8A Miscellaneous Electrical Systems

8A.1 Station Grounding and Surge Protection

8A.1.1 Description

The electrical grounding system is comprised of:

(1) An instrument and computer grounding network

(2) An equipment grounding network for grounding electrical equipment (e.g. transformer, switchgear, motors, distribution panels, cables, etc.) and selected mechanical components (e.g. fuel tanks, chemical tanks, etc.)

(3) A plant grounding grid

(4) A lightning protection network for protection of structures, transformers and equipment located outside buildings

The plant instrumentation is grounded through a separate insulated radial grounding system comprised of buses and insulated cables. The instrumentation grounding systems are connected to the station grounding grid at only one point and are insulated from all other grounding circuits. Separate instrumentation grounding systems are provided for plant analog (i.e., relays, solenoids, etc.) and digital instrumentation systems.

The equipment grounding network is such that all major equipment, structures and tanks are grounded with two diagonally opposite ground connections. The ground bus of all switchgear assemblies, motor control centers and control cabinets are connected to the station ground grid through at least two parallel paths. Bare copper risers are furnished for all underground electrical ducts and equipment, and for connections to the grounding systems within buildings. One bare copper cable is installed with each underground electrical duct run, and all metallic hardware in each manhole is connected to the cable.

A plant grounding grid consisting of bare copper cables is provided to limit step and touch potentials to safe values under all fault conditions. The buried grid is located at the switchyard and connected to systems within the buildings by a 500 MCM bare copper loop which encircles all buildings (Figure 8A-1).

Each building is equipped with grounding systems connected to the station grounding grid. As a minimum, every other steel column of the building perimeter will connect directly to the grounding grid.

The plant's main generator is grounded with a neutral grounding device. The impedance of that device will limit the maximum phase current under short-circuit conditions to a value not greater than that for a three-phase fault at its terminals. Provisions are included to ensure proper grounding of the isophase buses when the generator is disconnected.

The onsite, medium-voltage AC distribution system is low resistance grounded at the neutral point of the low-voltage windings of the unit auxiliary and reserve transformers.

The neutral point of the generator windings of the onsite, standby power supply units (i.e., the diesel generators and the combustion turbine generator), is through distribution-type transformers and loading resistors, sized for continuous operation in the event of a ground fault.

The neutral point of the low-voltage AC distribution systems are either solidly or impedance grounded, as necessary, to ensure proper coordination of ground fault protection. The DC systems are ungrounded.

The target value of ground resistance is one ohm or less for the Reactor, Turbine, Control, Service and Radwaste buildings. This is consistent with Section 12.1 of IEEE-80. If the target grounding resistance is not achieved by the ground grid, auxiliary ground grids, shallow buried ground rods or deep buried ground rods will be used in combination as necessary to meet the target ground resistance value.

The lightning protection system covers all major plant structures and is designed to prevent direct lightning strikes to the buildings, electric power equipment and instruments. It consists of air terminals, bare downcomers and buried grounding electrodes which are separate from the normal grounding system. Lightning arresters are provided for each phase of all tie lines connecting the plant electrical systems to the switchyard and offsite line. These arresters are connected to the high-voltage terminals of the main step-up and reserve transformers. Plant instrumentation located outdoors or connected to cabling running outdoors is provided with surge suppression devices to protect the equipment from lightning induced surges.

8A.1.2 Analysis

Regulatory guidance for the lightning protection system is provided in Regulatory Guide 1.204. The grounding and lightning protection systems are designed and required to be installed to the applicable sections of the following codes and standards.

(1) IEEE-80, Guide for Safety in AC Substation Grounding (Reference 8A-1)

(2) IEEE-81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Reference 8A-2)

(3) IEEE-665, Guide for Generation Station Grounding (Reference 8A-3)

(4) NFPA-78, National Fire Protection Association’s Lightning Protection Code (Reference 8A-4)

This code is utilized as recommended practices only. It does not apply to electrical generating plants.

(5) IEEE-666, Design Guide for Electric Power Service Systems for Generating Stations (Reference 8A-8)

(6) IEEE-1050, Guide for Instrumentation and Control Equipment Grounding in Generating Stations (Reference 8A-9)

(7) IEEE-C62.23, Application Guide for Surge Protection of Electric Generating Plants (Reference 8A-10)

8A.1.3 COL License Information

It is the responsibility of the COL applicant to perform ground resistance measurements to determine that the required value of one ohm or less has been met and to make additions to the system if necessary to meet the target resistance.

