DOCUMENT 00 0107

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 — Seal/Signature

James Posey Associates, Inc.
11155 Red Run Blvd, Ste 310
Baltimore, MD 21117
410-265-6100

Patrick Marquez
License: Maryland 24861
pmarquez@jamesposey.com

END OF DOCUMENT

Stedwick Elementary School
Federal Pacific Electrical Equipment Replacement

Table of Contents

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 01 - GENERAL REQUIREMENTS

DIVISION 26 - ELECTRICAL

SECTION 01 2300

ALTERNATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Documentation of changes to contract sum and contract time.

1.2 RELATED SECTIONS

A. Work schedule affected by alternates: Section 01 1000.

B. Product options and substitutions: Section 01 6000.

C. Technical Sections Affected by Alternates: See the description of each Alternate.

1.3 REQUIREMENTS

A. Submit Alternates with full description of the proposed Alternate and the effect on adjacent or related components.

B. Indicate variation of Bid Price for Alternates described below and list in Bid Form Document or any supplement to it, which requests a difference in Bid Price by adding to or deducting from the base bid price.

C. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

D. Provide each selected alternate complete with all changes in associated work as required for complete, operational installation, in conformance with general requirements.

1.4 SELECTION AND AWARD OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Bid will be evaluated on base bid price. After determination of lowest bidder, consideration will be given to Alternates and Bid Price adjustments.

1.5 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Switchboard MDP

1. Base bid: Remove and replace existing main switchboard MDP with new.
2. Alternate: Retrofit existing main switchboard MDP, in lieu of providing a new switchboard. The existing switchboard enclosure shall remain and internal components (i.e., busbars, circuit breakers, ground fault protection) shall be replaced. Existing 3000-ampere main service bolted pressure switch shall be replaced with a 3000-ampere main service circuit breaker. Provide switchboard with integral surge protective device in switchboard and ground-fault protection at service disconnect.
3. Affected sections: 26 2413 Switchboards

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 APPLICATION

A. Immediately after execution of the Owner-Contractor Agreement, in which accepted alternates will be listed, inform all subcontractors, suppliers, and staff assigned to the project, of the accepted alternates.

B. Provide all parties involved with complete information, including, but not limited to, drawings, general requirements, and technical specifications, defining the accepted alternates.

C. Coordinate all changes in the Work, caused by the Owner's selection or rejection of Alternates, as specified in Section 01 3100, Coordination.

END OF SECTION

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 panelboards manufactured by Federal Pacific with new panelboards.
2. Replace existing switchboard under base bid. Retrofit existing switchboard under alternate.

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 sized 8.5 inches by 11 inches for operating and maintenance manual.

C. Submit 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. Unless otherwise 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 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 and Architect 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 Architect 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.

C. Certification and construction waste management: Division 01.

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 SUBMITTALS

A. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 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.

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 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.

3.4 TESTS

A. During the progress of the work and after completion, test the branch circuits and distribution system.

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 hours.

E. Test circuit breakers larger than 100 amps 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 0504

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

1.2 DEFINITIONS

A. EPA: Environmental Protection Agency.

1.3 QUALITY ASSURANCE

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

1.4 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. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. 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 Cutting and Patching Division 01 and Section 26 0101 article, “Cutting and Patching.”

E. 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 0519

WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wires and cables rated 600 volts and less.

B. Type AC, MC, and NM cables are not permitted.

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:

1. 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 volts, single-phase, 2-wire		Black/Red, Red/Blue, or Blue/Black		
208/120 volts wye, 3-phase, 4-wire	White	Black		

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 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 IIsco.

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. Conceal wire and cable in new construction and in locations with finished walls, ceilings, and floors unless otherwise noted on drawings.

C. Wire and cable shall be installed in raceways.

3.2 INSTALLING INTERIOR WIRING

A. 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.

B. 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.

C. 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 DEFINITIONS

A. Area served by a separately-derived system: The area within the building that contains any part of a circuit of the system.

B. IBT: Intersystem Bonding Termination Grounding Busbar.

1.4 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. Grounding busbar: Predrilled rectangular bars of electro-tin plated copper, 0.25 inches thick, 12 inches long, unless otherwise indicated on drawings, with 0.3125-inch or 0.4375-inch diameter holes horizontally spaced 1 to 1.125 inches apart.

