

# SPECIFICATIONS

## FLOYD COUNTY WATER DEPARTMENT RAMBLEWOOD BOOSTER PUMP STATION REHAB AND BACKUP GENERATOR

Prepared For

### FLOYD COUNTY Board of Commissioners

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August 2016  
CTI Project G16016-01



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Prepared By

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## SECTION 26 00 10

### ELECTRICAL GENERAL PROVISIONS

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. Provide all labor, equipment, material, etc. required to complete installation specified herein, and/or shown or scheduled on the Drawings.
- B. This section supplements all sections of this Division and shall apply to all phases or work hereinafter specified, shown on the Drawings or required to provide a complete installation of electrical systems.
- C. The Specifications and Drawings for electrical work are complementary and are for the complete interpretation of the work.
- D. Unless noted or modified by specific notation to the contrary, the modification and/or description of any electrical item in the documents carries with it the instruction to furnish, install and connect same. It shall be understood that the intent governs the work, regardless of whether or not this instruction is explicitly stated.
- E. No exclusion from, or limitation in the Drawings or Specifications, for the electrical work shall be reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.

##### 1.2 SPECIAL CONDITIONS, ELECTRICAL

- A. By the act of submitting a bid, this Contractor agrees that all of the "Contract Documents" in each of the Divisions of the complete specifications resulting therefrom are included in his proposal.
- B. In Division 26, the word "Contractor" means the Electrical Contractor. The word "provide" means furnish, install and connect.
- C. Do not scale drawings having ¼ inch or smaller scale. Because of small scale, it is not possible to indicate all offsets, fittings and accessories; provide such as required for complete installation.
- D. The right is reserved to move any element as much as 5 feet at no increase in cost, provided Contractor is notified before work in question is started.
- E. All conductors, regardless of service, shall be installed in raceways, unless specifically noted otherwise.
- F. The Drawings are shown in part diagrammatic, intended to convey the scope of work, indicating the general arrangement of equipment, conduit and outlets. Follow the Drawings in laying out the work and verify places for the installation of the materials and equipment. Wherever a question exists as to the exact intended location of the outlets or equipment, obtain instructions from the Engineer before proceeding with the work.

### 1.3 CODES AND STANDARDS

- A. The intent is that the complete installation shall comply with applicable laws and ordinances, utility company regulations, and applicable requirements of the following:
  - 1. NFPA: National Fire Protection Association
  - 2. UL: Underwriters Laboratories
  - 3. NEC: National Electrical Code
  - 4. NEMA: National Electrical Manufacturers Assoc.
  - 5. OSHA: Occupational Safety & Health Act
  - 6. Standard Building Code
- B. Where the contract documents exceed minimum requirements, the contract documents take precedence.
- C. Comply with all requirements for permits, licenses, fees, and codes. Permits, licenses, fees, inspections, and arrangements required for the work under this contract shall be obtained by this contractor, at his expense, and made available at the completion of the work, unless otherwise specified.

### 1.4 COORDINATION OF WORK

- A. Plan all work so that it proceeds with a minimum of interference with other trades. Inform all parties concerned of openings required for equipment or conduit in the building construction for electrical work and provide all special frames, sleeves, inserts, supports, anchor bolts, etc. as required. Coordinate the electrical work with the mechanical installation.
- B. Work lines and established heights shall be in strict accordance with Drawings and Specifications and insofar as these Drawings and Specifications extend. Verify all dimensions shown and establish all elevations and detailed dimensions not shown.
- C. Lay out and coordinate all work well enough in advance to avoid conflicts or interferences with other work in progress so that in case of interference, the electrical layout may be altered to suit the conditions, prior to the installation of any work and without additional cost to the Owner.
- D. Coordinate all outlets, fixtures, etc. with floor, wall and ceiling patterns.

### 1.5 EXECUTION OF THE WORK

- A. Install equipment and materials in a neat and workmanlike manner and align, level and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance and repair.

### 1.6 DATA AND SHOP DRAWINGS

- A. Prior to installation, submit certified prints and/or descriptive data for major pieces of equipment, fixtures, insulation, controls, etc.
- B. Submittals shall show manufacturer's catalog number, performance data with indicated operating points, finishes, optional features and modifications.
- C. When work in accordance with manufacturer's recommendation is specified, a copy of recommendations will be kept in job office.

## PART 2 - PRODUCTS

### 2.1 REFERENCE TO DRAWINGS

- A. Reference shall be made to Drawing schedules and details for: manufacturer, model, catalog number, size, capacity, performance, installation, etc. of equipment and material. Equipment of manufacturers other than those named, will be acceptable provided, in the opinion of the Engineer, it is of equal substance, function, performance and appearance.

### 2.2 CHOICE OF MATERIALS AND EQUIPMENT

- A. In submitting substitutions, Bidders should note the following minimum considerations:
  - 1. Capacities shown are absolute minimal and must be equaled.
  - 2. Physical size limitations for space allotted.
  - 3. Structural properties.
  - 4. Noise level.
  - 5. Interchangeability.
  - 6. Compatibility with other materials, assemblies.
  - 7. Similar items shall be same manufacture and style, etc. except where specifically exempted.
- B. All materials and equipment, for which a UL Standard, or NEMA Standard is established, shall be so approved and labeled or stamped.

### 2.3 ELECTRICAL EQUIPMENT

- A. NEMA Standards shall be taken as minimum requirements for electrical equipment.
- B. Equipment shall operate properly under a 10% plus or minus voltage variation.

