8.1 INTRODUCTION

8.1.1 GENERAL

The electric power system of the Susquehanna Steam Electric Station Units 1 and 2 are designed to generate and transmit electric power to supply customer needs utilizing the power network of the PPL and of the PJM Inc. interconnection.

The two independent offsite electric connections to Susquehanna SES are designed to provide reliable power sources for plant auxiliary loads and the engineered safety features loads of both units such that any single failure can affect only one power supply and cannot propagate to the alternate source.

The onsite AC electric power system consists of Class 1E and non-Class 1E power systems. The two offsite power systems provide the preferred AC electric power to all Class 1E loads through the Class 1E distribution system. In the event of total loss of offsite power sources, four onsite independent diesel generators provide the standby power for all engineered safety features loads.

The non-Class 1E AC loads are normally supplied through the unit auxiliary transformer or the startup transformer. However, during plant startup, shutdown, and post-shutdown, power is supplied from the offsite power through the startup transformers.

Onsite Class 1E and non-Class 1E DC systems supply all DC power requirements of the plant.

8.1.2 UTILITY POWER GRID AND OFFSITE POWER SYSTEMS

Unit 1 and 2 generators are connected by separate isophase buses to their respective main step-up transformer banks as shown on Dwgs. E-1, Sh. 1 and E-1, Sh. 1A. Unit 1 main step-up transformer bank, with two three-phase, half capacity power transformers, steps up the 24 kV generator voltage to 230 kV; the Unit 2 bank, with three single phase power transformers, steps up the 24 kV generator voltage to 500 kV. As shown on Dwgs. E-1, Sh. 1 and E-1, Sh. 1A, the step-up transformer for Unit 1 connects to the Susquehanna 230 kV switchyard and for Unit 2 to the Susquehanna 500 kV switchyard. The Susquehanna 230kV switchyard is designed for six(6) 230 kV breaker and a half bays (one built as a two (2) single circuit breaker 230 kV bay), a 230 kV capacitor bank and two (2) 230 kV buses. Terminating positions are provided for eight lines, one generator lead, one 230 kV capacitor bank and a yard tie to the 500 kV switchyard. The Susquehanna 500 kV switchyard consists of four (4) bays, containing eight 500 kV circuit breakers. A 230 kV circuit breaker terminates the T21 230 kV yard tie. Each bay, except for Bay 5, can be developed into a full circuit breaker and half configuration. Terminating positions are provided for three lines, one 500 kV generator lead circuit, a circuit to a bank of three single phase 500-230 kV autotransformers and a capacitor bank circuit. The Susquehanna 230 kV switchyard and 500 kV switchyard are approximately 1.9 miles apart and are interconnected by a 500-230 kV bus tie transformer and transmission line. Aerial transmission connects the Susquehanna 230 kV switchyard with Sunbury, Susquehanna T10, Montour, Harwood, Jenkins, Acahela and Mountain – (owned and operated by UGI Corporation, Luzerne Electric) Substation/Switchyards. Aerial transmission lines integrate the Susquehanna 500 kV switchyard into the 500 kV system with connections at Wescosville, Lackawanna and Sunbury. Both the Susquehanna 500 kV switchyard and the 230 kV switchyard are tied into the PJM interconnection.

The plant startup and preferred power for the engineered safety features systems is provided from two independent offsite power sources shown in Dwg. D159760, Sh. 1.

a) A 230 kV line from the Susquehanna T10 230 kV switchyard feeds the start-up transformer # 10.

b) A 230 kV tap from the 500-230 kV tie line feeds the startup transformer # 20.

The offsite power systems and their interconnections are described in detail in Section 8.2.

8.1.3 ONSITE POWER SYSTEMS

The onsite power system for each unit is divided into two major categories:

a) Class 1E Power System

The Class 1E power system supplies all engineered safety features (ESF) loads, and other loads that are needed for safe and orderly shutdown, and for keeping the plant in a safe shutdown condition.

The Class 1E power system for each unit consists of four independent load group channels, channels A, B, C, and D. Any combination of three out of four load group channels meets the design basis requirements. In addition, two divisionalized load groups are established for those ESF loads which require one out of two load groups to meet the design basis requirements. ESF load group division separation and channel separation are shown in Tables 3.12-1 and 3.12-2 respectively. Physical separation is discussed fully in Subsection 3.12.3.4.

The Class 1E power system distributes power at 4.16 kV, 480V, 120V AC, ±24V DC, 125V DC, 250V DC voltage levels.

The Class 1E power system is shown on Dwgs. E-1, Sh. 1, E-1, Sh. 1A, E-1, Sh. 2, E-5, Sh. 1, E-5, Sh. 2, E-11, Sh. 1, E-11, Sh. 11, E-13, Sh. 1, E-8, Sh. 4, and E-8, Sh. 8.

b) Non-Class 1E Power System

The non-Class 1E AC portion of the onsite power system supplies electric power to all non-safety related plant auxiliary loads. The non-Class 1E AC auxiliary system distributes power at 13.8 kV, 4.16 kV, 480V, and 208/120V voltage levels. These distribution levels are grouped into two symmetrical bus systems emanating from the 13.8 kV level as shown in Dwgs. E-1, Sh. 1, E1, Sh. 1A, and E-1, Sh. 2.

Power transmitted to the utility grid is discussed in Subsection 8.1.2.

Non-Class 1E DC power is discussed in Subsection 8.3.2.

A detailed description of the onsite power system is found in Subsections 8.3.1 and 8.3.2.

8.1.4 SAFETY RELATED LOADS

The Class 1E loads supplied by the Class 1E AC power system are listed in Tables 8.3-1 to 8.3-5A. Class 1E loads supplied by the Class 1E DC system are listed in Tables 8.3-6A, 8.3-6B, 8.3-6C, 8.3-6D, 8.3-6E, 8.3-6F, 8.3-6G, 8.3-6H, 8.3-6I, 8.3-7A, 8.3-7B, 8.3-7C, 8.3-7D, and 8.3-8.

8.1.5 DESIGN BASES

8.1.5.1 Safety Design Bases

The following principal design bases are applied to the design of the onsite and offsite power systems:

Offsite Power System

a) Electric power from the offsite power sources to the onsite distribution system is provided by two physically separated transmission lines designed and located to minimize the likelihood of simultaneous failure.

b) The loss of generating units and the effects on system stability are addressed in Section 8.2.2.2 - Stability Analysis.

Onsite Power System

a) One unit auxiliary transformer per generating unit is provided to supply power to the plant electrical auxiliary distribution system.

b) Two startup transformers, located onsite within the Protected Area and common to both units, are provided to supply offsite power to the Class 1E power system and common plant auxiliary power system and to supply power to the Unit Auxiliary loads during startup, shutdown, and in the event of loss of a unit auxiliary transformer.

c) Outage of one startup and/or one engineered safeguard transformer would not jeopardize continued plant operation except where the operation is limited as suggested by Regulatory Guide 1.93. See compliance statement to Regulatory Guide 1.93 in Subsection 8.1.6.1

d) Standby diesel generators are shared by two units. See Subsection 8.1.6 responses to Regulatory Guide 1.81, for diesel generator capability and compliance discussions.

e) Each generating unit has its own independent DC system. Common DC loads can be supplied from the DC system of either Unit 1 or Unit 2. The common system DC loads which are required for both Unit 1 and Unit 2 operation, are provided with two sources of 125V DC control power, from the DC system of either Unit 1 or Unit 2, through a manual transfer switch.

f) The onsite Class 1E AC electric power system for each unit is divided into four independent load groups. Each load group has its own distribution buses and loads. Minimum engineered safety feature loads required to shut down the unit safely and maintain it in a safe shutdown condition are met by any three of the four load group channels. Each aligned emergency diesel generator supplies one load group of both units. Auxiliary loads

in Diesel Generator Bays A-D can be supplied from the AC electric power system of either Unit 1 or Unit 2. All other common loads are supplied from the Unit 1 AC electric power system.

g) The four Class 1E load groups are subgrouped generally to form two divisions for meeting the design basis of one out of two ESF load requirements.

h) Automatic or manual transfers are not provided between redundant load groups except swing buses as discussed in Subsection 8.3.1.3.5.

i) The Class 1E electric systems are designed to satisfy the single failure criterion in accordance with IEEE 379-1972.

j) The DC system battery banks are individually sized for four hours of operation under the maximum design loading without the support of the battery charger.

k) Raceways are not shared by Class 1E and non-Class 1E cables. However, the affiliated cables that are supplied from the Class 1E buses are treated as Class 1E cables with regard to redundant system separation and identification criteria.

l) Special identification criteria applies for Class 1E equipment, cabling, raceways, and affiliated circuits. Affiliated circuits are uniquely identified.

m) Separation criteria apply which establish requirements for preserving the independence of redundant Class 1E system and providing isolation between Class 1E and non-Class 1E equipment.

n) Class 1E equipment has been designed with the capability for periodic testing.

8.1.6 Regulatory Guides and IEEE Standards

Codes and standards applicable to the onsite power system are listed in Table 3.2-1. Generally, the system is designed in accordance with IEEE Standards 308-1974, 317-1972, 323-1971, 334-1971, 344-1971, 382-1972, 384-1974, 387-1972, and 450-1972. On June 6, 1987 a fifth diesel generator designated Diesel Generator E was added to the standby power system as part of the onsite power system. The modification that added Diesel Generator E was based on applicable codes and standards in effect on September 22, 1983. These later codes and standards are only applicable to the Diesel Generator E building and the modifications in the Diesel Generator A,B,C and D rooms to add the transfer points and interconnections. In general, the Diesel Generator E system is designed in accordance with IEEE Standards 308-1980, 323-1974, 334-1974, 344-1975, 379-1977, 382-1980, 383-1974, 384-1981, 387-1977, 420-1982, 450-1980, 484-1981, 485-1978, 535-1979, 603-1980, 649-1980 and 650-1979.

8.1.6.1 Compliance with Regulatory Guides

Compliance with General Design Criteria 17 and 18 of 10CFR50, Appendix A, is discussed in Subsections 8.3.1.11.1 and 8.3.2.2.1. Compliance with applicable Regulatory Guides 1.6, 1.9, 1.22, 1.29, 1.30, 1.31, 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, 1.106 and 1.148 is discussed below. The Diesel Generator E is based on the Regulatory Guides in effect on September 22, 1983. An * beside the effective date of the Regulatory Guides listed

below indicates the Regulatory Guide applicable to the plant is also applicable to Diesel Generator E.

a) Regulatory Guide 1.6 (3/71)*

The design of the standby power system is in compliance with Regulatory Guide 1.6.

The standby power system consists of four independent load groups. All safety related loads are divided among these four load groups so that loss of any one group will not prevent the minimum safety functions from being performed. Each load group consists of both standby AC and DC power systems.

Each AC load group has connections to two independent offsite power supplies and to a single onsite diesel generator. The power feeder breakers to each load group are interlocked so that only one of the power supplies can be connected at any one time except during diesel generator load test where the diesel generator is synchronized to one of the preferred offsite power sources. Only one diesel generator is tested at a time.

Each diesel generator is exclusively connected to the corresponding load group of the two units; i.e., Diesel Generator A connects to load group channel A of both units, etc. A fifth Diesel Generator E is used as a replacement for any one of the four Diesel Generators A, B, C or D. The main purpose of the Diesel Generator E is to allow maintenance to be performed on any one of the four diesel generators without the necessity for a two unit outage.

The diesel generator of one load group cannot be paralleled, either manually or automatically, with the diesel generator of the redundant load groups.

No provision exists for automatic transfer of loads between load groups except as discussed in Subsection 8.3.1.3.5.

The DC power system of each of the four load groups consists of a 125V DC battery and a charger. The battery charger is supplied by its corresponding AC power system. The DC power system of any one load group is independent of any other DC power system. The common loads, which require 125V DC, are provided with two sources of control power, through a manual transfer switch. The Class 1E loads are capable of being transferred between the Unit 1 and corresponding Unit 2 source. The Unit 1 and Unit 2 sources can not be cross connected through the common load transfer switches to assure independence between redundant safety related sources. The Diesel Generator E DC power system consists of a separate 125V DC battery and charger.

Two independent 250V divisionalized DC power systems are also provided for each unit to supply large DC loads. Loss of any one 250V DC subsystem will not prevent the safety functions from being performed.

Physical separation of Class 1E equipment is fully discussed in Section 3.12.

b) Regulatory Guide 1.9 (3/71)

The standby diesel generators A,B,C and D comply with Regulatory Guide 1.9 except as noted in 5) and 6) of the following:

1) The continuous or the 2000 hr rating of the standby diesel generators is greater than the sum of conservatively estimated loads needed to be supplied following any design basis event within one of the two units. Load requirements are listed in Tables 8.3-1 to 8.3-5.

2) The standby diesel generators are capable of starting and accelerating all engineered safety features and forced shutdown loads to the rated speed in the time frame and sequence shown in Tables 8.3-1 to 8.3-5.