1. Intersystem bonding termination grounding busbar (IBT) shall be 4 inches wide, with four rows of holes.
2. Stand-off insulators for busbar shall be flame-resistant fiberglass-reinforced thermoset polyester, UL recognized per UL Standard 891.

C. 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.

D. 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.

E. Exothermic type ground connections:

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

F. 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, motors, 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. Furnish and install main grounds for secondary electrical service to cold water main in accordance with NEC requirement. In addition to the cold water ground, provide ground rods as indicated or as required by NEC and applicable codes.

C. Grounding busbar: Busbars shall stand off the wall a minimum of 2 inches. Mount 6 inches above finished floor unless otherwise indicated. Insulate the busbar from its supports.

1. Conductors connecting busbar to other busbars, and to the grounding electrode system shall be attached to busbar with exothermic welds.
2. Connect other conductors to busbar using lugs.

D. Install copper grounding jumpers of 3/0 copper cable around each main water valve in the building. Install copper grounding jumpers around conduit expansion fittings. Jumpers shall be of adequate current carrying capacity corresponding to size of conduit.

E. 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.”

F. 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.

3.2 EQUIPMENT GROUNDING AND BONDING

A. Provide insulated equipment grounding conductors with feeders.

3.3 IDENTIFICATION

A. Comply with requirements in Section 26 0553, Identification for Electrical Systems.

3.4 GROUNDING SYSTEM TEST

A. Ensure that grounding system is continuous and that resistance to earth is not more than 5 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 RELATED SECTIONS

A. Switchboards: Section 26 2413.

1.3 SUBMITTALS

A. Product data: Concrete mix, grout, reinforcement, and accessories.

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 floor-mounted equipment. 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.

1.2 RELATED SECTIONS

A. Boxes: Section 26 0534.

1.3 DEFINITIONS

A. Conduit: Conduit, raceway, or tubing.

B. EMT: Electrical metallic tubing.

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. Electrical metallic tubing (EMT): Hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C80.3.

B. 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.

C. 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".

D. 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.

E. Weatherproof expansion fittings:

1. With bonding jumpers.
2. Basis of design: O-Z/Gedney Types AX and TX.

2.2 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. 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.

2.3 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-inch 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: Zinc plated.

2.4 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. Wire raceway systems completely, except where otherwise indicated, as shown on drawings and as required for satisfactory operation of each system.

B. Where wireways are required or used to facilitate the installation, size them to accommodate conductors, in accordance with NFPA 70.

C. Do not install conductors or pull rope during installation of conduit.

D. 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.

E. Rust-inhibitive paint: Unfinished metal components.

F. 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.

G. 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.

H. Make vertical runs plumb and horizontal runs level and parallel with building walls and partitions.

I. Ground conduits as required by NFPA 70.

J. Where conduits pass through building expansion joints, and wherever relative movement could occur between adjacent slabs, equip with weatherproof expansion fittings and bonding jumpers.

K. 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.

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.

1. Select inconspicuous locations. Do not install until locations have been approved by the Engineer.
2. Install boxes flush with wall or ceiling surfaces, with flat covers. Where removable ceiling units are used, locate boxes above ceilings.

3.3 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.

3.4 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-inch size and 0.5-inch rods for conduits larger than 2 inches.

B. Support groups of conduits run in parallel on trapeze hangers suspended from 0.5-inch hanger rods.

C. Space hangers 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 inches 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.

3.5 CONDUIT IN EXISTING BUILDING

A. Remove superfluous electrical equipment and cap outlets not being used, as specified in Section 26 0504, Electrical Demolition.

B. Suitably cap superfluous concealed outlets, and remove unused wire. Remove superfluous raceways exposed in finished areas, and abandon superfluous raceways concealed in walls.

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.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 JUNCTION AND PULL BOXES

A. Junction and pull boxes in feeder 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. Coordinate locations of boxes with installation of conduit as specified in Section 26 0533.

B. Firmly secure the boxes in place, plumb, level, and with front of device cover even with finished wall surface.

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. Panelboard designation and circuit number(s).

END OF SECTION

SECTION 26 0541

SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modifications to service entrance for electric service, 120/208 volts, 3-phase, 4-wire.

1.2 PAYMENT PROCEDURES

A. Modifications to electric service will be provided by Pepco (the Power Company).

B. Submit bill on completion of this part of the work. Owner will directly pay the Power Company.

1.3 SUBMITTALS

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

1.4 COORDINATION

A. Modifications to electric service will be provided 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 and meter, as described in the article “Installation by Power Company,” below.

