finished work from damage, defacement, staining, or scratching.
 3. Protect finishes from cleaning agents, or grinding and finishing equipment.
 4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
 5. Coordinate installations and temporarily remove items to avoid damage from finishing work.
- C. Repair damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, at no addition to the Contract sum.
- D. Protect work stored in place and supplies stored in the building.
1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
 2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.
- E. Protect electrical materials and products from weather events and accidents of construction.
- F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.15 FIRE PROTECTION

- A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.
- B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.16 PROJECT CONDITIONS

- A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.
- B. If, in the course of the work, workers encounter a material they suspect to present some hazard:
 - 1. Promptly notify the Owner in writing.
 - 2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.17 WARRANTY

- A. Work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties as specified in individual sections.
- B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is two years after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.
 - 1. Service reports for warranty work shall be provided to the Owner.
- C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.
- D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.
- E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.
- F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
- B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of conduits. Close superfluous openings and remove debris caused by work of this division.

- C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.
- D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and materials used for any patching or mending shall conform to the class of materials originally installed.
- E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

- A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

- A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Engineer finds them necessary or advantageous to progress of work.
- B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to work of more than one section of Division 26.
- B. Basic materials and equipment required for electrical work.
- C. Date sensitive equipment.
- D. Operating instructions.
- E. Testing wiring systems.

1.2 RELATED SECTIONS

- A. Project and special warranties: Division 01 and Section 26 0101.
- B. Operation and Maintenance Manuals: Division 01 and Section 26 0101.

1.3 DEFINITIONS

- A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.
- B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

- A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.
- B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:
 - 1. Product shall meet the specifications.
 - 2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.
- C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

1.5 QUALITY ASSURANCE

- A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the state, county, or city in which the work is performed.
- B. Electrical control panels, equipment, materials and devices provided or installed as work of Division 26 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.
- C. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.
- D. Products shall contain no urea-formaldehyde content.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Techniques, testing, and operating instructions specified in this section apply to products specified in other sections of Division 26.
- B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 MATERIALS

- A. Electrical equipment backing panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated in accordance with AWPA C27, in thickness indicated, not less than 0.5 inches nominal.
 - 1. One side finished.
- B. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. Application: Treat items indicated on the drawings, and the following:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
 - b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
 - c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - d. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 - e. Wood floor plates that are installed over concrete slabs-on-grade.
- C. Aircraft cable: 0.25-inch steel wire rope, galvanized, construction 7 by 19 strands, minimum 7000 pounds breaking strength.

2.3 DATE-SENSITIVE EQUIPMENT

- A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.
- B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.
 - 1. Immediately notify Engineer if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.
- B. The contract drawings are diagrammatic, and do not indicate all fittings or offsets in conduit or all pull boxes, access panels, or other specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.
- C. No conduit shall be run below the head of a window or door.
- D. Equipment and conduits installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.
- E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 INSTALLATION OF PRODUCTS AND EQUIPMENT

- A. Install conduit exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining adequate clearance for access at parts requiring servicing.
- B. Install conduit a sufficient distance from other work to permit a clearance of not less than 0.5 inches between its finished covering and adjacent work.
- C. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.
- D. Install plywood backing panels with finished face exposed.

3.3 OPERATING INSTRUCTIONS (DEMONSTRATION)

- A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.
- B. Where specified in technical sections, provide longer periods required for specialized equipment.

- C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.
 - 1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.
- D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.
- E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer.

3.4 TESTS

- A. During the progress of the work and after completion, test the branch circuits and distribution system, and the low-voltage alarm and signal systems.
- B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or workmanship, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.
- C. Furnish equipment and instruments necessary for testing.
- D. Tests shall demonstrate the following:
 - 1. Lighting, power, and control circuits are continuous and free from short circuits.
 - 2. Circuits are free from unspecified grounds.
 - 3. The resistance to ground of each non-grounded circuit is not less than one megohm.
 - 4. Circuits are properly connected in accordance with the applicable wiring diagrams.
 - 5. Circuits are operable. Demonstration shall include functioning of each control not less than ten times, and continuous operation of each lighting and power circuit for not less than 0.5 hour.
- E. Test circuit breakers larger than 100 amperes at full voltage.
- F. Make voltage built-up tests with a voltage sufficient to determine that no short circuits exist.
- G. Immediately repair defects and retest until systems are operating correctly.
- H. Submit test reports.

END OF SECTION

SECTION 26 0501

EXCAVATION AND FILL FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Trenching, backfilling, and compacting for electrical work underground.
- B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

- A. Cutting and patching Section 26 0101.
- B. Conduit: Section 26 0533.
- C. Identification for electrical systems: Section 26 0553.

1.3 REFERENCES

- A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft).

1.4 SUBMITTALS

- A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities, and proposed detailed trenching plan.
- B. Product data: Seed and mulch.
- C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.
- B. Grass seed: Fresh new-crop seed, 90 percent pure and 85 percent germination. Mix: 70 percent Kentucky Bluegrass, 25 percent Red Fescue and 5 percent Red Top. Only strains of Kentucky Bluegrass found adaptable to Maryland shall be acceptable.
- C. Mulch: Free of sticks, weeds, or other foreign matter; either licorice root, tan root, or tan bark; fibrous by-product of extraction. Use only one type throughout the project.

2.2 EQUIPMENT

- A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Contact local utility company underground information service (Pepco) before beginning excavation outside buildings.
- B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

- A. Perform excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work.
- B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade, or location.
- C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.

3.3 TRENCHING

- A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.
- B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:
 - 1. Electrical conduit: Depth required by NFPA 70 (NEC).
- C. Trenches shall be of necessary depth and width for the proper laying of conduit with a minimum of 8 inches on each side of the joint.
 - 1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 4 feet and deeper shall have shored sides as required by OSHA trenching regulations.
 - 2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of conduit on undisturbed soil at every point along its entire length, except for bell holes.
 - 3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
 - 4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.
 - 5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

- D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the Engineer and do not place any portion of the work on such surfaces until instructions are received.
- E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

3.4 BACKFILL

- A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.
- B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.
- C. Electrical systems backfill:
 - 1. Backfill and compact in 8-inch layers, to level finished grade with the excavated materials approved for backfilling.
 - 2. Surplus earth shall be mounded up on excavation and left to settle. When directed by the Engineer, surplus earth shall be removed and excavations leveled off to proper grade. Where direct burial cables are placed in trenches, first cover the cables with clean earth.

3.5 COMPACTION

- A. Test in accordance with the requirements of ASTM D 1557.
- B. Compact under slabs, roads, and sidewalks to a 95 percent density.
- C. Compact unpaved areas to a 90 percent density.
- D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.
- E. Take particular care in compaction of earth under joints of mechanical piping.

3.6 SEEDING

- A. Seed disturbed grass areas at the rate of 5 pounds per 1000 square feet, with the seed mix specified.
- B. Uniformly distribute seed with an approved machine to ensure a covering of plus or minus 1/4 inches. Sow half of the seed in one direction and the rest at right angles.
- C. Do not seed during windy weather or when ground is wet or otherwise untillable. Seed between the dates of March 1st to May 1st or August 15 to October 15 unless otherwise approved in writing.

3.7 MULCHING

- A. Mulch seeded areas immediately following seeding with fibrous mulch evenly applied at an average rate of 2 tons per acre so as to provide a loose depth of not less than 2 inches.
- B. Wet down mulch, unless a heavy rain wets it, to the Engineer's satisfaction, immediately after application.

END OF SECTION

SECTION 26 0504

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Extent and location of demolition are shown on the drawings.

1.2 QUALITY ASSURANCE

- A. Demolition shall be carried out as expeditiously as possible, in accordance with accepted practice and applicable building code provisions.

1.3 PROJECT CONDITIONS

- A. If, in the course of the work, workers unexpectedly encounter a material not identified for special removal but which they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:
 - 1. Promptly notify the Owner and Engineer in writing.
 - 2. Do not perform any work which would disturb the suspected material until written instructions have been received.
- B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
- C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep materials on hand to patch and maintain protection.

3.2 DEMOLITION

- A. Perform removal work neatly with the least possible disturbance to the building.
- B. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.
- C. Demolish, remove, demount, and disconnect inactive and obsolete conduit, fittings and specialties, equipment, and fixtures.
 - 1. Conduit and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least one inch below finished surface.

2. Remove materials above accessible ceilings.
3. Disconnect and cap items to remain behind finished surfaces.
4. Patch and repair surface materials as required in Division 01 and Section 26 0101 article, "Cutting and Patching."

D. Remove the anchors, bolts, and fasteners associated with conduit and equipment to be removed.

3.3 DISPOSAL

- A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

END OF SECTION

SECTION 26 0507

FIRESTOPPING FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Through-penetration firestopping in fire-rated construction.
- B. Through-penetration smoke-stopping in smoke partitions.

1.2 RELATED SECTIONS

- A. Conduit: Section 26 0533.

1.3 REFERENCES

- A. Underwriters Laboratories
 - 1. UL Fire Resistance Directory
 - 2. UL 1479: Through Penetration Firestops.
- B. American Society for Testing and Materials Standards:
 - 1. ASTM E 814: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.4 DEFINITIONS

- A. Assembly: Particular arrangement of materials specific to given type of construction described in referenced documents.
- B. Barriers: Time-rated fire walls, smoke barrier walls, time-rated ceiling/floor assemblies and structural floors.
- C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gases, and smoke.
- D. Penetration: Opening or foreign materials passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
- E. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.
- F. System: Specific products and applications, classified and numbered by the rating agency to close specific barrier penetrations.