3) The standby diesel generators are capable of maintaining, during steady state and loading sequence, the frequency and voltage above a level that may degrade the performance of any of the loads.

4) The standby diesel generators are capable of recovering from transients caused by step load increase or resulting from the disconnection of partial or full load so that the speed does not damage any moving parts.

5) The suitability of each diesel generator is confirmed by factory qualification testing.

6) Power quality is in accordance with IEEE 308-1974, Section 4.3. At no time during the loading sequence will the frequency and/or voltage drop to a level that will degrade the performance of any of the loads below their minimum requirements. The power quality is confirmed by preoperational tests.

c) Regulatory Guide 1.9 (12/79) (Diesel Generator E Only)

Diesel Generator E complies with Regulatory Guide 1.9 except as noted in 9) of the following:

1) The continuous or the 2000 hr rating of Diesel Generator E is greater than the sum of conservatively estimated loads needed to be supplied following any design basis event within one of the two units. Load requirements are listed in Tables 8.3-1 to 8.3-5.

2) Diesel Generator E is capable of starting and accelerating all engineered safety features and forced shutdown loads to the rated speed in the time frame and sequence shown in Tables 8.3-1 to 8.3-5.

3) At no time during the diesel generator loading sequence does the frequency and voltage decrease to less than 95 percent and 75 percent of nominal, respectively. Voltage is restored to within 10 percent of nominal within 60 percent of each load sequence time interval. During recovery from transients caused by step load increases or disconnection of the largest single load, the speed of Diesel Generator E does not exceed the nominal speed plus 75 percent of the difference between nominal speed and the overspeed trip point. The transient following the complete loss of load does not trip the overspeed trip setpoint.

4) Where applicable, the Diesel Generator E qualification is in accordance with the requirements of IEEE 323-1974.

5) Automatic startup, controls and surveillance systems are discussed in Subsection 8.3.1.4.

6) The Diesel Generator E seismic qualification is in accordance with the requirements of IEEE 344-1975 subject to Regulatory Guide 1.100.

7) The 300 start qualification testing for Diesel Generator E is based on testing of a similar existing diesel generator.

8) The load capability qualification test applied the continuous rating of Diesel Generator E to stabilize temperatures at which time the rated short-time load was applied for 2 hours immediately followed by 22 hours of loading at the continuous rating.

9) Periodic testing required by the TS of the Diesel Generators is performed at intervals determined in accordance with the Surveillance Frequency Control Program (see TS 5.5.15). The frequency specified in RG 1.108, Regulatory Position C.2.a of 18 months is not implemented.

d) Regulatory Guide 1.22 (2/72)*

The design of the Diesel Generator initiation systems and the Class 1E AC Electrical distribution degraded grid undervoltage protection system permits periodic testing of their actuation devices during plant operation.

e) Regulatory Guide 1.29 (2/76)

Refer to Section 3.13 for compliance statement.

f) Regulatory Guide 1.29 (9/78)

(Diesel Generator E Only)

Refer to Section 3.13 for compliance statement of Diesel Generator E and the connections to the transfer points in the Diesel Generator A, B, C and D rooms.

g) Regulatory Guide 1.30 (8/72)*

Refer to Section 3.13 for compliance statement.

h) Regulatory Guide 1.31 (Diesel Generator E Only)

Refer to Section 3.13 for compliance statement.

i) Regulatory Guide 1.32 (3/76)

All safety related electric systems are in compliance with Regulatory Guide 1.32. Compliance is discussed as follows:

The portions of Regulatory Guide 1.32 applying to DC power are discussed in Subsection 8.3.2.2.1(d).

The availability of the offsite power meets the criteria set forth in Regulatory Guide 1.32. The two offsite circuits have immediate access to the transmission network. See response to Regulatory Guide 1.93 for operating restrictions when offsite power is not immediately available.

IEEE 308-1974 is generally accepted by Regulatory Guide 1.32. Compliance with the Regulatory Guide is discussed as follows:

Class 1E AC power systems are designed to ensure that any design basis event, as listed in Table 1 of IEEE 308, does not cause either (1) loss of electric power to more than one load group, surveillance device, or protection system to jeopardize the safety of the reactor unit, or (2) transients in the power supplies, which could degrade the performance of any system.

Controls and indicators for the Class 1E 4.16 kV bus supply breakers are provided in the control room and on the switchgear. Controls and indicators for the standby AC power supplies are also provided in the control room and on the local diesel generator control panels. Control and indication for the standby power system is described in Subsection 8.3.1.

Class 1E equipment and associated design, operating, and maintenance documents are distinctly identified as described in Subsection 8.3.1.3.

Each Class 1E equipment is qualified by analysis, by successful use under required conditions, or by actual test to demonstrate its ability to perform its function under applicable design basis events.

The surveillance requirements of IEEE 308 are followed in design, installation, and operation of Class 1E equipment and consist of the following:

1) Preoperational equipment and system tests and inspections are performed in accordance with the requirements described in Chapter 14.

2) Periodic equipment tests are performed in accordance with the requirements of Chapter 16.

The standby AC power supplies are shared by both units. The total standby capacity is sufficient to operate the engineered safety feature loads following a design basis accident on one unit and a concurrent forced shutdown of the other unit.

The two preferred offsite power supplies are also shared by both units. The capacity of each offsite power supply is sufficient to operate the engineered safety features of one unit and safe shutdown loads of the other unit.

Connection of non-Class 1E equipment to Class 1E systems is discussed in the response to Regulatory Guide 1.75.

Selection of diesel generator set is discussed in the response to Regulatory Guide 1.9.

j) Regulatory Guide 1.32 (2/77) (Diesel Generator E Only)

The requirements of Regulatory Guide 1.32 (2/77) are the same as the requirements of Regulatory Guide 1.32 (3/76). The compliance to Regulatory Guide 1.32 (2/77) for the Diesel Generator E building and the connections to the transfer points in the Diesel Generator A, B, C and D rooms are the same as the compliance to Regulatory Guide 1.32 (3/76).

k) Regulatory Guide 1.40 (3/73) (Not Applicable to Diesel Generator E)

Refer to Subsection 3.11.2 for compliance statement.

l) Regulatory Guide 1.41 (3/73)*

The preoperational testing program conforms to the general guidance provided by Regulatory Guide 1.41 as described in Chapter 14.

The onsite Class 1E electric power system, designed in accordance with Regulatory Guides 1.6 and 1.32, is tested as part of the preoperational testing program and also after major modifications. The tests are performed in accordance with the requirements outlined in Chapter 14. Facilities are provided to test the independence between the redundant onsite power sources and their load groups.

The onsite Class 1E electric power system can be tested functionally, one load group at a time, by allowing one load group to be powered only by its associated diesel generator while the bus is isolated 1-14 from the preferred offsite power source. The isolation of the offsite power source can be done by direct actuation of undervoltage relays monitoring the Class 1E system.

Each test may include injection of simulated accident signals, startup of diesel generators, and automatic load applications. Functional performance of the loads is checked. Each test is of sufficient duration to achieve stable operating conditions and thus permit the onset and detection of adverse conditions that could result from improper assignment of loads.

During test of one Class 1E load group, the buses and loads of the redundant load group not under test are monitored to verify independence of load groups.

m) Regulatory Guide 1.47 (5/73)*

The design of the Class 1E AC Electrical system meets the intent of Regulatory Guide 1.47.

n) Regulatory Guide 1.53 (6/73)*

Refer to Section 3.13 for compliance statement.

o) Regulatory Guide 1.62 (10/73)*

The diesel generator initiation systems are required to meet the intent of Regulatory Guide 1.62, and are discussed in Subsections 7.6.1b.3 and 7.6.2b.

p) Regulatory Guide 1.63 (10/73) (Not Applicable to Diesel Generator E)

The design of electric penetration assemblies is in compliance with Regulatory Guide 1.63.

Refer to Section 3.13 for compliance statement.

q) Regulatory Guide 1.68 (01/77)

Refer to Section 3.13 for compliance statement.

r) Regulatory Guide 1.68 (08/78)

(Diesel Generator E Only)

Refer to Section 3.13 for compliance statement.

s) Regulatory Guide 1.73 (1/74) (Not applicable to Diesel Generator E)

Selection of electric valve operators for use inside the containment is in compliance with Regulatory Guide 1.73.

The electric valve operators for service inside the containment are type tested in accordance with IEEE 382-1972 as modified by Regulatory Guide 1.73. The tests consist of (1) aging, (2) seismic, and (3) accident or other special environmental requirements. Test parameters are discussed in Subsection 3.11.2.

See Section 3.13 for compliance statement for GE furnished valve operators.

t) Regulatory Guide 1.75 (1/75)

The Regulatory Guide endorses the IEEE 384-1974, subject to the additions and clarifications delineated in Section C of the guide. Regulatory compliance for the NSSS scope of supply Power Generation Control Complex (PGCC), Advance Control Room system (ACR) and Nuclear Steam Supply Shutoff System (NSSSS) local panels are addressed in Section 3.13. All remaining balance of plant (BOP) circuits and equipment meet the requirements of the Regulatory Guide 1.75 except as discussed and clarified in items 4, 5, 7, 11, 13, 14, 15, 16, 17 and 18 below.

1) The electric power system has physical independence required by General Design Criterion 3, 17, and 21 of Appendix A of 10 CFR Part 50 to provide the minimum number of circuits and equipment to perform the required safety and protective functions assuming a single failure.

2) The separation of circuits and equipment (including Class 1E from non-Class 1E circuits) is achieved by structural design, distance, or barrier (as defined per IEEE 384-1974 Section 4 and 5), or any combination thereof.

Two basic circuit isolation schemes are used to isolate control circuits of two redundant load groups and Class 1E from non-Class 1E control circuits. The first scheme consisting of an isolation type relay, P&B type MDR relay, is used to isolate interfacing control circuits. This relay has an internal physical separation between the coil and the electrical contacts. The relay coil motive power is transmitted through an extended rotary shaft which actuates a contact assembly. This relay is of Class 1E category and is designed for metal plate (barrier) mounting so that the coil circuit is at one side of the plate while the contact circuits are on the other. In all applications of this relay, either the metal plate is wide enough to provide a 6 inch minimal air space between the isolated circuits, or the relay is boxed so that the circuits have no common air space at all.

The second isolation scheme is applicable to non-interlocking control circuits of redundant separation groups (including non-Class 1E) that are housed in the same cabinet for operational expediency. In this case, the isolated circuit device is completely boxed, and all cabinet wiring to the device is either enclosed in a flexible metal conduit or is in a wireway with at least 6 inches of separation from the wiring and devices of the circuits it is isolated from. Isolation devices for power circuits are addressed in Paragraph 5 below.

3) The mechanical systems that are served by the electrical systems satisfy the physical independence requirements.

4) "Affiliated" circuits are non-Class 1E circuits which satisfy at least one of the following conditions:

   i) Supply power to non-Class 1E loads from Class 1E power supplies.

   ii) Routed in a common raceway with Class 1E circuits.

   iii) Share the same enclosure with Class 1E circuits without a 6 inch minimum separation or a physical barrier.

   "Affiliated" circuits are used in SSES in place of "associated" circuits which are defined in Section 4.5 of IEEE 384-1974. Affiliated circuits are same as associated circuits except the terminal equipment/devices are not subject to the requirements of Class 1E equipment/devices. "Affiliated" circuits encompass the isolation methods described in paragraph 5).

   The affiliated circuits are subject to the same requirements as Class 1E circuits, such as unique identification, derating, environmental qualification, flame retardance, splicing restriction, raceway fill, and separation, except circuits located in the Turbine Building. All Class 1E circuits (RPS) and affiliated circuits (control rod drive water pump motors, turbine building chillers, main condensate vacuum pump motors, and instrument air compressors), located in the Turbine Building, are routed in qualified Class 1E raceways although they are supported from a non-Seismic Category I structure.

5) Reference: Section 4.5 and 4.6 of IEEE 384-1974. Affiliated circuits are avoided wherever possible, but where non-Class 1E loads are connected to a Class 1E power supply, isolation between the Class 1E and non-Class 1E equipment is accomplished by either of methods i through iv below. Method V is applicable to non-Class 1E power supply feeding a non-Class 1E circuit which becomes affiliated due to the circuits proximity to Class 1E circuits/devices.

Isolation Methods:

(i) Shunt-tripping the Class 1E circuit breaker or tripping of the motor contractor (Class 1E) on a loss of coolant accident (LOCA) signal.

(ii) Shunt-tripping the Class 1E circuit breaker or tripping of the motor contractor (Class 1E) on a LOCA and total loss of offsite power (LOOP) signal.

(iii) An isolation system which consists of a Class 1E circuit overcurrent interrupting device is placed in series with a non-Class 1E circuit overcurrent interrupting device. The circuit between the two devices is affiliated. This method is used for a non-Class 1E distribution bus.

