8.3 ONSITE POWER SYSTEM

The description in this section is on a unit basis. Units 1 and 2 are identical in configuration and differ only in nomenclature.

The Onsite Power System for each unit consists of the various auxiliary Electrical Systems designed to provide reliable electrical power during all modes of operation and shutdown conditions. The systems have been designed with sufficient power sources, redundant buses, and required switching to provide reliable electrical power.

A one-line diagram of the station's Onsite Power System is shown on Figure 8.3-1, which indicates that power to supply the station electrical requirements is available via the station power transformers and the auxiliary power transformer.

The Offsite Power System in combination with the Onsite Power System has been shown by analysis and test to possess sufficient capacity and capability to automatically start and subsequently operate all safety loads within their voltage ratings for anticipated transients and accidents. The worst sustained undervoltage condition in the Onsite Power System vital buses, while connected to the Offsite Power System with two 500/13 kV transformers supplying the vital buses, was found to occur with the 500-kV offsite system at the minimum expected voltage with a concurrent loss-of-coolant accident (LOCA) on Unit 2 while in Mode 1 and Unit 1 in Mode 3 (or vice versa). This undervoltage condition results from the automatic transfer of the group buses from the auxiliary power transformers to the station power transformer and the automatic start of the required vital bus loads. The 4160-V Undervoltage Protection System is described in Section 8.3.1.2.

8.3.1 AC Power

8.3.1.1 Station Power and Auxiliary Power Transformers

The 500-13 kV station power transformers are connected to different bus sections of the 500-kV switching station as indicated on Figure 8.2-2. Each has the capacity to start both units at the same time.

The 13-kV north ring bus arrangement is shown on Figure 8.3-2. Sectionalizing breakers in this ring bus are normally open and each 500-13 kV transformer T1 and T2 feeds two (one for each unit) 13-4 kV station power transformers T11, T21 and T12, T22 associated with group buses. The 13kV south bus arrangement is shown on Figure 8.3-2a. Each isolated section (A and D) of the bus is powered from 500-13kV transformer T3 and T4 respectively and feeds two, one for each unit, 13-4kV station power transformers T13, T24 and T14, T23 associated with vital buses and circulating water switchgear. The 13-4kV station power transformers T13 and T14 (Unit 1) share the loads of three vital buses and two CW bus sections while T23 and T24 (Unit 2) share the loads of three vital buses and two CW bus sections. The 13-kV bus arrangements assure a continuous preferred power supply to each unit in the event one 500-13 kV transformer should become inoperable.

The 25-4-4 kV auxiliary power transformer primary side is connected to the generator isolated phase bus. Each of the two 4-kV secondary windings is connected to two 4160-V group buses.

8.3.1.2 4160-Volt System

The 4160-V system is divided into four group bus sections, three vital bus sections and two circulating water bus sections as shown on Plant Drawings 203001, 203062, 203002 and 602939.

The group buses feed plant auxiliaries other than engineered safeguards equipment. The group buses are energized by the 13-4 kV station power transformers during startup. After the generator is synchronized to the 500-kV system, the group buses are manually transferred to the 25-4-4 kV auxiliary power transformer. Should a unit trip, each 4160-V group bus automatically transfers from the auxiliary power transformer source to the station power transformer source.

The vital buses are fed directly from 13-4kV station power transformer T13, T14 (Unit 1) and T23, T24 (Unit 2). During normal operation, two of the vital buses are supplied from one station power transformer and the third from the other station power transformer. Station power transformers T13, T14 (Unit 1) and T23, T24 (Unit 2) are also power source for two sections of CW switchgear. The tie breaker between these sections is normally open. The in-feed breakers on each vital bus from the two station power transformers are electrically interlocked to prevent paralleling both sources through a vital bus. These in-feed breakers provide means for transferring between sources in the event of an interruption of power from one source. Control power for each of the three 4160-V vital buses is provided by a normal feed from one battery and an emergency feed from another battery through two manually-operated, mechanically-interlocked molded case circuit breakers. Each 4-kV vital bus provides power to a 460-V and 230-V bus. There are no interconnections between the redundant 460 or 230-V vital buses.

