8.0 ELECTRIC POWER

8.1 INTRODUCTION

8.1.1 Utility Grid Description

The generator units are connected to the respective transmission systems. The utilities have integrated transmission networks and interconnections with neignboring systems. A description of the system network and interconnections for the utility will be provided by the plant specific applicant.

8.1.2 Onsite Power System Description

One preferred circuit from the switchyard supplies power via the main transformer and a three winding auxiliary transformer. The second preferred (offsite) circuit is connected to a three winding standby transformer. Each of the transformer's secondary windings feed two 13.8 kV busses which in turn feed associated 4.16 kV and 480V loads. Refer to Figure 8.3-1 (sheets 1 and 2).

The two 13.8 kV busses supply power to safety related loads via 13.8/4.16 kV station service transformers. The safety related 480V loads are supplied from the 4.16 kV busses via 4.16/480 V transformers. A separate ESF transformer is provided for safety related loads only with the primary connection to the switchyard.

The 13.8 kV busses also supply power to nonsafety-related loads via 13.8 kV/480 V transformers and 13.8/4.16 kV transformers.

The onsite power system is divided into two separate load groups, each load group consisting of an arrangement of busses, transformers, switching, and load fed from a common power supply. Power is supplied to auxiliaries at 13.8 kV, 4.16 kV, 480 V, 480/277V, 208/120V, 120V AC and 250V DC and 125V DC.

The onsite standby power system includes the Class 1E AC and DC power for equipment used to maintain a cold shutdown of the plant and to mitigate the consequences of a DBA.

Class 1E AC system loads are separated into two load groups which are powered independently from 13.8 kV busses, or separate ESF transformer or two independent diesel generators (one per load group). Each load group distributes power by a 4.16 kV bus, 480 V load centers and 480 V motor control centers.

The Class 1E DC system provides four separate 125V DC battery supplies for Class 1E controls, instrumentation, power and control inverters.

8.1.3 Safety Related Loads

Refer to Table 8.3-2 for a listing of loads supplied by the Class 1E AC system. Refer to Table 8.3-1 for a list of loads supplied by the Class 1E DC system. The loads and their safety functions are identified in the above references.

8.1.4 Design Bases

8.1.4.1 Offsite Power System

The design of the offsite power system is the responsibility of the plant specific applicant. The design must meet the interface criteria given in Subsection 8A.1.

8.1.4.2 Onsite Power System

8.1.4.2.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The onsite power system includes a separate and independent Class 1E electric power system for (GDC-17).

SAFETY DESIGN BASIS TWO - The onsite Class 1E electric power system is divided into two independent load groups, each with its own power supply, busses, transformers, loads, and associated 125V DC control power. Each load group is independently capable of maintaining the plant in a cold shutdown (GDC-17).

SAFETY DESIGN BASIS THREE - One independent diesel generator is provided for each Class 1E AC load group.

SAFETY DESIGN BASIS FOUR - No provisions are made for automatic transfer of load groups between redundant power sources.

SAFETY DESIGN BASIS FIVE - No portion (AC or DC) of the onsite standby power systems is shared between units (GDC-5).

SAFETY DESIGN BASIS SIX - The Class 1E electric systems are designed to satisfy the single failure criterion (GDC-17).

SAFETY DESIGN BASIS SEVEN - For each of the four protection channels, one independent 125V DC and one 120V vital AC power source are provided. Batteries are sized for 2 hrs of operation without the support of battery chargers.

SAFETY DESIGN BASIS EIGHT - Raceways are not shared by Class 1E and non-Class 1E cables. However, associated cables connected to Class 1E busses are treated as Class 1E cables with regard to separation and identification and are run in their related Class 1E raceway system.

SAFETY DESIGN BASIS NINE - Special identification criteria are applied for Class 1E equipment, including cabling and raceways.

SAFETY DESIGN BASIS TEN - Separation criteria are applied which establish requirements for preserving the independence of redundant Class 1E load groups or power systems. Refer to Subsection 8.3.1.4.1.

SAFETY DESIGN BASIS ELEVEN - Class 1E equipment is designed with the capability of being tested periodically (GDC-18).

SAFETY DESIGN BASIS TWELVE - Two physically and electrically independent ESF transformers are provided to supply the Class 1E AC electric power system.

8.1.4.2.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - A separate non-Class 1E DC system is provided for non-Class 1E controls and DC motors.

8.1.4.3 <u>Design Criteria, Regulatory Guides, and IEEE Standards</u>

The onsite power system is generally designed in accordance with IEEE Standards 279, 308, 317, 323, 334, 344, 379, 382, 383, 384, 387, 450, and 484.

Compliance with Regulatory Guides 1.6, 1.9, 1.22, 1.29, 1.30, 1.32, 1.40, 1.41, 1.47, 1.53, 1.62, 1.63, 1.68, 1.73, 1.75, 1.81, 1.89, 1.93, 1.100, 1.106, 1.108, 1.118, and 1.131 and IEEE Standards 323-1974, 338-1971, 344-1975, 384-1974, 387-1977, 308-1974, and 317-1976 are discussed in RESAR-SP/90 PDA Module 2, "Regulatory Conformance".

8.2 OFFSITE POWER SYSTEM

The offsite AC power supply for the startup, normal operation and safe shutdown is supplied from the transmission network. The principal interface criteria as applied to the offsite power system is described in Subsection 8A.2. The details of the transmission network will be supplied by the plant specific applicant.

The Westinghouse standard plant is designed to have two physically independent and separate power sources. The alternate offsite source provides power to the standby transformer. The primary offsite source provides power via a backfeed connection from the unit output switchyard through the main transformer and unit auxiliary transformer. This is shown on the main one line diagram, Figure 8.3-1. The two circuits will be independent so that a failure of one circuit will in no way affect the other and result in loss of both circuits.

In addition, a third transformer (ESF) will be provided which will connect to the class 1E busses only. The primary side of the transformer will be connected directly to the switchyard.

8.3 ONSITE POWER SYSTEMS

8.3.1 AC Power Systems

8.3.1.1 Description

The onsite AC power system includes a Class 1E system and a non-Class 1E system.