1.5 SYSTEM DESCRIPTION

- A. Design requirements:
 - 1. Fire-rated construction: Maintain barrier and structural floor fire resistant ratings including resistance to cold smoke at penetrations.
 - 2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at penetrations.

1.6 SUBMITTALS

- A. Product data: Manufacturer's specifications and technical data including the following:
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions.
- B. Shop drawings: Submit firestop assemblies and devices for openings and through penetrations in fire-rated construction. Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.
 - 1. Details of each proposed assembly identifying intended products and applicable rating agency classification.
 - 2. Manufacturer or manufacturer's representative shall provide qualified engineering judgments and drawings relating to conditions where rated assemblies do not exist.
- C. Quality control submittals: Statement of qualifications.
- D. Certifications: Letters or forms showing acceptance by local authorities for systems without acceptance by a rating agency.

1.7 QUALITY ASSURANCE

- A. Products and assemblies shall be tested and labeled by an independent, nationally recognized testing and labeling authority.
- B. Installer's qualification: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:
 - 1. Acceptable to or licensed by manufacturer, state, or local authority where applicable.
 - 2. At least 2 years' experience with systems.
 - 3. Successfully completed at least 5 projects of comparable scale, using these systems.
- C. Local and state regulatory requirements: Obtain acceptance for proposed assemblies not conforming to specific rating agency classifications or rated assemblies.
- D. Materials shall have been tested to provide fire rating at least equal to that of the construction in which they are to be installed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver products in original unopened packaging with legible manufacturer's identification.
 - 2. Coordinate delivery with scheduled installation date, allow minimum storage at site.
- B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.9 PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced-air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

1.10 WARRANTY

- A. General project warranty and correction period, as required in general conditions and Division 01, requires repair or replacement of materials or systems which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers and products: Those listed in the UL Fire Resistance Directory for the UL System involved, or rated for the application by Warnock Hersey or by another acceptable rating agency.

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

- A. Systems or devices listed and labeled by a rating agency, and conforming to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. The system shall be symmetrical for wall applications. Systems or devices shall be asbestos-free.
 1. Additional requirements: Firestopping shall withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the rated system or device, and designed to perform this function.
 2. Additional requirements: Firestopping sealants shall be red in color to facilitate field verification of firestopping application.

2.3 MEMBRANE PENETRATIONS OF FIRE-RATED CONSTRUCTION

- A. Systems for devices using UL listed electrical boxes within a fire-rated wall, listed and labeled by a rating agency, and conforming to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. Systems shall be asbestos-free.
 - 1. Additional requirements: Firestopping shall withstand the passage of cold smoke either as an inherent property of the system, or using a separate product included as a part of the rated system or device, and designed to perform this function.
 - 2. Additional requirements: Firestopping sealants shall be red in color to facilitate field verification of firestopping application.

2.4 SMOKE-STOPPING AT SMOKE PARTITIONS

- A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.5 ACCESSORIES

- A. Fill, void or cavity materials and forming materials: Classified for firestopping use, or included in a rated firestopping assembly, by a rating agency.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

- A. Provide firestop devices or assemblies for every opening and penetration in floors or fire-rated construction.
- B. Install penetration seal materials in accordance with printed instructions of the rating agency and in accordance with manufacturer's instruction.
- C. Ensure an effective smoke barrier in each sealed penetration. Install smoke stopping as specified for firestopping.
- D. Protect materials from damage on surfaces subject to traffic.
- E. Where large openings are created in walls or floors to permit installation of conduits, cables, or other items, close unused portions of opening with firestopping material tested for the application.

3.4 FIELD QUALITY CONTROL

- A. Examine penetration seals to ensure proper installation before concealing or enclosing them.
- B. Keep areas of work accessible until inspection and acceptance by applicable authorities.
- C. Before substantial completion, patch and repair firestopping cut or penetrated by other construction work.

3.5 ADJUSTING AND CLEANING

- A. Clean up spills of liquid components.
- B. Neatly cut and trim materials as required.
- C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

END OF SECTION

SECTION 26 0519
WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wires and cables rated 600 volts and less.

1.2 RELATED SECTIONS

- A. Conduits: Section 26 0533.

1.3 REFERENCES

- A. ANSI/NEMA WC 70: Power Cables rated 2000 Volts or Less for Distribution of Electrical Energy.
- B. ASTM B3: Standard Specification for Soft or Annealed Copper Wire.
- C. ASTM B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors.
- D. UL 44: Standard for Thermoset-Insulated Wires and Cables.
- E. UL 83: Standard for Thermoplastic-Insulated Wires and Cables.
- F. Additional UL Standards as indicated.

1.4 SUBMITTALS

- A. Product data:
 - 1. Each type of wire and cable, including accessories.
 - 2. Include copies of UL certifications showing compliance with requirements in "Quality Assurance" below.

1.5 QUALITY ASSURANCE

- A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Products and installation shall comply with NFPA 70 and other applicable national, state, and local electrical codes.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General requirements: Deliver, store, and handle wire and cable in accordance with the manufacturer's instructions.
 - 1. Wire and cable shall be packaged in a manner that protects them during ordinary handling and shipping. Ship from manufacturer with ends temporarily sealed against moisture.
 - 2. Protect wire and cable during storage (both onsite and offsite).
 - a. Store in a clean and dry location. Elevate from surfaces where water can accumulate, and cover cable rolls to protect against weather.

3. Handle wire and cable as recommended by the manufacturer. Do not pull from the center or periphery of the cable reel.
4. Damaged wire and cable shall be removed from the project site.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE (600 volts maximum)

- A. Conductors: UL listed and NEMA WC 70 compliant; Copper, 98 percent conductivity, suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; solid bare annealed copper for No. 10 and smaller complying with ASTM B 3, and stranded for No. 8 and larger complying with ASTM B 8.
- B. Conductor insulation: Type THHN / THWN-2: Comply with UL 83; PVC insulation, nylon jacket.
- C. Conductor identification: Markings along outer braid denoting conductor size, voltage classification, type of insulation, and manufacturer's trade name, and color code. Identification shall extend to branch circuits and outlets. Use the color coding system tabulated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.
 1. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
 2. Colors on conductors No. 8 and larger, or No. 4 and larger grounded and grounding conductors: Colored tape wrapped a minimum of 6 inches on either end of conductor.

COLOR CODE (600 volts maximum)				
VOLTAGE	NEUTRAL	PHASE		
		A	B	C
120 volts, 2-wire	White	Black, Red, or Blue depending on phase		
208/120 volts wye, 3-phase, 4-wire	White	Black	Red	Blue

- D. Wires used solely for grounding purposes shall be green, where insulated.
- E. Control wiring shall be coded with colors different from those used to designate phase wires.

2.2 WIRING ACCESSORIES

- A. Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service where installed.
- B. Twist-on wire connectors (dry locations):
 1. Color-keyed.
 2. Basis of design: Ideal Industries, Inc., Wingnut®, 3M Company "Scotchlok", or King Innovation.
- C. Twist-on wire connectors (damp and wet locations):
 1. Connectors shall be listed under UL 486D.
 2. Basis of design: Ideal Industries, Inc., UnderGround®, models 60, 64, or 66 as appropriate; King Innovation DryConn®; or 3M Company.

- D. Compression connectors:
 - 1. Color-keyed.
 - 2. Basis of design: 3M Company "Scotchlok"™ compressor connectors, "10000" series for copper conductors, "20000" series for aluminum conductors, or Thomas & Betts (Blackburn) or IlSCO.
- E. Compression connectors (damp and wet locations):
 - 1. Protect connectors with a waterproof system, UL-listed for direct burial and 600 volts.
 - 2. Basis of design: 3M Company 8420 series, Thomas & Betts Model DBSK82, or IlSCO.
- F. Compression taps:
 - 1. Series CT-2 tap with CT-2C cover, or Series 54710 color-keyed compression taps,
 - 2. Basis of design: Burndy Corporation "Versitap" or OZ/Gedney.
- G. Power distribution blocks: Basis of design: Hubbell Burndy "U-Blok."
- H. Multi-tap connectors, clear insulated: Basis of design: Burndy Corporation "UNITAP" or IlSCO "Cleartap".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Provide wire and cable indicated in accordance with national, state, and local electrical codes.
- B. Wire and cable serving systems over 100 volts shall be installed in raceways, wireways, or pullboxes.

3.2 INSTALLING INTERIOR WIRING

- A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.
 - 1. Exit light and emergency lighting circuits: No. 10. Do not install in raceways, outlet boxes, or other locations with non-emergency wiring systems.
 - 2. Other systems (over 100 volts): Minimum No. 12 unless specified or shown on drawings to be smaller.
- B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.
 - 1. Feeders: Type THHN / THWN-2, single conductors in raceway.
 - 2. Branch circuits: Type THHN / THWN-2, single conductors in raceway.
 - 3. All other applications: Provide Type THHN / THWN-2, single conductors in raceway.
- C. Splicing shall be done in outlet boxes and junction boxes and not in conduit.
 - 1. Conductors No. 8 and larger: Terminated, spliced, and taped, wherever practical, with compression connectors or solderless connectors. Use tools recommended by the manufacturer.
 - 2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
 - 3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

- D. Wiring in high ambient temperature areas shall be of types required by NFPA 70 including over boilers and breechings, and lighting fixture channels.
- E. Wires shall be neatly shaped in panels, wireways, boxes, and appurtenances.