In the following discussion, component numbers for Unit 1 are used. The functional description applies to Unit 2 as well.

The 4-kV vital buses are normally energized from either No. 13 or No. 14 station power transformer through in-feed breakers 13ASD, 13BSD, 13CSD or 14ASD, 14BSD, 14CSD. In the event the normal source to a 4-kV bus becomes unavailable, that bus can be automatically transferred to its alternate source, provided the following conditions are met (assume No. 14 transformer is the normal source for vital bus 1A):

1. 1A bus differential or overload relays have not operated. Voltage on the bus is below a predetermined value. Breaker 14ASD is open.

2. 1ADD breaker (diesel generator) is open. No. 13 station power transformer is energized. SEC bus undervoltage relay has not operated.

In the event all offsite power is lost, the standby diesel generators are automatically started and the normal in-feed breakers to each 4-kV vital bus are opened. When the diesel generator is up to speed and voltage, its generator breaker is closed to energize that 4-kV bus. An interlock from the diesel generator breaker prevents closure of either in-feed breaker to that bus, thereby preventing any interconnection between redundant 4-kV buses.

The above controls and interlocks are in conformance with the provisions of Regulatory Guide 1.6.

Undervoltage protection on the 4160-V vital buses is provided in two levels as described below.

The first level uses undervoltage relays to sense the loss of offsite power. These relays monitor the 4160-V vital buses. When the voltage on these buses drops below 70 percent of its rated voltage, the undervoltage relays drop out. The drop-out action of the relays isolates the buses from the offsite sources, and initiates the SEC to accomplish safeguards loading.

The Second Level Undervoltage Protection System (SLUPS) is comprised of three under voltage and time delay relays per vital bus which react after the voltage at the vital bus drops below the setpoint of 95.1 percent (94.6% by technical specifications, the difference is relay calibration range) of rated voltage and does not recover to the relay reset setpoint for a period of 13 seconds.

Each SLUPS relay operates an auxiliary relay which provides an input to the undervoltage relays associated with the vital bus Safeguards Equipment Controller (SEC). The SEC utilizes this input to provide a two-out-of-three relay intelligence to separate the vital bus from the offsite power source and load it onto its associated emergency diesel generator. One of these SLUPS relays will also operate the vital bus 70-percent auxiliary relays (one for each SEC) to provide a two-out-of-three bus undervoltage intelligence similar to the 70-percent protection scheme.

A failure analysis has been completed for each component in the system. That analysis demonstrates that no single failure will result in the creation of an unanalyzed condition. This configuration:

1. Eliminates the possibility of vital bus flip-flopping.

2. Provides for separation of the vital buses from the preferred source on an individual basis only.

3. Satisfies GDC-17 relative to maintaining the connection between the offsite source and the onsite distribution system, as clarified in the following paragraphs.

Two situations exist whereby a single vital bus could be separated from its offsite source (SPT) when the offsite source is operating within expected limits. The first case occurs as a result of failure of the relay providing the No. 1 input to the affected SEC, coincident with a LOCA signal. This is judged to be acceptable on the following bases:

1. The affected vital bus is automatically loaded onto its emergency source and is available for accident mitigation.

2. The separation occurs only as a result of a failure of the relay providing the No. 1 input to the SEC.

The second case occurs as a result of a postulated malfunction of a single SPT, such that its secondary output is less than the setpoint of the second level undervoltage system but greater than the setpoint of the primary undervoltage system. This unlikely condition would have to occur to the SPT supplying power to two of the three vital buses. For this scenario, the second level undervoltage system would operate as designed, such that after 13 seconds the affected buses would be separated from the offsite source and loaded onto the emergency source.