B. Conduits: As specified and scheduled in Section 26 0533, Conduits.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate installation with Power Company.

3.2 INSTALLATION BY POWER COMPANY

A. Secondary cables and terminations to 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 1910.145: Specifications for Accident Prevention Signs and Tags.

F. UL 969: Standard for Marking and Labeling Systems.

G. 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.

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. Receptacle tape labels: Adhesive film label: Machine-printed, black letters on clear background, through thermal transfer or equivalent process. Minimum letter size height of 0.25 inches.

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. Tape markers: Vinyl, pressure-sensitive, with clear vinyl overlay.

D. 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. Apply identification products to surfaces after equipment finish work has been completed.

D. Clean surfaces before applying identification products, using materials and methods recommended by manufacturer of identification device.

E. Attach plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

3.2 APPLICATION

A. Miscellaneous:

1. Available fault current labels: Refer to Section 26 0573, Overcurrent Protective Device Studies, for fault current labeling requirements.
2. Arc flash warning labels: Refer to Section 26 0573, Overcurrent Protective Device Studies, for arc flash labeling requirements.

B. Junction and pull boxes: Label each junction and pull box, identifying circuit designation or type of system.

1. Exposed and concealed boxes: Mark with permanent ink marker on cover plate, externally visible.
2. Boxes with conductors greater than 600 volts: Apply labels identifying nominal system voltage on cover and minimum of one fixed side. One label shall be visible from the floor where boxes are installed exposed.

C. 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 volts, single-phase, 2-wire		Black/Red, Red/Blue, or Blue/Black		
208/120 volts wye, 3-phase, 4-wire	White	Black	Red	Blue

D. Receptacle labels: Apply adhesive film labels on outside of wiring device cover plates identifying circuit designation serving device.

E. 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.
d. For fusible equipment, identify fuse type and size on the front cover.
e. For enclosed circuit breaker equipment, identify device trip rating where rating is not visible.

2. Additional labeling requirements:

a. Identify the designation and location of the power source where the equipment power feed originates. (Example “Feed from: XXXXX; Location: XXXXX”).

(1) Where equipment has more than one source of power (i.e., transfer switch, separate control power source), the location and designation of each power source shall be clearly identified at the equipment location.

b. Identify available fault current and calculation date for service entrance equipment.

3. 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) Panelboards
(2) Switchboards

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) Panelboards
(2) Switchboards

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

a. Normal power system: Black background.
b. Emergency power system (life-safety branch): Red background.
c. Emergency power system (equipment branch): Blue background.

F. 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.

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

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

OVERCURRENT PROTECTIVE DEVICE STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical system fault-current and protective device study:

1. Fault-current analysis.
2. Coordination study and device settings.
3. Arc flash hazard analysis.

B. Description: Provide study for overcurrent protective devices connected to existing switchboard and new panelboards.

1.2 RELATED SECTIONS

A. Sections in Division 26, including 26 2416 Panelboards, and 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.
6. IEEE 1584 - Guide for Performing Arc flash Hazard Calculations.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

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):

1. 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, Owner 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. Arc flash hazard calculations including details of the incident energy and flash protection boundary calculations.
e. Recommendations for system improvements.
f. System one-line diagram.

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. Computer software program shall be capable of performing arc fault hazard analysis using equations as established by IEEE 1584 and requirements presented in NFPA 70E, Annex D.

E. 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 all data required to perform the power system studies. The Engineer performing the fault analysis, protective device coordination, and arc flash hazard analysis studies 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 studies 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. Switchboards.
3. New branch circuit panelboards.

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.

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 each switchboard and new panelboards. 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 SYSTEM ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (such as switchboards and new panelboards, where work could be performed on energized parts.

C. The arc flash hazard analysis shall include electrical equipment locations where work such as examination, adjustment, service, or maintenance could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering incident energy of 1.2 cal/cm^2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off).

1. Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum number of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

L. Incident energy and flash protection boundary calculations:

1. Arcing fault magnitude
2. Device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

3.6 ARC FLASH WARNING LABELS

A. The Contractor and organization performing the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. Labels will be based on recommended overcurrent device settings 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. The label shall include the following information, at a minimum:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number and issue date

D. Labels shall be machine printed, with no field markings.

E. Labels shall be in compliance with NFPA 70E and OSHA standards.

F. Provide arc flash labels in the following manner based on recommended overcurrent device settings.

1. For each new 208-volt panelboard, one arc flash label shall be provided.
2. For switchboard, one arc flash label shall be provided.

3.7 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, shall be provided in the equipment manuals.

3.8 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 coordination studies.

C. Notify Engineer and Owner in writing of any required equipment modifications.

END OF SECTION

SECTION 26 2413

SWITCHBOARDS

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. Overcurrent protective device studies: Section 26 0573.

C. Alternates: Section 01 2300.

D. Equipment foundations: Section 26 0528.

E. Surge protective devices: 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:

1. 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 Short-Circuit and Coordination 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. Switchboards manufactured by Schneider Electric; Square D products are 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.

1. 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. Ground fault protection system for main service disconnect:

1. Current sensor and relaying equipment: Split-core type current sensor shall enclose all phase conductors, and neutral conductors, if present, of the circuit to be monitored.
2. Monitor panel: Include a push-to-test button for the test circuit and a red, ground fault indicator light which indicates the circuit interrupter has opened due to a ground fault condition.
3. Test winding: Shall simulate the flow of ground fault current through the current sensor, in order to test the complete system, including sensor pickup, relaying equipment, and electric trip mechanism of the switch.

a. Ground fault relay: Solid-state construction, with adjustable pickup for ground fault currents from 200 amperes to 1200 amperes. Settings for individual relays shall be as shown on the drawings. Time delay provided by the field-adjustable ground fault relay circuitry shall have continuous settings from 0.03 to 0.6 seconds.

G. 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.

H. 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. Provide trip unit settings for maintenance after performing arc flash study in accordance with the NFPA 70E. The arc flash study shall provide arc flash energy and hazard category with “normal” and “maintenance” device protection (trip unit) settings respectively including protective coordination curves.

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 "Overcurrent Protective Device Studies" 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, Overcurrent Protective Device Studies.

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 2416

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Circuit breaker panelboards, distribution and lighting and appliance branch-circuit types.

B. Fusible branch circuit panelboards.

1.2 RELATED SECTIONS

A. Identification for electrical systems: Section 26 0553.

B. Overcurrent protective device studies: Section 26 0573.

C. Surge protective devices: Section 26 4313.

1.3 REFERENCES

A. ANSI/NECA 407: Recommended Practice for Installing and Maintaining Panelboards.

B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA PB 1: Panelboards.

D. NEMA PB 1.1: Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

E. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. UL 50: Enclosures for Electrical Equipment.

G. UL 67: Panelboards.

H. UL 1449: Surge Protective Devices.

1.4 DEFINITIONS

A. Circuit-breaker panelboards in this section:

1. Distribution panelboard: Capable of accepting up to 1200-ampere branch circuit breakers.
2. Lighting and appliance panelboards: Maximum branch circuit breaker amperage:

a. 120/208-volt panelboards: 100 amperes.

1.5 SUBMITTALS

A. Product data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated.

B. Bill of materials: Provide detailed list of components.

C. Shop drawings: For each type of panelboard, include the following details:

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings in panel schedule format.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Operation and maintenance data: For panelboards and components to include in operation and maintenance manuals. In addition to items specified in Division 01 and Section 26 0101, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Copy of each printed panelboard schedule representing final version following installation.

1.6 QUALITY ASSURANCE

A. Do not submit equipment submittals prior to completing Short-Circuit and Coordination Study as indicated in Section 26 0573.

B. Source limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a 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 Section 26 0500, Common Work Results for Electrical.

D. Comply with referenced standards and listings previously identified including NEMA PB 1, NFPA 70, and UL 67.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 DELIVERY, STORAGE, AND HANDLING

A. 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.

1.9 PROJECT CONDITIONS

A. Product selection for restricted space:

1. Drawings indicate maximum dimensions for panelboards, including clearances between panelboards, 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.

1.10 EXTRA MATERIALS

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

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Furnish spare breakers for panelboards as indicated in schedule on drawings.
3. Furnish spare fuses for fused switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Circuit breaker panelboards: Subject to compliance with requirements, provide circuit breaker panelboards manufactured by Schneider Electric; Square D products 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.