(iv) A Class 1E circuit interrupting device actuated by overcurrent is placed in series with a non-Class 1E equipment. The circuit between the interrupting device and the non-Class 1E equipment is affiliated.

(v) For non-Class 1E circuit in proximity of Class 1E circuits, an isolation system which trips on an overcurrent is placed in series with the non-Class 1E circuit.

All non-Class 1E loads connected to Class 1E power supplies per isolation methods i through iv are summarized in Table 8.1-2. Circuits using isolation method v are all Class 1E equipment space heaters, utility, or lighting circuits where the minimum physical separation cannot be met (see Para. 16). An isolation system is defined as two separate overcurrent devices (isolation method iii and v) placed in series in a circuit to minimize any failure in the non-Class 1E equipment from causing unacceptable influences in the Class 1E system. The type of isolation devices used actuated by overcurrent are breakers and fuses. One of the overcurrent devices of the isolation scheme is Class 1E and located in or adjacent to the Class 1E equipment. The other is non-Class 1E and located at or near the non-Class 1E equipment. The basis for the selection of two devices in series are:

a) Both devices are of different type and different electrical characteristic to eliminate the possibility of a common mode failure due to a manufacturing defect.

b) The devices are selected to minimize the effects on the Class 1E power supply against faults in the non-Class 1E equipment.

c) The devices are coordinated to clear the fault in the non-Class 1E equipment, without tripping the Class 1E main source breaker.

d) During a seismic event, the Class 1E devices feeding to non-Class 1E equipment will provide adequate circuit isolation in the event of a non-Class 1E equipment failure.

e) The devices are selected to protect the Class 1E circuits against faults at the non-Class 1E power circuit (isolation method v) such as short circuit and overvoltage.

6) Non-Class 1E power and control circuits are separated from the Class 1E and associated circuits by the minimum separation requirements specified in Section 5 of IEEE 384-1974.

Isolation devices are used where a non-Class 1E control circuit and Class 1E control circuits are interfaced. (See paragraph 2.)

7) Reference: Position C.7 of Regulatory Guide 1.75 and Sections 5.1.3, 5.1.4 and 5.6.2 of IEEE 384-1974.

Exception to Section 5.1.3 of IEEE 384-1974: The 1" minimum separation requirement of totally enclosed raceway is not met due to space limitation in some areas. This is limited to instrument to instrument, instrument to control, and control to control, and non-Class 1E control to Class 1E power totally enclosed raceway only. For justification, refer to Wyle Lab. Test Report No. NE56719 dated November 20, 1980.

Exception to Section 5.1.3 and 5.1.4 of IEEE 384-1974: The specified horizontal and specified vertical separation distances between free air temporary cables and enclosed Class 1E raceways may not be met. Free air temporary cables can be installed with no separation distance from totally enclosed Class 1E raceways. Temporary cables are non-Class 1E and have a specified removal date or removal event. Tests have demonstrated the acceptability of a single solid metal cable cover as a barrier when the worst case electrical fault occurs to a cable resting on the metal cable tray cover. The cables inside the cable tray maintained their functional capability during the testing.

Non-Class 1E, low energy circuits for digital/analog information and instrumentation such as annunciators, data loggers, meters, recorders and transient monitoring system are permitted to be connected to Class 1E devices for required inputs. These non-Class 1E circuits are exempted from separation requirement only with the same channel/division which the circuits are connected for their inputs. The cabling of these non-Class 1E low energy circuits, with the exception of annunciators, are routed exclusively in non-Class 1E instrumentation raceways which do not contain control or power (high energy) circuits except 120V AC.

Non-Class 1E low energy cables, with the exception of annunciator cables, routed in a common pull/junction box with control or power cables are separated in accordance with the requirements of Table 8.3-25.

All annunciator circuits are non-Class 1E. The cable runs of these circuits are separated from Class 1E circuits by the minimum separation requirements specified in Section 5 of IEEE 384-1974. However, annunciator cables are routed only in the

non-Class 1E control raceways which contain cables of voltage level of 120V AC, 125V DC and 250V DC.

Annunciator cables routed in a common pull/junction box with high energy cables are separated in accordance with the requirements of Table 8.3-25.

All instrumentation and annunciator cables have fire retardant insulation (see Subsection 8.3.3).

The raceways are of fire retardant materials. Instrumentation cables have grounded shields.

Analysis:

Annunciator and instrumentation circuits are low energy circuits. The annunciator circuits operate in 125V DC high impedance (60 K) source. Most of the instrumentation systems operate on 125V DC signals in high impedance circuits or 4-20 ma signals in low impedance circuits.

Since only low energy can be derived from instrumentation circuits, the probability of these non-Class 1E circuits providing a mechanism of failure to the Class 1E circuits inside Class 1E devices or enclosures is extremely low.

The worst credible event which could affect the Class 1E system through the non-Class 1E low energy circuits is a fire involving a control raceway containing annunciator cables. Assume in the worst case where annunciator cables from redundant Class 1E equipment are both shorted to a 120V AC, 125V DC or 250V DC cable due to the fire, further assume that the sensor contacts are both closed and that the overcurrent protective device of the 120V AC, 125V DC or 250V DC cable does not trip. Then the Class 1E devices could be damaged and therefore prevent the devices from performing their Class 1E function.

To summarize the above failure mode, the redundant Class 1E systems will fail only if all of the following conditions occur at the same time:

a. Annunciator cable from a Class 1E device is fused to the highest voltage circuit conductors (250V DC).

b. Annunciator cable from a redundant Class 1E device is also fused to the highest voltage source (250V DC).

c. The highest voltage (250V DC) circuit conductors are not short circuited or grounded.

d. The highest voltage (250V DC) circuit protective devices failed (breaker or fuse failed to perform its intended function)

e. Class 1E device contact closed (alarm state)

f. Redundant Class 1E device contact closed (alarm state)

g. In order for the Class 1E protective system, as designed, to fail due to fire the above six independent low probability events must happen simultaneously. This is considered extremely unlikely. Thus, the low energy non-Class 1E circuits, which are not separated from the Class 1E circuits at the input devices do not provide a mechanism of failure of the Class 1E system.

Analysis of the effects of the following listed potential high voltage sources in the annunciator and computer systems and their interface devices has shown that the Class 1E circuits, from which the annunciator and computer inputs are derived, meet their minimum performance requirements. The installed non-Class 1E interface devices are listed in Table 8.1-3.

- Impressed voltage faults in raceway
- Current Transformers
- Potential Transformers
- Rotating Machine and Transformer Temperature Sensors
- Main Generator Field

For new annunciator and computer inputs, developed from Class 1E circuits, Class 1E isolation devices will be used to provide isolation of the Class 1E circuits.

Annunciator and computer input cables are routed in non-Class 1E raceway which may contain 120V AC, 125V DC and 250V DC cables. Potential damage to cables in the raceway may cause accidental imposition of 120V AC, 125V AC or 250V AC on the annunciator or computer input wires and through these wires to Class 1E devices.

For impressed voltage faults in the raceway systems, the annunciator and computer digital input closed contacts could weld shut if sufficient current flowed for a sufficient duration. Analysis of the annunciator and computer digital interface devices shows that the Class 1E circuits from which these inputs are derived meet their minimum performance requirements even if the input interface device contacts weld shut. This is based upon:

- The interface devices change position and meet their minimum performance requirements before the contacts are exposed to potential contact welding.
- The interface devices are used for alarm and indication only and contacts are not used in Class 1E circuits.
- The interface devices meet their minimum performance requirements even with the input contacts welded shut.

- The interface devices are in affiliated (associated) circuits and contacts from these devices are not used in Class 1E circuits.

- Inputs are developed through electrical isolation devices to provide positive isolation of the circuits.

With the maximum credible voltage impressed on the analog computer inputs, the Class 1E circuits used to develop the computer inputs meet their minimum performance requirements. This is based upon an analysis that shows:

- The computer inputs are developed through electrical isolation devices. These devices prevent the specified impressed voltage faults from degrading the operation of the circuits on the Class 1E side of the devices below an acceptable level.

- The computer inputs are developed from instruments which are part of the primary coolant pressure boundary. Failure of these instruments does not prevent these devices from maintaining the integrity of the primary coolant boundary which is their sole safety-related function.

- The computer inputs are developed from Class 1E Resistance Thermometers Detectors (RTDs) whose failures do not effect the Class 1E circuits.

Current Transformers (CTs) impress short duration high voltage pulses, every half cycle, on connected secondary equipment when the CT secondary circuits are opened under load. These high voltage spikes could cause failure of the transducers used to develop computer inputs and allow the CT open circuit voltage to propagate through the computer to safety systems.

At Susquehanna SES, General Electric (GE) Type 4701 and 4722 series transducers are connected to the CTs and provide inputs to the computer. The transducers must fail before the high voltage pulses can propagate to the computer. Analysis of Westinghouse CTs with 600/5A and lower CT ratios concludes that the maximum estimated open CT secondary voltage is below the 2120V peak tested dielectric withstand of the Type 4722 transducers. Analysis and testing of Westinghouse CTs with CT ratios greater than 600/5A and GE 18,000/5A CTs shows that the maximum credible voltage produced by these CTs will not break down the insulation of the Type 4701 or 4722 transducers. These CTs will not impact other safety systems.

For the GE 40,000/5A CTs, no open CT secondary voltage data is available. Based on CT excitation curves, these CTs may produce more than the 4100V peak which would exceed the 8 hour dielectric withstand capability of the transducer. Circuit protectors (thyrites) have been installed across the secondary of these CTs to limit the voltage to less than 1500VRMS.

For the McGraw CTs, no open circuit voltage data is available. Based on CT excitation curves, the maximum voltage produced by these CTs may exceed the insulation capability of the Type 4701 or 4722 transducers. In the event the transducers flashover and subsequent flashovers occur at the computer input cabinets, this voltage may be impressed on Class 1E circuits connected to the same cabinet as these CTs if, and only if, the flashover does not involve ground. If the flashover involves ground it will provide a return path to the CT secondary circuit, thus completing the CT circuit and reducing the voltage to its normal value. In the event this voltage did reach the Class 1E circuits connected to the same chassis as these CTs, there is no effect on the safe shutdown of the plant. All Class 1E computer inputs connected to this chassis are developed from other current transformers or potential transformer through transducers. The McGraw CT open circuit voltage does not prevent these Class 1E circuits from meeting their minimum performance requirements.

A failure of potential transformers (PTs) could impress high voltages on the secondary circuits which could fail the transducers used to develop the computer inputs and allow the high voltage to migrate through the computer to other Class 1E circuits. The PTs have several possible failure mechanisms such as primary and secondary open and short circuits which would result in loss of computer signals but would not challenge any other circuits with high voltage. The two areas of concern are primary to secondary hot shorts which would apply primary voltage across the load, usually a transducer. Primary turn to turn shorts may also increase secondary voltage if enough turns failed.

At Susquehanna SES, there are no PTs connected directly to the computer. The PT circuits provide inputs through GE Types 4701 and 4722 transducers and Westinghouse TypeVP-840 transducers. An analysis shows that PTs will not fail in such a manner as to apply high voltage on the PT secondary circuits. These PTs are not high voltage sources to the computer because of the type of construction and insulation system, and the separation and isolation provided between the primary and secondary terminals. Moreover, the PT circuits are protected by fuses on the primary as well as on the secondary. Therefore, the PTs will not fail in such a manner as to apply high voltage on the PT secondary circuits.

High voltage cables (480V and higher) are not potential voltage sources into the computer since these cables run in different and separate raceway systems than the computer input cables and do not come in contact with the computer cables.

Rotating machine and transformer temperature sensors are not high voltage fault sources because these devices have a grounded lead or an insulating disc film which is designed to open and connect to ground during a high voltage fault. When the fault is connected to ground, the fault cannot propagate to the computer and is effectively isolated.

The Main Turbine Generator field circuit provides input to the computer through GE Type 4920E transducer. In the event the field circuits opens under load, the stored energy in the field could cause failure of the transducer and allow this high voltage to propagate through the computer to safety related circuits.

The Main Turbine Generator field circuits are the only remaining computer inputs developed through DC shunts. These are non-Class 1E circuits. These computer inputs are developed from low-resistance electric shunts which are designed to provide 100 millivolt maximum output signal. The shunt outputs are connected through two 6 amp fused to a GE Type 4920E isolation transducer which converts the 0-100 input signal to a 4-20 milliamp signal which is then connected to the computer.
This interface is a non-Class 1E device which provides a signal to the non-Class 1E computer and, therefore, does not require qualified isolation devices. An analysis of this circuit was performed to determine if a fault could propagate from the DC shunt to the computer, through the computer and then adversely affect a Class 1E circuit. The postulated fault is an unlikely event. If the fault occurs it must propagate through the shunt, relatively low amperage fuses, a device designed to prevent fault propagation, the computer input buffers, the interfaces between various sections of the computer and finally through the computer input buffer serving the Class 1E circuits.

The conclusion is that the combination described above, particularly the fused isolation transducer, provide adequate assurance that a fault at the DC shunt is not likely to affect a Class 1E circuit and, therefore, is acceptable.