END OF SECTION

## SECTION 26 00 20

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. This section includes limited scope general construction materials and methods for application with electrical installations as follows:
  - 1. Selective demolition including:
    - a. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
    - b. Dismantling electrical materials and equipment made obsolete by these installations.
  - 2. Excavation for underground utilities and services, including underground raceways, vaults, and equipment.
  - 3. Miscellaneous metals for support of electrical materials and equipment.
  - 4. Woodgrounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.
  - 5. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
  - 6. Access panels and doors in walls, ceilings, and floors for access to electrical materials and equipment.

##### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions or General Provisions and Division 1 specification sections.
- B. Section 26 00 10, Electrical General Provisions.

##### 1.3 DEFINITIONS

- A. The following definitions apply to excavation operations:
  - 1. **Additional Excavation:** Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The contract sum may be adjusted by an appropriate contract modification.
  - 2. **Subbase:** As used in this section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.

3. Subgrade: As used in this section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Engineer.

#### 1.4 SUBMITTALS

- A. General. Submit the following: Shop Drawings, Product Data, and Samples.
- B. Product data for the following products:
  1. Access panels and doors.
  2. Joint sealers.
- C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for electrical materials and equipment.
- D. *Coordination drawings* for access panel and door locations in accordance with Section 26 00 10, Electrical General Provisions.
- E. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.
- F. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this section.
- G. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of work. Include coordination for shut-off of electrical service, and details for dust and noise control.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications. Engage an experienced installer for the installation and application of joint sealers, access panels, and doors.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
  1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- C. Fire-Resistance Ratings. Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
  1. Provide UL label on each fire-rated access door.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle joint sealer materials in compliance with the manufacturer's recommendations to prevent their deterioration and damage.

## 1.7 PROJECT CONDITIONS

- A. Conditions Affecting Selective Demolition. The following project conditions apply:
  - 1. 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.
  - 2. Locate, identify, and protect 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.
- B. Conditions Affecting Excavations. The following project conditions apply:
  - 1. Maintain and protect existing building services which transit the area affected by selective demolition.
  - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
  - 3. Site information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
  - 4. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
  - 5. Remove existing underground utilities indicated to be removed.
    - a. Uncharted or Incorrectly Charted Utilities: Contact utility owner immediately for instructions.
    - b. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to Engineer prior to utility interruption.
  - 6. Use of explosives is not permitted.
- C. Environmental Conditions. Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

## 1.8 SEQUENCE AND SCHEDULING

- A. Coordinate the shut-off and disconnection of electrical service with the Owner and the utility company.
- B. Notify the Engineer at least 5 days prior to commencing demolition operations.
- C. Perform demolition in phases as indicated.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. Subbase Material. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
- B. Drainage Fill. Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1½-inch sieve, and not more than 5 percent passing a No. 4 sieve.
- C. Backfill and Fill Materials. Materials complying with ASTM D 2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

### 2.2 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating. ASTM A 36.
- B. Cold-formed Steel Tubing. ASTM A 500.
- C. Hot-Rolled Steel Tubing. ASTM A 501.
- D. Steel Pipe. ASTM A 53, Schedule 40, welded.
- E. Nonshrink, Nonmetallic Grout. Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.
- F. Fasteners. Zinc-coated, type, grade, and class as required.

### 2.3 MISCELLANEOUS LUMBER

- A. Framing Materials. Standard grade, light-framing-size lumber of any species. Number 3 common or standard grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels. Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

### 2.4 JOINT SEALERS

- A. General. Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

- B. Colors. As selected by the Engineer from manufacturer's standard colors.
- C. Elastomeric Joint Sealers. Provide the following types:
1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
  2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
  3. Products: Subject to compliance with requirements, provide one of the following:
    - a. One-Part, Nonacid-Curing, Silicone Sealant:
      - 1) "Chem-Calk N-Cure 2000," Bostic Construction Products Div.
      - 2) "Dow Corning 790," Dow Corning Corp.
      - 3) "Silglaze N SCS 2501," General Electric Co.
      - 4) "Silpruf SCS 2000," General Electric Co.
      - 5) "864," Pecora Corp.
      - 6) "Rhodorsil 5C," Rhone-Poulenc, Inc.
      - 7) "Spectrum 1," Tremco, Inc.
      - 8) "Spectrum 2," Tremco, Inc.
      - 9) "Dow Corning 795," Dow Corning Corp.
      - 10) "Rhodorsil 6B," Rhone-Poulenc, Inc.
      - 11) "Rhodorsil 70," Rhone-Poulenc, Inc.
      - 12) "Omniseal," Sonneborn Building Products Div.
      - 13) "Chem-Calk 100," Bostik Construction Products Div.
      - 14) "Gesil N SCS 2600," General Electric Co.
    - b. One-Part, Mildew-Resistant, Silicone Sealant:
      - 1) "Dow Corning 786," Dow Corning Corp.
      - 2) "SCS 1702 Sanitary," General Electric Co.
      - 3) "863 #345 White," Pecora Corp.
      - 4) "Rhodorsil 6B White," Rhone-Poulenc, Inc.

- 5) "Proglaze White," Tremco Corp.
  - 6) "OmniPlus," Sonneborn Building Products Div.
- D. Acrylic-Emulsion Sealants. One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Chem-Calk 600," Bostik Construction Products Div.
    - b. "AC-20," Pecora Corp.
    - c. "Sonolac," Sonneborn Building Products Div., "Tremco Acrylic Latex 834," Tremco, Inc.
- E. Fire-Resistant Joint Sealers. Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814 by Underwriter's Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Dow Corning Fire Stop Foam," Dow Corning Corp.
    - b. "Pensil 851," General Electric Co.