However, sufficient time exists (≈13 seconds) between the separation from the preferred source and the sequencing of the bus onto the emergency source to allow operation of the primary undervoltage system. The primary undervoltage system would sense a loss of power to the affected buses and, upon completion of its two-out-of-three bus logic, cause the remaining vital bus (supplied from the alternate SPT) to be separated from the preferred source. This condition has been evaluated and found to be acceptable for the following reasons:

1. Expected failure mechanisms for this type of transformer generally result in complete loss of secondary voltage.

2. The scenario described above only occurs when the degraded transformer is providing power to two of the three vital buses. Since only one of the two SPTs per unit can be loaded in such a fashion, the probability of an invalid separation occurring is further reduced.

3. In the unlikely event that this condition should occur, the bus which is separated from the functioning SPT is loaded onto its emergency source, thereby ensuring its availability in the event of an accident.

It should also be noted that the same scenario would occur if the PSE&G bulk power system was operating below expected limits. Separation from the offsite source is desirable for this condition.

Except as previously discussed, the loss of offsite power to vital buses, due to spurious operation of the voltage protection relays, will not occur when the offsite grid voltage is within its expected limits and both 500/13 kV transformers are supplying both Units 1 and 2.

There is a possibility of spurious tripping occurring during minimum grid conditions if one transformer is supplying both units' vital buses. The NRC Safety Evaluation Report dated October 21, 1981, which documents the NRC's review of Salem Station Units 1 and 2 adequacy of station electrical distribution system voltages, states that the incidence of spurious relay tripping in this case is dependent upon several events occurring simultaneously: (1) the loss of a station power transformer, (2) Loss of coolant accident on one unit, (3) shutdown of the other unit, (4) grid voltages at minimum expected value, and (5) rate of change of grid voltage exceeding the response time of the self regulating transformer. The NRC staff states that the probability of all of these events occurring simultaneously is very low and the consequences of such an occurrence would be a safe unit shutdown. Therefore, the NRC staff concludes that the incidence of spurious tripping is insignificant and Position 3 of the August 8, 1979 letter is met.

The second level undervoltage trip setpoint of 95.1 percent is based upon the results of detailed analyses of the Salem Generating Station electrical distribution system transient response characteristics. Those analyses indicate that, at the PSE&G bulk power system voltage minimum expected value and for a LOCA on one Salem unit, concurrent with the other unit in Mode 3, vital bus voltage will recover to a worst-case value of ≈97 percent. The minimum allowable trip value and trip setpoint are derived using the 90-percent minimum motor terminal voltage requirement as a starting point and then applying appropriate allowances required by Regulatory Guide 1.105. Specific motor loads not meeting the 90-percent criteria are analyzed to demonstrate the ability of those motor loads to fully meet their design function without tripping their protective devices or exceeding their thermal capabilities.

Group bus undervoltage protection (68 percent of nominal) will automatically trip the reactor coolant and condensate pump 4-kV breakers upon sensing an undervoltage (i.e., loss of voltage) condition on its respective 4-kV group bus (1E, 1F, 1G, and 1H) using 1/1 logic taken once.

8.3.1.3 460- and 230-Volt Systems

The 460-V Auxiliary System feeds most motors from 20 to 300 hp. The 230-V System feeds smaller loads and, for convenience of operation, a few motors larger than 15 hp. The 4160-V System feeds the 460-V and 230-V systems via 4160-460-V and 4160-240-V transformers.

The 460-V and 230-V Vital Bus Systems are divided into three bus sections which correlate to their respective 4160-V vital buses.

8.3.1.4 115-V ac Instrumentation Power

Four 12-kVA 115-V ac vital instrument buses (1/2 A,B,C & D) receive power from individual Uninterruptible Power Supplies (UPS) to form redundant channels for reactor control and protection instrumentation and safety-related equipment. Each vital instrument bus UPS's Rectifier receives normal source, vital 230-V ac power, converts (rectifies ac/dc) it to dc power, and then converts (inverts dc/ac) it to ac power. In the event of a 230-V ac power loss or an UPS's Rectifier malfunction, 125-V dc vital station battery power will automatically supply power to the UPS's Inverter, via the UPS's auctioneering circuit, to maintain uninterruptible ac output power.