8) In addition to the minimum separation requirements as outlined in items 6 and 7 above; (a) there are no cable splices in raceways, (b) cables and raceways are flame retardant, (c) cable trays are limited to 30 percent fill and are not filled above the side rails.

9) Raceway and cable identifications are in compliance with Regulatory Guide 1.75. Detailed description is given in Subsection 1.8.6.

10) Diesel generators A, B, C and D are housed in separate rooms within a Seismic Category I structure with independent air supplies. The auxiliaries and local controls of each unit are also housed in the same room as the unit they serve. Diesel generator E is housed in a separate Seismic Category I structure with independent air supply. The auxiliaries and local controls for the diesel generator are housed within the same structure as the unit.

11) Redundant Class 1E batteries are located in separate rooms within a Seismic Category I structure; however, each battery room is exhausted by an individual ventilation duct to a common exhaust plenum. Two redundant Class 1E centrifugal exhaust fans service the common exhaust ductwork.

Battery chargers of redundant load groups are physically separated in accordance with the requirements of Regulatory Guide 1.75.

12) All redundant Class 1E switchgear, motor control centers, and distribution panels are physically separated in accordance with Regulatory Guide 1.75.

13) Redundant Class 1E containment electrical penetrations are dispersed around the circumference of the containment and are physically separated in accordance with the requirements of Section 5.5 of IEEE 384-1974. Due to limited space, cable penetrations into the suppression pool contain both non-Class 1E and Class 1E circuits. These non-Class 1E circuits are for instrumentation, annunciation, and computer inputs and are not treated as affiliated circuits.

The suppression pool area is serviced by three (3) electrical penetration assemblies: W300, W301, and W330B. Penetrations for Unit I, 1W300 and 1W301, each contains circuits of one division of the Class 1E systems and non-Class 1E circuits. The third penetration, 1W330B, contains only non-Class 1E circuits. The Unit II penetrations 2W300 and 2W301 contain only circuits of one of the redundant Class 1E divisions and the third penetration 2W330B contains all the non-Class 1E circuits to the suppression pool area. Penetrations W300 and W301 are located in opposite quadrants of the suppression pool for each unit. Penetrations 1W300 and 1W301 also have non-Class 1E instrument and control circuits. Three of the non-Class 1E instrument circuits are for non-Class 1E RTD inputs (except on affiliated RTD cable, RM1I9804E, which is routed together with non-Class 1E circuits since it cannot be accommodated by another penetration module). These are low energy and do not degrade the Class 1E circuits as discussed in Section 8.I.6.I.q-7). The non-Class 1E control circuits are used for annunciator inputs only. These annunciator circuits derive digital information from the same Class 1E equipment as the Class 1E control cables (i.e., PSV-15704A2, solenoid valve control and valve position annunciation). No other non-Class 1E circuit cables are routed in the same raceway with the annunciator cables from the Class 1E valve to the penetration inboard to the suppression pool. For further justification on annunciator circuits see Section 8.1.6.1.q-7). The remainder of non-Class 1E instrument and control circuits are used for the Integrated Leak Rate Test (ILRT). This testing is performed only when the reactor is in the cold shutdown mode and personnel access to the suppression pool is permitted. After the ILRT test are completed these circuits are isolated from the rest of the plant as all test instruments and sensors are disconnected and removed from both the suppression pool and the reactor building areas. The segments of the ILRT circuits not disconnected after testing are run in separate plant raceways used only for the ILRT system.

All future non-Class 1E circuits will be routed through the penetration 1W330B reserved for non-Class 1E only.

14) References: Section 5.6.2 and 5.6.3 of IEEE 384-1974.

In general, circuits for redundant Class 1E systems and circuits for non-Class 1E systems are located in separate enclosures such as, boxes, racks, and panels. However, in cases where redundant channel/division Class 1E circuits or Class 1E and non-Class 1E circuits, or RPS and other Class 1E and non-Class 1E circuits are located in the same enclosure, physical separation is achieved either by minimum of 6" horizontal and vertical separation, steel barriers, metallic enclosure,

or metallic flexible conduit (exception to this separation requirement is taken for non-Class 1E low energy circuits discussed in paragraph 7 of this section). Where the above separation methods are not feasible, one of the separation group circuits except for RPS are to be covered with one of the following qualified nonflammable materials:

i. Have Industries, siltemp sleeving type S and woven tape type WT65.

ii. Carborundum, Fiberfrax sleeving type HP144T and woven tape type 3L144T.

These materials have been qualified to be used as separation barriers (Wyle Lab. Test Report No. 56669 dated May, 1980).

Applications of these materials are controlled and documented by the engineering office. Enclosures that contain wiring and devices for Class 1E circuits are labeled distinctively to identify externally the separations system and grouping (see Subsection 3.12.3.2). Internal to enclosures, terminal blocks and devices such as relays, switches and instruments are uniquely identified. In addition, external cables are color coded and marked to be readily identified (see Subsection 3.12.3.4.2). Wire bundles or cables internal to control boards are not distinctively or permanently identified.

15) Due to spatial limitation beneath the reactor vessel, the following is a description of electrical cable separation for the Neutron Monitoring System (NMS), Reactor Protection System (RPS), and Control Rod Drive System (CRD):

i. All Class 1E cables are routed through enclosed raceway such as enclosed wireways, rigid and flexible conduits except as noted in paragraph iv.

ii. Non-Class 1E cables are routed in open trays.

iii. Cables of different systems may be routed in some portion of raceway. But channel separation is maintained.

iv. Because of space limitation and need for flexibility, the flexible conduits end after the horizontal runs where cables drop down for connection to connectors.

v. The 1 inch minimum separation requirement of IEEE 384-1974 is not met for enclosed raceways beneath the reactor vessel. Also, the minimum separation requirements of IEEE 384-1974 Section 5.1.3 or 5.1.4 and not met for Class 1E enclosed raceways and non-Class 1E open trays.

All cables (Class 1E and non-Class 1E) beneath the reactor vessel are low energy instrumentations circuits. Fire hazard beneath the reactor vessel is described in Fire Protection Review Report Section 6.2.3 Fire Zone 1-1H.

16) Non-Class 1E circuits inside a Class 1E equipment, such as lighting, utility or space heater circuit, shall be considered affiliated unless a 6" minimum separation or physical barrier from the Class 1E circuits is provided or unless analysis or test

shows that the non-Class 1E space heater circuits will not affect the Class 1E system. If power is supplied from a non-Class 1E distribution panel, an isolation device or system (Isolation Method V) is installed at or near the equipment to prevent failures in the non-Class 1E circuits from affecting redundant Class 1E circuits.

Alternatively, the non-Class 1E supply cables may be routed in separate raceways such that no common mode failure could affect redundant Class 1E circuits due to a single event.

17) The Safety Parameter Display System (SPDS) is a non-Engineered Safeguard system that derives digital and analog information from Safety-Related and non-Safety Related systems. The input cables for the SPDS are assigned the electrical groupings of the system from which the SPDS derives its input. The output information of the SPDS is totally non-Class 1E. SPDS cables routed in the Main Control Room, the Upper and Lower Cable Spreading Rooms, and all General Plant areas are separated as described in Section 8.1.6.1.q-6. SPDS cables, in part, are also routed through the Upper and Lower Relay Room floor modules. SPDS cables assigned the separation group of Division I and Affiliated are routed in the Upper Relay Room Floor, which primarily contains Division I and non-Class 1E Cables. SPDS cables assigned the separation group of Division II and Affiliated are routed in the Lower Relay Room Floor, which primarily contains Division II and non-Class 1E cables. The SPDS Divisionalized and Affiliated assigned cables share partial routings with non-Class 1E control and instrumentation cables in the respective Upper and Lower Relay Room Floor sections, particularly at the transitional intersections of the lateral and longitudinal floor ducts and at the cable convergence area entering the bottom of the Relay Room panels. SPDS Divisionalized and Affiliated assigned cables deriving input from NSSS systems are routed the same as the existing respective Safety Related cables in the Relay Room floor ducts.

For Regulatory Guide compliance for NSSS scope of supply see Subsections 7.1.2.5.8, 7.2.2.1.2.1.10, 7.3.2a.1.2.1.10, 7.3.2a.2.2.1.9, 7.3.2a.3.2.1.2, 7.4.2.1.2.1.11, and 7.6.2 3.2.3.4.

SPDS Cables, assigned to Divisionalized and Affiliated separation groupings, deriving input from BOP systems are also routed the same as the existing respective safety related cables in the Relay Room floor ducts with additional requirement that: no non-Class 1E cable can share a common or partial routing with BOP SPDS cables of redundant safety related systems (i.e., Division I and II). In the unlikely event that the non-Class 1E control and instrument cables, routed with the BOP SPDS cables Divisionalized and Affiliated, assigned the separation groups that are in the Relay Room ducts, could provide a failure mechanism to the Class 1E system, this event could only affect one of the Redundant Divisions of the Class 1E systems. The cables and components of the unaffected Division will not be degraded and will be available to perform the required Safety Related functions(s).

Affiliated cables are routed between SPDS non-Class 1E components. As per FSAR Section 18.1.17 Plant Safety Parameter Display System Requirements, the cabling between the non-Class 1E SPDS components is required to be installed to

withstand an earthquake and therefore was routed in Class 1E raceway which is seismically qualified. Since the SPDS cables are in Class 1E raceway and are not safety Related they were designated affiliated. These cables routed between SPDS non-Class 1E components shall remain affiliated based on SPDS requirements and proximity to Class 1E cables and equipment.

18) Inside containment for low energy non-Class 1E instrumentation and control cables, where the separation requirements with Class 1E/RPS circuits per IEEE 384-1974 is not met due to spatial limitations, for cables in transition from tray to conduit or conduit to tray or penetration box to tray; the effects of lesser separation are analyzed to demonstrate that Class 1E/RPS cables are not degraded below an acceptable level to perform their intended function per IEEE 384-1974 section 4.6.1(3). The analysis is documented in specific calculations per requirements of section C-6 of Regulatory Guide 1.75.

Non-Class 1E instrumentation cables are for Rod Position Indication System (RPIS), transient monitoring system, temperature sensor cables and Integrated Leak Rate System (ILRT).

Non-Class 1E control cables are for SRV flow monitoring system instrumentation, Traversing Incore Probe indexing mechanisms, Drywell sump level sensors and area cooling flow switches, space heaters for Drywell area unit coolers, and annunciation and interlocks for Reactor Recirc. system components.

Analysis

The instrumentation systems operate on 1-5 Volt DC signals in high impedance circuits or 4-20 mA signals in low impedance circuits. ILRT cables are used for portable RTD connections during Integrated Leak Rate Testing performed when reactor is in cold shutdown mode and personnel access to suppression pool is permitted. After testing is completed, these circuits are isolated from the rest of the plant as all sensors and instruments are disconnected and removed from suppression pool and reactor building areas. Since only low energy can be derived from these instrumentation circuits, the probability of these non-Class 1E circuits providing a mechanism of failure to the Class 1E/RPS cables with lesser separation is extremely low.

The control systems operate on 120V AC, or less, at relatively low current values. The two worst case scenarios analyzed involve Drywell area unit cooler space heater and flow switch control circuits. In both cases, assuming a short circuit at the locations where the Zetex wrap is removed, the calculated potential to damage other cables is significantly less than the calculated potential to damage other cables based on actual test results of faulted cables. The probability of these non-Class 1E control circuits providing a mechanism of failure to the Class 1E/RPS cables, based on their calculated potential to damage thee cables, is extremely low to non-existent.

The worst credible event which could affect the Class 1E/RPS cables through the non-Class 1E low energy instrumentation and control cables is fully analyzed based on actual test results applicable to specific locations. The analysis determined that there will be no effect on the functional capability of Class 1E/RPS cables, with a conservative assumption of non-Class 1E instrumentation and control cables having a damage potential equal to that of a highest damage potential cable; the maximum temperature to which Class 1E/RPS cables could be subjected to were estimated to be far below the temperatures used during qualification testing of these cables.

19) The Class 1E Channel C and D 4.16 kV Buses supply power to divisional and affiliated loads as well as their respective Class 1E channel loads. The trip circuitry for each breaker of divisional and affiliated loads is supplied control power through an automatic transfer logic. The automatic transfer logic transfers the breaker trip logic upon loss of normal control power to an alternate control power source which supplies control power to the trip logic through an isolation scheme. The Channel A/Division I battery is the normal control power source for the trip circuitry of the breaker supplying the divisional or affiliated loads connected to the Class 1E Channel C 4.16 kV Bus. The alternate control power source is the Channel C battery. The Channel B/Division II battery is the normal control power source for the trip circuitry of the breakers supplying the divisional or affiliated loads connected to the Class 1E Channel D 4.16 kV Bus. The alternate control power source is the Channel D battery. The alternate control power source to the breaker trip circuitry of the divisionalized or affiliated loads consists of an isolation scheme which utilizes two Class 1E interrupting devices in series. The isolation scheme is similar to the isolation scheme used to connect non-Class 1E loads to a Class 1E power supply as described in Paragraph 5, isolation method iii. The circuit between the two Class 1E interrupting devices is designed as "affiliated" to be consistent with isolation method iii even though the circuit is Class 1E. The circuits using this isolation scheme are summarized in Table 8.1-4. The basis for selection of the two Class 1E interrupting devices in series utilizes similar criteria to isolation method iii, Paragraph 5:

1. One of the overcurrent devices of the isolation scheme is located in or adjacent to the channelized DC control power source. The other device is located at or near the divisional or affiliated load.