3.3 COORDINATION WITH DEVICES AND EQUIPMENT

- A. Where conductor size or parallel conductors shown on drawings connect to terminals on devices or equipment, which is not sized for the connection:
 - 1. Provide a junction box as near the equipment as possible, but no more than 10 feet away. Obtain approval of location before installing.
 - 2. Provide conductor(s) sized to the ampacity of the equipment, from equipment to junction box.
 - 3. In the junction box, splice the conductors from the equipment to the conductors of sizes, or parallel conductors, shown on the drawings.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding electrical systems and equipment.
- B. Ground system test.

1.2 REFERENCES

- A. IEEE STD 142
- B. NFPA 70
- C. ASTM F467 and F468
- D. UL 467

1.3 SUBMITTALS

- A. Product data: Ground rods and connections.
- B. Certifications: System test.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Ground conductor, unless specifically noted otherwise, shall be copper, 98 percent conductivity, solid for No. 10 AWG and smaller and stranded for No. 8 AWG and larger.
- B. Ground rods:
 - 1. Copper bonded steel, 0.75 inch diameter by 10 feet long, one end pointed and the other end tinned,
 - 2. Basis of design: Erico International Corporation.
- C. Mechanical type ground connectors:
 - 1. Connectors:
 - a. IEEE 837 and UL 467 compliant, listed for use for specific types, sizes, and combinations of conductors and connected items.
 - b. Basis of design: FCI Burndy G Series.
 - 2. Nuts, bolts, and washers: Silicon bronze alloy type B per ASTM F467 and F468.

D. Exothermic type ground connections:

1. Exothermic welding systems.
2. Basis of design: "Cadweld," manufactured by Erico International Corporation.

E. Lugs:

1. Lugs shall be two- or four-hole.
2. Basis of design: Burndy Hylug series.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Provide the complete grounding of conduit systems, electrical equipment, conductor and equipment enclosures, and neutral conductors in accordance with applicable codes. Grounded phase and neutral conductors shall be continuously identified. Continuity of metal raceways shall be insured by double locknuts.
- B. Ground system connections which are beneath the floor and in a concealed or inaccessible location shall be brazed or welded. Brazing and welding shall be "CADWELD."
- C. Bonding straps and jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to equipment mounted on vibration isolation hangers and supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connections for outdoor locations; if a disconnect-type connection is required, use a bolted clamp secured with a minimum of two bolts and lock washers.
- D. Ufer ground (concrete-encased grounding electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.2 EQUIPMENT GROUNDING AND BONDING

- A. Provide insulated equipment grounding conductors with feeders and branch circuits.

3.3 APPLICATIONS

- A. Underground grounding conductors: Install bare copper conductor, No. 4/0 AWG minimum.
1. Bury at least 24 inches below grade.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 26 0553, Identification for Electrical Systems, for instruction signs. The label or its text shall be green.

3.5 GROUNDING SYSTEM TEST

- A. Ensure that grounding system is continuous and that resistance to earth is not more than 10 ohms.
- B. Test each ground rod for resistance to earth before making connections to rod; tie grounding system together and test for resistance to earth.
 - 1. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.
- C. Submit written results of each test including location of rods as well as resistance and soil conditions at time measurements were made.

END OF SECTION

SECTION 26 0528

EQUIPMENT FOUNDATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment foundations (housekeeping pads).

1.2 SUBMITTALS

- A. Product data: Concrete mix, grout, reinforcement, and accessories.
- B. Certifications: Test report showing strength of concrete.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Concrete: Indoor: 3,000 psi compressive strength at 28 days.

2.2 GROUT

- A. Non-shrink grout: Premixed, consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi in 28 days.
 - 1. Five Star Products, Inc. "Five-Star Grout"
 - 2. L&M Construction Chemicals, Inc. "Crystex"
 - 3. Sonneborn "SonogROUT"

2.3 METAL REINFORCEMENT

- A. Reinforcing bars: Deformed steel bars in accordance with ASTM A615, Grade 60, clean and free from loose rust, scale, or other coatings that will reduce bond.
- B. Welded wire fabric reinforcing: ASTM A 185 No. 6 steel wire spot-welded at intersections and of size 6 by 6 inch mesh.
- C. Metal accessories: Include spacers, chairs, bolsters, ties, and other devices necessary for properly placing, spacing, supporting, and fastening reinforcement in place.

PART 3 - EXECUTION

3.1 INSTALLING EQUIPMENT FOUNDATIONS (HOUSEKEEPING PADS)

- A. Provide 4-inch-high concrete foundations (housekeeping pads) for switchboard. Furnish foundations, bolts, sleeves, and appurtenances and install as recommended by equipment manufacturer. Anchor the concrete foundations by dowels inserted into the floor slab. Provide welded wire fabric reinforcement.

- B. Equipment shall be properly aligned. Level and grout equipment where necessary. Support conduit independently of equipment and so as not to cause a strain or thrust.
- C. Coordinate exact locations and configurations of equipment, foundations, and supports with the approved shop drawings of the equipment.

END OF SECTION

SECTION 26 0533

CONDUITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit, raceways, and accessories, aboveground and below ground.

1.2 RELATED SECTIONS

- A. Boxes: Section 26 0534.

1.3 DEFINITIONS

- A. Conduit: Conduit, raceway, or tubing.
- B. EMT: Electrical metallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. PVC: Polyvinyl chloride.

1.4 SUBMITTALS

- A. Product data:
 - 1. Each type of conduit and raceway included in the work, and related fittings.
 - 2. Accessory materials.
 - 3. Hangers and fasteners.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

- A. Galvanized steel conduit: Hot-dip galvanized with threads galvanized after cutting:
 - 1. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.6.
- B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.
 - 1. Insulating bushings: Basis of design: Thomas & Betts Series 22.
 - 2. Hub fittings with recessed sealing ring and nylon insulated throat: Basis of design: Thomas & Betts Series 370.
 - 3. Fittings for exposed locations: Conduit outlet bodies, cast iron or cast aluminum, zinc or cadmium plated.
- C. Electrical metallic tubing (EMT): Hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C80.3.

- D. Connectors and couplings for EMT: Concrete- or rain-tight, compression or set screw type, made of zinc- or chromium-plated steel. Connectors shall have nylon insulating throats.
 - 1. Compression connector: Basis of design: Thomas & Betts No. 5223.
 - 2. Compression coupling: Basis of design: Thomas & Betts No. 5220.
 - 3. Set screw connector: Basis of design: Steel City No. TC722A.
 - 4. Set screw coupling: Basis of design: Steel City No. TK122A.
- E. Flexible metal conduit (Type FMC): Made of sheet metal strip, interlocked construction, conforming to UL 1.
- F. Connectors and couplings for flexible metal conduit:
 - 1. Connectors: Angle wedge with nylon insulated throat.
 - 2. Basis of design: Thomas & Betts "Tite-Bite" connector Series 3110 and 3130.
- G. Liquidtight type connectors:
 - 1. UL 14814A. Fittings: With nylon insulated throat.
 - 2. Basis of design: Thomas & Betts Series 5331.
- H. Plastic conduit: Polyvinyl chloride (PVC) Schedule 40, rated for use with 90-degree conductors, for exposed, underground, and encased applications, complying with NEMA Specification TC-2 and UL 651.
- I. Plastic conduit fittings, solvents and adhesives:
 - 1. Fittings: Complying with NEMA TC 3 and UL 514.
 - 2. Solvents and adhesives: As recommended by conduit manufacturer.
- J. Wireways: Steel wireway with hinged cover, complying with UL 870 Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
 - 1. Cover: Front accessible opening along complete length of wireway.
 - 2. Finish: Gray polyester powder finish inside and out.
 - 3. Basis of design: Square D "Square-Duct" or Pentair/Hoffman "Angled Trough".
- K. Fittings for wireways: Made with removable covers to permit installation of a complete system with access to wires throughout the system, UL listed with wireways. Connections: Threaded screws at every connector.
- L. Weatherproof expansion fittings:
 - 1. With bonding jumpers.
 - 2. Basis of design: O-Z/Gedney Types AX and TX.

2.2 SLEEVES FOR RACEWAYS

- A. Steel pipe sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
 - 1. Sleeves for exterior walls: Anchor flange welded to perimeter.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0507.

2.3 ACCESSORY MATERIALS

- A. Pull rope: Polypropylene, minimum 0.1875 inches thick, tensile strength 800 pounds, work load 130 pounds.
- B. Caps and plugs: Basis of design: Thomas & Betts Series 1470.
- C. Lubricant:
 - 1. UL approved.
 - 2. Basis of design: Ideal Industries, Inc. "Yellow 77".
- D. Bituminous protective coating: Coal tar based, self-priming on steel, applied in a wet film thickness at least 22.0 mils (559 microns) per coat.
- E. Rust inhibitive paint:
 - 1. Alkyd based, white, black, or bronzetone; applied in a wet film thickness of at least 2.9 mils.
 - 2. Basis of design: Benjamin Moore Super Spec HP D.T.M. Alkyd Low Lustre P23.

2.4 CONDUIT HANGERS

- A. Adjustable hangers: Basis of design: Kindorf C-711 lay-in hanger or C-710 Clevis hanger.
- B. Trapeze hangers:
 - 1. Constructed of channels with notched steel straps.
 - 2. Steel strap basis of design: Kindorf C-105.
- C. Channels:
 - 1. Steel, 1.5 inches wide with 7/8-inches continuous slot, gauges and weights.
 - 2. Basis of design: Kindorf B-900 series, hot-dipped galvanized finish.
- D. Beam clamps:
 - 1. Adjustable type for connecting hanger rod to steel beam.
 - 2. Basis of design: Kindorf E-160 or U-569
- E. Hangers for conduit 1 inch and smaller, through or below bar joists: "Hang-on" hangers attached to joists with Minerallac scissor clips or two-piece stud clips.
- F. Finish: For hangers, assemblies, plate washers, rods, locknuts, channels, bolts, and appurtenances:
 - 1. Zinc plated.
 - 2. Hot-dip galvanized, where required for weather-exposed or damp locations.