Each UPS also contains a 12-kVA ac Line Regulator and Static Switch that receives alternate source, vital 230-V ac power from the same normal source vital 230-V ac bus. In the event of an UPS's Inverter malfunction, the Static Switch senses a loss of Inverter output voltage and automatically fast transfers the associated vital instrument bus loads to the ac Line Regulator 115-V ac output. When the UPS's Inverter voltage returns to normal, the Static Switch will automatically return the associated vital instrument bus loads to the Inverter output.

Table 8.3-1 depicts channel designations for each vital instrument bus power feed. The 115-V ac Control Power System for Units 1 and 2 is illustrated on Plant Drawing 211370.

8.3.1.5 Standby Power Supplies

The standby ac power source consists of three automatically starting diesel generators. Each diesel generator set supplies power to one 4160-V vital bus in the event of a loss of offsite power. The system is shown on Figure 8.3-1.

The nameplate continuous rating of the diesel generator units is 2600 kW, 900 rpm, 4160-V, 3 phase, 60 cycles. The units are sized to handle the loads necessary for a design basis LOCA coincident with the loss of all offsite power. The diesel generators are designed to be ready to accept load within 13 seconds after receipt of a signal to start.

The diesel generator units are located in the Auxiliary Building at Elevation 100 feet. Within the building the diesel-generators are isolated from each other and from other equipment in the area by fire walls and fire doors. An Automatic Fire Protection System is installed for the protection of the CO2 diesel generator equipment. Separate detectors are located in each compartment so that only the area containing the fire is blanketed.

The two 30,000-gallon fuel-oil storage tanks are located below the diesels at Elevation 84 feet. Each diesel generator has its own fuel oil day tank with a 550-gallon capacity. The tank is mounted above the unit for gravity feed of fuel at startup. Each diesel generator unit has its own lube-oil jacket cooling, ventilation, and dual air starting system. Cooling water is supplied by the Service Water System.

Any two of the diesel generators and their associated vital buses can supply sufficient power for operation of the required safeguards equipment for a design basis LOCA coincident with a loss of offsite power. Sufficient redundancy is provided in the safety features and their assignment to the vital buses so that failure to energize any one vital bus does not prevent operation of the required minimum safety equipment.

In addition to the emergency diesel generators, there is a gas turbine generator installed at the site. This unit is rated at approximately 40 MW and is normally used for peaking purposes.

The gas turbine unit is connected to the auxiliary electrical system such that it can be paralleled with the normal source of plant startup or standby power.

Figure 8.3-2 shows the gas turbine connection to the 13-kV ring bus system.

8.3.1.5.1 Diesel Generator Capacity and Loading

Each diesel generator unit is rated as follows:

TIME	KW	PF	KVAR	KVA
1/2 HR	≤3100	0.8	2325	3875
2 HRS	≤2860	0.8	2145	3575
2000 HRS	≤2750	0.8	2063	3438
CONT	≤2600	0.8	1950	3250

A detailed loading study (Calculation ES-9.002(Q)) has been performed for the diesel generator units based on the following:

1) Design basis Loss of Offsite Power Accident (LOPA). All three D/G's start successfully.

2) Design basis Loss of Coolant Accident (LOCA) coincident with Design Basis LOPA. All three D/G's start successfully and experience worst case active single failure.

3) Design basis LOCA coincident with Design Basis LOPA. Active single failure analyzed is one (1) D/G failing to start.

Conclusions of this study indicate that for the above mentioned scenarios, all expected loads are within the Diesel generator ratings as given above. Furthermore, the study also confirms that the auto connected loads do not exceed the short time rating (2 Hour) as defined in Regulatory Guide 1.9 Rev. 2 and IEEE STD 387-1977. Tables 8.3-2 and 8.3-3 indicate the timing and sequence in which the loads are automatically connected to the D/G's for the LOPA only and LOCA +LOPA cases.

In the event that the D/G loading requires revision, the changes will be evaluated to verify that they are enveloped by the worst case transient load (Service water pump start) and therefore do not result in unacceptable voltage and frequency responses, consistent with the intent of Regulatory Guide 1.9 Rev. 2.

In addition to prototype tests conducted in the manufacturer's plant, testing has been performed at the station to simulate the various modes of loading. These tests verified that the specified diesel generator load acceptance criteria have been met.