2. Both devices are of different type and different electrical characteristics to eliminate the possibility of a common mode failure due to a manufacturing defect or design service life.

3. The devices are selected to minimize the effects on the channelized DC control power source against faults in the trip circuitry of the divisional or affiliated loads.

4. The devices are coordinated to clear the fault in the trip circuitry of the divisional or affiliated loads, without tripping the main source breaker to the channelized control power source.

5. During a seismic or accident conditions, the devices feeding the trip circuitry of the divisional or affiliated loads provide adequate circuit isolation in the event of a single failure in the trip circuitry of a divisional or affiliated load.

20) The Containment Radiation Monitors (CRM) are seismically qualified to meet the requirements of Regulatory Guide 1.45. The area where the monitors are located in the Reactor Building is a harsh area post-accident. The monitors are not environmentally qualified. The monitors are supplied power and control power from the Class 1E System. Each power supply for the monitors has an isolation scheme which uses a dynamic and environmentally qualified interrupting device in series with a seismically qualified interrupting device. This isolation scheme is similar to the isolation scheme used to connect a non-Class 1E load to a Class 1E power supply as described in Paragraph 5, Isolation Method III. For the CRM, both interrupting devices are Class 1E and the circuit between the two interrupting devices is designated as Class 1E. The circuits using this isolation scheme are summarized in Table 8.1-5. The basis for selection of the two interrupting devices in series utilizes similar criteria to that in FSAR Section 8.1.6.1.q.5:

1. One of the overcurrent devices of the isolation scheme is located in or adjacent to the divisional power or control power source. The other device is located at or near the divisional load.

2. Both devices are of different type and different electrical characteristics to eliminate the possibility of a common mode failure due to a manufacturing defect or design service life.

3. The devices are selected to minimize the effects on the Division I or Division II power or control power sources against faults in the CRM System.

4. The devices are coordinated to clear the fault in the CRM system, without tripping the main source breaker to the Division I or Division II power or control power source.

5. During a LOCA event, the devices in the Division I or Division II power or control power sources provide adequate isolation in the event of a CRM system failure.

u) Regulatory Guide 1.75 (9/78) (Diesel Generator E Only)

The requirements of Regulatory Guide 1.75 (9/78) are the same as the requirements of Regulatory Guide 1.75 (1/75). The compliance and exceptions to Regulatory Guide 1.75 (9/78) for the Diesel Generator E building and the connections to the transfer points in the Diesel Generator A, B, C and D rooms are the same as the compliance and exceptions to Regulatory Guide 1.75 (1/75) for the BOP circuits of the plant.

A transfer scheme for substituting Diesel Generator E for any of the channelized Diesel Generators A, B, C or D utilizes a double-break configuration as an isolation method to assure independence between redundant safety related load groups. Power, control and instrumentation circuits from the channelized Diesel Generators A, B, C and D that tie to Diesel Generator E have two normally open contacts in series for each circuit. The normally open contacts are located in two separate locations. One contact of each circuit is in the channelized Diesel Generator A, B, C or D room. The second normally open contact of each circuit is in the Diesel Generator E building. Substitution of Diesel Generator E is accomplished by closing the normally open contacts of the circuits from the channelized diesel generator for which Diesel Generator E is being substituted. The normally open contacts of the circuits from the other channelized diesel generators continue to be open thereby providing the double-break isolation and maintaining independency.

The Diesel Generator E Class 1E circuitry to the transfer scheme's normally open contacts in the Diesel Generator E Building is designated as a unique Channel H. Cable and raceway for Channel H are separated from non-Class 1E and the other channelized Class 1E channel/division cable and raceway in the Diesel Generator E building. Whenever Diesel Generator E is substituted for a channelized diesel generator, Diesel Generator E and its auxiliaries are considered to be the channel to which Diesel Generator E is aligned. The Channel H cables and raceway assimilate or are compatible with the channel/division of the substituted channelized diesel generator. The double-break configuration assures the independence of the Diesel Generator E and its auxiliaries from the three remaining channelized diesel generators which were not substituted. Whenever Diesel Generator E is not aligned, the double break configuration assures the independence of Diesel Generator E and its auxiliaries from the four channelized diesel generators.

When Diesel Generator E is aligned only those circuits of the transfer scheme to the substituted diesel generator are energized and operational. The circuits of the transfer scheme between the transfer points of the three remaining channelized diesel generators and Diesel Generator E are de-energized and isolated. Any creditable failure of the de-energized cables will not effect the Channel H cables due to the double break configuration. Likewise, a creditable failure on the Channel H is restricted to the aligned channel by the double break configuration.

When Diesel Generator E is not aligned, the channelized circuitry of the transfer scheme is de-energized and isolated by the double break configuration. The channel H circuitry is operational but isolated from the channelized circuitry of the transfer scheme by the double break configuration.

The channel/divisional Class 1E internal wiring to the transfer switches within the transfer points is isolated by 6 inches or a barrier except within the cover of the transfer switches. Inside the cover, the internal wiring is routed in separate bundles so as to maximize the distance. However, as indicated above, the transfer switch is either closed which results in the wiring on both sides of the switch assimilating the same separation group or the switch is open which is isolating energized, operable wiring from de-energized, inoperable wiring.

v) Regulatory Guide 1.81 (1/75)*

The design of the electric power systems meets Regulatory Guide 1.81.

The DC power systems are not shared between the two units.

The standby AC power supplies are shared between the two units. The standby AC power systems have the capability to concurrently supply the engineered safety feature loads of one unit and the safe shutdown loads of the other unit, assuming a total loss of offsite power and a single failure in the onsite power system, such as the loss of one diesel generator.

The standby AC power systems for the two units are designed with minimum interactions between each unit's safety feature circuit so that allowable combinations of maintenance and test operations in either or both units would not degrade the capability to perform the minimum required safety functions in any unit, assuming a total loss of offsite power.

The Unit 1 AC Distribution System is a shared system between both units, since the common equipment (Emergency Service Water, Standby Gas Treatment System, Containment Structure HVAC, etc.) is energized only from the Unit 1 AC Distribution System. There are no Unit 2 specific loads energized from the Unit 1 AC Distribution System. The capacity of the Unit 1 AC Distribution System is sufficient to operate the engineered safety features of one unit and the safe shutdown loads of the other unit.

w) Regulatory Guide 1.89 (11/74)*

Refer to Section 3.13 for compliance statement.

x) Regulatory Guide 1.93 (12/74)*

Redundant offsite and onsite power sources are provided to meet the "Limiting Conditions for Operation" as defined in Regulatory Guide 1.93. See Chapter 16 for plant operating restrictions after the loss of power sources.

y) Regulatory Guide 1.106 (11/75) (3/77)

The requirements of Regulatory Guide 1.106 are met (Position C2).

The thermal overload protection devices trip setpoints for all safety related motors on motor-operated valves (MOV) in Table 8.1-1 are also established in favor of completing the MOVs safety function except for the following MOV's:

HV-01110E
HV-01120E
HV-01112E
HV-01122E

Additionally, the thermal overload protection devices for all safety related motors on motor-operated valves (MOV) are continuously bypassed and temporarily placed in force during testing except as discussed.

The thermal overload protection devices for the above MOV's are automatically bypassed when an accident signal occurs with the Diesel Generator E not aligned as discussed in subsection 8.1.6.1.z.

The thermal overload protection devices are periodically tested to ensure that these devices operate within the manufacturer's performance characteristics.

The following MOV thermal overload protection devices are not continuously bypassed; however, the trip setpoints are established in favor of completing the MOV's safety function.

TV-08612A	TV-08612B
TV-08643A	TV-08643B
TV-08652A	TV-08652B
TV-08662A	TV-08662B
HV-141F020	HV-241F020

Continuous bypass is a normally closed (N.C.) contact from either a relay or switch which is connected in parallel across the thermal overload trip contact. Continuous bypass is accomplished by the use of an operate/test or normal/test type selector switch located in Panel 0C697 at rear section of control room:

A. Operate/Test Type Switches

1. In the operate position, a set of normally closed (N.C.) contacts for each MOV is connected in parallel across the thermal overload trip contacts, thus bypassing the overload trip.

2. In the test position, the above set of contacts open thus permitting the overload trip contacts to trip the motor on closing or opening should an overload condition occur.

B. Normal/Test Type Switches

1. In the normal position, a set of normally open (N.O.) contacts in series with one or more relays (designated as 95) de-energizes the 95 relays. A set of normally closed relay contacts is paralleled across the thermal overload trip contacts thus bypassing the overload trip. Loss of power to the relays will cause the overloads to be bypassed.

2. In the test position the above, N.O. contacts close, energizing the 95 relays, and thus opens the contact across the MOV overload trip contacts. This permits a motor overload to trip the motor during a closing or opening test operation.
A bypass indication system is provided to alert the control room operator when a safeguard MOV is in a disabled condition. Loss of power supply, such as when the breaker is tripped for maintenance, or loss of control power is indicated in the bypass indication panel C694 located behind the unit operating benchboard. A Division I or II group alarm will then be made and this will be annunciated at the emergency core cooling benchboard C601.

Table 8.1-1 provides a listing of all MOV's with their thermal overload bypassed during plant operation (refer to Section 1.7 for changes).

The individual contacts that bypass the thermal overload trip contacts are not periodically tested.

z) Regulatory Guide 1.106 (3/77)(Diesel Generator E Only)

The requirements of Regulatory Guide 1.106 are met.

When Diesel Generator E is not aligned for Diesel Generator A, B, C or D, the thermal overload protection on the Loop A and B ESW supply and return valves to Diesel Generator E is automatically bypassed. Automatic bypass is a normally open (N.O.) contact of a relay connected in parallel across the thermal overload trip contact which changes state to a closed contact due to the relay energizing.

When Diesel Generator E is not aligned, automatic bypass is accomplished by a relay energized by a LOCA or LOOP signal.

aa) Regulatory Guide 1.118 - PERIODIC TESTING OF ELECTRIC POWER AND PROTECTION SYSTEMS (June 1976) and (June 1978 for the E Diesel Generator only)

The requirements of Regulatory Guide 1.118 are met.

Periodic testing of electrical power and protection systems of the Class 1E AC Electrical system is conducted to meet the intent of Regulatory Guide 1.118 (6/76), which invokes the requirements of IEEE 338-1975.

Periodic testing of electrical power and protection systems of the E Diesel Generator meets the intent of Regulatory Guide 1.118 (6/78), which invokes the requirements of IEEE 338-1977.

bb) Regulatory Guide 1.148 (03/81) (Diesel Generator E Only)

Refer to Section 3.13 for compliance statement.

8.1.6.2 Compliance with IEEE 338, 344, and 387

IEEE 338-1971, 344-1971 and 387-1972 are applicable to the plant except for the Diesel Generator E where IEEE 338-1977, 344-1975, 387-1977 are applicable.

a. IEEE 338-1971, IEEE 338-1975 and IEEE 338-1977

IEEE 338-1971 is referenced in FSAR sections 7.2, 7.3, 7.4 and 7.6. Susquehanna SES, with the exception of the E Diesel Generator, was designed in accordance with IEEE 338-1971. However, Regulatory Guide 1.118 (dated 6/76), Periodic Testing of Electric Power and Protection Systems, referenced in FSAR Sections 3.13 and 8.1.6.1, endorses the requirements of IEEE 338-1975 as a generally acceptable method for the periodic testing of electric power and protection systems. For the E Diesel Generator, Regulatory

Guide 1.118 (dated 6/78) Periodic Testing of Electric Power and Protection Systems endorses the requirements of IEEE 338-1977.

b. IEEE 344-1971 and IEEE 344-1975

Compliance with this standard is discussed in Section 3.10c.2.2, "Seismic Qualification for Electrical Equipment Operability". See FSAR Table 3.2-1. IEEE 344-1975 is applicable only to Diesel Generator E.

c. IEEE 387–1972 and IEEE 387-1977

The following paragraphs analyze compliance with the design criteria of IEEE 387, Criteria for Diesel Generator Units as Standby Power Supplies for Nuclear Power Generating Stations. IEEE 387-1977 is applicable only to Diesel Generator E. See FSAR Section 8.1.6, Regulatory Guides and IEEE Standards, FSAR Section 8.3.1.4.11.2.c and FSAR Table 3.2-1.