B. Fusible branch circuit panelboards: Subject to compliance with requirements, provide fusible branch circuit panelboards manufactured by Eaton Corporation; Bussmann products or comparable product by one of the following:

1. ABB; General Electric products
2. Eaton Corporation; Bussmann
3. Littelfuse, Inc.
4. Mersen
5. Schneider Electric; Square D products
6. Siemens Industry, Inc.

2.2 PANELBOARDS, GENERAL

A. UL listing: UL 67, listed and labeled.

B. Integrated equipment short-circuit rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal to or greater than the integrated equipment rating shown or scheduled on the drawings.

1. Rating shall be established by testing in accordance with UL 67, with the overcurrent devices mounted in the panelboard. Make short-circuit tests on the overcurrent devices and on the panelboard structure simultaneously, by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. The source shall be capable of supplying specified panelboard short-circuit current or greater.
2. Testing of overcurrent devices only while individually mounted is not acceptable. Testing the bus structure by applying a fixed fault to the bus structure alone is not acceptable.
3. Mark each panelboard with its maximum short-circuit current rating at the supply voltage.
4. Series rating of panelboards with devices outside of the panelboard enclosure are not permitted.

C. Enclosures: Recess- or surface-mounted as indicated, NEMA PB 1, Type 1, UL 50, galvanized steel.

1. Size: Where multiple-width or multiple-section panelboards are indicated or required, each cabinet shall be the same width and height.
2. Provide enclosure type as indicated below or listed on drawings:

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

D. Directory card: Inside panelboard door, mounted in metal frame with transparent protective cover with information as indicated in Part 3, Identification.

E. Provisions for future devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. 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.

2.3 CIRCUIT-BREAKER PANELBOARDS

A. Factory-assembled complete with bolt-on circuit breakers.

B. Cabinets and fronts: Minimum 20 inches wide, unless otherwise noted, wiring gutter space in accordance with UL 67, with minimum four-inch width on every side.

1. Cabinet front: Hinged trim with entire front hinged to cabinet box with piano hinge and screw fasteners for surface mounted cabinets. Door-in-door construction, one or more latches as required for size, with outer door covering the gutter.
2. Door: Required for sizes up to and including 600 amperes.

a. Lock: Flush, cylinder tumbler type, with catch and spring-loaded stainless steel door pull. All panelboards shall be keyed alike. Provide two keys per lock. Provide extra keys as required in "Extra Materials" in Part 1 above.
b. Hinges: Steel, completely concealed.

C. Circuit breakers: UL 489; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Circuit Analysis performed under Section 26 0573, whichever is greater.

1. Breakers shall be 1-, 2- or 3-pole, with an integral crossbar to ensure simultaneous opening of all poles in multipole circuit breakers.
2. Operating mechanism: Over center, trip-free, toggle-type with quick-make, quick-break action. Handles shall have on, off, and tripped positions.

3. Circuit breakers shall be able to be installed in the panelboard without requiring additional mounting hardware or disturbing adjacent units, bars, or branch circuit connections.
4. Where indicated on the drawings, provide shunt-trip main breakers, standard main breakers, or lugs.
5. Main and branch circuit breakers shall have device ampacity rating engraved on the front or side of each breaker handle. The breaker rating shall be clearly visible without removing panelboard cover.
6. Circuit breakers shall be rated for use with 75°C wire (conductor temperature rating).
7. Thermal-magnetic circuit breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 amperes and larger.
8. Adjustable instantaneous-trip circuit breakers: Magnetic trip element with front mounted, field-adjustable trip setting.
9. Electronic trip circuit breakers: RMS sensing; field-replaceable rating plug or field replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.

10. Ground-fault circuit interrupter (GFCI) type circuit breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
11. Tandem breakers are not permitted.

D. Bussing assembly and temperature rise: Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule, established by heat rise tests conducted in accordance with UL 67.

    1. Conductor dimensions shall not be accepted in lieu of actual heat tests.
    2. Current-carrying parts of the bus structure shall be hard-drawn copper, 98 percent conductivity.
    3. Provide a separate copper ground bus with screw terminals for branch wiring and feed-through lugs.

E. Additional connections: Where indicated on drawings, provide the following:

    1. Feed-through lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
    2. Sub-feed (double) lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Distribution panelboards: Distribution panelboard shall be capable of accepting up to 250 - ampere branch circuit breakers, or as indicated on drawing wiring panel schedules. Current characteristics shall be as scheduled on the drawings.