The diesel generators have the capability to attain rated speed and voltage within 13 seconds after receipt of the start signal,

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and to accept load in the sequence shown in Tables 8.3-2 and 8.3-3. The Loading Control System will automatically energize the required loads within 35 seconds. Safety analyses that credit the operation of the diesel generators conservatively assume start and load delay times that bound these values as well as any value specified by Technical Specifications.

The Safeguards Equipment Control (SEC) System, which controls the loading of the diesel generators, is described in Section 7. Control power for the controller in each train (A, B, and C) is supplied from the 115-V ac instrument bus in that train.

8.3.1.5.2 Diesel Generator Control and Trip Functions

The diesel generators are started automatically by the safety injection signal or indication of a loss of all offsite power to the 4160-V vital buses. The latter signal, determined using 2/3 logic, initiates the loading sequence for each vital bus. The loading sequence trips the vital bus in-feed breakers and all motor feeder breakers, closes the diesel generator breaker after the unit comes up to its speed and voltage permissive setpoints, and connects the required safeguard loads in a predetermined sequence. The loading sequence logic for each vital bus is separate and independent of that for the other buses. The diesel generator loading sequences under emergency conditions are discussed in Section 7.

Following an automatic start (by loss of normal auxiliary power or by an accident signal), the following automatic protective devices are in service during emergency startup and operation of the diesel generator:

1. Shut down the diesel generator and trip the diesel generator breaker due to:

    a. Mechanical

        1) Engine overspeed

        2) Lube oil pressure low

b. Electrical

1) Generator differential current relays

2. Trip the diesel generator breaker only due to:

a. Electrical

1) 4 kV bus differential

Manual diesel generator control is provided as follows:

1. On the local diesel generator control panels:

Diesel generator "START-STOP" selector switch, "EMERGENCY STOP" pushbutton, "LOCK-OUT" switch (key operated) "AUTO-MANUAL" mode selector switch.

Diesel generator breaker "TRIP - CLOSE" selector switch

Generator voltage "RAISE - LOWER" control switch

Speed "RAISE - LOWER" control switch

Regulator "MANUAL - AUTO" switch

Diesel unit trip relay "RESET"

Fuel transfer pump "OFF - AUTO - RUN" selector switch, "REGULAR - BACKUP" selector switch

Starting air compressor "OFF - AUTO - RUN" selector switch

Turbo air compressor "OFF - AUTO - RUN" selector switch

2. In the Control Room:

Diesel generator "START-STOP" pushbuttons, "CLOSE - TRIP" pushbuttons.

Following a manual start, the following automatic protective devices are in service during startup and operation of the diesel generator:

1. Shut down the diesel generator and trip its 4-kV circuit breaker due to:

    a. Mechanical

        1) Engine overspeed

        2) Lube oil pressure low

        3) Jacket water temperature high

        4) Lube oil temperature high

        5) Engine overcrank

    b. Electrical

        1) Generator differential current relays

        2) Loss of generator excitation

        3) Diesel generator breaker failure protection

2. Trip the diesel generator breaker only due to:

    a. Electrical

        1) Overcurrent relay

        2) Reverse power relay

3. Prevent the Diesel Generator Circuit Breaker from closing only due to:

a. Electrical

1. Syncrocloser check relay; the syncrocloser check relay provides a permissive to allow the operator to synchronize the Diesel Generator with its vital bus. The permissive will be enabled during a specific closing phase angle range, slip limit (ΔF limit), voltage range, and blocked when out of these ranges and when the breaker control switch at the Diesel Generator Control Panel is intentionally held closed prior to achieving synchronization.

Elimination of trips could cause damage to the diesel generators if a trip condition were to occur.

8.3.1.5.3 Diesel Generator Instrumentation

To facilitate control and adjustment of the diesel generators, the following instrumentation and alarms are provided.

