

Appendix F
Electrical Engineering Design Criteria

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F.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 Watson Cogeneration Steam and Electric Reliability Project (Project). 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).

F.2 CODES AND STANDARDS

The design of the electrical systems, subsystem, and components will be in accordance with the laws and regulations of the federal government, State of California, Los Angeles County, and City of Carson local agencies and industry standards. The most current issue or revision of rules, regulations, codes, ordinances, and standards 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)
- ASTM International (ASTM)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- California Electrical Code (CEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

F.3 FACILITY AND TRANSFORMERS

F.3.1 Facility

The facility will generate power at 13.8 kilovolts (kV) and step it up to 69 kV for internal power distribution for the Watson facility and neighboring refinery. The generator output will be connected to the 13.8 to 69 kV transformer by non-segregated phase bus duct. Two 69 to 230 kV transformers will step the power up for connection to the existing 230 kV gas insulated substation (GIS) Watson substation for export to the grid via two existing transmission lines.

The new 69 kV switchgear will be a GIS ring bus configuration. It will be located on existing Watson facility grounds. The two transformers connecting the 69 kV GIS to the 230 kV GIS are rated approximately 200 MVA each, top rating.

Facility electrical equipment including medium and low voltage switchgear, motor control centers, and batteries and UPS systems will be located in an on-site Power Distribution Center walk-in enclosure.

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

All electrical 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 coordinated with PG&E's requirements.

F.3.2 Transformers

The generator will be connected to the 230 kV switchyard through two 230 to 69 kV transformers connecting the 230 kV GIS to the 69 kV GIS and through a 69 to 13.8 kV generator step-up transformer (GSU). The GSU will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.116. The transformer will be two-winding, delta-wye, Oil Non Forced Air Non Forced (ONAN)/Oil Non Forced Air Forced (ONFA)/ONFA cooling, and 65 degrees Celsius (°C) rises. The neutral point of the high voltage (HV) wye-connected winding will be solidly grounded. Each GSU will have metal oxide surge arrestors adjacent to the HV bushing terminals. The GSUs will have manual de-energized ("no-load") tap changers located in the HV windings.

The generator will be connected to the GSU through a low-side generator breaker to allow a tap for a unit auxiliary transformer. The unit auxiliary transformer steps the 13.8 kV down to 4,160V and connect to 4,160V switchgear via a non-segregated phase bus duct by way of a main circuit breaker to supply the facility 4,160V loads. The 13.8 to 4.16 kV transformer is sized to supply 100 percent of the combustion turbine's auxiliary loads with suitable margin across the site's full ambient temperature range. The unit auxiliary transformer 4,160V winding neutral will be connected to ground grid through low-impedance grounding resistors to limit system ground fault current.

TABLE F1
DESIGN AND CONSTRUCTION LORS

LORS	Applicability	Compliance
Go-128, CPUC, “Rules for Underground Electric Line Construction”	CPUC rule covers required clearances, grounding techniques, maintenance, and inspection requirements.	3.6.2: 3.5.4 3.9.3: 3.4.11.2
Title 8 CCR, Section 2700 <i>et seq.</i> “High Voltage Electrical Safety Orders”	Establishes essential requirements and minimum standards for installation, operation, and maintenance of electrical installation and equipment to provide practical safety and freedom from danger.	3.6 3.9.3
GO-52, CPUC, “Construction and Operation of Power and Communication Lines”	Applies to the design of facilities to provide or mitigate inductive interference.	3.6. 3.9.3 3.4.5

Notes:

- CCR = California Code of Regulations
- CPUC = California Public Utilities Commission
- LORS = laws, ordinances, regulations, and standards

TABLE F2
ELECTRIC AND MAGNETIC FIELD LORS

LORS	Applicability	Compliance
Decision 93-11-013, CPUC	CPUC position on EMF reduction.	3.6.4.3
GO-131-D, CPUC, “Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities in California”	CPUC construction application requirements, including requirements related to EMF reduction.	3.6 3.4.5
ANSI/IEEE 544-1994, “Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines”	Standard Procedure for measuring EMF from an electric line that is in service.	3.6.4.3

Notes:

- ANSI = American National Standards Institute
- CCR = California Code of Regulations
- CPUC = California Public Utilities Commission
- EMF = electromagnetic field
- IEEE = The Institute of Electrical and Electronics Engineers
- LORS = laws, ordinances, regulations, and standards

TABLE F3
HAZARDOUS SHOCK LORS

LORS	Applicability	Compliance
8 CCR 2700 <i>et seq.</i> “High Voltage Electrical Safety Orders”	Establishes essential requirements and minimum standards for installation, operation, and maintenance of electrical equipment to provide practical safety and freedom from danger.	3.6.4.3 3.6.5.3 3.6.2
ANSI/IEEE 80, “IEEE Guide for Safety in AC Substation Grounding”	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.	3.6.2
NESC, ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C	Covers grounding methods for electrical supply and communications facilities.	3.6.2

Notes:

- AC = alternating current
- ANSI = American National Standards Institute
- CCR = California Code of Regulations
- IEEE = The Institute of Electrical and Electronics Engineers
- LORS = laws, ordinances, regulations, and standards
- NESC = National Electrical Safety Code

TABLE F4
COMMUNICATIONS INTERFERENCE LORS

LORS	Applicability	Compliance
47 CFR 15.25, “Operating Requirements, Incidental Radiation”	Prohibits operations of any device emitting incidental radiation that causes interference to communications; the regulation also requires mitigation for any device that causes interference.	3.6.4.3: 3.6.5:
GO-52, CPUC	Covers all aspects of the construction, operation, and maintenance of power and communication lines, and specifically applies to the prevention or mitigation of inductive interference.	3.6. 3.9.3 3.4.5
CEC staff, Radio Interference and Television Interference (RI-TVI) Criteria (Kern River Cogeneration) Project 82-AFC-2, Final Decision, Compliance Plan 13-7	Prescribes the CEC’s RI-TVI mitigation requirements, developed and adopted by the CEC in past citing cases.	3.6.4.3

Notes:

- AFC = Application for Certification
- CEC = California Energy Commission
- CFR = *Code of Federal Regulations*
- CPUC = California Public Utilities Commission
- LORS = laws, ordinances, regulations, and standards