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APPENDIX 10D

Electrical Engineering Design Criteria

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10D1 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 facility. 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.

10D2 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 and industry standards. The current issue or revision of the documents at the time of the filing of this 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.

- The Antifriction Bearing Manufacturers Association (AFEMA)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- California State General Order 95
- California State General Order 128
- Edison Electric Institute (EEI)
- 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)
- Occupational Safety and Health Act (OSHA)
- Underwriters' Laboratories (UL)

10D3 General

The complete electrical system shall be designed for personnel safety, reliable service, the addition of future loads, ease of maintenance, convenience of operation and interchangeability of equipment.

The equipment, its operation and mechanical strength, will be selected and coordinated in line with applicable codes and code practice.

10D4 Power Systems

10D4.1 Voltage Levels

The following voltage levels are will be used for the applications listed unless otherwise approved by the Applicant:

VOLTAGE LEVEL	APPLICATION
230 kV, 3 phase, 60Hz	High voltage power distribution and transmission
69 kV, 3 phase, 60Hz	Medium voltage power supply for plant start-up and maintenance
16.5 kV or 18.2 kV, 3 phase, 60 Hz	Power generation & primary distribution level
4160 V, 3 phase, 60 Hz	Service to motors greater than 200 horsepower and secondary distribution system
480 V, 3 phase, 60 Hz	Service to motors 3/4 through 200 horsepower inclusive, welding receptacles
480Y/277 V, 3 phase, 60 Hz	Lighting
208Y/120 V, 3 phase, 60Hz	Receptacle and specific low power circuits
120 V, Single phase, 60 Hz	Inverter output, instrumentation control circuits, and motors smaller than 3/4 horsepower
125 V, dc	Switchgear control and inverter battery supplies

10D4.2 Plant Electrical Distribution System

The plant electrical distribution system shall be of the secondary selective type.

Power voltage levels shall be established at each bus. Transformers establishing these voltage levels shall be sized to power 100 percent of the operating load on single ended operation. The required transformer size shall be based on the transformer self-cooled rating at 55ºC operation.

Electrical equipment shall be fully rated for the available fault level. Tiebreakers shall be operated normally open.

Electrical system shall be fully coordinated for both ground faults and phase faults.

The 4160-volt systems shall be resistance grounded at the transformer secondary neutral with ground detection alarm.

The 480-volt, 3-phase, 3-wire systems shall be high resistance at the transformer secondary neutral with ground detection alarm.

The grounding resistors for 4160-volt systems shall be rated at 400 amperes for 10 seconds.

Phasing shall be 1, 2, 3 from left to right, and top to bottom, facing the front of the switchgear.

10D5 Grounding

The station grounding system will be an interconnected network of bare copper conductor and ground rods. The system will be provided to protect plant personnel and equipment from the hazards that can occur during power system faults and lightning strikes. A plant and switchyard ground grid study shall be performed using ETAP or other approved ground grid design software.

10D5.1 Design Basis

The station grounding grid will be designed for adequate capacity to dissipate heat from ground current under the most severe conditions in areas of high ground fault current concentrations, with grid spacing such that safe voltage gradients are maintained. Bare conductors to be installed below grade will be spaced in a grid pattern to be indicated on the construction drawings. Each junction of the grid will be bonded together by a compression connectors or an exothermal welding process.

Grounding stingers will be brought through the ground floor and connected to the building steel and selected equipment. The grounding system will be extended, by way of stingers and conductor installed in cable tray, to the remaining plant equipment.

10D6 230 kV Switchyards and Transmission Lines

10D6.1 230 kV Switchyard

The 230 kV switchyard for the power plant will be outdoor, air-insulated, and consist of twelve (12) high voltage SF_6 insulated circuit breakers arranged in a "breaker and one-half" configuration with gang-operated no-load disconnect switches on each side of each breaker.

The switchyard will be located on the west side of the site bordering the existing PG&E transmission tower easement for the Bellotta interconnection to the 230 kV Rancho Seco Switchyard.

The SF_6 breakers will be of dead tank design with two bushing current transformers on each bushing and will have two (2) redundant trip coils. Each circuit breaker will be provided with an independent breaker failure relay protection scheme. Breaker failure protection will be accomplished by fault detector relays and timing relays for each breaker. All circuit breaker continuous, momentary and interrupting ratings will be selected based upon the application. All circuit breakers will be rated for multiple continuous current levels, easily upgradeable in the future to the higher current ratings (i.e., 2,000 A, 3,000 A, 4,000 A).

The disconnect switches will be no-load, gang-operated, vertical break. All switches will be manually operated. One switch will be located at each line termination or transformer connection for isolation of the line or transformer for maintenance.

Where rigid bus structures are used, the bus bar will be tubular aluminum alloy. Where strain bus is used, the cables will be AAC, or ACRS. Cable connections between the tube bus and equipment will be AAC or ACSR cable. Tube and cables will meet all electrical and mechanical design requirements. The phasing arrangement of the CPP switchyard will be 3 - 2 – 1 (Phases A – B – C) east to west and north to south. (SMUD transmission line phase rotation is C-B-A [1 – 2 – 3]).

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 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. 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 ensure the safety of equipment, personnel, and the public. Protective relaying will meet IEEE requirements and will be properly coordinated. Switchyard protective relaying, metering and control panels will be located in the switchyard control house. All 230 kV CPP Switchyard alarms, bus voltages and breaker positions will be sent to the Control Room.

Each bus and line will be provided with a redundant high impedance differential relay system. Each outgoing line will be provided with redundant high-speed relay systems with transfer trip capability.

Each circuit breaker will be provided with an independent breaker failure relay protection scheme. Breaker failure protection will be accomplished by fault detector relays and timing relays for each breaker.

Communication between the CPP switchyard and the Rancho Seco Switchyard at the other end of the overhead transmission lines will be included. Remote Terminal Units (RTUs) will allow interface and remote control of the switchyard.

Revenue metering will be provided on the 230 kV outgoing lines recording net power to or from the switchyard (bidirectional). Meters and the metering panel will be provided.

10D6.2 230 kV Rancho Seco Switchyard

The existing 230 kV switchyard at the Rancho Seco Plant will be modified to accept the new circuits from CPP. The east and west buses will be extended south where a new bay will be added. This bay will consist of four new SF_6 circuit breakers in a breaker and one half arrangement between the east and west buses. A dead-end structure(s) will be installed to terminate the aerial cables from the CPP. Two circuits will connect to the switchyard at this location. Motor-operated disconnect switches will be installed on the dead-end structure(s) for each circuit.

Materials, spacing and construction techniques for the extension will be similar to those of the existing yard. Protective relaying, metering and control for the new bay will be located in the existing switchyard control house.

10D6.3 230 kV Transmission Lines

A short transmission line will be used to connect the CPP to the existing 230 kV switchyard at the Rancho Seco Plant. Two circuits will be supported from monopole towers that will run parallel and adjacent to the existing PG&E Bellotta easement near the switchyard where they will bear east to the new dead-end structures at the switchyard expansion.