## 2.5 ACCESS DOORS

- A. Steel Access Doors and Frames. Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- B. Frames. 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
- 1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
  - 2. For gypsum wallboard or plaster: Perforated flanges with wallboard bead.
  - 3. For full-bed plaster applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- C. Flush Panel Doors. 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
- 1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- D. Locking Devices. Flush, screwdriver-operated cam locks.

- E. Locking Devices. Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.
- F. Manufacturers. Subject to compliance with requirements, provide products by one of the following:
  - 1. Bar-Co., Inc.
  - 2. J. L. Industries
  - 3. Karp Associates, Inc.
  - 4. Milcor Div. Inryco, Inc.
  - 5. Nystrom, Inc.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers. Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

#### 3.3 SELECTIVE DEMOLITION

- A. General. Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- B. Materials and Equipment To Be Salvaged. Remove, demount, and disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- C. Disposal and Cleanup. Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- D. Electrical Materials and Equipment. Demolish, remove, demount, and disconnect the following items:
  - 1. Inactive and obsolete raceway systems, controls, and fixtures.
    - a. Raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings.

### 3.4 EXCAVATION

- A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.
- B. Shoring and Bracing. Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of the time period excavations will be open.
  - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- C. Install sediment and erosion control measures in accordance with local codes and ordinances.
- D. Dewatering. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
  - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
  - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.
- E. Material Storage. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
  - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
  - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- F. Excavation for Underground Vaults and Electrical Structures. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
  - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1-inch diameter and larger with emulsified asphalt tree paint.
  - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- G. Trenching. Excavate trenches for electrical installations as follows:
  - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of raceways and equipment.

2. Excavate trenches to depth indicated or required.
  3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
  4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.
- H. Cold Weather Protection. Protect excavation bottoms against freezing when atmosphere temperature is less than 35 F (1-2 C).
- I. Backfilling and Filling. Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
  2. Under building slabs, use drainage fill materials.
  3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
  4. For raceways less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation of raceways, provide a 4-inch-thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
  5. Other areas, use excavated or borrowed materials.
- J. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
  2. Removal of concrete formwork.
  3. Removal of shoring and bracing, and backfilling of voids.
  4. Removal of trash and debris.
- K. Placement and Compaction. Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- L. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

- M. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- N. Compaction. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
  - 1. Percentage of Maximum Density Requirements. Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
  - 2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.
- O. Subsidence. Where subsidence occurs at electrical installation excavations during the period 12 months after substantial completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance quality, and condition of surface or finish to match adjacent areas.

### 3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding. Comply with AWS "Structural Welding Code."

### 3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

- C. Attach to substrates as required to support applied loads.

### 3.7 APPLICATION OF JOINT SEALERS

- A. General. Comply with joint sealer manufacturer's printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
  - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
  - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- C. Installation of Fire-Stopping Sealant. Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

### 3.8 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

END OF SECTION

**SECTION 26 05 19**  
**WIRES AND CABLES**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of contract, including General and Supplemental Conditions or General Provisions and Division 1 specification sections.

**1.3 RELATED SECTIONS**

- A. The following sections contain requirements that relate to this section:
  - 1. Section 26 00 10, Electrical General Provisions.
  - 2. Section 26 00 20, Basic Electrical Materials and Methods.

**1.4 SUBMITTALS**

- A. Product data for electrical wires, cables, and connectors.

**1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements. Comply with provisions of the following code:
- B. NFPA 70 "National Electrical Code."
  - 1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
- C. Local electrical code.
- D. UL Compliance. Provide components which are listed and labeled by UL under the following standards, where applicable.
  - 1. UL Std. 4 Armored Cable.
  - 2. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
  - 3. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
  - 4. UL Std. 486B Wire Connectors for Use with Aluminum Conductors.
  - 5. UL Std. 854 Service Entrance Cable.
- E. NEMA/ICEA Compliance. Provide components which comply with the following standards, where applicable:

1. WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
  2. WC-7 Cross Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
  3. WC-8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- F. IEEE Compliance. Provide components which comply with the following standard, where applicable:
1. Std. 82 Test Procedures for Impulse Voltage Tests on Insulated Conductors.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers. Subject to compliance with requirements, provide products by one of the following:
1. Wire and Cable
    - a. American Insulated Wire Corp.
    - b. Brintec Corp.
    - c. Carol Cable Co. Inc.
    - d. Senator Wire and Cable Co.
    - e. Southwire Company.
    - f. Belden
  2. Connectors for Wires and Cable Conductors
    - a. AMP.
    - b. 3M Company.
    - c. O-Z/Gedney Co.
    - d. Schneider Electric Square D.

### 2.2 WIRES AND CABLES

- A. General. Provide wire and cable suitable for the temperature, conditions, and location where installed.
- B. Conductors. Unless otherwise specified, provide solid conductors for power and lighting circuits No. 10 AWG and smaller. Provide stranded conductors for sizes No. 8 AWG and larger.
- C. Conductor Material. Copper for all wires and cables.
- D. Insulation. Unless otherwise specified, provide THHN/THWN-2 insulation for all conductor sizes 500MCM and larger, and No. 8 AWG and smaller. For all other sizes provide THHN/THWN-2 or XHHW-2 insulation as appropriate for the locations where installed.
- E. Color coding for phase identification in accordance with the table in Part 3.3 D. below.
- F. Jackets. Factory-applied nylon or PVC external jacketed wires and cables for pulls in raceways over 100 feet in length, for pulls in raceways with more than three equivalent

90-degree bends, for pulls in conduits underground or under slabs on grade, and where indicated.