8.3.1.1.1 Non-Class 1E AC System

The non-Class 1E AC system is that part of the power system which is outside the broken line enclosure as indicated in Figure 8.3-1. The non-Class 1E AC system distributes power at 13.8 kV, 4.16 kV, 480 V and 120 V.

The unit auxiliary transformer is connected to the main generator via a generator circuit breaker. The supply for the primary winding of the auxiliary transformer is tapped between the generator circuit breaker and the low voltage bushings of the main step up transformer. During normal operation, the non-Class 1E AC auxiliary loads are energized by the main generator and the auxiliary transformer. The auxiliary transformer is a three winding transformer with two secondary windings rated at 13.8 kV each.

During plant startup or planned shutdown, the non-Class 1E AC loads are fed from the alternate offsite source via the main step up transformer, unit auxiliary transformer with the generator circuit breaker open.

During all modes of operation, the supply from the standby transformer serves as a backup. In the event of unit trip (except for faults in the generator-transformer zone), the circuit breaker isolates the generator from the systems. The 13.8 kV system remains energized by backfeeding through the main and auxiliary transformer from the alternate offsite source.

The auxiliary transformer and the standby transformer have the capacity to supply both non-Class 1E and both Class 1E load groups simultaneously.

The switchgears for the 13.8 kV busses are standard 1000 MVA. All circuit breakers are air break type. Each 13.8 kV bus supplies power to reactor coolant pumps, other nonsafety related motors and transformers for distribution at 4.16 kV and 480 V level.

8.3.1.1.2 Class 1E AC System

The Class 1E AC system is that portion of the onsite power system inside the broken-line enclosures shown in Figure 8.3-1, sheet 2.

The Class 1E AC system distributes power at 4.16 kV, 480 V, 208/120 V, and 120 V AC to all safety related loads. Also, the Class 1E AC system supplies certain selected loads which are not safety related but are important to the plant operation. Table 8.3-2 lists the major safety related and isolated nonsafety related loads supplied from the Class 1E AC system.

In addition to the above power distribution, the Class 1E AC system contains standby power sources which provide the power required for safe shutdown in the event of a loss of the preferred power sources.

The following describes various features of the Class 1E systems:

POWER SUPPLY FEEDERS - Each 4.16 kV load group is supplied by two preferred power supply feeders and one diesel generator (standby) supply feeder. Each 4.16 kV bus supplies motor loads and 4.16 kV/480 V load center transformers with their associated 480 V busses.

BUS ARRANGEMENTS - The Class 1E AC system is divided into two redundant load groups per unit (load groups 1 and 2). Either one of the load groups is capable of providing power to safely shutdown a unit following DBA. Each AC load group consists of a 4.16 kV bus, 480 V load centers, 480 V motor control centers, and lower voltage AC supplies.

LOADS SUPPLIED FROM EACH BUS - Refer to Table 8.3-2. for a listing of Class 1E system loads.

MANUAL AND AUTOMATIC INTERCONNECTIONS BETWEEN BUSSES, BUSSES AND LOADS, AND BUSSES AND SUPPLIES - No provisions exist for manually or automatically connecting one Class 1E load group to another redundant Class 1E load group or for automatically transferring loads between load groups. Therefore, each Class 1E load group is completely independent of its redundant load group.

Interlocks are provided that would prevent an operator error that would parallel the standby power sources of redundant load groups.

For a further discussion of interlocks, refer to Subsection 8.3.1.1.3.

INTERCONNECTIONS BETWEEN SAFETY-RELATED AND NONSAFETY-RELATED BUSSES - No interconnections are provided between the safety and nonsafety-related busses at the same voltage level. One of the safety related busses (4.16 kV) is normally supplied power from a 13.8 kV nonsafety-related bus.

There are some essential non Class 1E loads powered from each safety related 4.16 kV and 480 V busses. The 4.16 kV amd 480 V circuit breaker to which these loads are connected are qualified to Class 1E requirements of IEEE 323 and IEEE 344. These circuit breakers are automatically tripped by the safety features sequencer upon receipt of a safety injection signal, but these can be manually reclosed under administrative control. Isolation is therefore provided in accordance with the requirements of Regulatory Guide 1.75.

REDUNDANT BUS SEPARATION - The Class 1E switchgear, load centers, and motor control centers for the redundant load groups are located in separate rooms of the seismic Category 1 building in such a way as to ensure physical separation. Refer to Subsection 8.3.1.4.1 and Subsection 8.3.1.1.7 for the criteria governing redundant bus separation.

CLASS 1E EQUIPMENT CAPACITIES -

a. 4.16 kV Switchgear

Bus	2000A continuous rating

Incoming breakers	2000A continuous, 350 MVA interrupting
Feeder breakers	1200A continuous, 350 MVA interrupting

b. 480 V Unit Load Centers

Transformers	1000/1333 kVa, 3 phase, 60 Hz,
Bus	2000A continuous
Incoming breakers	1600A continuous, 50,000A rms symmetrical interrupting
Feeder breakers	800A continuous, 30,000A rms symmetrical interrupting (with instantaneous trip) 25,000A rms symmetrical interrupting (without instantaneous trip)

c. 480 V Motor Control Centers

Horizontal bus	600A continuous, 25,000A rms symmetrical
Vertical bus	300A continuous, 25,000A rms symmetrical
Breakers (molded case)	25,000A rms symmetrical, minimum interrupting (singly for thermal-magnetic breakers and in combination with a starter for magnetic only breakers)

AUTOMATIC LOADING AND LOAD SHEDDING - The automatic loading sequence of the Class 1E busses is indicated in Table 8.3-2.

If preferred, power is available to the 4.16 kV Class 1E bus following a LOCA, the Class 1E loads will be started in programmed time increments by the load sequencer. The emergency standby diesel generator will be automatically started but not connected to the bus. However, in the event that preferred power is lost following a LOCA, the load sequencer will function to shed selected loads and automatically start the associated standby diesel generator (connection of the standby diesel generator to the 4.16 kV Class 1E bus is performed by the diesel generator control circuitry). Load sequencers will then function to start the required Class 1E loads in programmed time increments.