2.5 FASTENERS

- A. General: Select fasteners such that load applied does not exceed one-fourth of manufacturer's load capacity in 3500 psi concrete.
- B. Fasteners to concrete: Self-drilling type expansion anchors, or machine bolt drop in anchors for drilled holes. Fasteners to concrete ceilings shall be vibration- and shock-resistant.

- C. Fasteners to drywall or cavity wall: Toggle bolts, hollow-wall drive anchors, or nylon anchors as required.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Provide complete, separate, and independent raceway system for each of the various wiring systems including, but not limited to, the following:

1. Lighting
2. Power
3. Exit Lighting*
4. Emergency Lighting System*

*These wiring systems may be installed in common raceways.

- B. Wire raceway systems completely, except where otherwise indicated, as shown on drawings and as required for satisfactory operation of each system.
- C. Where wireways are required or used to facilitate the installation, size them to accommodate conductors, in accordance with NFPA 70.
- D. Types and locations of conduits are scheduled at the end of the section.
- E. Do not install conductors or pull rope during installation of conduit.
- F. Where conduit is connected to a cabinet, junction box, pull box, or auxiliary gutter, protect the conductors with an insulating bushing. Provide locknuts both inside and outside the enclosure. Where conduit is stubbed up to above ceilings for future wiring, close ends with bushings.
- G. Bituminous protective coating:
 1. Coat exposed threads on steel conduits in concrete slabs at couplings and fittings, after joints are made up.
 2. Coat metallic conduits below grade not in concrete, and where emerging from below grade or slabs, four inches above and below grade or slab.
- H. Rust-inhibitive paint:
 1. Exposed threads of exterior conduit.
 2. Unfinished metal components.
- I. Make turns in conduit runs with manufactured elbows or using machines or tools designed to bend conduit. Turns shall be not less than the various radii permitted by NFPA 70.
- J. Sizes:
 1. Do not use conduit smaller than 0.75 inches.
 2. Feeder conduits shall be as large as indicated, or as required by NFPA 70 (whichever is larger). Do not install more than one feeder in a single conduit.
 3. Conduit sizes shown on drawings are based on Type THHN/THWN-2 wire.
- K. Make vertical runs plumb and horizontal runs level and parallel with building walls and partitions.
- L. Ground conduits as required by NFPA 70.

- M. Where conduits pass through building expansion joints, and wherever relative movement could occur between adjacent slabs, equip with weatherproof expansion fittings and bonding jumpers.
- N. Run conduits exposed where connecting to surface-mounted cabinets and equipment in electrical and mechanical equipment spaces. Install conduit concealed above suspended ceilings.
- O. Immediately after each run of conduit is completed, test it for clearance, smooth the joints, and close at each end with caps or plugs to prevent entrance of moisture or debris.
- P. Conduit installed outdoors or at indoor locations exposed to continuous or intermittent moisture shall provide a liquidtight seal. Use steel or malleable iron hub fittings. Coat exposed threads with bituminous protective coating.

3.2 INSTALLING PULL BOXES, JUNCTION BOXES, OUTLET BOXES

- A. Install as specified in Section 26 0534, Boxes.
- B. Install pull or junction boxes in long runs of conduits or where necessary to reduce the number of bends in a run.

3.3 INSTALLING FLEXIBLE CONDUIT

- A. Installation shall comply with NFPA 70.
 - 1. Minimum length: Two feet.
 - 2. Maximum length: Six feet.
- B. Where fittings are brought into an enclosure with a knockout, install a gasket assembly consisting of an O ring and retainer on the outside.

3.4 INSTALLING PULL ROPE AND CONDUCTORS

- A. After conduit is installed, fish pull rope. After completion of the work of this project, pull rope shall remain in conduits identified as to be left empty.
- B. Do not use a pull rope that has a tensile strength of more than one of the conductors of a two-wire circuit, more than two of the conductors of a three-wire circuit, or more than three of the conductors of a four-wire circuit.
- C. Do not pull conductors into the conduits until the system is entirely completed and wet building materials are dry.
- D. Use only a lubricant approved for use with conductor materials and pull rope materials.

3.5 INSTALLING SLEEVES

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0507.
- B. Concrete slabs and walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Fire-rated assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Size pipe sleeves to provide 0.25-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- F. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- G. Interior penetrations of non-fire-rated walls and floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
- H. Fire-rated-assembly penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 0507.

3.6 INSTALLING CONDUIT HANGERS

- A. Single runs of overhead conduits 1.25-inch size and larger shall be supported by adjustable hangers, using 0.375-inch rods for conduits up to 2.0 inch size and 0.5-inch rods for conduits larger than 2.0 inches.
- B. Support groups of conduits run in parallel on trapeze hangers suspended from 0.5-inch hanger rods.
- C. Space hangers not over not over 10 feet apart. Support conduits within 3 feet of each outlet, junction or pull box.
- D. Below bar joist construction, support hangers from a length of structural channel, welded to the top chords of at least two joists.
- E. Where large numbers of conduits are grouped together, stagger individual hangers so as not to concentrate the load on a few joists.
- F. Where hanger rods are attached to structural beams, use adjustable beam clamps.
- G. Below precast plank construction, hanger rods shall pass through the precast planks and be secured on top side with nut, locknut, and plate washer. Plate washers shall be at least 4 inches square and 0.125 inch thick. Top of hanger assembly shall be concealed in the concrete fill which will be placed over the planks.
- H. Attach hanger rods to concrete with expansion bolts and anchors.

3.7 CONDUIT IN EXISTING BUILDING

- A. Remove superfluous electrical equipment and cap outlets not being used, as specified in Section 26 0504, Electrical Demolition.
- B. In existing areas that are being renovated it is the intent to show on the drawings what the finished areas will contain when completed. Except as specified otherwise, existing conduit, and outlet boxes may be reused where they meet specifications and code requirements. Replace existing products or materials which are not suitable for reuse as determined by the Engineer.
- C. Suitably cap superfluous concealed outlets, and remove unused wire. Remove superfluous raceways exposed in finished areas, and abandon superfluous raceways concealed in walls.

- D. Install concealed conduit in existing building wherever possible above ceilings, in new walls, and in existing furred spaces.
- E. Where existing conduit penetrates fire-rated partitions, and where there is no firestopping, provide firestopping. Maintain fire rating of walls, partitions, ceilings, and floors at existing conduit penetrations. Comply with Section 26 0507.

3.8 INSTALLING UNDERGROUND CONDUIT, GENERAL

- A. Depth: Outside building: Top of conduit no less than 24 inches below finish grade.
- B. Slope: At least 3 inches in 100 feet away from buildings and toward drainage points.
- C. Cleaning: At the completion of each run, in each conduit, first run a testing mandrel not less than 12 inches long with diameter 0.25 inch less than the inside diameter of the conduit; then draw through a stiff-bristled brush until particles are removed. Immediately install conduit plugs.
- D. Except at conduit risers, make changes in direction of runs, either vertical or horizontal, by long sweep bends. Bend may be made up of one or more curved or straight sections or combinations. Use manufactured bends with a minimum radius of 36 inches.

3.9 INSTALLING UNDERGROUND CONDUIT WITHOUT CONCRETE ENCASEMENT

- A. Run conduit in straight lines except as necessary.
- B. Trenches: At least 3 inches clearance on each side of the conduit.
- C. Warning tape: Install in backfill approximately 12 inches below grade.

3.10 SCHEDULE OF LOCATIONS

- A. IMC with screw joint couplings: Wiring to exterior equipment.
- B. EMT: Sizes 4 inches and smaller, except as noted above.
- C. FMC: Where noted elsewhere in this section.
- D. PVC with solvent cement joints: For exterior circuits, direct-buried.

END OF SECTION

SECTION 26 0534

BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Boxes with covers.

1.2 RELATED SECTIONS

- A. Conduits: Section 26 0533.
- B. Surface raceways: Section 26 0535.

1.3 SUBMITTALS

- A. Product data: Each type of box included in the project.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Outlet, switch, and junction boxes:
 - 1. Sheet metal: NEMA OS 1, sherardized or galvanized stamped.
 - 2. Cast-metal, where required for weather-exposed, or exposed locations: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

2.2 JUNCTION AND PULL BOXES

- A. Junction and pull boxes in feeder and branch circuit conduit runs: Galvanized, of size required for conduit arrangement and not less than the size required by NFPA 70, and furnished with screwed covers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide box at each outlet, switch, and appurtenance. Each box shall be of a type suitable for the duty intended and shall be installed in accordance with the manufacturer's instructions.
 - 1. Where conduit is weather-exposed, provide cast-steel or cast-aluminum boxes.
- B. Coordinate locations of boxes with installation of conduit as specified in Section 26 0533.
- C. Firmly secure the boxes in place, plumb, level, and with front of device cover even with finished wall surface.
- D. Outlet boxes used for supporting lighting fixtures: Furnish with malleable iron fixture studs of "No-Bolt" type, secured by locknut. Provide structural channel supports for boxes occurring in ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction. Special supports for boxes shall be as directed and approved by the Engineer.