- G. Cables. Provide the following type(s) of cables in NEC-approved locations and applications where indicated. Provide cable UL-listed for particular application:
1. Armored Cable: Types AC and ACL.
  2. Metal-Clad Cable: Type MC.
  3. Nonmetallic-Sheathed Cable: Types NM and NMC.
  4. Aboveground Service-Entrance Cable: Type SE.
  5. Underground Service-Entrance Cable: Type USE.
  6. Underground Feeder and Branch-Circuit Cable: Type UF.
  7. Portable Cord: Type S.
- H. Instrumentation Cable. UL 300-volt PLTC with individually foil-shielded twisted copper pairs and overall foil-shielding in a sunlight and oil-resistant PVC jacket. Minimum conductor size shall be No. 16 AWG unless otherwise noted.
- I. Ethernet Cable. Category 5e twisted bonded pair cable, with overall shield and heavy-duty sunlight and oil-resistant jacket.

## 2.3 CONNECTORS FOR CONDUCTORS

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types, and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

## PART 3 - EXECUTION

### 3.1 WIRING METHOD

- A. Use the following wiring methods as indicated:
1. Wire: Install all wire in raceway.
  2. Armored Cable, Type AC: where permitted by code.
  3. Armored Cable, Type AC: for wiring in gypsum board partitions and for connections from raceway outlet boxes to lighting fixtures.
  4. Metal Clad Cable, Type MC: where indicated and elsewhere, where permitted by code.
  5. Metal Clad Cable, Type MC: in cable trays and elsewhere, where indicated.
  6. Nonmetallic Sheathed Cable, Types NM and NMC: for lighting wiring, where permitted by code.
  7. Service Entrance Cable, Types SE and USE: where permitted by code.

8. Service Entrance Cable, Type SE: for service entrance cable and for feeders (and branch circuits).
9. Service Entrance Cable, Type USE: for underground service feeders to building. Install in raceway under pavement and planter area, and within 3 feet of structures.
10. Underground Feeder and Branch Circuit Cable, Type UF: where permitted by code.
11. Underground Feeder and Branch Circuit Cable, Type UF: for underground branch circuit work. Install direct buried on a 2-inch minimum depth fine sand bed, with a 4-inch minimum layer of the same material covering the conductors. Install in raceway under pavement and planter areas and within 3 feet of structures. Provide line marker type complying with section "Electrical Identification." Portable Cord, Type S: for flexible pendant leads to outlets and equipment where permitted by code and as indicated.
12. Instrumentation Cable: for instrumentation and control circuits operating at 48 volts DC or less.
13. Ethernet Cable: for digital automation and control communication.

### 3.2 INSTALLATION OF WIRES AND CABLES

- A. General. Install electrical cables, wires and connectors in compliance with NEC.
- B. Coordinate cable installation with other work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL-listed pulling compound or lubricant, where necessary.
- D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- E. Conceal all cable in finished spaces.
- F. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.
- G. Keep conductor splices to minimum.
- H. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- I. Use splice and tap connectors which are compatible with conductor material.
- J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- K. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

- L. Do not run instrumentation cables in the same wireway, raceway, or conduit with power or control cables operating at 115 volts or higher.
- M. Ground shields of instrumentation cables.

3.3 FIELD QUALITY CONTROL

- A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.
- B. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.
- C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.
- D. Color Coding for Phase Identification. Color code secondary service, feeder, and branch circuit conductors with factory-applied color as follows:

<u>208Y/120VOLTS</u>	<u>PHASE</u>	<u>480Y/277 VOLTS</u>
BLACK	A	YELLOW
RED	B	BROWN
BLUE	C	ORANGE
WHITE	NEUTRAL	WHITE
GREEN	GROUND	GREEN

.END OF SECTION

## SECTION 26 05 26

### ELECTRICAL GROUNDING

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. The Contractor shall furnish, install and connect all materials required to provide a complete exterior and interior structure and equipment grounding system, including grounding provisions for transformers, motor control centers, motors, exterior lighting standards and other equipment as indicated on the Drawings, specified herein, or required by the National Electrical Code (NEC), National Fire Protection Association (NFPA), National Electrical Safety Code (NESC) and/or Federal, State and local codes and ordinances. Special grounding requirements shall be in accordance with the latest issue of NFPA Standards 77 and 78 for static electricity and lightning protection.
- B. An integrated grounding system shall be installed that interconnects all electrical metallic segments of apparatus compartments, centers, and exposed building metal structural parts.
- C. The grounding system shall include deep-driven ground rods at each manhole, handhole and building perimeter, interconnected with at least one, No. 4/0 AWG soft, stranded copper conductor run between manholes, handholes, and to each building or structural steel point of connection. The integrated system shall measure a sustained resistivity to each of one ohm or less. Ground rods to be driven not less than 10 feet below grade (or surface from which driven) in any case.

