GROUNDING AND GROUND-FAULT PROTECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Extent of grounding and ground-fault protection work is as directed by the NEC and additional grounding as indicated by the contract documents.

B. Types of grounding and ground-fault protection in this section include but are not limited to the following:

1. Grounding:
   - Underground metal piping.
   - Underground metal water piping.
   - Underground metal structures.
   - Grounding electrodes.
   - Grounding rods.
   - Separately derived systems.
   - Service equipment.
   - Enclosures.
   - Systems.
   - Equipment.
   - Isolated ground systems.

2. Ground-Fault Protection:
   - Ground-fault circuit interrupters.
   - Ground-fault sensing and relaying equipment.

C. Provide an equipment grounding conductor in all feeder wiring runs. Provide ground bus in all panels, switchboards and equipment enclosures. Bond ground conductor in all metallic enclosures.

PART 2 - PRODUCTS
2.01 GROUNDING:

A. Materials and Components: Except as otherwise indicated, provide each electrical grounding system indicated, with assembly of materials including, but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, and other items and accessories needed for complete installation. Where more than one type meets indicated requirements, selection is Installer's option. Where materials or components are otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

B. Metallic Raceway: Where existing metallic raceway provides a grounding path, the raceway couplings, connection, jumpers, bonds and installation methods shall meet all requirements to provide a continuous ground return path.

C. Equipment grounding conductor: Where specified or required by the application, provide code size equipment grounding conductors throughout the raceway system. Bond the equipment grounding conductor at all metal enclosures, equipment frames, housings, racks, etc. entered.

D. Electrical Bonding Jumpers:
   1. Bonding Jumper Braid: Copper braided tape, constructed of 30-gauge bare copper wires and properly sized for indicated applications.
   2. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire; 3/4" wide, 9/1-2" long; 48,250 CM. Protect braid with copper bolt hole ends with holes sized for 3/8" dia. bolts.

E. Electrical Grounding Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC.

F. Ground Rods and Plates:
   2. Electrical Grounding Connections Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, thermoweld process, bonding straps, as recommended by accessories manufacturers for type services indicated.
2.02 GROUND-FAULT PROTECTION DEVICES:

A. General: Except as otherwise indicated, provide ground-fault protection devices and components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for applications indicated.

B. Circuit Interrupters/Circuit-Breakers: Provide where required 1" wide module bolt-on panel board circuit breakers, with integral ground-fault circuit interrupters, UL-rated Class A, Group 1; 20-ampere ratings, 1-pole construction, 120-volts, 60 Hz, 22000 AIC. Provide with solid-state ground-fault sensing and signaling, with 5 milliamperes ground-fault sensitivity, plus or minus 1 milliampere. Equip with PUSH-TO-TEST capability. Provide modules which fit panelboards in which they are located.

C. Ground-fault Sensing and Relaying Equipment: Provide ground-fault sensing and relaying equipment for 480 V, 60 Hz, grounded system consisting of current sensor to encircle and monitor circuit's phase and neutral conductors, relaying equipment to provide desired ground-fault current sensitivity and time-current response characteristics, monitor panel, and low voltage power circuit-breaker, equipped to function in conjunction with other elements of GFP system, and constructed with the following features:

1. Current Sensors: Provide zero sequence current sensors for feeder and branch devices and ground return sensors for main service device; inputs compatible to relay. Construct sensor frame so it can be opened to permit removal or installation around conductors without disturbing conductors. Provide test winding in sensor for testing operation of GFP unit including sensor pick-up, relay, and circuit protection device operation.

2. Ground-Fault Relay: Provide solid-state ground-fault relay, which requires no external source of electrical power, drawing energy to operate GFP system directly from output of current sensor. Construct with adjustable pick-up current sensitivity for GF currents from 200 to 1200 amperes, with calibrated dial to show pick-up point settings. Provide factory-set time delay of 0.5 seconds and which precludes tampering with setting after installation.
3. Circuit Breaker: Provide molded case circuit breaker of ratings indicated. Construct with thermal and magnetic elements for conventional overload and fault current protection; and with GF trip mechanism capable of being activated by GF relay causing opening of circuit when ground fault of required magnitude occurs.

4. Monitor Panel: Provide monitor panel capable of indicating relay operation, and provide means for testing system with or without interruption of service. Construct so GF system can not be left in an inactive or OFF state. Provide indicator lamps and TEST and RETEST control switches.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ground-fault sensing and relaying equipment which may be incorporated in the work include, but are not limited to, the following:

- General Electric Co.
- Siemens
- Pringle Electrical Mfg Co.
- Square D Co.
- Cutler-Hammer

PART 3 - EXECUTION

3.01 INSTALLATION OF GROUNDING AND GROUND-FAULT PROTECTION SYSTEMS:

A. Install electrical grounding systems and ground-fault protection devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding and ground-fault protection devices comply with requirements. Comply with requirements of NEC, NESC, and NEMA standards for installation of grounding and ground-fault protection systems and devices. Provide ground fault system where code required.

B. Coordinate with other electrical work as necessary to interface installation of grounding system and ground-fault protection devices with other work.

C. Weld cable connections to ground rods and coat with protective asphaltic paint.

D. Install braided type bonding jumpers with ground clamps on water meter piping to electrically bypass water meter.
E. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

F. Install ground-fault protection devices complying with electrical winding polarities indicated.

G. Fasten ground-fault sensing devices without mechanical stresses, twisting or misalignment being exerted by clamps, supports, bus bars or cables.

H. Install ground-fault sensing windows symmetrically around power conductor bus bars or cable. Maintain clearances between conductors and ground-fault sensor body recommended by device manufacturer.

I. Set field-adjustable GFP devices for pickup and time sensitivity ranges as indicated, after installation of devices.

J. Where indicated on the drawings, provide additional isolated ground system. Isolated ground systems shall provide electrical isolation from outlet or device continuous to service equipment neutral/ground bonding point.

3.02 FIELD QUALITY CONTROL:

A. Upon completion of installation of ground-fault protection devices and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

B. Upon completion of installation of electrical grounding system, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 3 ohms, take appropriate action to reduce resistance to 3 ohms or less by driving additional ground rods. Then retest to demonstrate compliance.

C. Perform resistance-to-ground tests of electrical grounding system one year following time of substantial completion and submit written report indicating results. Where resistance is greater than 3 ohms, chemically treat soil to reduce resistance to 3 ohms or less. Then retest to demonstrate compliance.

3.03 PERSONNEL TRAINING:

A. Building Maintenance Personnel Training: Train Owner's building maintenance personnel in procedures for testing and determining resistance-to-ground values of
grounding system. Also instruct maintenance personnel in preparation and application of chemical solution for earth surrounding grounding rods for reducing ohmic resistance to required levels.

END OF SECTION
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