3.2 IDENTIFICATION

- A. Identification on outside covers of pull and junction boxes in ceiling space or exposed on walls: Paint with colored enamel or mark with permanent waterproof black marker, or both, as specified.
 - 1. Other special systems: Mark with system type, such as EPO.
 - 2. Power and lighting: Panelboard designation and circuit number(s).

- B. Identification inside boxes for recess-mounted or concealed in walls and partitions: Plasticized card stock tags marked with permanent waterproof black markers.
 - 1. Other special systems: Mark with system type, such as EPO.
 - 2. Power and lighting: Panelboard designation and circuit number(s).

END OF SECTION

SECTION 26 0535
SURFACE RACEWAYS

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Surface raceway, metal, to serve emergency power off switch on existing wall.

1.2 RELATED SECTIONS

- A. Conduits: Section 26 0533.

1.3 SUBMITTALS

- A. Product data: Surface raceway.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis-of-design product: Subject to compliance with requirements, provide the specified Wiremold product, or comparable product by one of the following:

- 1. Hubbell Inc./Hubbell Wiring Device-Kellems
- 2. Legrand North and Central America, LLC/Wiremold

2.2 SURFACE METAL RACEWAYS

- A. UL listed and meeting requirements of NFPA 70 (NEC).
- B. One-piece type:
 - 1. 3/4 inches by 2 1/32 inches as a minimum size, galvanized steel 0.04 inches thick, complete with device boxes, fittings, connectors, and appurtenances.
 - 2. Basis of design: Wiremold 700.
- C. Finish: Field paintable baked enamel, ivory.

PART 3 - EXECUTION

3.1 INSTALLING SURFACE METAL RACEWAYS

- A. Install surface metal raceways in accordance with sizes as required by NFPA 70 (NEC).
- B. Install each assembly as recommended by the manufacturer.
 - 1. Where field cutting is required, make each cut with the manufacturer's tool specifically designed for cutting the part and model.
 - 2. Metal raceway shall be electrically continuous and bonded in accordance with NEC.
 - 3. Each assembly shall be installed so each section or component is coupled together and no conductors or cables are exposed at any location.

- C. Attach raceway and boxes to walls with fasteners as specified for conduits. Attach each outlet box with at least two screws. Secure one-piece raceways with two-hole straps at intervals not exceeding 32 inches and with no less than two straps per straight raceway section.
- D. Make raceway runs plumb and true and parallel with building.

3.2 CLEANING AND ADJUSTING

- A. Touch up surfaces damaged during installation with paint supplied by the manufacturer.

END OF SECTION

SECTION 26 0541
SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Service entrance for electric service, 208 volts, 3-phase, 4-wire.

1.2 RELATED SECTIONS

- A. Equipment foundations: Section 26 0528.

1.3 PAYMENT PROCEDURES

- A. New electric service will be installed by Pepco (the Power Company).
- B. Submit the bill on completion of this part of the work. Owner will directly pay the Power Company.

1.4 SUBMITTALS

- A. Shop drawings: Submit shop drawings and other information as required to the Power Company.

1.5 COORDINATION

- A. Modifications to electric service will be installed by Pepco (the Power Company). Contact the designated power company service representative and verify the status of the project service application. If the current service application has expired, resubmit the service application using load data from the original application.
- B. Arrange a project site meeting to verify that the proposed service entrance configuration is acceptable to the service company. Participants of the meeting shall include the service company representative, the Owner, the Contractor and the Engineer.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Power Company will provide secondary cables, as described in the article "Installation by Power Company," below.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate installation with the Power Company.

3.2 INSTALLATION BY POWER COMPANY

- A. Secondary cables and terminations to CT cabinet section of building main switchboard, including meters.

3.3 INSTALLATION INCLUDED IN WORK OF THIS PROJECT

- A. Conduit to utility meter.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes electrical identification materials and devices required to comply with ANSI, NFPA, and OSHA standards.
- B. This section addresses identification of electrical equipment, raceways, boxes, conductors, and other related electrical system components.

1.2 SECTION INCLUDES

- A. Identification of power conductors and control cables.
- B. Identification of equipment.
- C. Miscellaneous identification products.

1.3 RELATED SECTIONS

- A. Sections in Division 26.

1.4 REFERENCES

- A. ANSI Z535.4: Standard for Product Safety Signs and Labels.
- B. ANSI/IEEE C2: National Electrical Safety Code.
- C. NFPA 70: National Electrical Code.
- D. NFPA 70E: Standard for Electrical Safety in the Workplace.
- E. OSHA 29 CFR 1910.144: Safety Color Code for Marking Physical Hazards.
- F. OSHA 29 CFR 1910.145: Specifications for Accident Prevention Signs and Tags.
- G. UL 969: Standard for Marking and Labeling Systems.
- H. Definitions: Circuit designation includes both equipment source and equipment position.

1.5 SUBMITTALS

- A. Product data: For each type of electrical identification product.

1.6 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.

- C. Comply with OSHA standards.
- D. Comply with ANSI Z535.4 for safety labels.

1.7 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other sections requiring identification applications, drawings, shop drawings, manufacturer's wiring diagrams, and the operation and maintenance manual; and with those required by codes, standards, and safety regulations. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers, or approved equal:
 - 1. Brady USA, Inc.
 - 2. Carlton Industries
 - 3. Graphic Products, Inc.
 - 4. Ideal Industries, Inc.
 - 5. Panduit Corporation
 - 6. Presco
 - 7. Seton Identification Products
 - 8. Thomas & Betts Company
 - 9. Utility Safeguard

2.2 GENERAL PRODUCT REQUIREMENTS

- A. Except where otherwise indicated, provide manufacturer's standard identification products of category and type suitable for each application. Where more than one identification method is specified for an application, the Installer shall select and utilize each material in a consistent manner.

2.3 CONDUCTOR AND CABLING IDENTIFICATION

- A. Adhesive labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- B. Color-coded, adhesive tape: Self-adhesive, vinyl tape, in appropriate colors for system voltage and phase.
- C. Marker tapes: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.4 EQUIPMENT IDENTIFICATION

- A. Engraved plastic nameplates: Laminated plastic, engraved, white letters on black background, except where other color schemes are noted or specified.
 - 1. Size: Minimum 0.75 inches by 2.5 inches.
 - 2. Letter size: Minimum height of 0.375 inches.
 - 3. Mechanically fastened, except adhesive mounted where necessary due to substrate.

- a. Mechanical fastener: Punched or drilled, with vandalproof stainless steel or brass screws or rivets.
- B. Adhesive film label: Machine-printed, black letters on white background, through thermal transfer or equivalent process, with clear weatherproof and UV-resistant covering. Minimum letter size height of 0.375 inches.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape for use with underground cables, conduits, and ductbanks. Comply with ANSI Z535.
 - 1. Not less than 6-inches wide by 4 mils thick.
 - 2. Tape Material:
 - a. Made of metal detectable polyester or vinyl.
 - b. Compounded for permanent direct-burial service. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to destructive substances commonly found in soils.
 - 3. Printed legend with black lettering, indicating type of underground line.
 - a. Provide inscriptions for power cabling with red-colored tape: Example – “CAUTION – BURIED ELECTRIC LINE BELOW”.
- B. Warning labels: Self-adhesive warning labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configures for display on front cover, door, or other access to equipment unless otherwise noted.
- C. Adhesive: Heavy-duty, thermo-resistant, industrial grade adhesive, for adhesion to any surface without identification curling, peeling, or falling off.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification products at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Existing equipment: Apply identification products to unmarked existing equipment where work is being performed.
- D. Apply identification products to surfaces after equipment finish work has been completed.
- E. Clean surfaces before applying identification products, using materials and methods recommended by manufacturer of identification device.
- F. Attach plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- G. Underground-line warning tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade.

3.2 APPLICATION

- A. Junction and pull boxes: Label each junction and pull box, marked with permanent ink marker, identifying circuit designation or type of system.
- B. Wiring and cabling identification:
 - 1. Power circuit conductor identification, 600 volts or less: Apply color-coded identification for cables, feeders, and power circuit conductors exposed in accessible vaults, junction and pull boxes, utility structures, and equipment enclosures. Apply color-coding scheme as indicated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.
 - a. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
 - b. Colors on conductors No. 8 and larger, or No. 4 and larger for grounded and grounding conductors: Apply colored tape wrapped a minimum of 6 inches on either end of conductor and in boxes where splices or taps are made.
 - c. Conductors used solely for grounding purposes shall be green, if insulated.
 - d. Where multi-conductor cables are used, use same color coding system for identification of wiring.

COLOR CODE (600 volts maximum)				
VOLTAGE	NEUTRAL	PHASE		
		A	B	C
120 volts, 2-wire	White	Black, Red, or Blue depending on phase		
208/120 volts wye, 3-phase, 4-wire	White	Black	Red	Blue

- 2. Control and low-voltage system wiring shall be coded with colors and markings different from those used to designate phase wires.
- C. Equipment identification: Install unique designation label consistent with contract documents and shop drawings.
 - 1. Labeling instructions:
 - a. Engraved plastic laminate nameplates, unless otherwise indicated.
 - b. Unless otherwise required, provide a single line of text with 0.5-inch high lettering on 1.5-inch high label. Where two or more lines are required, use single label with increased height.
 - c. For multi-section or multi-compartment equipment, apply labels identifying each compartment or section.
 - 2. Apply nameplates and labels to equipment according to the below identification schemes:
 - a. Identify available fault current and calculation date. Apply products to the following equipment:
 - (1) Switchboard
 - b. Identify equipment designation; voltage rating; phase and number of wires; and designation and location of load served. Apply products to the following equipment:
 - (1) Switchboard

3. Nameplates shall incorporate white lettering on colored backgrounds based on the following color-coding scheme:

a. Normal power system: Black background.