INSTRUMENTATION AND CONTROL SYSTEMS FOR THE APPLICABLE POWER SYSTEMS WITH THE ASSIGNED POWER SUPPLY IDENTIFIED - The DC control supplies for switchgear breaker operation are separate and independent so that Class 1E DC load group 1 supplies Class 1E load group 1 switchgear. The battery chargers for DC load group 1 are fed from the same load group switchgear. Class 1E DC load group 2 supplies Class 1E load group 2 switchgear. For further information on the DC power system, refer to Subsection 8.3.2.

Each 4.16 kV switchgear bus and 480 V load center bus is equipped with an undervoltage relay for annunciation in the control room. The voltage of each bus is monitored by instruments in the control room.

ELECTRIC CIRCUIT PROTECTION SYSTEMS - Protective relay schemes or direct-acting trip devices on primary and backup circuit breakers are provided throughout the onsite power system in order to:

a. Isolate faulted equipment and/or circuits from unfaulted equipment and/or circuits

b. Prevent damage to equipment

c. Protect personnel

d. Minimize system disturbances

The short circuit protective system is analyzed to ensure that the various adjustable devices are applied within their ratings and set to be coordinated with each other to attain selectivity in their operation. The combination of devices and settings applied affords the selectivity necessary to isolate a faulted area quickly with a minimum of disturbance to the rest of the system.

Major types of protection applications that are used consist of the following:

a. Overcurrent Relaying

Each bus supply breaker (except the standby diesel breaker) is equipped with three inverse-time overcurrent relays and one inverse-time group fault relay for bus faults and to provide backup for feeder circuit relays. Bus supply breakers from the standby emergency diesel generators are equipped with three inverse-time overcurrent relays only. Ground protection is provided on the generator neutral.

Each 4.16 kV motor circuit breaker has three overcurrent relays, each with one long-time and two instantaneous elements for overload, locked rotor, and short circuit protection. Each 4.16 kV motor circuit breaker is also equipped with an instantaneous ground current relay.

The current for Class 1E motors is monitored by computer in the control room and at the Class 1E switchgear.

Each 4.16 kV supply circuit breaker to a load center transformer has three overcurrent relays with long-time and instantaneous elements. An instantaneous overcurrent ground current relay provides sensitive ground fault protection.

b. Undervoltage Relaying

Each 4.16 kV Class 1E bus is equipped with under-voltage relays for diesel generator start initiation and undervoltage annunciation.

Each 480 V Class 1E load center bus is equipped with undervoltage relays for undervoltage annunciation.

c. Differential Relaying

The main, unit auxiliary, and standby transformers are equipped with differential relays. These relays provide high-speed disconnection to prevent severe damage in the event of transformer internal faults.

Motors rated above 3,500 horsepower are equipped with differential protection.

The main generator and the standby emergency generators are provided with differential protection.

d. 480 V Load Center Overcurrent Relaying

Each 480 V load center circuit breaker is equipped with a solid state device which has an adjustable phase and ground overcurrent trip.

e. 480 V Motor Control Center Overcurrent Relaying

Molded case circuit breakers provide time overcurrent and/or instantaneous short circuit protection for all connected loads. The molded case circuit breakers for motor circuits are equipped with instantaneous trip only. Motor overload protection is provided by ambient condensated thermal trip units in the motor controller. The molded case breakers for non-motor feeder circuits provide thermal time overcurrent protection as well as instantaneous short circuit protection.

During startup, all starters for motor-operated valves are equipped with thermal overload relays. Prior to core loading, the thermal overload relay trip contacts for all Class 1E valves are permanently bypassed with jumpers.

The starters and the feeder circuit breakers located in the motor control center are coordinated with the motor control center incoming supply breakers so that, upon ground fault, the protective device nearest the fault trips first. Where coordination is not possible using the protective devices normally furnished in a standard motor control center module, solid-state ground fault protectors are added to the affected modules on an individual basis.

TESTING OF THE AC SYSTEMS DURING POWER OPERATION - All Class 1E circuit breakers and motor controllers are testable during reactor operation. During periodic Class 1E system tests, subsystems of the engineered safety features actuation system, such as safety injection, containment spray, and containment isolation, are actuated, thereby causing appropriate circuit breaker or contactor operation. The 4.16 kV and 480 V circuit breakers and control circuits can also be tested independently while individual equipment is shut down. The circuit breakers can be placed in the test position and exercised without operation of the associated equipment.

8.3.1.1.3 Standby Power Supply

The standby power supply for each safety-related load group consists of one diesel generator complete with its accessories and fuel storage and transfer systems. It is capable of supplying essential loads necessary to reliably and safely shut down and isolate the reactor. One diesel generator is connected exclusively to a single 4.16 kV safety feature bus of a load group. The Class 1E system has two load groups, and the safety-related equipment on both load groups is similar. The load groups are redundant and, one load group is adequate to satisfy minimum engineered safety features demand caused by a LOCA and loss of preferred power supply. The diesel generators are electrically isolated from each other. Physical separation for fire and missile protection is provided between the diesel generators, since they are housed in separate rooms of a seismic Category 1 structure. Power and control cables for the diesel generators and associated switchgear are routed to maintain physical separation.

Ratings for diesel generator sets are established in order to satisfy the requirements set forth in Regulatory Guide 1.9. Refer to Subsection 8.1.4.3.

The diesel generator loads are determined on the basis of nameplate rating, pump pressure and flow conditions, or pump runout conditions. The basis for each load is noted in Table 8.3-2. The continuous rating of the diesel generator is based on the maximum total load required at any time.

The functional aspects of the onsite power system are discussed below.

STARTING INITIATING CIRCUITS - The diesel generators are started on the following:

a. Receipt of a safety injection signal (SIS)

b. Loss of voltage to the respective 4.16 kV Class 1E bus to which each generator is connected

c. Manual - Remote switch actuation (main control room)

d. Manual - Local switch actuation (diesel generator room)

e. Emergency Manual - Local switch actuation (diesel generator room)

DIESEL STARTING MECHANISM AND SYSTEM - Refer to Section 9.5 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems".

TRIPPING DEVICES - The diesel generator protection systems indicate automatic and immediate protective actions to prevent or limit equipment damage and allow restoration of the equipment upon correction of trouble.