#### PART 2 - PRODUCTS

##### 2.1 FABRICATION AND MANUFACTURE

- A. Grounding Cable, Connectors and Clamps
  1. Ground cables shall be bare for the main ground grid and green color coded insulated runs installed with main feeders, annealed stranded tinned copper wire. Mechanical connectors for grounding cable (used only in above ground accessible locations) shall be made of tin-plated aluminum alloy, U.L. approved for use with aluminum and/or copper conductors and shall be so stamped. Welding type ground connections shall be used underground or at inaccessible locations. Ground connectors and clamps shall be equal to those manufactured by:
    - a. Appleton Electric Company
    - b. Gedney Electric Company, Inc.
    - c. Steel City Division, Midland Ross Corp.
    - d. Thomas & Betts Company, Inc.
  2. Welding type ground connectors shall be equal to those manufactured by:

- a. Burndy Engineering Company, Inc. (Thermoweld)
  - b. Erico Products, Inc. (Cadweld)
- B. Ground Rods
1. Ground rods shall be copper clad steel  $\frac{3}{4}$ -inch diameter or stainless steel - inch diameter, in 10 foot sections as indicated on the Drawings.
  2. Copper clad steel ground rods shall be fabricated by molten welding process and shall be manufactured by:
    - a. Copperweld Steel Company, Glassport, PA
    - b. Power System Division, McGraw Edison Company
    - c. Or Equal
  3. Stainless steel ground rods shall be equal to those manufactured by:
    - a. Metal Forming Corp. (Mefco), Division of Vanadium Alloys Steel Company (Vasco Metals Company), Elkhart, IN
- C. Insulating Material. Where insulation of grounding system connections is required, self-fusing electrical tape Minnesota Mining No. 23, or equivalent product by Bishop or equal, shall be used over the conductors and covered by vinyl electrical tape, Minnesota Mining No. 88, equivalent product by Bishop or equal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Installation Requirements and Methods

1. It is the intent of this Specification that a complete and continuous grounding system be provided for:
  - a. An adequate path for ground fault currents;
  - b. Safety to personnel from accidental electric shock hazards; and
  - c. Prevention of hazardous discharge of static electricity.
  - d. Whether or not indicated in detail on the Drawings a continuous ground path must be provided for all electrical circuits from the point of utilization back to the source by means of ground wires, bonded metallic conduit runs, etc.
2. All ground connections which will not later be accessible and all ground connections in manholes shall be made by means of welded type connectors. All contact surfaces for grounding connections shall be thoroughly cleaned and bright.
3. As far as practical, ground cables shall be continuous without joints or splices throughout their lengths. Where grounding cable is protected by metallic conduit it shall be bonded to the conduit at both ends.

4. Unless otherwise indicated on the Drawings, the metallic raceway system shall provide the principal ground return path. Bonding jumpers shall be installed at all sheet metal boxes to provide a continuous ground return path through the conduit.

#### B. Electrical Systems

1. Conduits shall be effectively grounded to the metal framework of motor control centers, panelboards, and junction boxes as specified under other sections of the Specification. Grounding conductors provided in cables and in conduit shall be connected to the appropriate ground buses of the equipment.
2. Ground grids shall be installed using copper clad steel or stainless steel ground rods. Connections from the ground grid to the ground buses shall be made as indicated on the Drawings.
3. The resistance of each ground rod and ground grid shall be checked to ensure continuity of the ground connection before bonding the copper ground conductor to the system.
4. Grounding connection to cold water pipe shall be made with an approved clamp type fitting which shall not mechanically injure the water pipe. The fitting shall bond both the ground conductor and its protective conduit to the water pipe. Minimum No. 4/0 bonding jumper with approved ground clamps shall be installed around the water meter.

#### C. Electrical Equipment

1. Conduits shall be effectively grounded to the metal framework of safety switches, transformers, individual motor starter, motors and other equipment as specified under other sections of this Specification.
2. Ground wires contained in cables or conduits shall terminate at utilization equipment by connection to ground buses where provided or directly to the metallic enclosure. Where motors or other utilization equipment (other than lighting fixtures) are connected to the electrical system via flexible conduit a continuous ground path shall be provided to the utilization equipment, either by means of an external jumper across the flexible conduit or by use of a flexible conduit containing an integral ground wire, such as "Sealtite".

- D. Miscellaneous Equipment Grounding. Metal lighting standards, supports for electrical equipment, and other equipment indicated on the Drawings, specified herein, or required by NEC, NFPA, NESC and/or local codes and ordinances.

END OF SECTION

**SECTION 26 05 29**  
**SUPPORTING DEVICES**

**PART 1 - GENERAL**

**1.1 SCOPE OF WORK**

- A. Conduit and equipment supports.
- B. Fastening hardware.

**1.2 COORDINATION**

- A. Coordinate size, shape and location of concrete pads with sizes of furnished equipment.

**1.3 QUALITY ASSURANCE**

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

- A. Support Channel: Stainless steel.
- B. Hardware: Stainless steel.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- D. Do not use powder-actuated anchors.
- E. Do not drill structural steel members.
- F. Fabricate supports from stainless structural steel or stainless steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

- G. In wet locations install free-standing electrical equipment on concrete pads.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide stainless steel channel supports to stand cabinet one inch off wall.
- I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

END OF SECTION

## SECTION 26 05 33

### CONDUIT

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. Rigid metal conduit and fittings.
- B. Intermediate metal conduit and fittings.
- C. Electrical metallic tubing and fittings.
- D. Flexible metal conduit and fittings.
- E. Liquid-tight flexible metal conduit and fittings.
- F. Non-metallic conduit and fittings.

