SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

1.3 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS
A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3 (Use only when specified)
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding products shall be Erico’s CADWELD system. Connectors shall be provided in kit form and selected per manufacturers written instructions for specific types, sizes, and combination of conductors and connected items.

2.3 GROUNDING ELECTRODE SYSTEM

A. Ground Rods: Copper-clad or Zinc-coated in diameter and length as indicated on the engineering design drawings. (Minimum ¾” X 10’)

B. Grounding Electrode System: For all generator installations, new buildings, and SES replacements for existing buildings.
   1. Minimum two (2) ground rods separated by 23 feet.
   2. Ground rods to be installed in 12” diameter ground well, drilled to a depth of 10’-6” and encased in ground enhancement material. (See Engineering Drawings for Details).
      a. Acceptable Manufacturer
         1) Ground Enhancement Material (GEM): ERICO

C. Ground Wells: Handholds shall be a minimum of 12” deep, open bottomed, with a 9” reinforced concrete lid. Acceptable manufacturers: (See Engineering Drawings for Traffic Rating)
   1. Oldcastle precast
   2. Christy Concrete
   3. Carson
   4. Eritech

D. Concrete Encased Electrode (Ufer): For all generator installations and new buildings connect the slab reinforcing steel to the grounding electrode conductor with a permanent bond.

E. Structural steel: for all new buildings connect the structural steel to the concrete encased electrode conductor as indicated

F. Metal underground water pipe: for all new buildings, connect to the grounding electrode conductor if indicated.

G. Bond (per paragraph 3.1 D) all the above types of grounding electrodes found on the drawings to form a Grounding Electrode System as indicated.
2.4 GROUNDING ELECTRODE CONDUCTORS

A. Install stranded (unless otherwise indicated) copper conductors of the size required by the drawings.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductor, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum. Trench depth 36 inches below grade, Underground Grounding Conductor at 30 inches minimum with 6 inches of “GEM” below.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors, unless otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Welded or Bolted connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

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

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

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. (See Paragraph 3.1B)

B. Ground Rods: Install ground rods in 12” diameter ground well, drilled to a depth of 10’-6” and encased in “Ground Enhancement Material”. Install ground well handhold at each grounding electrode location (See Paragraph 2.3C) for inspection and testing of grounding electrode system. Set top of ground well flush with finished grade or floor.

1. Interconnect ground rods with grounding electrode conductor, Minimum 2/0 bare Copper. (See Paragraph 3.1B).
2. For grounding electrode system, install rods spaced at least 23’ from each other (or 2.2 X Rod Length Minimum) and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
   a. Acceptable exothermic-welded connector manufacturers:
      1) CADWELD

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

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

3.4 FIELD QUALITY CONTROL

A. Using an independent testing company hired by the Contractor, perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
      a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.

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

END OF SECTION