Excluding accident conditions, the tripping of the diesel generator occurs for any of the following reasons:

a) Loss of excitation

b) Engine overspeed

c) Low lube oil pressure

d) High jacket coolant temperatures

e) High crankcase pressure

f) Generator differential

g) Generator overcurrent

h) Reverse power

i) Underfrequency

With the exception of engine overspeed and generator differential, all trips are bypassed under an accident signal. In accordance with the provisions of BTP ICSB17, the engine overspeed and generator differential trips are retained to protect the diesel generator set from massive damage.

The remaining trips are only functional during tests when the diesel generator is operating in parallel with two preferred power systems.

The diesel generators are monitored from the control room, and each device, when actuated, initiates an annunciator in the control room. These functions are also provided with alarms in the diesel generator room. The alarms are set so that they provide a warning of impending trouble prior to the trip of the diesels.

INTERLOCKS - Circuit breaker electrical interlocks are provided to prevent automatic closing of a diesel generator breaker to an energized or faulted bus.

If the preferred power has been lost, undervoltage relays on the incoming (offsite) side of the 4.16 kV feeder breakers prevent closure of these breakers.

Only one 4.16 kV circuit breaker controls the incoming preferred source power to a 4.16 kV Class 1E bus.

When operating from the diesel generator supply (loss of offsite power), redundant load groups cannot be connected together since there is no interconnection between the two redundant Class 1E busses.

PERMISSIVES - A single key-operated switch (AUTO, LOCAL/MANUAL) in the diesel generator room is provided for each diesel generator to block automatic start signals when the diesel is out for maintenance (i.e., LOCAL/MANUAL position). When in the LOCAL/MANUAL position, an annunciator is initiated in the control room.

A pushbutton in the control room and a local pushbutton are provided to allow manual start capability.

During periodic diesel generator tests, subsequent to diesel start and synchronization to the preferred system, a switch in the control room allows parallel operation with the preferred system.

LOAD-SHEDDING CIRCUITS - Upon recognition of a loss of or degraded voltage on a 4.16 kV Class 1E bus, a logic signal is initiated to effect the following on each load group:

a. Shed selected loads

b. Send signal to start diesel

c. Trip 4.16 kV preferred power supply breakers

Two voltage sensing schemes are employed on each 4.16 kV Class 1E bus to initiate the required logic signal. One scheme will recognize a loss of voltage, and the other will recognize a degraded voltage. Four potential transformers on each bus provide the necessary input voltages to the protective devices necessary to achieve the above protection.

In order to recognize a loss of voltage, four instantaneous undervoltage relays are used. The output contacts of these relays are directed to logic circuits that process the four undervoltage input circuits into the 2-out-of-4 logic circuit described above. This scheme is used on each bus.

The loss of voltage logic signal is set below the minimum bus voltage encountered during diesel generator sequential loading. A brief time delay is employed to prevent false trips arising from transient undervoltage (spike) conditions.

In order to recognize a degraded voltage, a diverse protection scheme is used. The above four potential transformers each provide an analog output signal of 0-120 volts. This signal is directed to logic circuits and processors that convert the analog signals into a 2-out-of-4 logic signal, whenever the signal drops below a preset value. This scheme serves only to trip the incoming offsite power circuits breakers when that power source has been determined to be degraded. This design cannot adversely affect the sequential loading of the diesel generators.

The degraded voltage logic signal is set at the minimum permissible continuous bus voltage. A time delay is provided that prevents damage to or spurious tripping of the permanently connected Class 1E loads by limiting the amount of time they are exposed to a degraded voltage. The final voltage and time setpoints will be determined based on an analysis of the auxiliary power distribution system, including the Class 1E busses at all voltage levels. The use of an SIS contact in series with the degraded voltage logic circuit output contact ensures that the Class 1E busses will be immediately separated from the offsite power system whenever an accident occurs and the offsite power system is not able to accept the loads continuously. An alarm is also provided to alert the operator to a degraded voltage condition.

As each generator reaches rated voltage and frequency, the generator breaker connecting it to the corresponding 4.16 kV bus closes. With the SIS, connection of the diesel generator to the 4.16 kV bus is not made unless the preferred source of power is lost. The diesel generator is able to accept loads within 10 seconds after receipt of a starting signal, and all automatically sequenced loads are connected to the Class 1E bus. Refer to Table 8.3-2. Relays at the diesel generator detect generator rated voltage and frequency conditions and provide a permissive interlock for the closing of the respective generator circuit breaker. Upon loss of the preferred source of power without a LOCA, the load sequencer system initiates the starting of the diesel generators and sheds all loads, except the load centers.

Following diesel start and connection to the Class 1E bus, the loads are automatically sequenced onto the bus at programmed time intervals. A fast responding exciter and voltage regulator ensure voltage recovery of the diesel generator after each load step. Field flashing is utilized on the diesel generators for fast voltage builoup during the start sequence. Momentary voltage and frequency dips will not exceed a maximum of 25 percent below nominal rating (4.16 kV) for voltage and 5 percent for frequency.

The voltage levels at safety related busses are optimized for the expected load conditions throughout the anticipated range of voltage of the offsite system by adjustment of transformer taps. This analysis will be verified by testing.

Breakers in the 4.16 kV and 480 V Class 1E bus supply power to the selected nonsafety loads listed in Table 8.3-2. If an SIS is not present, these breakers are closed by the sequencer. Should an SIS be present, these breakers are automatically tripped if they had been previously closed. After the breakers have been tripped and the SIS has been manually reset, the operators can close these under administrative control to reenergize the selected nonsafety loads, should their operation be desired.

Testing-Circuit design incorporates test provisions to periodically monitor the operational capability of the safety-related Class 1E systems during power operation. Initially, all safety-related equipment is tested to verify compliance with performance specifications after final assembly and during the startup testing phase.

The diesel generators are tested prior to plant startup to demonstrate their capability to satisfy design requirements. The following tests are administered to certify the adequacy of the units for the intended service:

a) Starting tests
b) Load acceptance tests
c) Rated load tests
d) Design load tests
e) Load rejection tests
f) Electrical tests
g) Functional tests

The suitability and qualification testing program of each diesel generator unit of the standby power system is confirmed in accordance with IEEE 387 and NRC Regulatory Guide 1.9. If the diesel generator sets are of a type or size not previously used as standby emergency power sources in nuclear power plant service, reliability qualification testing for the diesel generator sets is performed in accordance with Branch Technical Position ICSB2.