1. Controls on the local diesel generator control panels:

   Generator ammeter (with phase selector switch), wattmeter, voltmeter (with phase selector switch), frequency meter, varmeter, field ammeter, field voltmeter, synchroscope, synchronizing lights, synchroscope switch, 4 kV bus voltmeter (with phase selector switch), diesel generator running time meter, RPM meter
   Jacket water pressure gage
   Raw water pressure gage
   Fuel oil header pressure gage
   Fuel oil transfer pump pressure gage

Air manifold pressure gage

Starting air pressure at engine (duplex gage)

Starting air tank pressure (duplex gage)

Turbo air tank pressure (two duplex gages)

Jacket water heat exchanger differential pressure (duplex gage)

Lube oil filter differential pressure (duplex gage)

Lube oil strainer differential pressure (duplex gage)

Fuel oil primary filter differential pressure (duplex gage)

Fuel oil secondary filter differential pressure (duplex gage)

Lube oil header pressure

Lube oil pump discharge pressure

Lube oil heat exchanger differential pressure

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2. Controls in the Control Room:

Diesel generator voltage, frequency, watts, amps.

3. Alarms local to the diesel generator:

Cooling water temperature low
Cooling water temperature high
Jacket water temperature high
Jacket water heater failure
Lube oil temperature high
Lube oil heater failure
Fuel oil day tank level low
Expansion tank level high
Crankcase level high/low
Engine lube oil header pressure low
Fail to start (overcrank)
Diesel generator tripped
Generator negative phase sequence
Fuel oil day tank level high
Pre-lube pump failure
Crankcase blower failure
Exciter regulator on manual control
Diesel generator locked out (for maintenance)
DC control voltage failure-a single alarm to include the following:

Loss of dc power to the engine control
Loss of dc power to the generator field
Loss of dc power to the unit trip circuit
Loss of dc power to the local alarm system

Air receiver No. 1 pressure low
Air receiver No. 2 pressure low
Generator breaker trip
Generator field ground

Expansion tank level low
Generator overspeed
Generator overvoltage
Generator loss of PT secondary voltage
Generator ground fault
Turbo air receivers low pressure

4. Alarms in the Control Room:

Diesel generator trouble (a common alarm which will be actuated by the operation of any of the above local alarms).

Diesel generator urgent trouble-a single alarm to include the following:

Jacket water temperature high
Lube oil temperature high
Engine lube oil header pressure low
Air receiver pressure low
Pre-lube pump failure
Generator ground fault
Turbo air receivers low pressure

Fuel oil day tank level trouble (a common alarm for all three unit day tanks).

Loss of dc power to the engine control, generator field, trip circuits.

Diesel generator in Local-Manual control mode, failure to start, emergency trip, locked out.

Generator breaker spring charger failure, breaker trip.

8.3.1.5.4 Diesel Generator Support Systems

Diesel Generator Support Systems are desciibed in the following sections:

Fuel Storage and Transfer System	Section 9.5.4
Jacket Water Cooling System	Section 9.5.5
Starting Air System	Section 9.5.6
Lube Oil System	Section 9.5.7

8.3.1.6 Tests and Inspections

Periodic tests will be conducted to ensure proper operation of electrical features necessary for plant safety. Tests will be conducted to identify and correct electrical or mechanical deficiencies before they result in a system failure.

Tests will be conducted periodically to verify the starting of the diesel generators on loss of voltage to the 4160-V vital buses and their ability to carry load.

The standby ac power sources (diesel generators) are automatically started and connected to the vital buses in the event the normal offsite sources become unavailable. The standby diesel generators are automatically started by either a safety injection signal or a 2-out-of-3 undervoltage signal derived from undervoltage relays located on the three 4-kV vital buses. Testability of each of these signals is provided. The Solid State Protection System (SSPS) test cabinet is used to check the continuity of the SSPS output relay contact, the field wiring, and the Safeguards Equipment Controls (SEC) input relay without actually operating the SEC unit.

The undervoltage relays can be tested by operating test switches to simulate a single bus undervoltage condition. During the test mode an alarm is actuated in the Control Room signifying that diesel generator automatic start is defeated.

