# Appendix 2D
# Electrical Engineering Design Criteria

**APPENDIX 2D**

# Electrical Engineering Design Criteria

## 2D.1 Introduction

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and construction of electrical engineering systems for the Hidden Hills Solar Electric Generating System. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specification, and construction specifications.

## 2D.2 Codes and Standards

The design of the electrical systems and components will be in accordance with the laws and regulations of the federal government and the State of California, local ordinances, and industry standards. The current issue or revision of the documents at the time of filing this Application for Certification will apply, unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirement will apply.

The following codes and standards are applicable to the electrical aspects of the power facility:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- California Building Standards Code 2010
- California Electrical Code 2010
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- National Association of Corrosion Engineers (NACE)
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

## 2D.3 Switchyard and Transformers

### 2D.3.1 Switchyard

The project consists of two independent plants. Both plants tie into a new 230 kV switchyard. Each site has a steam turbine generator that will connect to the switchyard via a generator step-up transformer.

The switchyard will employ a breaker-and-a-half scheme with disconnect switches on each side of the breakers. Each line will be equipped with the appropriate instrument transformers for protection and metering. Instrument transformers will also be used for generator synchronizing. Surge arresters will be provided for the outgoing lines in the area of the takeoff towers.

The switchyard will be located in the site's common area. This area is the closest to the connecting transmission line. An overhead span will be required for the transmission line connection.

The breakers will be of the dead tank design with current transformers on each bushing. Disconnect switches will be located on each side of the breakers to isolate the breaker, and one switch will be located at each line termination or transformer connection for isolation of the lines or transformer for maintenance. Tubular bus used on the bus will be aluminum alloy. Cable connections between the tube bus and equipment will be ACSR, AAAC, or AAC cable. Tube and cables will meet all electrical and mechanical design requirements. Instrument transformers (current and capacitive voltage transformers) will be included for protection and synchronization.

A grounding grid will be provided to control step and touch potentials in accordance with IEEE Standard 80, Safety in Substation Grounding. Metallic equipment, structures, and fencing will be connected to the grounding grid of buried conductors and ground rods, as required for personnel safety. The substation ground grid will be tied to the plant ground grid.

Lightning protection will be provided by shield wires or lightning masts. The lightning protection system will be designed in accordance with IEEE 998 guidelines.

All faults will be detected, isolated, and cleared in a safe and coordinated manner as soon as practical to ensure the safety of equipment, personnel, and the public. Protective relaying will meet IEEE requirements and will be coordinated with the utility.

Revenue metering will be provided for each power block connection at the station's switchyard to record net power to or from the utility. Meters and a metering panel will be provided.

### 2D.3.2 Transformers

The generators will be connected to the 230-kV switchyards through main step-up transformers. The step-up transformers will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.91. The step-up transformers will be two-winding, delta-wye, ONAN/ONAF/ONAF. The neutral point of high-voltage winding will be solidly grounded. Each main step-up transformer will have metal oxide surge arrestors connected to the high-voltage terminals and will have manual de-energized ("no-load") tap changers located in high-voltage windings.

Each power block's startup power will be backfed from the utility through the GSU transformer and the unit auxiliary transformer. When the unit is shut down, auxiliary power will be fed from one 33/4.16 kV station service transformer. The station service transformer shall be connected to a local utility line and shall be metered separately.