Manual starting of each diesel generator from the control room is incorporated into the design to permit periodic testing. During testing, the diesel generator is manually synchronized to its bus after reaching rated voltage and frequency. Automatic synchronizing is not used. An accident signal occurring during periodic testing of a diesel generator automatically overrides the test mode and places the diesel generator in the emergency mode.

Periodic testing of the diesel generators will be scheduled to verify their continued capability and availability to perform their design function.

Fuel Oil Storage and Transfer Systems

For a discussion of the fuel oil storage and transfer system of the onsite standby diesel generators see Chapter 9 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems".

Cooling and Heating Systems

For a discussion of cooling and heating systems of the onsite standby diesel generators see Chapter 9 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems".

Instrumentation and Control System

The local diesel generator starting mode selector switch is normally in the automatic mode position. The only time it is in the manual position is for maintenance. The diesel generator starting mode selector switch, located in the control room, is normally in the automatic mode (emergency standby) position. The only time it is in the manual (off-auto) position is during maintenance or routine periodic testing. When the switch is in the manual position, an alarm in the control room persists until the switch is returned to the auto mode. Other manual controls alarm if failure to return them to the start position inhibits automatic operation of the diesel generators.

Automatic control of the diesel generators and Class 1E loads requiring sequencing is provided. Manual control of the diesel generators and safety related systems is available locally and in the main control room. Arrangement of control circuitry maintains the required redundancy compatible with the related power circuit.

Control power is obtained from redundant 125V DC systems. Train A loads receive power from battery Subsystem A and Train B loads from battery Subsystem B. See Figure 8.3-2.

The DC power from the station batteries is required by each diesel generator for controls, alarms, protective relays, air-starting solenoid valves, and, if required, generator field flashing. These loads are estimated and tabulated in Table 8.3-1 and will be finalized in the RESAR-SP/90 FDA document.

Instrumentation is provided to continually monitor the status of the safety-related systems. Diesel generator status is indicated and alarmed in the control room. If running, automatic shutdown of a diesel generator is also annunciated.

The following instrumentation is provided to monitor the operability of the diesel generators:

a) Voltmeters

b) Ammeters

c) Frequency meters

d) Varmeters

e) Wattmeters

f) Running time meters

g) Tachometer

Incorporated instrumentation and alarms for the diesel generator cooling, starting, lubricating, and ventilating systems are discussed in Section 9.5 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems".

The following indicating or alarm devices for the onsite standby power system are provided:

a) Bus voltage, current, and frequency

b) Circuit breaker position lights

c) Diesel generator power flow and starting status

d) Diesel generator cooling water temperature, lube oil temperature, starting air pressure, and fuel oil level

e) Battery voltage

f) Protective relaying operational alarms

Status indication of safety-related switchgear breakers and valves is also provided.

8.3.1.1.4 Control Rod Drive Power Supply

Electric power to control rod drive mechanisms is supplied by two full-capacity, motor-generator sets. Each motor-generator set is connected to a separate Class 1E 4160 V switchgear. Each generator is of the synchronous type and is driven by a 250 hp induction motor. The AC power is distributed to the rod control power cabinets through two series-connected reactor trip breakers.

8.3.1.1.5 Vital Instrument AC Power Supply

Four independent Class 1E 120 V vital instrument AC power supplies are provided to supply the four channels of the protection systems and reactor control systems. Each vital instrument AC power supply consists of one inverter, one distribution bus, and one manual transfer switch. Normally, the inverter is operating to supply the vital AC bus. Each inverter is supplied by a separate Class 1E battery system, as described in Subsection 8.3.2. If an inverter is inoperable or is to be removed from service, the vital AC bus can be supplied from the spare inverter or alternate source via 480-120V regulating transformer. A key interlock is provided to ensure that only a single power source is connected to the vital bus at one time. Refer to Figure 8.3-2 for the single-line arrangement of the vital instrument AC power supply.

8.3.1.1.6 Nonvital Instrument AC Power Supply

The nonvital 120 V instrument AC power supply is designed to furnish reliable power to all nonsafety-related plant instruments.

The nonvital instrument AC system is divided into two panelboard sections. Each section is supplied by a common single-phase isolation transformer connected to a Class 1E motor control center. In the event of the loss of normal auxiliary power, the transformers are automatically energized by the emergency diesel generators.

8.3.1.1.7 Electric Equipment Layout

The following are the general features of the electric equipment layout:

a. Class 1E switchgear, load centers, and motor control centers of redundant load groups are located in separate rooms within seismic category 1 buildings.

b. Four Class 1E battery supplies are located in the seismic Category 1 building. Each battery is located in a separate room. Battery ventilation considerations are addressed in Chapter 9 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems".

c. The battery charger, inverter, and DC busses associated with each of the four subsystems are in separate rooms outside the battery rooms.

d. Two cable spreading rooms are provided, one above and one below the control room. This enhances redundant cable separation.

e. Redundant diesel generators and associated supporting equipment are located in separate rooms in the seismic category 1 building.

8.3.1.1.8 Design Criteria for Class 1E Equipment

Design criteria are discussed below for the Class 1E equipment:

MOTOR SIZE - For all motors rated above 480 volts, the horsepower is generally equal to or greater than the maximum horsepower required by the driven load normal running or runout conditions.

MINIMUM MOTOR ACCELERATING VOLTAGE - All Class 1E motors are specified with accelerating capability at 75 percent of the motor nameplate rating.

To prevent valve damage from the oversizing of motors, all motor-operated valve actuators are specified with accelerating capability at 80 percent of the nameplating rating.

The electrical system is designed so that the total starting voltage drop on the Class 1E motor circuits is less than that required to accelerate those motors.

MOTOR STARTING TORQUE - The motor starting torque is capable of starting and accelerating the connected load to normal speed within sufficient time to perform its safety function for all expected operating conditions, including the design minimum bus voltage stated in Subsection 8.3.1.1.3.