G. Branch circuit panelboards: Panelboard shall be capable of accepting up to 100- ampere branch circuit breakers at 120/208 volts.

    1. Branch circuit breakers serving exit lights and fire alarm shall be provided with handle-blocking devices which shall prevent accidental operation but not prevent tripping.

2.4 FUSIBLE BRANCH CIRCUIT PANELBOARDS

A. Factory-assembled complete with branch fuse disconnect:

1. Emergency (life-safety) panelboard(s) shall be fusible branch circuit panelboards.
2. Main lug only, main fused switch, or main non-fused switch as indicated on the drawings, with main fused switch selectively coordinated with fusible branch switches.
3. Six spare single-pole 20-ampere fuses, unless otherwise noted.
4. UL Listed minimum interrupting rating of 200,000 rms symmetrical amperes at 600 volts AC.

B. Cabinets and fronts: Minimum 20 inches wide, wiring gutter space in accordance with UL 67.

1. Cabinet front: Door-in-door construction, one or more latches as required for size, with outer door covering the gutter.
2. Door: Lock, two keys per lock, steel hinges, and circuit directory card on inside of door.

C. Branch fuse disconnects: UL 248, UL 98, and NEMA FU 1; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Current Analysis performed under Section 26 0573, whichever is greater.

1. Incorporating overcurrent protection fuse and disconnecting means into a single integrated finger-safe component (1-pole, 2-pole or 3-pole) mechanically interlocked to prevent removal of the fuse while fuse terminals are energized.
2. Interchangeable from 15 amperes to 100 amperes without requiring additional space.
3. Time-delay UL Listed Class CF power fuses (equivalent to Class J).
4. Visible circuit ON/OFF indication positions and open fuse indication.
5. Permanently installed lockout means in the OFF position.

D. Bussing assembly and temperature rise: Panelboard bus structure and mains shall have current ratings as shown on the drawings:

1. Sufficient cross section to meet UL 67 temperature rise requirements.
2. Current-carrying parts of the bus structure shall be hard-drawn copper, 98 percent conductivity.
3. Provide a separate copper equipment ground bar and neutral bus bar.

2.5 SOURCE QUALITY CONTROL

A. With branch circuit breakers installed, short-circuit test panelboards as complete units, in accordance with requirements of UL 67.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach panelboards to the wall where indicated on the drawings. Install in accordance with NEMA PB 1.1 and manufacturer's written installation instructions.

1. Mounting height:

a. 72 inches to top of panelboard.
b. Panelboards taller than 72 inches: Bottom edge no more than 4 inches above floor.
c. Top breaker maximum height: No more than 6 feet, 7 inches above the floor or working platform.

B. Comply with applicable portions of NECA 407.

C. Frame and mount printed circuit directory indicating type and location of equipment on each circuit.

D. Wiring in gutters: Arrange conductors into groups, and bundle and wrap with wire ties.

E. Install filler plates in unused spaces.

3.2 CONNECTIONS

A. Connect panelboards and components to wiring and to ground as indicated.

B. Shared neutral conductors shall not be permitted, except where indicated.

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.

3.3 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 panelboard and associated components located on front of assembly.

C. Identify field-installed wiring and components. Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements.

D. Identify available fault current and calculation date. Refer to Division 26 Section "Overcurrent Protective Device Studies" for additional requirements.

E. Provide printed directory for each panelboard. Handwritten directories are not acceptable. Copying of panel schedules and descriptions on drawings is not acceptable. Circuit directory shall reflect final circuit installation. Include the following information:

1. Panelboard designation and room location.
2. Circuit breakers, size and number of poles.
3. Circuit or feeder description including destination room name(s) and number(s).
4. Clear description of type of load circuit serves.
5. Panelboard ratings: Main bus ampacity, main circuit breaker or main lug ampacity, AIC rating.
6. Incoming primary feeder size and source panelboard circuit designation.

F. Room names and numbers on the panelboard circuit directories shall match names and numbers used by the Owner. Note that room names and numbers on the drawings may not match the Owner's final room name and numbering scheme.

3.4 FIELD QUALITY CONTROL

A. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuit.

B. Make continuity tests of each circuit.

C. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification for molded-case circuit breakers, with the exception of thermographic survey. Certify compliance with test parameters.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. Clean interior and exterior of panelboards.