Since the SEC units are completely independent of each other, the SSPS test cabinets are used to provide independent output signals from both SSPS trains to the three SEC units. Buffer relays are used on each vital bus undervoltage sensor to supply independent signals to each SEC unit. Thus, complete channel independence is maintained.

The SEC units are completely redundant. Both SSPS trains feed each SEC; a failure of an SSPS train will not negate safeguards operation. Failure of a bus undervoltage relay to operate will not negate safeguards operation since a 2-out-of-3 undervoltage logic is used to sense loss of offsite power conditions. If only one bus experiences undervoltage, and the sensor on that bus fails to recognize the condition, only that bus will not be loaded; the remaining buses will supply power to the required amount of safeguards equipment.

The diesel generators can be started and loaded during power operation. As discussed above, the 4-kV bus undervoltage relays can also be tested during power operation. The complete operation of detecting the loss of normal power sources, starting of the standby power sources, and connecting these sources to the vital buses can be accomplished during plant shutdown.

These design provisions satisfy General Design Criterion 18.

8.3.2 DC Power

8.3.2.1 250-, 125-, and 28-Volt Systems

Separate 125-V and 250-V dc sources supply power for operation of switchgear, annunciators, vital instrument buses, inverters, emergency lighting, communications, and turbine generator emergency auxiliaries. Three independent 125-V dc sources provide power to the engineered safety features. Plant Drawings 211357, 203007, 223720 and 203008 illustrate the 28-V, 125-V, and 250-V station dc systems, respectively. Safety-related loads are identified by the use of the symbols A, B, C, D on the feeders. Battery load profiles are shown in Tables 8.3-5 and 8.3-6.

As shown on Plant Drawings 203007 and 223720, three 125-V batteries are provided for each unit to supply an independent source of control power for each of the three 4160-V and 460-V vital buses and for the 125-V distribution cabinets. A backup source of control power for each of these buses is provided via manually operated breakers under administrative control.

The station dc systems provide a continuous source of power for operation of circuit breakers, valve controls, inverters, etc. No initiation or control is required to connect the batteries to the dc buses.

Two separate non-safety related 125-V dc batteries have been provided to serve the 4160 V CW switchgear, 13 kV south bus section breakers, SCADA systems and portions of switchgear relaying systems.

8.3.2.2 Station Batteries

The Station Battery System includes one non-vital 250-V, three vital 125-V, and two vital 28-V batteries, static battery chargers for each battery, and a ground detection system and undervoltage alarm relay for each bus.

The batteries are mounted on corrosion-resistant, seismically designed steel racks in separately ventilated and isolated areas. The 250-V, 125-V, and 28-V batteries are rated 1326, 2320, and 800 ampere hours, respectively, at the 8-hour rate of discharge.

Each charger maintains a floating charge on its associated battery, and is capable of supplying the required equalizing charge when necessary. Each 125-V and 28-V Battery System (one battery, two chargers, and one switchgear unit) has a ground detection system, undervoltage alarm relay, and dc voltmeters and ammeters. Each 28-VDC charger is equipped with an ac failure relay. Loss of ac input and/or dc output is annunciated in the Control Room. Each Unit 1 125-VDC battery charger is equipped with a loss of AC voltage alarm. Each Unit 2 125-VDC charger is equipped with a summary trouble alarm which indicates AC Power Failure, High Voltage Shutdown, No Charge and High/Low Voltage. Alarms from both Unit 1 and Unit 2 battery chargers are printed in the Control Room.

Each 125-VDC battery is connected to its associated switchgear through a disconnect switch and protective fuses. The 250-V AND 28-VDC batteries are connected to their associated switchgear through protective fuses. The dc distribution switchgear consists of metal-clad structures, each with an ungrounded main bus, and 2 pole air circuit breakers.

During normal operation, the dc load is fed from the battery chargers with the batteries floating on the system. Upon loss of dc power from a battery charger, the dc load is drawn from the batteries. The batteries are sized for 2 hours of operation after a loss of ac power, based upon the required operation of the dc emergency equipment. If all offsite power is lost, the battery chargers are energized from the emergency diesel generators and resume their function automatically.