MINIMUM MOTOR TORQUE MARGIN OVER PUMP TORQUE THROUGH ACCELERATING PERIOD - The minimum torque margin (accelerating torque) is such that the pump-motor assembly reaches nominal speed within sufficient time to perform its safety function at design minimum terminal voltage.

MOTOR INSULATION - Insulation systems are selected on the basis of the particular ambient conditions to which insulation is exposed. For Class 1E motors located within the containment, the insulation system is selected to withstand the postulated accident environment.

TEMPERATURE MONITORING DEVICES PROVIDED IN LARGE HORSEPOWER MOTORS - Each motor in excess of 1,500 hp is provided with six resistance temperature detectors (RTD) embedded in the motor slots, two per phase. In normal operation, the RTD at the hottest location (selected by test) monitors the motor temperature and provides a computer alarm in the control room on high temperature.

INTERRUPTING CAPACITIES - The interrupting capacities of the protective equipment are determined as follows:

a. Switchgear

Switchgear interrupting capacities are greater than the maximum short circuit current available at the point of application. The magnitude of the short circuit currents in the medium voltage systems is determined in accordance with ANSI C37.010. The offsite power system, a single operating diesel generator, and running motor contributions are considered in determining the fault level. All motors connected to the bus are considered to be running when the short circuit is postulated.

High voltage power circuit breaker interrupting capacity ratings are selected in accordance with ANSI C37.06.

b. Load Centers, Motor Control Centers, and Distribution Panels

Load centers, motor control centers, and distribution panel circuit breakers have a symmetrical rated interrupting current as great as the determined total available symmetrical current at the point of application. Symmetrical current is determined in accordance with the procedures of ANSI C37-1973 for low-voltage circuit breakers other than molded-case breakers and of NEMA Standards Publication AB 1 for molded case circuit breakers.

ELECTRIC CIRCUIT PROTECTION - Refer to Subsection 8.3.1.1.2 for criteria regarding the electric circuit protection.

GROUNDING REQUIREMENTS - Equipment and system grounding will be designed using IEEE 80, 1971 "Guide for Safety in AC Substation Grounding," and IEEE 142, 1972, "Recommended Practice for Grounding of Industrial and Commercial Power Systems" as a guide.

8.3.1.1.9 Cable Derating and Cable Tray Fill

The ampacity and group derating factors of the cables are in accordance with the manufacturer's recommendations and IPCEA publications P46-426 for cables in conduit, duct bank, and maintained spaced trays and P54-440 for cables in randomly filled trays. The cable ampacities are based on a maximum conductor temperature of 90°C, 100-percent load factor, and all cables fully loaded.

For trays containing power cables only, fill is generally limited to 30 percent of the usable cross section of a 4-inch-deep tray. Where this condition cannot be maintained, a review will be made in each case for the adequacy of the design for both physical fill and derating.

Trays containing only control or instrumentation cables are generally limited to a 50-percent fill. Where this condition cannot be maintained, a review will be made in each case for adequacy of design for physical fill only and will allow a higher fill percentage so that the total fill does not protrude above the loading depth of the tray.

Conduit fill is in compliance with the provisions of Chapter 9.0 (Table 4) of the NEC 1984. Where these provisions cannot be maintained, a review will be made in each case and will allow a higher fill percentage based on actual cable sizes, conduit sizes, length of conduit, and number of bends.

8.3.1.2 Analysis

8.3.1.2.1 Compliance with General Design Criteria 17 and 18 and Regulatory Guides

For discussion of regulatory guides in regard to Class 1E AC systems, refer to RESAR-SP/90 PDA Module 2, "Regulatory Conformance".

Compliance with General Design Criteria 17 and 18 is discussed in Section 3.1 of RESAR-SP/90 PDA Module 7, "Structural/Equipment Design".

8.3.1.2.2 Safety-Related Equipment Exposed to Hostile Environment

Information on Class 1E equipment that must operate in a hostile environment during and/or subsequent to an accident is furnished in Section 3.11 of RESAR-SP/90 PDA Module 7, "Structural/Equipment Design".

8.3.1.3 Physical Identification of Safety Related Equipment

Each circuit (scheme) and raceway is given a unique alpha-numeric identification. This identification provides a means of distinguishing a circuit or raceway association with a particular channel or load group, and is assigned on the basis of the following criteria:

SEPARATION GROUP 1 - A safety related instrumentation control, or power scheme/raceway associated with safety related load group 1 or protection system channel 1.

SEPARATION GROUP 2 - A safety related instrumentation, control, or power scheme/raceway associated with protection system channel 2.

SEPARATION GROUP 3 - A safety related instrumentation, power, or control scheme/raceway associated with protection system channel 3.

SEPARATION GROUP 4 - A safety related instrumentation, control, or power scheme/raceway associated with safety related load group 2 or protection system channel 4.

Nonsafety-related cables and raceways associated with all normal plant (non-Class 1E) equipment are uniquely identified and separately routed from safety-related cables and raceways, as described in Subsection 8.1.4.3.

The unique identification afforded all nonsafety-related cables is their black color.

Nameplates with colored backgrounds are provided for all IEEE 308 Class 1E equipment (such as transformers, motors, motor control centers, switchgear, panels, and switchboards). Each separation group has its distinguishing color. The applicable channel or load group designation is marked on each nameplate. For the identification of instrumentation and control equipment, refer to Subsection 7.1.2.

Raceways are marked in a distinct, permanent manner at intervals not to exceed 15 feet and at points of entry to, and exit from, enclosed areas.

Color identification is provided for each separation group of all field-wired, safety related cables.

Within control panels where more than one separation group is present, wiring is identified by separation group designation or, if enclosed by conduit, the conduit is identified by separation group designation.

Within a cabinet or panel which is associated and identified with a single separation group, the internal wiring is exclusively associated with the same separation group and, therefore, requires no further identification.

In cases where the majority of the wiring within a cabinet or panel is primarily one separation group, standard color wire and/or sleeves for the majority separation group is used. The remaining wiring is identified, using the appropriate color, as defined in applicable specifications or drawings. When colored sleeves are used in lieu of colored wiring, the sleeves are provided at both ends of the wire and at strategic intervals along its length.

Design drawings provide distinct identification of Class 1E equipment.