Adequate cooling and ventilation equipment is provided to maintain an acceptable service environment within the diesel generator rooms during and after any design basis event, even without support from the preferred power supply.

Each diesel generator is capable of starting, accelerating, and accepting load as described in Subsection 8.3.1.4. The diesel generator automatically energizes its cooling equipment within an acceptable time after starting.

Frequency and voltage limits and the basis of the continuous rating of the diesel generator are discussed in the compliance statement to Regulatory Guide 1.9 in Subsection 8.1.6.1.

Mechanical and electric systems are designed so that a single failure affects the operation of only a single diesel generator.

Design conditions such as vibration, torsional vibration, and overspeed are considered in accordance with the requirements of IEEE 387.

Each diesel governor can operate in the droop mode and the voltage regulator can operate in the paralleled mode during diesel generator testing. If an underfrequency condition occurs while the diesel generator is paralleled with the preferred (offsite) power supply, the diesel generator will be tripped automatically.

When aligned to a Class 1E 4.16 kV Bus, each diesel generator is provided with control systems permitting automatic and manual control. The automatic start signal is functional except when a diesel generator is not aligned. Provision is made for controlling the aligned diesel generators from the control room and from the diesel generator room/building. Subsection 8.3.1.4.10 provides further description of the control systems.

Voltage, current, frequency, and output power metering is provided in the control room for the aligned diesel generators to permit assessment of the operating condition of each diesel generator.

Surveillance instrumentation is provided in accordance with IEEE 387 as follows:

1) Starting System

Starting air pressure low alarm

2) Lubrication System

Lube oil pressure low trip and lube oil temperature high and low alarms. Lube oil pressure low trip is by coincident logic.

3) Fuel System

Fuel oil level in day tank high and low, fuel oil pressure high and low, and fuel oil level in storage tank high and low alarms

4) Primary Cooling System

Essential service water low pressure

5) Secondary Cooling System

Jacket coolant temperature high and low, jacket coolant pressure low

6) Combustion Air Systems

Failure alarm is provided

7) Exhaust System

Pyrometers located at diesel generator local control panel

8) Generator

Generator differential, ground overcurrent, and reverse-power, underfrequency, and overvoltage trip and alarm. Neutral overvoltage and overcurrent alarm.

9) Excitation System

Low field current and overexcitation relay trip and alarm

10) Voltage Regulation System

Diesel generator overvoltage alarm

11) Governor System

Diesel generator underfrequency alarm and trip, and engine overspeed trip

12) Auxiliary Electric System

4.16 kV bus undervoltage relays initiate bus transfer and alarm.

A detailed list of trip and alarm functions and testing of the diesel generator is discussed in Subsection 8.3.1.4.6

TABLE 8.1-1

Motor Operated Valves With
Thermal Overload Continuously Bypassed During Plant Operation

MOTOR OPERATED VALVE	SYS	DIV/CH	DWG.
HV-01222A	RHR SW	I	E-150 SH 32
HV-01222B	RHR SW	II	E-150 SH 4
HV-01224A1	RHR SW	I	E-150 SH 33
HV-01224B1	RHR SW	II	E-150 SH 8
HV-01224A2	RHR SW	I	E-150 SH 33
HV-01224B2	RHR SW	II	E-150 SH 8
HV-01112E*	ESW	H	E-146 SH 17
HV-01122E*	ESW	H	E-146 SH 18
HV-01110E*	ESW	H	E-146 SH 19
HV-01120E*	ESW	H	E-146 SH 20
HV-01201A1	RHR SW	I	E-150 SH 34
HV-01201A2	RHR SW	I	E-150 SH 34
HV-01201B1	RHR SW	II	E-150 SH 34
HV-01201B2	RHR SW	II	E-150 SH 34
HV-11210A	RHR	I	E-150 SH 10
HV-11210B	RHR SW	II	E-150 SH 11
HV-11215A	RHR SW	I	E-150 SH 5
HV-11215B	RHR SW	II	E-150 SH 12
HV-15766	CONT. ISO.	I	E-171 SH 5
HV-15768	CONT. ISO.	II	E-171 SH 6
HV-12603	CONT. ISO.	I	E-172 SH 2
HV-11345	CONT. ISO.	II	E-147 SH 15
HV-11313	CONT. ISO.	I	E-147 SH 4
HV-11346	CONT. ISO.	II	E-147 SH 14
HV-11314	CONT. ISO.	I	E-147 SH 3
HV-E11-1F009	RHR	I	E-153 SH 17
HV-E11-1F040	RHR	I	E-153 SH 40
HV-G33-1F001	RWCU	I	E-165 SH 6
HV-E11-1F103A	RHR	I	E-153 SH 27
HV-E11-1F075A	RHR SW	I	E-150 SH 5
HV-E11-1F048A	RHR	I	E-153 SH 18
HV-E11-1F006C	RHR	I	E-153 SH 20
HV-E11-1F004C	RHR	I	E-153 SH 19
HV-E11-1F015A	RHR	I	E-153 SH 25
HV-E11-1F024A	RHR	I	E-153 SH 23
HV-E21-1F015A	CS	I	E-155 SH 5
HV-E41-1F002	HPCI	I	E-152 SH 16
HV-B21-1F016	NSSSS	I	E-170 SH 2
HV-E11-1F022	RHR	I	E-153 SH 37

TABLE 8.1-1

MOTOR OPERATED VALVE	SYS	DIV/CH	DWG.
HV-E11-1F010A	RHR	I	E-153 SH 41
HV-E11-1F004A	RHR	I	E-153 SH 19
HV-E11-IF006A	RHR	I	E-153 SH 20
HV-E11-1F027A	RHR	I	E-153 SH 28
HV-E11-1F007A	RHR	I	E-153 SH 26
HV-E11-1F104A	RHR	I	E-153 SH 27
HV-E11-1F028A	RHR	I	E-153 SH 96
HV-E11-1F047A	RHR	I	E-153 SH 21
HV-E11-1F073A	RHR SW	I	E-150 SH 5
HV-E11-1F003A	RHR	I	E-153 SH 91
HV-E11-1F017A	RHR	I	E-153 SH 24
HV-E21-1F001A	CS	I	E-155 SH 4
HV-E21-1F031A	CS	I	E-155 SH 2
HV-E21-1F004A	CS	I	E-155 SH 1
HV-E21-1F005A	CS	I	E-155 SH 3
HV-E11-1F021A	RHR	I	E-153 SH 29
HV-E11-1F016A	RHR	I	E-153 SH 95
HV-15112	RHR	I	E-153 SH 41
HV-E51-1F007	RCIC	II	E-154 SH 4
HV-E51-1F084	RCIC	II	E-154 SH 16
HV-E11-1F027B	RHR	II	E-153 SH 95
HV-E11-1F048B	RHR	II	E-153 SH 9
HV-E11-1F015B	RHR	II	E-153 SH 16
HV-E11-1F006B	RHR	II	E-153 SH 36
HV-E11-1F021B	RHR	II	E-153 SH 29
HV-E11-1F010B	RHR	II	E-153 SH 41
HV-E11-1F004B	RHR	II	E-153 SH 10
HV-E11-1F007B	RHR	II	E-153 SH 93
HV-E11-1FI04B	RHR	II	E-153 SH 94
HV-E11-1F028B	RHR	II	E-153 SH 12
HV-E11-1F047B	RHR	II	E-153 SH 11
HV-E11-1F016B	RHR	II	E-153 SH 95
HV-E11-1F003B	RHR	II	E-153 SH 11
HV-E11-1F017B	RHR	II	E-153 SH 14
HV-E21-1F031B	CS	II	E-155 SH 2
HV-E21-1F001B	CS	II	E-155 SH 4
HV-E11-1F103B	RHR	II	E-153 SH 94
HV-E11-1F075B	RHR SW	II	E-150 SH 5
HV-E11-1F073B	RHR SW	II	E-150 SH 29
HV-E11-1F006D	RHR	II	E-153 SH 20
HV-E11-1F004D	RHR	II	E-153 SH 19
HV-E11-1F024B	RHR	II	E-153 SH 13
HV-E21-1F015B	CS	II	E-155 SH 5
HV-E21-1F004B	CS	II	E-155 SH 1

TABLE 8.1-1

MOTOR OPERATED VALVE	SYS	DIV/CH	DWG.
HV-E21-1F005B	CS	II	E-155 SH 3
HV-E32-1F001K	MSIV	II	E-189 SH 1
HV-E32-1F002K	MSIV	II	E-189 SH 1
HV-E32-1F003K	MSIV	II	E-189 SH 1
HV-E32-1F001P	MSIV	II	E-189 SH 1
HV-E32-1F002P	MSIV	II	E-189 SH 1
HV-E32-1F003P	MSIV	II	E-189 SH 1
HV-E32-1F001B	MSIV	II	E-189 SH 1
HV-E32-1F002B	MSIV	II	E-189 SH 1
HV-E32-1F003B	MSIV	II	E-189 SH 1
HV-E32-1F001F	MSIV	II	E-189 SH 1
HV-E32-1F002F	MSIV	II	E-189 SH 1
HV-E32-1F003F	MSIV	II	E-189 SH 1
HV-E32-1F006	MSIV	I	E-189 SH 1
HV-E32-1F007	MSIV	I	E-189 SH 1
HV-E32-1F008	MSIV	I	E-189 SH 1
HV-E32-1F009	MSIV	I	E-189 SH 1
HV-E51-1F045	RCIC	I	E-154 SH 5
HV-E51-1F012	RCIC	I	E-154 SH 6
HV-E51-1F013	RCIC	I	E-154 SH 7
HV-15012	RCIC	I	E-154 SH 8
HV-E51-1F046	RCIC	I	E-154 SH 9
HV-E51-1F008	RCIC	I	E-154 SH 3
HV-E51-1F031	RCIC	I	E-154 SH 10
HV-E51-1F010	RCIC	I	E-154 SH 11
HV-E51-1F019	RCIC	I	E-154 SH 12
HV-E51-1F060	RCIC	I	E-154 SH 13
HV-E51-1F059	RCIC	I	E-154 SH 14
HV-E51-1F022	RCIC	I	E-154 SH 15
HV-E51-1F062	RCIC	I	E-154 SH 17
HV-E41-1F012	HPCI	II	E-152 SH 10
HV-E41-1F001	HPCI	II	E-152 SH 5
HV-E41-1F011	HPCI	II	E-152 SH 7
HV-E41-1F006	HPCI	II	E-152 SH 9
HV-E41-1F079	HPCI	II	E-152 SH 17
HV-E41-1F059	HPCI	II	E-152 SH 11
HV-E41-1F004	HPCI	II	E-152 SH 12
HV-E41-1F003	HPCI	II	E-152 SH 13
HV-E41-1F042	HPCI	II	E-152 SH 14
HV-E41-1F002	HPCI	II	E-152 SH 16
HV-E41-1F075	HPCI	II	E-152 SH 17
HV-E41-1F008	HPCI	II	E-152 SH 6
HV-E41-1F007	HPCI	II	E-152 SH 8
HV-E41-1F066	HPCI	II	E-152 SH 15

TABLE 8.1-1

MOTOR OPERATED VALVE	SYS	DIV/CH	DWG.
HV-G33-1F004	RWCU	II	E-165 SH 7
HV-B21-1F019	NSSSS	II	E-170 SH 3
HV-E11-1F008	RHR	II	E-153 SH 15
HV-E11-1F023	RHR	II	E-153 SH 38
HV-E11-1F049	RHR	II	E-153 SH 39
HV-21144A	RB HVAC	I	E-216 SH 30
HV-21144B	RB HVAC	II	E-216 SH 31
HV-14182A	RWCU	I	E-165 SH 19
HV-14182B	RWCU	I	E-165 SH 19

- Thermal overload is automatically bypassed when an accident signal occurs with the Diesel Generator E not aligned.