##### 1.2 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.
- C. ANSI C80.5 - Rigid Aluminum Conduit.
- D. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

#### PART 2 - PRODUCTS

##### 2.1 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit. ANSI C80.1.
- B. Rigid Aluminum Conduit. ANSI C80.5.
- C. PVC Externally Coated Conduit. NEMA RN 1; rigid steel conduit with external 20 mil PVC coating and internal galvanized surface.
- D. Fittings and Conduit Bodies. ANSI/NEMA FB 1; threaded type, material to match conduit and aluminum.

##### 2.2 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit. Galvanized steel.
- B. Fittings and Conduit Bodies. ANSI/NEMA FB 1; use fittings and conduit bodies specified above for rigid steel conduit.

##### 2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. EMT. ANSI C80.3. Galvanized tubing.

- B. Fittings and Conduit Bodies. ANSI/NEMA FB 1; steel, compression type.
- 2.4 FLEXIBLE METAL CONDUIT AND FITTINGS
- A. Conduit. FS WW-C-566; steel.
  - B. Fittings and Conduit Bodies. ANSI/NEMA FB 1.
- 2.5 LIQUID-TIGHT FLEXIBLE CONDUIT AND FITTINGS
- A. Conduit. Flexible metal conduit with PVC jacket.
  - B. Fittings and Conduit Bodies. ANSI/NEMA FB 1.
- 2.6 PLASTIC CONDUIT AND FITTINGS
- A. Conduit. NEMA TC 2; Schedule 40 or Schedule 80 PVC.
  - B. Fittings and Conduit Bodies. NEMA TC 3.
- 2.7 CONDUIT SUPPORTS
- A. Conduit Clamps, Straps, and Supports. Steel or malleable iron.
- PART 3 - EXECUTION
- 3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT
- A. Size conduit for conductor-type installed or for Type THW conductors, whichever is larger. Minimum size for above-ground circuits is  $\frac{3}{4}$  inch; minimum size for underground circuits is 1 inch.
  - B. Arrange conduit to maintain headroom and present a neat appearance.
  - C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
  - D. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
  - E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
  - F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
  - G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
  - H. Support conduit at a maximum of 7 feet on center.
- 3.2 CONDUIT INSTALLATION
- A. Cut conduit square using a saw or pipe cutter; deburr cut ends.

- B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.
- D. Install no more than the equivalent of four 90-degree bends between boxes.
- E. Use conduit bodies to make sharp changes in direction, as around beams.
- F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size.
- G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- I. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.
- J. Install expansion-deflection joints where conduit crosses building expansion or seismic joints.
- K. Where conduit penetrates fire-rated walls and floors, provide pipe sleeve two sizes larger than conduit; pack void around conduit with oakum and fill ends of sleeve with fire-resistive compound.
- L. Route conduit through roof openings for piping and duct work where possible; otherwise, route through roof jack with pitch pocket.
- M. Maximum size conduit in slabs above grade shall be  $\frac{3}{4}$  inch. Do not route conduits to cross each other in slabs above grade. Conduits crossing each other may not be larger than  $\frac{3}{4}$  inch.
- N. Use PVC-coated rigid steel factory elbows for bends in plastic conduit runs longer than 100 feet, or in plastic conduit runs which have more than two bends regardless of length.
- O. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

### 3.3 UNDERGROUND DUCTBANK INSTALLATION

- A. Install top of duct bank a minimum 30 inches below finished grade.
- B. Install conduit with minimum grade of 4 inches per 100 feet.
- C. Terminate conduit in end bell at manhole entries.
- D. Stagger conduit joints in concrete encasement 6 inches minimum vertically.
- E. Use suitable separators and chairs installed not greater than 4 feet on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement.
- F. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank.

- G. Provide two No. 4 steel reinforcing bars in top of bank under paved areas.
- 3.4 CONDUIT INSTALLATION SCHEDULE (UNLESS OTHERWISE NOTED)
- A. Underground installations more than five feet from foundation wall shall be Type A or Schedule 40 plastic conduit encased in concrete envelope.
  - B. Installations in or under concrete slab, or underground within five feet of foundation wall shall be rigid steel conduit or Schedule 40 plastic conduit encased in concrete envelope. Underground entry into building shall be rigid steel conduit.
  - C. In slab above grade use rigid steel conduit or Schedule 40 plastic conduit.
  - D. Exposed outdoor locations shall be PVC-coated rigid steel conduit.
  - E. Wet interior locations shall be PVC-coated rigid steel conduit.
  - F. Concealed dry interior locations shall be rigid steel conduit or intermediate metal conduit.
  - G. Exposed dry interior locations shall be rigid steel conduit.
  - H. Exposed corrosive environments (chemical and chlorine rooms) shall be Schedule 80 PVC.

END OF SECTION

**SECTION 26 28 16**  
**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. Disconnect switches.
- B. Fuses.
- C. Enclosures.

**1.2 REFERENCES**

- A. ANSI/UL 198C - High-Intensity Capacity Fuses; Current Limiting Type.
- B. ANSI/UL 198E - Class R Fuses.
- C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- D. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- E. NEMA KS 1 - Enclosed Switches.

**1.3 SUBMITTALS**

- A. Submit product data, including outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES**

- A. General Electric.
- B. Seimens.
- C. Schneider Electric Square D.
- D. Substitutions: Under provisions of Section 26 00 10, Electrical General Provisions.