Operating and maintenance documents pertaining to Class 1E equipment are distinctly identified.

8.3.1.4 <u>Independence of Redundant Systems</u>

8.3.1.4.1 Separation Criteria

This section establishes the criteria and the bases for preserving the independence of redundant Class 1E power systems.

8.3.1.4.1.1 Raceway and Cable Routing

a. Wherever possible, cable trays are arranged from top to bottom, with trays containing the highest voltage cables at the top and trays containing the lowest voltage cables at the bottom. A raceway designated for a single voltage category of cables contains only cables of the same voltage category. Voltage categories are:

1. 15-kV power (non-Class 1E)

2. 5-kV power

3. Large 600-V power (cables from load centers)

4. 600 V power (cables from motor control centers, control and digital signal cables)

5. Instrumentation cables

b. Cables associated with each safety related separation group, as defined in Subsection 8.3.1.3, are run in separate conduits, cable trays, ducts, and penetrations.

c. The arrangement of electrical equipment and cabling minimizes the possibility of a fire in one separation group from propagating to another separation group.

In the absence of confirming analyses to support less stringent requirements, the following rules applied to those areas in which the only source of fire is electrical. Areas in which the only source of fire is electrical are divided into two groups, cable spreading areas and general plant areas.

GENERAL - Routing of instrumentation, control, or power cables through rooms or spaces where there is a potential for accumulation of large quantities of combustible fluids is avoided. Where such routing is unavoidable, only cables of one separation group are allowed. In addition, the cables are enclosed in conduit. Openings in solid floors for vertical runs of cables are sealed with fire resistant material. Similarly, horizontal runs of cables are sealed at every fire rated wall penetration.

Cable Spreading Areas--A cable-spreading area located below the control room is provided for each Class 1E train and two protection channels. The cable-spreading area does not contain high-energy equipment (i.e. switchgear, transformers, rotating equipment) or potential sources of missiles or pipe whip. Minimum separation between redundant Class 1E trains or channels, or between Class 1E and non-Class 1E train trays in the cable-spreading areas is 1-foot horizontal and 3 feet vertical.

Where termination arrangements preclude maintaining this separation, solid-enclosed raceways, barriers, or tray covers are used as discussed in Regulatory Guide 1.75.

Circuit aboves 480 V are not routed in the cable-spreading area. Power supply feeders to instrument and control room distribution panels are installed in enclosed raceways.

In addition to the fire barriers, used only if adequate physical separation cannot be obtained, fire detection and fire protection systems are provided as discussed in Section 9.5 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems". Alarms located in the control room give operators an early warning of fire.

General Plant Areas--In plant areas where hazards are limited to failures or faults internal to the electric equipment or cables, minimum spacing between redundant cable trays are separated horizontally 3 feet, and 5 feet between those separated vertically. If minimum spacing is unattainable, a fire barrier is provided in accordance with IEEE 384.

8.3.1.4.1.2 Hostile Environments

In general, Class 1E wiring systems will not be routed through an area where there is potential for accumulation of large quantities of oil or other combustible material. If such routing is unavoidable, only one system of redundant cables is allowed in any such area, and the cables are protected by flame retardant material as discussed in Subsection 9.5.1 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems". In areas containing potential missiles, physical arrangement of protective barriers preclude simultaneous loss of more than one redundant system.

8.3.1.4.1.3 Electrical Penetration Areas

Separate penetrations are provided for 13.8 kV power, 480 V power, control, and instrumentation cables of each Class 1E train and protection channel. The design objective is maximum possible separation between Class 1E trains, and between any large piping penetrations and Class 1E trains to minimize damage from steam or waterline ruptures. Protection from the main steam and feedwater lines is provided by means of reinforced concrete walls or floors. Electrical penetration areas located on different floor elevations provide adequate physical separation between redundant circuits. In cases where redundant instrumentation channels will be routed on the same elevation, and in the same general area, the redundant channels will be located on opposite sides of the areas, if feasible. Minimum separation distance between individual penetration nozzles is 6 foot centerline to centerline.

8.3.1.4.1.4 Cable Tray Crossover Areas

In cases where redundant trays cross over each other in areas where only electrical equipment is located, there is a minimum vertical separation of 15 inches (free air space). A barrier extending 1 foot from each side of the trays and 3 feet along each tray from the crossover is provided.

8.3.1.4.2 Seismic Requirements

Cable trays, supports, and ducts carrying Class 1E circuits meet Seismic Category I requirements. In addition, trays and supports carrying non-Class 1E circuits that could jeopardize the integrity of Class 1E circuits or other safety related equipment are also designed to meet seismic requirements.

8.3.1.4.3 Administrative Responsibilities and Controls for Assuring Separation Criteria During Design and Installation

The scheme and raceway channel identification (refer to Subsection 8.3.1.3) facilitates and ensures the maintenance of separation in the routing of cables and the connection of control boards and panels. At the time of the cable routing assignment in the design office, the routing engineer checks to ensure that the separation group designation on the scheme to be routed is compatible with the raceways in the intended route. Extensive use of computer program checks helps ensure separation. Each circuit and raceway is identified in the computer program, and the identification includes the applicable separation group. The program used in routing specifically checks to ensure that cables of a particular separation group are routed through the appropriate raceways. The routing is also confirmed by quality control personnel, during installation, to be consistent with the design document. Color identification of equipment and cabling (refer to Subsection 8.3.1.3) assists field personnel in this effort.

8.3.2 DC Power Systems

8.3.2.1 Description

The DC power system consists of four independent Class 1E 125V DC subsystems, one non-Class 1E 125V DC system, and one non-Class 1E 250V DC system. The DC power system is designed to provide reliable and continuous power for controls, instrumentation, inverters and DC emergency auxiliaries.

The Class 1E DC system provides DC electric power to the Class 1E DC loads and for control and switching of the Class 1E systems. Physical separation, electrical isolation, and redundancy are provided to comply with the requirements of IEEE 308. The four Class 1E DC subsystems are shown in Figure 8.3-2. Each Class 1E DC power subsystem consists of one 125V battery, one battery charger, one inverter and distribution switchboards. The battery chargers for DC subsystems A and C are supplied power from different Class 1E busses of load group 1 (Train A). Similarly, the battery chargers for DC subsystem B and D are supplied 480V AC power from different Class 1E busses of load group 2 (Train B). The inverters provide four independent 120V AC vital instrumentation and control power supplies for the channels of reactor protection and engineered safety features.