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
1	Control Structure HVAC Chiller Condenser Water Pump OP170A	Control Structure H&V Room Div. I Engineered Safeguard MCC OB136	i
2	Control Structure HVAC Chiller Condenser Water Pump OP170B	Control Structure H&V Room Div. II Engineered Safeguard MCC OB146	i
3	Drywell Area Unit Cooler 1V411A	Reactor Area Div. I Engineered Safeguard MCC 1B236	i
4	Drywell Area Unit Cooler 1V411B	Reactor Area Div. I Engineered Safeguard MCC 1B246	i
5	Drywell Area Unit Cooler 1V412A	Reactor Area Div. I Engineered Safeguard MCC 1B236	i
6	Drywell Area Unit Cooler 1V412B	Reactor Area Div. II Engineered Safeguard MCC 1B246	i
7	Drywell Area Unit Cooler 1V413A	Reactor Area Div. I Engineered Safeguard MCC 1B236	i
8	Drywell Area Unit Cooler 1V413B	Reactor Area Div. II Engineered Safeguard MCC 1B246	i
9	Drywell Area Unit Cooler 1V417A	Reactor Area Div. I Engineered Safeguard MCC 1B236	i
10	Drywell Area Unit Cooler 1V417B	Reactor Area Div. II Engineered Safeguard MCC 1B246	i
11	Drywell Area Unit Cooler 2V411A	Reactor Area Div. I Engineered Safeguard MCC 2B236	i

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
12	Drywell Area Unit Cooler 2V411B	Reactor Area Div. II Engineered Safeguard MCC 2B246	i
13	Drywell Area Unit Cooler 2V412A	Reactor Area Div. I Engineered Safeguard MCC 2B236	i
14	Drywell Area Unit Cooler 2V412B	Reactor Area Div. II Engineered Safeguard MCC 2B246	i
15	Drywell Area Unit Cooler 2V413A	Reactor Area Div. I Engineered Safeguard MCC 2B236	i
16	Drywell Area Unit Cooler 2V413B	Reactor Area Div. II Engineered Safeguard MCC 2B246	i
17	Drywell Area Unit Cooler 2V417A	Reactor Area Div. I Engineered Safeguard MCC 2B236	i
18	Drywell Area Unit Cooler 2V417B	Reactor Area Div. II Engineered Safeguard MCC 2B246	i
19	Instrument Air Compressor ‘A’ 1K107A	Channel B Div. II Engineered Safeguard Load Center 1B220	ii
20	Instrument Air Compressor ‘B’ 1K107B	Channel D Div. II Engineered Safeguard Load Center 1B240	ii
21	Instrument Air Dryer Panel ‘A’ 1C142A	Reactor Bldg. Div. II Engineered Safeguard MCC 1B247	ii
22	Instrument Air Dryer Panel ‘B’ 1C142B	Reactor Bldg. Div. II Engineered Safeguard MCC 1B226	ii

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
23	Instrument Air Compressor ‘A’ 1K205A	Reactor Bldg. Div. I Engineered Safeguard MCC 1B217	ii
24	Instrument Gas Compressor ‘B’ 1K205B	Reactor Bldg. Div. I Engineered Safeguard MCC 1B236	ii
25	Instrument Gas Compressor ‘A’ 2K107A	Channel A Div I Engineered Safeguard Load Center 2B210	ii
26	Instrument Air Compressor ‘B’ 2K107B	Channel C Div I Engineered Safeguard Load Center 2B230	ii
27	Instrument Air Dryer Panel ‘A’ 2C142A	Reactor Bldg. Div. I Engineered Safeguard MCC 2B237	ii
28	Instrument Air Dryer Panel ‘B’ 2C142B	Reactor Bldg. Div. I Engineered Safeguard MCC 2B216	ii
29	Instrument Gas Compressor ‘A’ 2K205A	Reactor Bldg. Div. II Engineered Safeguard MCC 2B227	ii
30	Instrument Gas Compressor ‘B’ 2K205B	Reactor Bldg. Div. II Engineered Safeguard MCC 2B246	ii
31	Turbine Area 480V MCC 1B116	Channel A Div I Engineered Safeguard Load Center 1B210	iii
32	Turbine Area 480V MCC 1B126	Channel B Div II Engineered Safeguard Load Center 1B220	iii
33	Instrument AC (Alternate) UPS1D240	Reactor Area Div. I Engineered Safeguard MCC 1B216	iii

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
34	Instrument AC (Preferred) UPS1D240	Reactor Area Div. I Engineered Safeguard MCC 1B236	iii
35	Instrument AC (Alternate) UPS1D130	Reactor Area Div. II Engineered Safeguard MCC 1B226	iii
36	Instrument AC (Preferred) UPS1D130	Reactor Area Div. II Engineered Safeguard MCC 1B246	iii
37	Reactor Recirc Pump Suction HV-B31-1F023A	Reactor Area Div. I Engineered Safeguard MCC 1B237	iv
38	Reactor Recirc Pump Suction HV-B31-1F023B	Reactor Area Div. II Engineered Safeguard MCC 1B246	iv
39	Computer Power Supply Inverter 1D656	Reactor Area Div. I Engineered Safeguard MCC 1B236	iii
40	Vital Power Supply Inverter 1D666	Reactor Area Div. II Engineered Safeguard MCC 1B246	iii
41	Reactor Recirc Pump Suction HV-B31-2F023A	Reactor Area Div. I Engineered Safeguard MCC 2B237	iv
42	Reactor Recirc Pump Suction HV-B31-2F023B	Reactor Area Div. II Engineered Safeguard MCC 2B246	iv
43	125V DC Distribution Panel 1D615	Channel A/Div. I 125V DC Load Center 1D612	iii
44	125V DC Distribution Panel 1D625	Channel B/Div. II 125V DC Load Center 1D622	iii

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
45	125V DC Distribution Panel 1D635	Channel C 125V DC Load Center 1D632	iii
46	125V DC Distribution Panel 1D645	Channel D 125V DC Load Center 1D642	iii
47	480/277V Essential Lighting Panel 1EP07	Reactor Area Div. I Engineered Safeguard MCC 1B217	iii
48	480/277V Essential Lighting Panel 1EP08	Reactor Area Div. II Engineered Safeguard MCC 1B227	iii
49	480/277V Essential Lighting Panel 1EP03	Reactor Area Div. II Engineered Safeguard MCC 1B226	iii
50	480/277V Essential Lighting Panel 1EP04	Reactor Area Div. II Engineered Safeguard MCC 1B246	iii
51	Turbine Area 480V MCC 2B116	Channel A Div. I Engineered Safeguard Load Center 2B210	iii
52	Turbine Area 480V MCC 2B126	Channel B Div. II Engineered Safeguard Load Center 2B220	iii
53	Instrument AC (Alternate) UPS2D240	Reactor Area Div. I Engineered Safeguard MCC 2B216	iii
54	Instrument AC (Preferred) UPS2D240	Reactor Area Div. I Engineered Safeguard MCC 2B236	iii
55	Instrument AC (Alternate) UPS2D130	Reactor Area Div. II Engineered Safeguard MCC 2B226	iii

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
56	Instrument AC UPS2D130	Reactor Area Div. II Engineered Safeguard MCC 2B246	iii
57			
58			
59	Computer Power Supply Inverter 2D656	Reactor Area Div. I Engineered Safeguard MCC 2B236	iii
60	Vital Power Supply Inverter 2D666	Reactor Area Div. II Engineered Safeguard MCC 2B246	iii
61			
62			
63	125V DC Distribution Panel 2D615	Channel A/Div. 1 125V DC Load Center 2D612	iii
64	125V DC Distribution Panel 2D625	Channel B/Div. II 125V DC Load Center 2D622	iii
65	125V DC Distribution Panel 2D635	Channel C 125V DC Load Center 2D632	iii
66	125V DC Distribution Panel 2D645	Channel D 125V DC Load Center 2D642	iii
67	480/277V Essential Lighting Panel 2EP07	Reactor Area Div. I Engineered Safeguard MCC 2B217	iii
68	480/277V Essential Lighting Panel 2EP08	Reactor Area Div. II Engineered Safeguard MCC 2B227	iii

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
69	480/277V Essential Lighting Panel 2EP03	Reactor Area Div. II Engineered Safeguard MCC 2B226	iii
70	480/277V Essential Lighting Panel 2EP04	Reactor Area Div. II Engineered Safeguard MCC 2B246	iii
71	480/277V Essential Lighting Panel 0EP01 *	Control structure H&V Room Div I. Engineered Safeguard MCC OB136	iii
72	480/277V Essential Lighting Panel 0EP02 **	Control structure H&V Room Div II Engineered Safeguard MCC OB146	iii
73	480V/277V Essential Lighting Panel 1EP05	Control structure H&V Room Div. II Engineered Safeguard MCC OB146	iii
74	Reactor Bldg. Chiller compressor 1K206A	Channel A/Div. I Emergency Auxiliary Switchgear 1A201	iv
75	Control Rod Drive Water pump 1P132A	Channel A/Div. I Emergency Auxiliary Switchgear 1A201	iv
76	Turbine Bldg. Chiller compressor 1K102A	Channel A/Div. I Emergency Auxiliary Switchgear 1A201	iv
77	Reactor Bldg. Chiller compressor 1K206B	Channel B/Div. II Emergency Auxiliary Switchgear 1A202	iv
78	Main condenser Mechanical vacuum pump 1P105	Channel B/Div. II Emergency Auxiliary Switchgear 1A202	iv
79	Turbine Bldg. Chiller compressor 1K102B	Channel B/Div. II Emergency Auxiliary Switchgear 1A202	iv

* **The affiliated cable load end terminates at 0TS601.**
** **The affiliated cable load end terminates at 0TS602.**

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
80	Control Rod Drive Water Pump 1P132B	Channel D/Div. II Emergency Auxiliary Switchgear 1A204	iv
81	Control Structure Passenger Elevator ODS108	Control Structure H&V Room Div. I Engineered Safeguard MCC OB136	iv
82	Engr. Safeguard Service Water Pumphouse Lighting Panel OLP16	Div. I Engr. Safeguard Service Water Pumphouse MCC OB517	i
83	Engr. Safeguard Service Water Pumphouse Distribution Panel OPP509A	Div. I Engr. Safeguard Service Water Pumphouse MCC OB517	i
84	Engr. Safeguard Service Water Pumphouse Distribution Panel OPP511	Div. II Engr. Safeguard Service Water Pumphouse MCC OB527	i
85	Spray Pond Piping Drain Pump OP513A	Div. I Engr. Safeguard Service Water Pumphouse MCC OB517	i
86	Spray Pond Piping Drain Pump OP513B	Div. I Engr. Safeguard Service Water Pumphouse MCC OB527	i
87	Reactor Bldg. Closed Cooling Water Pump 1P210A	Reactor Area Div. I Engineered Safeguard MCC 1B216	iv
88	Reactor Bldg. Closed Cooling Water Pump 1P210B	Reactor Area Div. I Engineered Safeguard MCC 1B237	iv
89	Deleted		
90	Deleted		
91	Reactor Bldg. Service Elevator 1DS204	Reactor Area Div. II Engineered Safeguard MCC 1B246	iv

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
92	Process Radiation Monitoring Cabinet 1C604	Div. I 24V DC Distribution Panel 1D672	iv
93	Process Radiation Monitoring Cabinet 1C604	Div. II 24V DC Distribution Panel 1D682	iii
94	Control Rod Drive Water Pump 2P132A	Channel A/Div I Emergency Auxiliary Switchgear 2A201	iv
95	Turbine Bldg. Chiller Compressor 2K102A	Channel A/Div I Emergency Auxiliary Switchgear 2A201	iv
96	Reactor Bldg. Chiller Compressor 2K206B	Channel B/Div. II Emergency Auxiliary Switchgear 2A202	iv
97	Main Condenser Mechanical Vacuum Pump 2P105	Channel C/Div. I Emergency Auxiliary Switchgear 2A203	iv
98	Reactor Bldg. Chiller Compressor 2K206A	Channel C/Div. I Emergency Auxiliary Switchgear 2A203	iv
99	Control Rod Drive Water Pump 2P132B	Channel D/Div. II Emergency Auxiliary Switchgear 2A204	iv
100	Turbine Bldg. Chiller Compressor 2K102B	Channel D/Div. II Emergency Auxiliary Switchgear 2A204	iv
101	Reactor Bldg. Closed Cooling Water Pump 2P210B	Reactor Area Div. II Engineered Safeguard MCC 2B247	iv
102	Reactor Bldg. Closed Cooling Water Pump 2P210A	Reactor Area Div. II Engineered Safeguard MCC 2B226	iv
103			
104			
105	Process Radiation	Div. I 24V DC	iv

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
106	Process Radiation Monitoring Cabinet 2C604	Div. II 24V DC Distribution Panel 2D682	iii
107	Containment Vacuum Relief Valve PSV-15704A1	Div. I 120V Inst. AC 1Y216 PNL	iv
108	PSV-15704B1		iv
109	PSV-15704CI		iv
110	PSV-15704DI		iv
111	PSV-15704E1		iv
112	PSV-15704A2	Div. II 120V Inst. AC 1Y226 PNL	iv
113	PSV-15704B2		iv
114	PSV-15704C2		iv
115	PSV-15704D2		iv
116	PSV-15704E2		iv
117	PSV-25704A1	Div. I 120V Inst. AC 2Y216 PNL	iv
118	PSV-25704B1		iv
119	PSV-25704C1		iv
120	PSV-25704D1		iv
121	PSV-25704E1		iv
122	PSV-25704A2	Div. II 120V Inst. AC 2Y226 PNL	iv
123	PSV-25704B2		iv
124	PSV-25704C2		iv

