Heaters for Safety Showers
Voltages: 13.8 (4.16) kV; 600V or 480V
NEMA C84.1-2011, IEC 60038

Distribution Scheme: Radial, Loop, Double-Ending

Protection: Fuses, Circuit Breakers, Resistance or Solid Ground

Standard Current ratings: NEC 240.6 Standard Ampere Ratings, IEC 60059 (logarithmic progression)

Motor Voltage Ranges: ½Hp single phase, 200 Hp maximum LV, >200 Hp MV (IEC HV)

Motor Protection: Fuses / MCP’s / MCCB’s. Overload Class 10, 20, 30
480V – 480/277 V or 480-208/120 for lighting and receptacle loads

Transformer Secondary: Bus Duct, Cable in tray, Cables underground
Include the following:

- **Utility Supply System**
  - Available SC current (including X/I ratio)
  - Line supply voltage
  - High-voltage protective devices and switches
  - Show the normal operating mode
  - Type(s) of relays

- **Transformers**
  - Nameplate rating(s) (kVA and kV) and temperature rise
  - Cooling Method (ONAN, ONAF (AA, FA))
  - High-voltage winding voltage taps and winding connection (delta/wny)
  - Low-voltage winding voltage taps and winding connection (delta/wny)
  - Impedance and kVA base
  - Grounding scheme and ohmic value of neutral resistor(s) if used; show connections
  - Surge arrestors and capacitors (show switching if switched), and connections
  - Metering of utility supply, primary protective devices

IEEE C57.12.00-2010 - IEEE Standard for General Requirements for Liquid-Immersed Transformers
IEEE C57.12.01-2005 - Standard General Requirements for Dry-Type Distribution and Power Transformers
When listing the AIC rating of switchboards and panelboards, show the minimum rating acceptable, do not round up to what is perceived as the next industry standard rating. Engineers often round up to one particular manufacturer's standards giving that manufacturer a competitive advantage during the bidding phase.
No cable schedule on smaller jobs
Schedules (tabular format) where possible for ease of takeoff
3 #4AWG: Is it 3 – 1/c #4 or 1 – 3/c #4? Call out ground where used.
Electrical Drawing Preparation

Grounding vs Earthing

Electrical Drawing Preparation

Grounding Plans

Electrical Drawing Preparation

Grounding Plans

**Grounding vs Earthing**

**INPUTS:**
- Basis of Design
- Ground Resistance Data
- Grounding Calculations
- Layout Drawings
  - Process Equipment (Large Motors, Tanks)
  - Electrical Rooms
- Structural Drawings
  - Foundations
  - Columns
Drawing number, title block name match the master drawing list
Primary

- Earth Electrode Subsystem
  network of interconnected rods, wires, pipes, or other configuration of metals which establishes electrical contact between the elements of the facility and the earth

- Fault Protection Subsystem
  ensures that personnel are protected from shock hazard and equipment is protected from damage or destruction resulting from faults that may develop in the electrical system

Primary

- Lightning Protection Subsystem
  provides a nondestructive path to ground for lightning energy contacting or induced in facility structures

- Signal Reference Subsystem
  The purpose of a signal reference ground is to provide a low impedance signal reference system for electronic equipment to minimize noise-induced voltages and thereby reduce equipment malfunctions
Safety Grounding – Step & Touch Potential

- Secondary
  - Static Protection
    static ground is a connection between a piece of equipment and earth to drain off static electricity charges before they reach a sparking potential.
  - Cathodic Protection
    Cathodic protection is a method to reduce corrosion by minimizing the difference in potential between anode and cathode.
  - Safety (Maintenance) Grounding
    Temporary grounding is provided to protect workers engaged in deenergized electric line maintenance.

Extra precaution in Hazardous Areas

- Facility Ground System
  - Primary
    - Earth Electrode Subsystem IEEE 142-2007 (Green Book)
    - Fault Protection Subsystem NFPA 70 (NEC®)
    - Lightning Protection Subsystem NFPA 780
    - Signal Reference Subsystem IEEE 1100-2005 (Emerald Book)
  - Secondary
    - Static Protection NFPA 77
    - Cathodic Protection NACE SP0989
    - Safety (Maintenance) Grounding NFPA 70E, IEEE C2
Alternating-current systems of 50 volts to less than 1000 volts that supply premises wiring and premises wiring systems shall be grounded under any of the following conditions:

1. Where the system can be grounded so that the maximum voltage to ground on the ungrounded conductors does not exceed 150 volts
2. Where the system is 3-phase, 4-wire, wye-connected in which the neutral conductor is used as a circuit conductor
3. Where the system is 3-phase, 4-wire, delta-connected in which the midpoint of one phase winding is used as a circuit conductor

All grounding electrodes as described in 250.52(A)(1) through (A)(7) that are present at each building or structure served shall be bonded together to form the grounding electrode system.

1. Metal Underground Water Pipe
2. Metal Frame of the Building or Structure
3. Concrete-Encased Electrode
4. Ground Ring
5. Rod and Pipe Electrodes
6. Other Listed Electrodes
7. Plate Electrodes
Structures exceeding 76 m (250 ft) in perimeter shall have a down conductor for every 30 m (100 ft) of perimeter or fraction thereof.

Ground rods shall be not less than 12.7 mm (1/2 in.) in diameter and 2.4 m (8 ft) long.

This interconnection shall include lightning protection, electric service, communications, and antenna system grounds, as well as underground metallic piping systems.

Grounding electrodes shall be connected to steel columns around the perimeter of the structure at intervals averaging not more than 18 m (60 ft).

5.4 Metal Towers and Tanks. Metal towers and tanks constructed so as to receive a stroke of lightning without damage shall require only bonding to grounding electrodes as required in Chapter 4, except as provided in Chapter 7. \( \pi(R)^2 > 250 \) for 17.84 ft diameter.

Recommended practice is that all grounding and bonding connections for metal piping systems be noted on the appropriate mechanical and electrical drawings.

UL 96, the Standard for Safety of Lightning Protection Components
UL 96A, the Standard for Installation Requirements for Lightning Protection Systems

NFPA 75-2013 Standard for the Fire Protection of Information Technology Equipment
1 MIL-HDBK419A
2 AFI 32-1065
3 UFC 3-570-02A
4 UFC 3-560-01