8.3.2.3 Station Battery Monitoring

Two chargers, each capable of 100-percent normal load, are provided for each 28-V and 125-V dc battery. Each normal charging source supplies the continuous dc loads and maintains a float charge on the battery to ensure the capability of each battery to deliver its emergency dc requirements. The 28-V and 125-V chargers are fed from the vital ac buses. Each 28-V and 125-V battery is fed from two separate vital buses. One charger is under administrative control to assure that the 230-V ac buses will not become interconnected.

One 250-V dc charger is provided due to the nature of the 250-V dc loads, with a provision to tie in the other unit's 250-V charger, if needed.

Each of the 6 batteries per unit is continuously monitored in the Control Room for voltage and discharge current. Listed below are all the monitoring devices associated with each battery. A brief description of the function of each device and its location is given.

Battery Voltmeter - Monitors dc bus voltage with continuous readout in the Control Room.

Battery Load Ammeter - Monitors discharge current with continuous readout in the Control Room.

Ground Detectors - Monitors leakage from positive and negative buses to station ground with continuous readout in the Control Room. In addition, local ground detection circuit is provided adjacent to each charger for test purposes.

Undervoltage Alarm - Monitors each dc bus and alarms in the Control Room when bus voltage drops below a preset value.

Charger Voltmeter - Monitors charger output voltage at charger cabinet.

Charger Alarm - Monitors ac input to charger and alarms in the Control Room upon loss of input voltage to both 28-VDC chargers. Each Unit 1 125-VDC battery charger is equipped with a loss of AC voltage alarm. Each Unit 2 125-VDC battery charger is equipped with a charger trouble relay which provides a summary alarm in the Control Room if the energized charger experiences an AC power failure, high voltage shutdown, no charge or high/low voltage. The 250-VDC chargers also have an overvoltage alarm in the Control Room should the bus voltage rise above a preset value.

DC Distribution Cabinet Undervoltage Alarm - Each 28-V and 125-V dc distribution cabinet is provided with an undervoltage relay which monitors bus voltage and alarms in the Control Room.

Blown Fuse Alarm - Each battery fuse is monitored to alarm in the Control Room if the fuse should blow.

Protection against overcharging is provided within the charger itself which is a constant voltage-current limited device.

Surveillance requirements are set forth in the Technical Specifications.

The general cleanliness of battery, float charge, cell cracks, electrolyte leakage, ventilation equipment, cell to cell connections, etc, are periodically inspected to assure good service and long battery life. Thus, degradation can be monitored and rectified during surveillance and testing program.

8.3.2.4 CW Switchgear Batteries

Each CW Switchgear Battery System includes one 125-V battery, two static battery chargers, ground detection and metering cabinet.

The batteries are mounted on corrosion resistant steel racks in separate ventilated and isolated areas located in the Circulating Water Switchgear Building. Each battery is rated 960 ampere-hours at the 8-hour rate of discharge.

Each charger maintains a floating charge on its associated battery, and is capable of supplying the required equalizing charge when necessary. Each battery charger provides a charger failure alarm signal to the SCADA System.

The battery is connected to its associated 125-V distribution panel through protective fuses and a manual transfer switch. The manual transfer switch allows either 125-V distribution panel to be switched to the other battery if its own battery is out of service.

During normal operation, the dc load is fed from the battery chargers with the battery floating on the system. Upon loss of AC power to the battery chargers and the P250 computer inverter, the battery can supply the full P250 inverter load of 15KVA for up to 2 hours and the remaining DC loads for up to 4 hours.

8.3.3 Containment Penetration/Conductor Overcurrent Protection

The containment penetrations/conductors are protected by deenergizing circuits which are not required for reactor operation and by ensuring the operability of primary/backup overcurrent protective devices through periodic testing of equipment/systems. The containment penetration/conductor overcurrent protection devices are listed in and controlled by Engineering Calculations Numbers ES-13.010(Q) and ES-13.005 (Q) for Salem Units 1 and 2, respectively. An integrated system functional test includes the simulated automatic actuation of circuit breakers to verify response times and trip setpoints.