**2.2 DISCONNECT SWITCHES**

- A. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- B. Fuse Clips: Designed to accommodate Class R fuses.
- C. Nonfusible Switch Assemblies: NEMA KS 1; Type HD; GD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- D. Enclosures: NEMA KS 1; as indicated on Drawings.

## 2.3 ACCEPTABLE MANUFACTURERS – FUSES

- A. Bussman.
- B. Chase-Shawmut.
- C. General Electric.
- D. Substitutions: Under provisions of Section 26 00 10, Electrical General Provisions.

## 2.4 FUSES

- A. Fuses 600 Amperes and Less: ANSI/UL 198C, Class J; ANSI/UL 198E, Class RK1; RK5; as indicated on Drawings; current limiting, one-time fuse, 250 volt.
- B. Interrupting Rating: 200,000 rms amperes.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install disconnect switches where indicated on Drawings.
- B. Install fuses in fusible disconnect switches.

END OF SECTION

## SECTION 26 32 13

### EMERGENCY STANDBY GENERATOR SYSTEM

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. The work covered by this section consists of furnishing all labor, equipment, and materials necessary to furnish, install, test, and place in satisfactory operation one liquid-cooled, natural gas fuel, emergency standby generator system, including accessories as described herein and/or shown on the Drawings.

##### 1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Submit shop drawings and engineering data to the Engineer.
- B. Submit product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery charger, exhaust silencer, vibration isolators, and enclosure.
- C. Provide certified factory test report certifying unit's full power rating, stability, voltage, and frequency regulation.

##### 1.3 STORAGE AND PROTECTION

- A. Accept packaged engine generator set and accessories on site in crates and verify damage.
- B. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

##### 1.4 OPERATION AND MAINTENANCE DATA

- A. Submit complete operation and maintenance data on the standby generator system.
- B. Include instructions for normal operation, routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

##### 1.5 GUARANTEE

- A. Provide a one – year guarantee against defective or deficient equipment and workmanship.

##### 1.6 QUALIFICATIONS

- A. Manufacturer. Company specializing in packaged engine generator system with a minimum of three years experience.
- B. Supplier. Authorized distributor of engine generator manufacturer with service facilities within 150 miles of project site.

## 1.7 MAINTENANCE SERVICE

- A. Furnish service and maintenance of packaged engine generator system for one year from date of substantial completion.

## 1.8 EXTRA MATERIALS

- A. Furnish one set of any special tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.
- B. Provide two additional sets of all fuel, oil, and air filter elements required for the engine generator system.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Onan.
- B. Kohler.
- C. Generac.

### 2.2 EMERGENCY STANDBY GENERATOR SYSTEMS

- A. Install the standby electric system at the location shown on the Drawings and as specified herein with all accessories and transfer switch as required.
- B. All equipment shall be new and of current production of a national firm, which manufactures the alternator and control panel and assembles the standby electric plant as a matched unit, having a service and parts organization within an approved distance of this project backed up by a national sales and service organization.
- C. The standby generator set shall be rated continuous standby 240 volts, 3 phase, 4 wire, 0.8 power factor, 25 kW, and operate on natural gas fuel.
- D. Generator shall be capable of starting and running two - 5 hp NEMA Code H motors 3rd 5 kW of incidental load with a maximum voltage dip of 20 percent.

### 2.3 ENGINE

- A. Type. Water-cooled inline or V-type, four-stroke cycle, electric ignition, internal combustion engine.
- B. Rating. Sufficient to operate at 10 percent overload for one hour at specified elevation and ambient limits.
- C. Fuel System. Appropriate for use of natural gas.
- D. Engine Speed. 1800 rpm.

- E. Governor. Electric isochronous type to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.
- F. Safety Devices. Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.
- G. Engine Starting. DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
- H. Engine Jacket Heater. Thermal circulation-type water heater with integral thermostatic control, sized to maintain engine jacket water at 90°F (32°C) and suitable for operation on 240 volts AC.
- I. Radiator. Radiator using glycol coolant, with blower-type fan, sized to maintain safe engine temperature in ambient temperature of 110°F (43°C).
- J. Radiator Air Flow Restriction: 0.5 inch of water (9.34 mm of mercury), maximum.
- K. Provide minimum 40 ampere automatic battery charging alternator.
- L. Engine Accessories. Lube oil filter, intake air filter, lube oil cooler, gear-driven water pump. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine-generator control panel.
- M. Mounting. Provide unit with suitable spring-type vibration isolators and mount on structural steel base.

## 2.4 GENERATOR

- A. The generator shall be four pole, brushless, of drip-proof construction with amortisseur windings. Insulation shall be Class F with epoxy varnish. Generator shall be equipped with temperature compensated solid state voltage regulator and voltage adjusting rheostat.
- B. Radio interference suppression meeting commercial standards shall be supplied. Voltage regulation shall be within 1 percent of rated voltage, from no load to rated load. Upon application of 80 percent of rated load in one step, voltage dip shall not exceed 20 percent; recovery to stable voltage shall occur within 1 second. Stable or steady operation is defined as operation with terminal voltage remaining constant within  $\pm\frac{1}{2}$  of 1 percent of rated voltage. Voltage adjustment range shall be  $\pm 5$  percent of rated voltage. Temperature rise shall be 105°C at rated output. If a line to neutral short circuit occurs, the generator shall support 300 percent rated current for 10 seconds without externally mounted devices.
- C. Furnish a resettable line current sensing circuit breaker with inverse time versus current response which protects the generator from damage due to overload. This breaker shall not trip within the 10 seconds specified above. Include battery-voltage operator shunt trip to open circuit breaker on engine failure. Furnish separate visual diagnostic means on the generator rotor for determining that exciter voltage is being

developed and that the excitation system is supplying current to the generator field according to load requirements.