B. Refinish painted surfaces damaged during construction to match the rest of the panelboard.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Receptacles.

1.2 RELATED SECTIONS

A. Identification: Section 26 0553.

1.3 REFERENCES

A. ANSI/NEMA WD 6: Wiring Devices - Dimensional Specifications.

B. NEMA WD 1: General Color Requirements for Wiring Devices.

C. UL 498: Attachment Plugs and Receptacles.

1.4 SUBMITTALS

A. Product data: Each type of device used in the project.

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. Acceptable manufacturers:

1. Eaton/Arrow Hart
2. Hubbell/Bryant
3. Legrand/Pass & Seymour (P&S)
4. Leviton Manufacturing Co.

B. Receptacles: NEMA 5-20R, 20-ampere rating, 125 volts AC, 2-pole, 2-wire plus ground, conforming to NEMA WD 1 and WD 6 configuration numbers, and UL 498.

1. Specification grade: Ground-fault circuit-interrupter (GFCI) type, self-test, duplex: Basis of design: P&S 2097TR, tamper-resistant.

C. Device colors:

1. Normal power receptacles: White.
2. Generator power receptacles: Red.

3.1 IDENTIFICATION

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

B. Identify receptacles with panelboard identification and circuit number. Use self-adhesive labeling.

END OF SECTION

SECTION 26 4313

SURGE PROTECTIVE DEVICES

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.

B. Panelboards: Section 26 2416.

C. Circuit breaker: Section 26 2416, Panelboards.

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, latest edition, listed.
2. UL 1449, latest 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 (UL 1449 Type 2 only).

1.5 QUALITY ASSURANCE

A. Each SPD shall be UL 1449, latest edition, listed and labeled.

B. A single manufacturer shall provide SPD’s for every location, except at switchboard.

1.6 WARRANTY

A. In addition to the general project warranty and correction period, provide manufacturer's special warranties to cover replacement of modules (modular type SPDs) or entire SPD (non-modular type SPDs) and damaged caused by transient over-voltage events. Length of warranties:

1. Service entrance SPD: Ten years.
2. Secondary distribution SPD: Ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Service entrance SPD's: Basis-of-design product: Subject to compliance with requirements, provide SPD units integral to service entrance equipment manufactured by Schneider Electric; Square D products, 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.

B. Distribution equipment SPD's: Basis-of-design product: Subject to compliance with requirements, provide SPD units manufactured by Schneider Electric, Square D SurgeLogic, or comparable product by one of the following:

1. ABB; General Electric products.
2. Eaton Corporation.
3. Erico International Corp.; Pentair.
4. Schneider Electric; Square D products.
5. Siemens Industry, Inc.
6. Surge Suppression 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, Switchboards.

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 µs waveform).

2. The UL 1449, latest edition; voltage protection ratings (VPR) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120V	700V	800V	1200V	700V

3. UL 1449 listed maximum continuous operating voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation	MCOV
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.

2.3 SURGE PROTECTIVE DEVICES FOR PANELBOARDS

A. SPD unit externally mounted and field wired to the panelboard as specified in Section 26 2416, Panelboards. SPD integral to the panelboard shall not be acceptable.

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's shall meet or exceed the following criteria:

1. Surge current capacity, single pulse rated, (L-N + N-G):

a. For power distribution panelboards: 100 kA per phase.
b. For branch-circuit panelboards: 100 kA per phase. The UL 1449, latest edition; voltage protection ratings (VPR) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120V	700V	800V	1200V	700V

2. UL 1449 listed maximum continuous operating voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation	MCOV
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.

H. Enclosure: NEMA 250 Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install per manufacturer’s installation instructions and recommendations.

B. Install SPD's plumb, level and rigid without distortion.

3.2 INSTALLING SURGE PROTECTIVE DEVICES FOR PANELBOARDS

A. Install SPD external to branch panelboards.

B. Install per manufacturer’s installation instructions with lead lengths as short (less than 24 inches) and straight as possible.

1. Rearrange circuit breaker locations in panelboards to ensure short and straightest possible leads to each SPD.

3.3 ADJUSTMENTS AND CLEANING

A. Remove debris from SPD and wipe dust and dirt from all components.

B. Repaint marred and scratched surfaces with touch up paint to match original finish.

3.4 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