D. Warning and caution labels:

1. Apply warning and caution labels on equipment in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements including arc flash hazard warning labels and special clearance requirements.
2. Apply warning and caution labels at locations where safe operation and maintenance of electrical system equipment is of concern.

E. Service-entrance equipment: Update field marking of service entrance equipment maximum available fault current values in accordance with NFPA 70 requirements.

F. Underground warning tape: Apply underground warning tape above underground conduit or direct-buried cable.

3.3 FIELD QUALITY CONTROL

- A. Coordinate names, abbreviations, colors, and other designations with construction documents, submittals, and applicable code and standards requirements. Utilize consistent designations and identification techniques throughout project.
- B. Install identification products at locations that are clearly visible at normal viewing angles and without interference with operation and maintenance of the equipment.
- C. Install identification products in a neat and clean, workmanship-like manner where products are securely attached and oriented parallel to equipment edges.

END OF SECTION

SECTION 26 0573

FAULT CURRENT AND OVERCURRENT PROTECTIVE DEVICE STUDY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical system fault-current and protective device study:
 - 1. Fault-current analysis.
 - 2. Protective device analysis and settings.

1.2 RELATED SECTIONS

- A. Sections in Division 26, including Section 26 2413 Switchboards.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - 2. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - 3. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 4. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code, latest edition.
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace.
- D. Occupational Safety and Health Administration (OSHA): OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.

1.4 SUBMITTALS

- A. Product data: For computer software to be used to perform studies.
- B. Product certificates: For coordination-study and fault-current analysis computer software programs, certifying compliance with IEEE 399.
- C. Qualifications: Submit evidence indicating individual and organization compliance with requirements indicated in "Quality Assurance" below.

- D. Preliminary electrical system study: Submit for review before distribution equipment shop drawings have been submitted, and before equipment order has been released to the manufacturer.
 - 1. If formal completion of the study may delay the project schedule, Engineer may approve use of the preliminary draft for ordering equipment.
 - 2. If approved for use in ordering equipment, preliminary draft shall include sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
- E. Final electrical system study:
 - 1. Submit final report for review and record.
 - 2. Incorporate changes resulting from deficiencies and corrections of preliminary draft report.
- F. Reports:
 - 1. Electrical system study report: Submit reports required above including the following items:
 - a. General report information: Scope, definitions, descriptions, assumptions, and other information necessary to properly interpret results of the report.
 - b. Tabulated summary comparing protective device ratings and calculated available fault-current levels.
 - c. Fault-current analysis calculations.
 - d. System one-line diagram.
 - e. Input and output data used for each component and for study calculations.
 - 2. Submit final reports as electronic files in portable document format (.pdf) to Owner. Submit program base files in file format of computer software utilized to perform study.

1.5 QUALITY ASSURANCE

- A. Electrical system study shall be performed by one or more independent qualified organizations, and under the supervision and approval of a Registered Professional Engineer skilled in performing and interpreting the power system studies.
- B. Qualifications of organization performing electrical system study: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices:
 - 1. Registered Professional Engineer shall be a full-time employee of the equipment manufacturer or of an approved engineering firm.
 - 2. Registered Professional Engineer shall have a minimum of five (5) years of experience in performing power system studies and registered in the state where the project is located.
- C. Qualifications of computer-based software: Widely available, complying with standards, guides, and codes as referenced above.
- D. Comply with IEEE 399 for general study procedures.
- E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Computer software: Subject to compliance with requirements, utilize product by one of the following:
 - 1. EDSA Micro Corporation
 - 2. Operation Technology, Inc.
 - 3. SKM Systems Analysis, Inc. (Basis of Design)

2.2 COMPUTER SOFTWARE REQUIREMENTS

- A. Comply with IEEE 399.
- B. Computer software program shall be capable of performing fault-current analysis of project electrical distribution system.
- C. Computer software program shall be capable of plotting and diagramming time-current characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
- D. Software shall include a comprehensive equipment library of manufacturer-based and IEEE / ANSI based equipment to accurately model the electrical distribution system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine project submittals for compliance with electrical distribution system requirements outlined on the drawings and in electrical specification sections.

3.2 SYSTEM DATA COLLECTION

- A. The Contractor shall furnish data required to perform the power system study. The Engineer performing the fault analysis study shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to ensure completion of the study as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. If applicable, include fault contribution of existing motors and equipment in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.
- C. The Engineer performing the studies shall gather and tabulate input data necessary to support each study including the following:
 - 1. Product data for each component of the electrical distribution system.
 - 2. Utility available fault contribution and impedance values.
 - 3. Drawings, one-line, and riser diagrams showing system configuration, equipment designations, feeder lengths, and other applicable system characteristics.

3.3 SYSTEM FAULT CURRENT ANALYSIS

- A. Calculate the maximum available short-circuit momentary current and interrupting duties in amperes rms symmetrical for electrical power distribution system components. The calculation shall be performed for current immediately after initiation and for a three-phase bolted fault at each of the following locations:
 - 1. Electric utility's supply termination.
 - 2. Switchboard.
- B. Study the project's electrical distribution system from normal and alternate power sources throughout electrical distribution system.
- C. For grounded systems, provide line-to-ground fault current values for areas as defined above for the three-phase, bolted fault, short-circuit study.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.
- E. Study report:
 - 1. Input data: Gather and provide the following input data, in tabular or graphic form, used to perform fault calculations and other studies in this section.
 - a. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
 - b. Short-circuit reactance of rotating machines with associated X/R ratios.
 - c. Cable type, construction, size, quantity per phase, length, impedance and conduit type.
 - d. Circuit breaker types and sizes.
 - 2. Methods and assumptions: Indicate calculation methods and assumptions that may have been used to perform analysis.
 - 3. Results: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram. Provide the following in a table format:
 - a. Source fault impedance and generator contributions
 - b. X/R ratios
 - c. Asymmetry factors
 - d. Motor contributions
 - e. Short circuit KVA
 - f. Symmetrical and asymmetrical fault currents
 - 4. Equipment evaluation and conclusions:
 - a. Verify interrupting ratings and withstand ratings are equal to or higher than calculated fault current levels.
 - b. Verify adequacy of phase conductors at maximum three-phase, bolted fault currents.
 - c. Verify adequacy of equipment grounding conductors and grounding electrode conductors for grounded systems at maximum ground-fault currents
 - 5. Recommendations: List recommendations for equipment with inadequate ratings. Notify Engineer, in writing of existing equipment improperly rated for the calculated available fault current of the system.

3.4 AVAILABLE FAULT CURRENT LABELS

- A. Provide a machine printed adhesive label on the enclosure for switchboard. The label shall include the following information, at a minimum:
 - 1. Available fault current
 - 2. Calculation date
- B. Labels will be based on calculated maximum available short-circuit momentary current and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. Labels shall be in compliance with NFPA 70E and OSHA standards.

3.5 PROTECTIVE DEVICE ANALYSIS

- A. Perform protective device analysis using approved computer software program. Prepare a written and graphical report using results of fault current study and proposed protective devices and system distribution components. Comply with IEEE 399.
- B. Coordination curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series using time-current curves plotted on log-log scale graphs.
- C. Prepare separate sets of curves to demonstrate full system coordination. Include the following equipment on plotted coordination curves:
 - 1. Electric utility's overcurrent protective devices.
 - 2. Low-voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
 - 3. Conductor damage curves.
- D. Recommended device settings: Prepare a tabulated summary of recommended device settings for system adjustable protective devices. Include the following information:
 - 1. Device tags.
 - 2. Circuit breakers:
 - a. Sensor and plug ratings, where applicable.
 - b. Adjustable pickups and time delays (long time, short time, ground)
 - c. Adjustable time-current characteristic
 - d. Adjustable instantaneous pickup
 - e. Recommendations for improved system coordination

3.6 FIELD QUALITY CONTROL

- A. Field adjustment: Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make modifications to equipment as required to accomplish conformance with short circuit and protective device study.
- C. Notify Engineer in writing of any required equipment modifications.

END OF SECTION

SECTION 26 2413

SWITCHBOARD

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Service entrance switchboard rated 600 volts and less, for interior installation, including:
 - 1. Utility metering section
 - 2. Main service disconnect circuit breaker type
 - 3. Distribution sections, circuit breaker type
 - 4. Surge protective device

1.2 RELATED SECTIONS

- A. Identification for electrical systems: Section 26 0553.
- B. Fault current and overcurrent protective device study: Section 26 0573.
- C. Equipment foundations: Section 26 0528.
- D. Surge protective device: Section 26 4313.

1.3 REFERENCES

- A. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA AB 1, Molded Case Circuit Breakers and Molded Case Switches.
- C. NEMA PB 2, Deadfront Distribution Switchboards.
- D. NEMA PB 2.1, Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 V or Less.
- E. UL 891, Dead-Front Switchboards.

1.4 SUBMITTALS

- A. Product data: For switchboard including overcurrent protective devices, ground-fault protective devices, transient voltage suppression, and accessories. Include weights, dimensions, minimum clearances; and manufacturer's technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop drawings: For switchboard, include the following:
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly, location, and size of each field connection.
 - 2. Single-line diagram representation of switchboard, bus configuration, current, and voltage ratings.
 - 3. Short-circuit current rating of switchboard assembly and overcurrent protective devices.
 - 4. Utility company metering provisions with indication of approval by utility company.
 - 5. Scheduled of features, characteristics, ratings, and factory settings of individual protection devices.