8A.2 Cathodic Protection

8A.2.1 Description

A cathodic protection system is provided. Its design is plant unique as it must be tailored to the site conditions. The COL applicant must provide a design meeting the requirements listed in Subsection 8A.2.3.

8A.2.2 Analysis

There are no SRP or regulatory requirements nor any national standards for cathodic protection systems. The system is designed to the requirements listed in Subsection 8A.2.3.

8A.2.3 COL License Information

The COL applicant is required to meet the following minimum requirements for the design of the cathodic protection systems. These requirements are the same as those called for in Chapter 11, Section 9.4 of the Utility Requirements Document issued by the Electric Power Research Institute (Reference 8A-5).

(1) The need for cathodic protection on the entire site, portions of the site, or not at all shall be determined by analyses. The analyses shall be based on soil resistivity readings, water chemistry data, and historical data from the site gathered from before commencement of site preparation to the completion of construction and startup.

(2) Where large protective currents are required, a shallow interconnected impressed current system consisting of packaged high silicon alloy anodes and transformer-rectifiers, shall normally be used. The rectifiers shall be approximately 50% oversized in anticipation of system growth and possible higher current consumption.

(3) The protected structures of the impressed current cathodic protection system shall be connected to the station grounding grid.

(4) Localized sacrificial anode cathodic protection systems shall be used where required to supplement the impressed current cathodic protection system and protect surfaces which are not connected to the station grounding grid or are located in outlying areas.

(5) Prepackaged zinc type reference electrodes shall be permanently installed near poorly accessible protected surfaces to provide a means of monitoring protection level by measuring potentials.

(6) Test stations above grade shall be installed throughout the station adjacent to the areas being protected for termination of test leads from protected structures and permanent reference electrodes.

8A.3 Electric Heat Tracing

8A.3.1 Description

The electric heat tracing system provides freeze protection where required for outdoor service components and fluid warming of process fluids if required, either in or out doors. If the operation of the heat tracing is required for proper operation of a safety-related system, the heat tracing for the safety-related system is required to be Class 1E. Power for heat tracing is supplied from buses backed by the onsite standby generators. Non-Class 1E heat tracing has access to the combustion turbine generator through the same load group as the components protected. Class 1E heat tracing is assigned to the appropriate division of Class 1E power.

8A.3.2 Analysis

There are no SRP or regulatory guidance provided for electric heat tracing systems. They are required to be designed and installed to the applicable sections of the following codes and standards.

(1) IEEE-622, Recommended Practice for the Design and Installation of Electric Heat Tracing Systems in Nuclear Power Generating Stations (Reference 8A-6)

(2) IEEE-622A, Recommended Practice for the Design and Installation of Electric Pipe Heating Control and Alarm Systems in Nuclear Power Generating Stations (Reference 8A-7)

8A.3.3 COL License Information

No COL applicant information is required.

8A.4 References

The following codes and standards have been referenced in this section of Tier 2.

8A-1 IEEE-80, Guide for Safety in AC Substation Grounding

8A-2 IEEE-81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

8A-3 IEEE-665, Guide for Generation Station Grounding

8A-4 NFPA-78, National Fire Protection Association's Lightning Protection Code

8A-5 Utility Requirements Document, Advanced Light Water Reactor, Volume II, ALWR Evolutionary Plant, Electric Power Research Institute

