APPENDIX 2E

Electrical Engineering Design Criteria

APPENDIX 2E

Electrical Engineering Design Criteria

2E1 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 Contra Costa Generating Station (CCGS). More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement, and construction specifications as required by the California Energy Commission (CEC).

2E2 Codes and Standards

The design of the electrical systems and components will be in accordance with the laws and regulations of the federal government, State of California, Contra Costa County, and industry standards. The current issue or revision of the documents at the time of the filing of this Application for Certification (AFC) will apply, unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirement shall 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 Code (CBC) 2007
- California Electrical Code 2007
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- National Association of Corrison Engineers
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

2E3 Switchyard and Transformers

2E3.1 Switchyard

The CCGS switchyard will be located on the West side of the site and will interconnect to nearby Contra Costa Substation, Pacific Gas & Electric, (PG&E) with aboveground aerial cables depending upon the final design interface with PG&E.

The CCGS switchyard will be of the air-insulated aluminum bus type and will consist of high voltage SF_6-insulated dead-tank circuit breakers arranged in a radial configuration. Connections to the nodes will be provided for each generator and for the inter-ties to the utility grid. Each circuit breaker will be equipped with a no load break, air-insulated, disconnect switch on each side. Air-insulated tubular aluminum bus will be used as the primary bus construction and interconnection material within the switchyard. The buses will be attached to post insulator columns on structural steel supports.

Current and voltage transformers will be located at points within the switchyard to provide for metering and relaying.

Control, protection and monitoring for the switchyard will be located in the electrical building and generation control module. Monitoring and alarms will be available to the DCS operator workstations in the control room. All protection and circuit breaker control will be powered from the 125 Vdc system.

The switchyard design will meet the requirements of the National Electrical Safety Code—ANSI C2.

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

Lightning protection will be provided by shield wires and/or lightning masts for any overhead lines. The lightning protection system will be designed in accordance with IEEE 998 guidelines.

All faults shall be detected, isolated, and cleared in a safe and coordinated manner as soon as practical to insure the safety of Equipment, Personnel, and the Public. Protective relaying will meet IEEE requirements and will be coordinated with PG&E's requirements.

The protection will be designed to maintain integrity when isolating a faulted node. Each circuit breaker will be provided with independent breaker failure relay protection scheme. Breaker failure protection will be accomplished by protective and timing relays for each breaker. Each high voltage breaker will have 2 redundant trip coils.

Interface with PG&E's supervisory control and data acquisition (SCADA) system will be provided. Interface will be at the interface terminal box and RTU. Communication between the facility switchyard and the control building to which it is connected will be included.

2E3.2 Transformers

Each generator will be connected to the 230kV switchyard through a separate 18-kV to 230-kV generator step-up, GSU, transformers. The GSU transformers will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.116 and will be two-winding, delta-wye, ONAN/ONAF/ONAF, 65°C rise. The neutral point of the HV winding wye-connected winding will be solidly grounded. Each GSU transformer will have metal oxide surge arrestors adjacent to the HV terminals and will have manual de-energized ("no-load") tap changers located in the HV windings.

Two (2) generators will be connected to their GSUs through low side generator breakers to allow auxiliary power taps at 18 kV. The 18 kV generator bus taps will supply power to two (2) unit auxiliary transformers, UAT, which will be two winding, delta-wye connected, 18kV to 4.16kV with a low-impedance grounding resistor connected to the transformer low side neutral bushing. The UATs will supply power to a double-ended 4.16 kV switchgear line-up with circuit breakers and fused medium voltage motor starting contactors.

Facility power for 480V loads will be supplied through six (6) secondary unit substation, SUS, transformers for which each will derive high side power from the double-ended 4.16kV switchgear. The SUS transformers will be provided as two-winding, delta-wye 4.16 kV to 480V transformers with high-impedance grounding resistors connected to the transformer low side neutral bushing.