6. Wiring diagrams for power and control, differentiating between manufacturer-installed and field-installed wiring.
 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
- C. For service entrance switchboards, submit to utility company, Pepco for approval.
- D. Coordination drawings: Floor plans, drawn to 1/4" = 1'-0" scale, on which the following items are shown and coordinated with each other based on input from installers of the items involved:
1. Dimensioned concrete base; outline of equipment; and required clearances; relationship between components and adjacent architectural, structural, and mechanical elements.
 2. Underground conduit stub-up locations, where applicable.
 3. Overhead conduit riser locations.
 4. Grounding cable locations and terminations.
 5. Identify equipment sections including front and rear orientation.
- E. Field quality-control test reports: Results of field testing.
- F. Operation and maintenance data: For switchboards to include in the maintenance manuals specified in Division 01. Include manufacturer's detailed written instructions on adjusting overcurrent protective devices.

1.5 QUALITY ASSURANCE

- A. Do not submit equipment submittals prior to completing Fault Current and Overcurrent Protective Device Study as indicated in Section 26 0573.
- B. Source limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency accepted by the authority having jurisdiction, and marked for intended location and application; listed as a complete assembly.
1. UL label and local testing (where required): As specified in 26 0500, Common Work Results for Electrical.
- D. Product selection for restricted space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 COORDINATION

- A. Coordinate layout and installation of switchboard and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery in sections of lengths that can be moved past obstructions in delivery path.

- B. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 PROJECT CONDITIONS

- A. Product selection for restricted space:
 - 1. Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
 - 2. Contractor shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum clearances specified in NFPA 70.
- B. Interruption of existing electrical service: Do not interrupt electrical service to facilities occupied by owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service. Provide applicable details of proposed outage including sequence of work and methods of providing temporary electrical service.
 - 2. Do not proceed with interruption of electrical service without written permission.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Switchboard manufactured by Eaton Corporation is the basis for design of the project. The following listed manufacturers also provide units of acceptable quality. If units by any of these manufacturers should be proposed, verify that they meet requirements specified in Division 01 and the article "Product Options" in Section 26 0101, and submit shop drawings as specified in the article "Submittals" above.
 - 1. ABB; General Electric products
 - 2. Eaton Corporation
 - 3. Schneider Electric; Square D products
 - 4. Siemens Industry, Inc.

2.2 MAIN SWITCHBOARD

- A. Service entrance switchboard, NEMA PB 2, UL listed, in a NEMA 250 Type 1 enclosure except as indicated otherwise.
- B. Construction: Deadfront with front access.
 - 1. Formed code-gauge steel, welded and bolted together to support cover plates, bussing, and component devices during shipment and installation.
 - 2. Finish: Gray enamel over a rust-inhibiting phosphate primer.
 - 3. Furnish each unit with a master nameplate, listing standard manufacturer information including voltage, ampacity, frequency, and short-circuit ratings; manufacturer's model and project designations.
- C. Sections: Each shall have an open bottom and individual removable top plate for installation and termination of conduit.

1. Wireway front covers: Hinged to permit access to the branch breaker load side terminals without removing the covers.
- D. Bussing: Plated copper and of sufficient cross-sectional area to meet UL 891 for temperature rise.
1. Through bus: Ampacity, and braced to have a short-circuit current rating of RMS symmetrical amperes, as shown on the drawings. The through bus shall have provisions for the addition of future sections. Bolt supports, connections and joints with grade 5 hex head bolts and Belleville washers.
 2. Potential and current transformers: ANSI C57.13.
- E. Main circuit breaker section: Enclosed, molded-case type circuit breaker, totally front-accessible and front-connectable. Line side circuit-breaker connections shall be jaw type plug-on.
1. Circuit breaker: NEMA AB 1, handle lockable; frame size, trip rating, number of poles, and auxiliary devices as indicated; interrupting capacity rating to meet available fault current.
 - a. 200 amperes and larger: Trip units interchangeable within frame size.
 - b. 400 amperes and larger: Field-adjustable short-time and continuous current settings.
 - c. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
- F. Circuit breaker distribution sections:
1. Circuit breakers shall be suitable for mounting in the switchboard sections for which they are scheduled: Either group- or individually-mounted distributed sections.
 - a. Group-mounted circuit breakers through 1200 amperes:
 - (1) Circuit breaker(s) shall be grouped-mounted plug-on with mechanical restraint on a common pan or rail assembly.
 - (2) The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
 - (3) Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.
 - (4) Line-side circuit breaker connections shall be jaw type.
 - (5) Unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including appropriate connectors and mounting hardware.
 2. Thermal magnetic molded case circuit breakers: Molded case circuit breaker(s), with integral thermal and instantaneous magnetic trip in each pole. Ampere and fault current-interrupting ratings shall be as noted on the schedules.
- G. Energy reduction maintenance switch (ERMS):
1. Switchboard shall contain an arc energy reduction maintenance switch (ERMS) for each circuit breaker rated 1200 amperes or larger including any provisional spaces indicated as "space and provision" and marked with 1200-ampere or greater frame size. The ERMS shall include the following features:
 - a. External override and circuitry which shall be connected to a breaker's trip unit, and shall be adjustable between 2.5x – 10x trip unit sensor rating.

- b. Operation: Enabled via a mode selector switch located adjacent the circuit breaker or electronic trip unit integral to circuit breaker.
 - (1) Mode selector switch: A separate local LED status indicator light shall demonstrate switch is in the “normal” or “maintenance” mode. The selector switch shall be lockable and accessibly mounted on the front enclosure cover above or adjacent to each breaker position served.
 - (2) Electronic trip unit: Confirmation of protection mode via LED indicator light.
- c. An ERMS hazard warning label shall be provided indicating presence of the ERMS.

2.3 SURGE PROTECTIVE DEVICES (SPD)

- A. As part of the main service switchboard, provide service entrance SPD specified in Section 26 4313, Surge Protective Devices.

2.4 FACTORY TESTS

- A. Each switchboard, as a complete unit, shall be given a single short-circuit current rating by the manufacturer. Rating shall be established by actual tests by the manufacturer, in accordance with UL specifications, and on equipment similar to the switchboard provided for this project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces where switchboard will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.
- B. Verify that equipment foundations are level and ready to receive equipment.
- C. Verify field measurements are as indicated on architectural drawings and coordination drawings.
- D. Verify that required utilities are available, in proper location, and ready for use.
- E. Beginning of installation indicates installer accepts conditions.

3.2 INSTALLATION

- A. Provide equipment foundation (housekeeping pad).
- B. Level switchboard in place before mounting and bolt to the foundation. Assemble sections as required by the manufacturer and in accordance with NEMA PB 2.1.
- C. Frame and mount printed operating instructions, including control and key interlocking sequences and emergency procedures, on front of switchboards.

3.3 CONNECTIONS

- A. Connect switchboards and components to wiring systems according to other sections of Division 26 and instructed by manufacturer’s recommendations.
- B. Ground equipment according to Section 26 0526, Grounding and Bonding, and as instructed by manufacturer’s recommendations.

- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's values are not indicated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

- A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, auxiliary devices, controls, and wiring. Identify equipment ratings.
- B. Nameplates: Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements. Provide identification nameplate for each switchboard and each section, including associated components, located on front of assembly.
- C. Identify field-installed wiring and components as specified in 26 0553, Identification for Electrical Systems.
- D. Identify available fault current and calculation date. Refer to Division 26 Section "Fault current and Overcurrent Protective Device Study" for additional requirements.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's field service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems. Certify compliance with test parameters.
 - 2. Inspect, test, and adjust the equipment.
 - a. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
 - b. Test insulation resistance for each switchboard bus, components, and connecting supply, feeder, and control circuit.
 - c. Test continuity of each circuit.
 - d. Test ground-fault protection of service entrance equipment.
- C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Ensure that the equipment functions properly by actual operation prior to final acceptance.

3.6 ADJUSTING

- A. Set field-adjustable, circuit breaker trip characteristics according to results in Section 26 0573, Fault Current and Overcurrent Protective Device Study.

3.7 CLEANING

- A. Clean interior and exterior of switchboards.
- B. Refinish painted surfaces damaged during construction to match the rest of the switchboard.

3.8 OPERATING INSTRUCTIONS

- A. As specified in Section 26 0500, Common Work Results for Electrical, provide operating instructions.
- B. Provide at least 8 hours of additional instruction time for the equipment specified in this section, consisting of 2 periods of 4 consecutive hours, during a period of not less than 60 days.

END OF SECTION

SECTION 26 2726

WIRING DEVICE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Emergency shutoff pushbutton.

1.2 RELATED SECTIONS

- A. Boxes: Section 26 0534.
- B. Surface raceways: Section 26 0535.

1.3 SUBMITTALS

- A. Product data: Emergency shutoff pushbutton and clear lockable enclosure.

PART 2 - PRODUCTS

2.1 EMERGENCY SHUTOFF PUSHBUTTON

- A. Emergency pushbutton to shut down equipment or circuits: Equal to Safety Technology International (STI) "Stopper Station" series, UL listed and ADA compliant, with mushroom pushbutton button recessed in housing; with STI "Stopper Station Shield" hinged cover.
 - 1. Housing: Polycarbonate with stainless-steel back plate, and spacer where recommended by manufacturer.
 - 2. Contacts: Interchangeable or replaceable normally open or normally closed, single-pole, single-throw (SPST), rated for 6 amperes at 600 volts AC.
 - 3. Protective cover: Clear cover, lockable, with two keys minimum for lock.
 - 4. Operation: Push to activate and turn to reset operation.
 - 5. Color and identification indicated on the drawings.
- B. Emergency power off: Yellow housing and custom label: EMERGENCY POWER OFF.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices in complete compliance with the manufacturer's recommendations.