One spare battery charger and one spare inverter are provided for the power block. These items are physically located central to all of the Class 1E DC systems. They are not, however, electrically connected. In the event of the failure of these devices, the spare can be connected to the affected system. Therefore, the malfunctioning inverter or charger can be repaired without imposing long-term disruption of the system.

All the DC components (i.e., batteries, racks, chargers, inverters and distribution panelboards) are designated seismic Category 1, and are designed to maintain their functional capability during and after an SSE.

The non-Class 1E loads for the power block are supplied by separate DC systems. A 125V DC system is provided to supply the nonvital control and instrumentation. In addition, a 250V DC system is provided to supply non vital DC motors.

The 125V DC and 250V DC system for the non-Class 1E loads include a battery and two battery chargers, one charger serving as a backup for the other.

8.3.2.1.1 Safety Related DC Loads

Table 8.3-1 identifies the typical DC loads related to each Class 1E 125V DC subsystem.

8.3.2.1.2 Class 1E Station Batteries and Battery Chargers

BATTERY CAPACITY - The Class 1E batteries are sized to have capacity which is greater than 50% above the required capacity based on initial design. This margin is greater than that required by IEEE 450 which requires 80 percent capacity battery replacement.

BATTERY CHARGER CAPACITY - The capacity of each Class 1E battery charger is based on the largest combined demand of all the steady-state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state within 12 hours regardless of the status of the plant during which these demands occur.

INSPECTION, MAINTENANCE, AND TESTING - Testing of the DC power system will be performed during plant operation in accordance with Regulatory Guide 1.118 and IEEE Standard 450.

8.3.2.1.3 Separation and Ventilation

The Class 1E batteries, chargers and DC switchgear of each separation group are located in separate rooms of the seismic Category 1 building. The batteries are located in separate rooms where the ventilation system is designed to preclude hydrogen accumulation. Subsection 9.4.1 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems", contains a description of the battery room ventilation system. Battery room temperature will also be controlled or the batteries will be derated accordingly. However, criteria regarding battery capacity as stated in Subsection 8.3.2.1.1 will still be maintained.

8.3.2.2 Analysis

The DC power system is in conformance with the IEEE Standard 308, Regulatory Guides 1.6 and 1.32 and satisfies GDC 17 and 18.

Refer to Section 3 for a complete analysis.

8.3.3 Fire Protection for Cable Systems

The detailed description of the fire protection and detection system in areas of heavy cable concentration is given in Subsection 9.5.1 of RESAR-SP/90 PDA Module 13, "Auxiliary Systems". The fire hazard to cables is minimized by use of flame retardant insulation and jacket construction. In addition, fire or smoke detection equipment is installed in areas of heavy cable concentration.

Subsection 8.3.1.4.1 provides information regarding separation between redundant cable trays.

TABLE 8.3-1

CLASS 1E DC SYSTEM LOADS

I. DC Subsystem A (Separation Group 1)

a. Diesel generator Train A control and field flashing

b. Solenoid valves, indicating lights, and miscellaneous power and controls associated with load group 1

c. Class 1E Switchgear of load group 1 DC control

d. Inverter A

e. Reactor trip switchgear, Channel 1 DC control

f. Main control room DC emergency lighting

g. Load shedder and emergency load sequencer panel

h. Engineered safety features status panel

i. Diesel generator 1 control panel

II. DC Subsystem B (Separation Group 2)

a. Diesel generator Train B control and field flashing

b. Solenoid valves, indicating lights, and miscellaneous power and controls associated with load group 2

c. Class 1E switchgear of load group 2 DC control

d. Inverter B

e. Reactor trip switchgear Channel 2 DC control

f. Engineered safety features status panel

g. Load shedder and emergency load sequencer panel

h. Diesel generator 2 control panel

III. DC Subsystem C (Separation Group 3)

a. Inverter C

b. Miscellaneous indicators, power, and controls associated with Separation Group 3

TABLE 8.3-1 (Sheet 2)

IV. DC Subsystem D (Separation Group 4)

a. Inverter D

b. Miscellaneous indicators, power, controls associated with Separation Group 4

TABLE 8.3-2

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "A" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
CLASS 1E TRAIN										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "A" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
CLASS 1E TRAIN										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c)

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "A" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
CLASS 1E TRAIN										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,

[ ]

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "A" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
NON CLASS 1E										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c)

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "A" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
NON CLASS 1E										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c)

[ ]

Loss of Injec Phase	Coolant Recirc Phase	Blackout Hot Standby	Shutdown
Kw	Kw	Kw	Kw

(a,c)

[ ]

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "B" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
CLASS 1E TRAIN										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "B" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
CLASS 1E TRAIN										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c)

TABLE B.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "B" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
CLASS 1E TRAIN										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c)

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "B" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
NON CLASS 1E										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c)

TABLE 8.3-2 (Continued)

TWO TRAIN EMERGENCY ELECTRICAL LOAD REQUIREMENTS
AND DIESEL GENERATORS

W APWR TWO TRAIN "B" LOADS ONLY

Component	Name Plate Rating	Input Capacity	Eff	Load Factor	Delay Time	Loss of Inject Phase	Coolant Recirc Phase	Delay Time	Blackout Hot Standby	Shutdown
NON CLASS 1E										
TRAIN A AND B COMPONENTS	Kw	Kw	(%)	(%)	Seconds	Kw	Kw	Seconds	Kw	Kw

(a,c)

[ ]

Loss of Injec Phase	Coolant Recirc Phase	Blackout Hot Standby	Shutdown
Kw	Kw	Kw	Kw

(a,c)

[ ]

FIGURE 8.3-1

(SHEETS 1 AND 2)

"WAPWR AC MAIN SINGLE LINE DIAGRAM"

(FOLDOUTS)

PROPRIETARY

FIGURE 8.3-2

"WAPWR DC AND 120 VAC ONELINE DIAGRAM"

(FOLDOUT)

PROPRIETARY