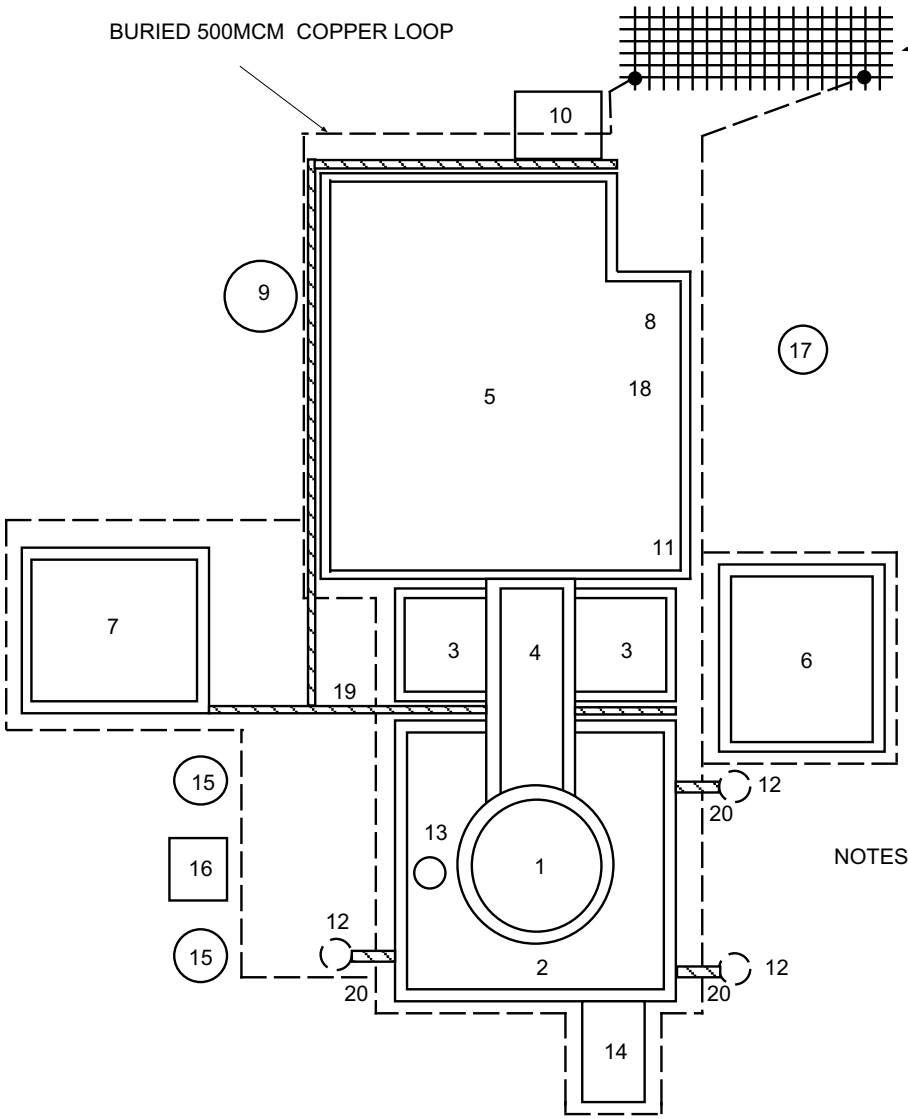
8A-6 IEEE-622, Recommended Practice for the Design and Installation of Electric Heat Tracing Systems in Nuclear Power Generating Stations

8A-7 IEEE-622A, Recommended Practice for the Design and Installation of Electric Pipe Heating Control and Alarm Systems in Nuclear Power Generating Stations

8A-8 IEEE-666, Design Guide for Electric Power Service Systems for Generating Stations

8A-9 IEEE-1050, Guide for Instrumentation and Control Equipment Grounding in Generating Stations

8A-10 IEEE-C62.23, Application Guide for Surge Protection of Electric Generating Plants



NO.	FACILITY
1	REACTOR CONTAINMENT
2	REACTOR BUILDING
3	CONTROL BUILDING
4	MAIN STEAM/FEEDWATER TUNNEL
5	TURBINE BUILDING
6	SERVICE BUILDING
7	RADWASTE BUILDING
8	HOUSE BOILER
9	CONDENSATE STORAGE TANK
10	UNIT AUXILIARY TRANSFORMERS
11	NORMAL SWITCHGEAR
12	DIESEL OIL STORAGE TANK (3 BURIED)
13	STACK
14	EQUIPMENT ENTRY LOCK
15	FIRE PROTECTION WATER STORAGE TANK (2)
16	FIRE PROTECTION PUMPHOUSE
17	BUNKER FUEL TANK
18	COMBUSTION TURBINE GENERATOR
19	RADWASTE TUNNELS RB, CB, TB
20	DG OIL TRANSFER TUNNEL (3)

NOTES;

STRUCTURES AND BUILDINGS TO BE GROUNDED TO THE YARD LOOP PER THE FOLLOWING SPECIFICATIONS:

A. ELECTRICAL GROUNDING REQUIREMENTS SPECIFICATIONS

B. LIGHTNING PROTECTION SPECIFICATION

Figure 8A-1 Site Plan (Grounding)