3.2 IDENTIFICATION

- A. Comply with Section 26 0553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and inspections: After installing devices and after electrical circuitry has been energized, test for compliance with requirements.

- C. Correct malfunctioning device on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new device and retest.
- D. Report results of tests and inspections in writing.

END OF SECTION

SECTION 26 4313

SURGE PROTECTIVE DEVICE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surge protective devices (SPD's) for the protection of AC electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally generated transients resulting from inductive or capacitive load switching.

1.2 RELATED SECTIONS

- A. Switchboards: Section 26 2413.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. MCOV: Maximum continuous operating voltage.
- C. MOV: Metal-oxide varistor.
- D. SPD: Surge protective device.
- E. VPR: Voltage protection rating.

1.4 SUBMITTALS

- A. Product data: Manufacturer's catalog information, including unit dimensions and rated capacities for each type of unit included in the project.
- B. Certifications:
 - 1. Cover page of manufacturer's UL test report for each type of unit, showing that the unit is UL 1449 Fourth Edition listed.
 - 2. UL 1449 Fourth Edition listing documentation verifying the following:
 - a. Voltage protection rating (VPR).
 - b. Maximum continuous operating voltage (MCOV).
 - 3. Electromagnetic interference certification in accordance with UL 1283.

1.5 QUALITY ASSURANCE

- A. Each SPD shall be UL 1449 Fourth Edition listed and labeled.

1.6 WARRANTY

- A. In addition to the general project warranty and correction period, provide manufacturer's special warranties providing unlimited replacements of suppressor modules if they are destroyed by transients. Length of warranties:
 - 1. Service entrance SPD: Ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Service entrance SPD: Basis-of-design product: Subject to compliance with requirements, provide SPD unit integral to service entrance switchboard manufactured by Eaton Corporation, or comparable product by one of the following:
 - 1. ABB; General Electric products.
 - 2. Eaton Corporation.
 - 3. Schneider Electric; Square D products.
 - 4. Siemens Industry, Inc.

2.2 SERVICE ENTRANCE SURGE PROTECTIVE DEVICE

- A. Service entrance SPD unit factory installed and mounted integral to the service entrance switchboard as specified in Section 26 2413, Switchboard.
- B. Suppression components shall be MOV based, serviceable, and replaceable.
- C. SPD shall provide surge current paths for the following modes of protection: L-N, L-G, L-L, and N-G.
- D. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.
- E. Provide terminals for the necessary power and ground connections. Each terminal shall accommodate wire sizes of No. 10 to No. 1 AWG.
- F. SPD shall meet or exceed the following criteria:
 - 1. Surge current capacity, single pulse rated (L-N + N-G): 200 kA per phase (8/20 μ s waveform).
 - 2. The UL 1449 Fourth Edition; voltage protection ratings (VPR) shall not exceed the following:

<u>System Voltage</u>	<u>L-N</u>	<u>L-G</u>	<u>L-L</u>	<u>N-G</u>
208Y/120V	700V	800V	1200V	700V
 - 3. UL 1449 listed maximum continuous operating voltage (MCOV):

<u>System Voltage</u>	<u>Allowable System Voltage Fluctuation</u>	<u>MCOV</u>
208Y/120V	25 percent	150V
- G. SPD shall be equipped with the following:
 - 1. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - 2. Audible alarm with on/off silence function and diagnostic test function.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in switchboard per manufacturer's installation instructions and recommendations.

3.2 INSTALLING SERVICE ENTRANCE SURGE PROTECTIVE DEVICE

- A. Install the SPD on the load side of the main service disconnect.
- B. Keep conductors between the SPD and point of attachment short and straight.
- C. Bond SPD's ground to the service entrance ground.

3.3 FIELD QUALITY CONTROL

- A. Test and inspections:
 - 1. Perform each visual and mechanical inspection and electrical test in accordance with NETA Acceptance Testing Specifications in section for Surge Arresters, Low-Voltage, except for inspection and test procedures involving anchorage and bolted connections. Certify compliance with test parameters.
 - 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup procedures according to manufacturer's written instructions.
- B. SPD device shall be considered defective if it does not pass tests and inspections.

END OF SECTION

SECTION 26 5100
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting fixtures, including LED light engines, LED drivers, and accessories.

1.2 SUBMITTALS

- A. Product data: For each type of lighting fixture indicated, arranged in order of lighting fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of lighting fixtures, photometrics and efficiency, wattage, reflectors, glassware, voltage, suspension, and appurtenances.
 - 2. Certified results of laboratory tests for lighting fixtures for photometric performance.
 - 3. LED drivers.
 - 4. Lumen output, rated color temperature, and manufacturer's LED binning procedures.
- B. Maintenance data: For lighting fixtures to include in maintenance manuals specified in Division 01.

1.3 QUALITY ASSURANCE

- A. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.
- B. Lighting fixtures and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- C. Comply with NFPA 70.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.4 COORDINATION

- A. Lighting fixtures, mounting hardware, and trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-design products: Lighting fixtures indicated in the Lighting Fixture Schedule on the drawings are the basis of design of the project.
 - 1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to Bidding and Contracting requirements and Division 01 requirements for substitutions.

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

1. Drivers:

- a. Philips/Advance
- b. Osram Sylvania
- c. Universal Lighting Technologies
- d. Lutron
- e. EldoLED

2.2 LIGHTING FIXTURES, GENERAL

- A. Lighting fixtures shall comply with UL 1598 and be complete with casings, fittings, holders, shades, and appurtenances, wired and completely assembled.
- B. Metal parts: Free from burrs, sharp corners, and edges.
- C. Sheet metal components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, frames, and other internal access: Smoothly operating, free from light leakage under operating conditions, and arranged to permit access without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during access and when secured in operating position.
- E. Metal finishes: Painted after lighting fixture fabrication.
- F. Reflecting surfaces: Minimum reflectance as follows, unless otherwise indicated:
 1. White surfaces: 85 percent.
 2. Specular surfaces: 83 percent.
 3. Diffusing specular surfaces: 75 percent.
 4. Laminated silver metalized film: 90 percent.
- G. Lenses, diffusers, and covers: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated, exactly as scheduled or specified in optical details and lighting characteristics.
 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.

2.3 LED LIGHT ENGINES

- A. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the lighting fixture manufacturer.
- B. LED light engines shall be integrated into an engineered package for the specific lighting fixture application, including heat dissipation components.
- C. Color temperature: As specified in lighting fixture schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variation between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the owner.

D. Minimum performance characteristics:

1. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
2. Lumen output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
3. Color rendering index: Rated at 80 or higher.

2.4 LED DRIVERS

- A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED light sources, as required.
- B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.
- C. Performance Criteria:
1. Driver shall have a Class A sound rating.
 2. Driver shall have a power factor (PF) greater than 0.90.
 3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.
- D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.
- E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.5 EXIT SIGNS

- A. General requirements: Exit signs shall meet the Energy Star Program requirements to operate on 5 watts or less input power per face. Comply with UL 924 and the following:
1. Sign colors and lettering size: Comply with authorities having jurisdiction.
- B. Internally lighted signs:
1. Light sources for ac operation: Light-emitting diodes, 70,000 hours minimum rated life.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 26 0500, Common Work Results for Electrical, for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Rod hangers: 3/16-inch-minimum diameter, cadmium-plated, threaded steel rod.
- C. Aircraft cable support: Use cable, anchorages, and intermediate supports recommended by lighting fixture manufacturer.

2.7 FINISHES

- A. Lighting fixtures: Manufacturer's standard, unless otherwise indicated.
1. Paint finish: Applied after fabrication over corrosion-resistant treatment or primer, free of defects.
 2. Metallic finish: Corrosion-resistant.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before ordering the lighting fixtures, consult with the installer of the ceilings to ensure that the correct lighting fixture trim is supplied and installed. Provide the supports and accessories required for installation in each ceiling system.
- B. Before ordering the lighting fixtures, verify the specified voltage with the voltage shown on the drawings to ensure the correct voltage is supplied.

3.2 INSTALLATION

- A. Furnish and install a complete lighting fixture for every outlet indicated on the drawings so that every outlet shall be properly provided with a suitable lighting fixture of type specified, of wattage indicated.
- B. Lighting fixture wire shall bear UL label. Lighting fixture wiring for lighting fixtures and branch circuit wiring in lighting fixture channels shall be type THHN.
- C. Furnish lighting fixtures in the quantities, sizes, and types indicated on drawings.

3.3 LIGHTING FIXTURE SUPPORT

- A. Support from building structure: Provide fasteners appropriate to the supporting substrate, and wire, jack chain, or rods as specified for particular lighting fixture types below.
 - 1. Provide channels bolted or welded between joists where required to obtain proper spacing for lighting supports.
 - 2. Connections to joists or beams: Beam clamps. For wire supports, wrap wire securely around structural member.
 - 3. Connections to concrete: Embedded, as specified in Section 26 0533, Conduits.

3.4 CLEANING

- A. Lighting fixtures, used for temporary lighting during construction, shall be cleaned free of construction dirt to like-new condition.

END OF SECTION