- D. The generator, having a single maintenance-free bearing, shall be direct coupled to the flywheel housing, with a disc coupling between the rotor and the flywheel.

## 2.5 CONTROLLER AND INSTRUMENTATION PANEL

- A. Set mounted controller facing rear shall be vibration isolated on the generator enclosure and be of solid state design. Relays will be acceptable only for high current circuits. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:

1. Fused DC circuits.
2. Complete standby 2-wire start/stop control which shall operate on activation of a remote contact.
3. Cranking period controlled by a speed sensor which disengages the starting motor when the engine has started. Battery charging alternator or generator voltage may not be used for this signal.
4. Cranking cyler with individually adjustable (2 to 20 seconds) ON and OFF cranking periods.
5. Overcranking protection designed to open the cranking circuit after 30 to 90 seconds if the engine fails to start.
6. The starting system shall be designed for restarting in the event of a false engine start by permitting the engine to completely stop and then re-engage the starter.
7. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, or overspeed are received with reset button.
8. Adjustable factor set at 5-minute time delay to permit unloaded running and stopping of the standby set after transfer of the load to normal power feed.
9. Alarm horn.
10. Three position (AUTOMATIC-OFF-TEST) selector switch.
11. Emergency stop switch.
12. Indicating lights to signal switch:
  - a. Off Flashing Red
  - b. Overcrank Red
  - c. Emergency Stop Red
  - d. High Coolant Temperature Red
  - e. Overspeed Red
  - f. Low Oil Pressure Red

13. Test button for indicating lights.
14. Connections to the controller shall be by plug-in wiring harnesses.

B. Set mounted instrument panel shall include:

1. Dual range voltmeter  $\pm 2$  percent accuracy.
2. Dual range ammeter  $\pm 2$  percent accuracy.
3. Voltmeter-ammeter phase selector switch.
4. Lights to indicate high or low meter scale.
5. Direct reading pointer type frequency meter  $\pm 0.3$  hertz accuracy.
6. Panel illuminating light.
7. Battery charging ammeter.
8. Oil pressure gauge.
9. Coolant temperature gauge.
10. Running time meter.

## 2.6 FUEL SYSTEM

- A. Provide natural gas fuel system.

## 2.7 GENERATOR SET MOUNTING

- A. The standby generator set shall be equipped with factory-installed heavy-duty fabricated steel base to prevent distortion of alignment between generator and engine when installed. Install adjustable spring-type vibration isolators between the generator set and concrete pad. The vibration isolators shall be designed specifically for the generator set furnished. The Contractor shall be responsible for submitting complete design of the vibration isolator system. The isolator shall be designed by Amber/Booth Company or approved equal. External isolators may be omitted if a suitable integral vibration isolation system is provided, subject to the approval of the Engineer.

## 2.8 ENCLOSURE

- A. Provide a weather-protective enclosure for the generator set. Housing shall have hinged, lockable access doors and stainless steel hardware. Sheet metal shall be finished with the manufacturer's standard paint.

## 2.9 ACCESSORIES

- A. Accessories shall include one 90-ampere-hour 12-volt battery, battery rack, and battery cables.
- B. Engine exhaust silencer shall be rated for critical (residential).

## 2.10 AUTOMATIC TRANSFER SWITCH

- A. Provide 100-amp automatic transfer switch with 100 percent continuous rating. Switch shall be double throw with mechanically-held, silver alloy contacts. Switch shall be furnished by generator manufacturer and shall be UL listed.
- B. Provide the following features:
  - 1. Field-adjustable time delay start, transfer, retransfer, and stop.
  - 2. Field-adjustable voltage and frequency sensors on all phases on both sources.
  - 3. 7-day, solid state exercise clock.
  - 4. Integral 2-amp battery charger.
  - 5. Auxiliary contacts for remote monitoring.
  - 6. Indicator lights for key status functions.
  - 7. Programmed transition with time delay for high inductive loads.
  - 8. NEMA 1 enclosure.
  - 9. Permanently-attached manual operating handle.

## PART 3 - EXECUTION

### 3.1 FACTORY TESTING

- A. The emergency generator system shall be given a running test at the factory using the engine furnished for the actual installation. Provide the Engineer with four copies of a certified final factory test report certifying the unit's full power rating, stability, voltage, and frequency regulation.

### 3.2 INSTALLATION AND CHECKOUT

- A. Install emergency generator system in strict accordance with the Drawings and approved manufacturer's shop drawings and installation instructions. Check couplings for proper alignment and adjust if necessary.
- B. Following installation, a qualified field representative (not a sales representative) of the manufacturer shall thoroughly check out and test the equipment. The manufacturer's representative shall furnish the Engineer with a written certification of satisfactory installation.
- C. The field representative shall thoroughly instruct the Owner's personnel as to correct operating and testing procedures.

### 3.3 FIELD TESTING

- A. Following installation and checkout, the ability of the emergency generator system to operate automatically under power fail and power restore conditions without overheating, leaking of oil, or excessive vibration or noise shall be demonstrated to the satisfaction of the Engineer. Provide at Contractor's expense all water required for the field tests and make any adjustment or modifications required for satisfactory operation.

END OF SECTION