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
125	PSV-25704D2		iv
126	PSV-25704E2		iv
127	Fuel Pool Level Transmitter LT-25347 and Level/Temperature Recorder LR/TR-25347	Div. II 120V Inst. AC 2Y226 PNL	iii
128			
129	ES Transformer Cooling Fans and Control OX201	Diesel Generator Rm. Chi. A Engineered Safeguard MCC OB516	iv
130	ES Transformer Cooling Fans and Control OX203	Diesel Generator Rm. Ch. B Engineered Safeguard MCC OB526	iv
131	ES Transformer Cooling Fans and Control OX201	Diesel Generator Rm. Ch. C Engineered Safeguard MCC OB536	iv
132	ES Transformer Cooling Fans and Control OX203	Diesel Generator Rm. Ch. D Engineered Safeguard MCC OB546	iv
133	HPCI Vacuum Tank Condensate Drain Pump 1P215	Div. II 250V DC Motor Control Center 1D274	iv
134	HPCI Barometric Condensate Vacuum Pump 1P216	Div. II 250V DC Motor Control Center 1D274	iv
135	RCIC Barometric Condensate Vacuum Pump 1P219	Div. I 250V DC Motor Control Center 1D254	iv
136	RCIC Vacuum Tank Condensate Vacuum Pump 1P220	Div. I 250V DC Motor Control Center 1D254	iv
137	SLC Storage Tank Electric Heater ‘A’ 1E219	Channel C 480V Motor Control Center 1B236	iv
138	SLC Storage Tank Electric Heater ‘B’ 1E220	Channel C 480V Motor Control Center 1B236	iv

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
139	HPCI Vacuum Tank Condensate Drain Pump 2P215	Div. II 250V DC Motor Control Center 2D274	iv
140	HPCI Barometric Condensate Vacuum Pump 2P216	Div. II 250V DC Motor Control Center 2D274	iv
141	RCIC Barometric Condensate Vacuum Pump 2P219	Div. I 250V DC Motor Control Center 2D254	iv
142	RCIC Vacuum Tank Condensate Drain Pump 2P220	Div. I 250V DC Motor Control Center 2D254	iv
143	SLC Storage Tank Electric Heater ‘A’ 2E219	Div. I 480V Motor Control Center 2B236	iv
144	SLC Storage Tank Electric Heater ‘B’ 2E220	Div. I 480V Motor Control Center 2B236	iv
145	ES Transformer Cooling Fans and Control OX213	Diesel Generator Rm. Ch. A Engineered Safeguard MCC OB516	iv
146	ES Transformer Cooling Fans and Control OX211	Diesel Generator Rm. Ch. B Engineered Safeguard MCC OB526	iv
147	ES Transformer Cooling Fans and Control OX213	Diesel Generator Rm. Ch. C Engineered Safeguard MCC OB536	iv
148	ES Transformer Cooling Fans and Control OX211	Diesel Generator Rm. Ch. D Engineered Safeguard MCC OB546	iv
149	Essential Ltg. Pnl OLP5B and Transformer OLX5B	Diesel Generator E Ch. H Engineered Safeguard MCC OB565	iii
150	125V DC Dist. Pnl OD599	Diesel Generator E Ch. H Engineered Safeguard 125V DC SWBD OD597	iii
151	Deleted		

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
152	Deleted		
153	Deleted		
154	Deleted		
155	Deleted		
156	Fuel Pool Level Transmitter LT-15347 and Level/Temperature Recorder LR/TR-15347	Div. II 120V Inst. AC 1Y226 PNL	iii
157	SPDS Regulating Transformer 1x800	Reactor Area Div. I Engineered Safeguard MCC 1B216	iv
158	SPDS Regulating Transformer 1x801	Reactor Area Div. II Engineered Safeguard MCC 1B226	iv
159	SPDS UPS (Alternate) 2D288	Reactor Area Div. I Engineered Safeguard MCC 2B216	iii
160	SPDS UPS (Preferred) 2D288	Division I 250VDC Load Center 2D652	iii
161	SPDS UPS (Alternate) 2D289	Reactor Area Div. II Engineered Safeguard MCC 2B226	iii
162	SPDS UPS (Preferred) 2D289	Division II 250VDC Load Center 2D662	iii
163	Reactor Building Steam Line Drain Valve HV-241-2F021	Division II 480V Motor Control Center 2B227	iii
164	125V/24V DC/DC Converters ES-60401, ES-60405, ES-60409, ES-64901, and ES-65101	125V DC Distribution Panel 2D614-31	iii
165	125V/24V DC/DC Converters ES-61601, ES-63301, and ES-65501	125V DC Distribution Panel 2D614-34	iii
166	125V/24V DC/DC Converters ES-63402 and ES-64301	125V DC Distribution Panel 2D614-36	iii
167	125V/24V DC/DC Converters ES-60402, ES-60406, ES-60410, ES-64902 and ES-65102	125V DC Distribution Panel 2D624-31	iii
168	125V/24V DC/DC Converters ES-61602 and ES-63401	125V DC Distribution Panel 2D624-34	iii

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
169	125V/24V DC/DC Converters ES-63302 and ES-65502	125V DC Distribution Panel 2D624-36	iii
170	125V/24V DC/DC Converters ES-60403, ES-60407, ES-60411, ES-64903 and ES-65103	125V DC Distribution Panel 2D634-31	iii
171	125V/24V DC/DC Converters ES-60404, ES-60408, ES-60412, ES-64904 and ES-65104	125V DC Distribution Panel 2D644-31	iii
172	125V/24V DC/DC Converter ES-42401	125V DC Distribution Panel 1D614-05 or 2D614-05	iii
173	125V/24V DC/DC Converter ES-42402	125V DC Distribution Panel 1D624-05 or 2D634-05	iii
174	125V/24V DC/DC Converter ES-42403	125V DC Distribution Panel 1D634-05 or 2D634-05	iii
175	125V/24V DC/DC Converter ES-42404	125V DC Distribution Panel 1D644-05 or 2D644-05	iii
176	Main Steam Line Drain to Condenser Valve HV-141F021	Div I 480V Motor Control Center 1B216	iii
177	125V/24V DC/DC Converters ES-50401, ES-50403, ES-50405, ES-54901 and ES-55101	125V DC Distribution Panels 1D614-31/2D614-35	iii
178	125V/24V DC/DC Converters ES-53401, ES-55501, ES-55401, ES-53301	125V DC Distribution Panels 1D614-34/2D614-32	iii
179	125V/24V DC/DC Converters ES-55403, ES-51601, ES-53001	125V DC Distribution Panels 1D614-36/2D614-38	iii
180	125V/24V DC/DC Converters ES-50407, ES-54902, ES-50408, ES-55102 and ES-50410	125V DC Distribution Panels 1D624-31/2D624-35	iii
181	125V/24V DC/DC Converters ES-53402, ES-55402, ES-54301, and ES-53302	125V DC Distribution Panels 1D624-34/2D624-32	iii
182	125V/24V DC/DC Converters ES-51602, ES-55404, ES-53002, and ES-55502	125V DC Distribution Panels 1D624-36/2D624-38	iii
183	125V/24V DC/DC Converters ES-50413, ES-50415, ES-50411, ES-54903 and ES-55103	125V DC Distribution Panels 1D634-31/2D634-32	iii
184	125V/24V DC/DC Converters ES-50418, ES-50420, ES-50417, ES-54904 and ES-55104	125V DC Distribution Panels 1D644-31/2D644-32	iii

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
185	HPCI Oil Temperature Recorder TRE411R605	120V Instrument AC Distribution Panel 1Y216-02	iii
186	RHR Temperature Recorder TRSE111R601	120V Instrument Distribution Panel 1Y216-02	iii
187	HPCI Oil Temperature Recorder TRE411R605	120V Instrument AC Distribution Panel 1Y216-02	iii
188	RHR Temperature Recorder TRSE111R601	120V Instrument Distribution Panel 1Y216-02	iii
189	Drywell Sump Level & Equip. Tank Level Recorder LR/FR 16103	120 V Instrument Distribution Panel 1Y216-02	iii
190	Drywell Sumps / Equipment Drain Tank Level Recorder LR26114	120V Instrument Distribution Panel 2Y216-02	iii
191	Turbine Bldg 250V DC Control Center 1D155	Div. I 250V DC Load Center 1D652	iii
192	Turbine Bldg 250V DC Control Center 1D165	Div. II 250V DC Load Center 1D662	iii
193	Computer Power Supply Inverter 1D656	Div. I 250V DC Load Center 1D652	Iii
194	Vital Power Supply Inverter 1D666	Div. II 250V DC Load Center 1D662	iii
195	Reactor Protection System MG Set Motor 1S237A	Div. I Reactor Area Engineered Safeguard MCC 1B217-052	iv
196	Reactor Protection System MG Set Motor 1S237B	Div. II Reactor Area Engineered Safeguard MCC 1B227-053	iv
197	Reactor Protection System MG Set Motor 2S237A	Div. I Reactor Area Engineered Safeguard MCC 2B217-052	iv
198	Reactor Protection System MG Set Motor 2S237B	Div. II Reactor Area Engineered Safeguard MCC 2B227-053	iv
199	480-240/120V Transformer 0X604***	Control structure H&V Room Div. II Engineered Safeguard MCC OB146	iii
200	Spent Fuel Pool Instr Sys Pwr Conditioning XFMR 1X690	120 V Instrument AC Distribution Panel 1Y216	iii
201	Spent Fuel Pool Instr Sys Pwr Conditioning XFMR 2X690	120 V Instrument AC Distribution Panel 2Y226	iii
202	480V HCVS Power Distribution Panel 0PP604	Control Structure H&V Room Div. 1. Engineered Safeguard MCC 0B136	iii

*** The affiliated cable load end terminates at 0TS602.

TABLE 8.1-2

AFFILIATED AND NON-CLASS IE CIRCUITS THAT CONNECT TO CLASS IE POWER SUPPLIES

Number	NON Class 1E Load	Class 1E Power Supply	Method of Isolation (Reference FSAR 8.1.6 1t.5)
203	480-208/120V Regulating Transformer 2X297	Div. II 480V Motor Control Center 2B227	iv
204	480-208/120V Regulating Transformer 1X297	Div. I 480V Motor Control Center 1B217	iv
205	DG A Starting Air Compressor 0K507A1	Diesel Generator Rm Ch. A Engineered Safeguard MCC 0B516	iii
206	DG A Starting Air Compressor 0K507A2	Diesel Generator Rm Ch. A Engineered Safeguard MCC 0B516	iii
207	DG B Starting Air Compressor 0K507B1	Diesel Generator Rm Ch. B Engineered Safeguard MCC 0B526	iii
208	DG B Starting Air Compressor 0K507B2	Diesel Generator Rm Ch. B Engineered Safeguard MCC 0B526	iii
209	DG C Starting Air Compressor 0K507C1	Diesel Generator Rm Ch. C Engineered Safeguard MCC 0B536	iii
210	DG C Starting Air Compressor 0K507C2	Diesel Generator Rm Ch. C Engineered Safeguard MCC 0B536	iii
211	DG D Starting Air Compressor 0K507D1	Diesel Generator Rm Ch. D Engineered Safeguard MCC 0B546	iii
212	DG D Starting Air Compressor 0K507D2	Diesel Generator Rm Ch. D Engineered Safeguard MCC 0B546	iii

TABLE 8.1-3

NON-CLASS 1E
ANNUNCIATOR AND COMPUTER INTERFACE DEVICES

ANNUNCIATOR INTERFACE DEVICES
Westinghouse MOC Auxiliary Switch
Limitorque Limit Switch
NAMCO Limit Switch
GE CR105 Magnetic Contactor
GE HFA51 Relay
GE HMA11 Relay
Cutler-Hammer Reversing Contactor
Cutler-Hammer Type "M" Relay
Agastat EGP Relay
Agastat E7024 Timing Relay
Westinghouse High Speed AR Relay
Magnetrol Model 751 Level Switch
FCI Mode 8-66 Liquid Level Controller
Riley 86 T/C Monitor
Potter & Brumfield KH-4690 Relay
Bailey 745 Alarm Unit
GE Type CR2940
AGA Type TR
Cutler-Hammer Type 10250T P.B.
Potter & Brumfield Type MDR
GE Type 2820
Westronics Recorder
Barkadale Pressure Switch
Static Inc. Pressure Switch
Barton-Pressure Switch
Square D Pressure Switch
Square D Level Switch
Balsbaugh-Conductivity TI
Potter & Brumfield Type KRP
Westinghouse MOC Auxiliary Switch

TABLE 8.1-3

NON-CLASS 1E
ANNUNCIATOR AND COMPUTER INTERFACE DEVICES

ANNUNCIATOR INTERFACE DEVICES
Limitorque Limit Switch
NAMCO Limit Switch
GE CR105 Magnetic Contactor
GE HFA51 Relay
GE HMA11 Relay
Cutler-Hammer Reversing Contactor
Cutler-Hammer Type "M" Relay
Agastat EGP Relay
Agastat E7024 Timing Relay
Westinghouse High Speed AR Relay
Megnetrol Model 751 Level Switch
FCI Mode 8-66 Liquid Level Controller
GE Range Switch
Potter & Brumfield KH-4690 Relay

TABLE 8.1-4

DIVISIONAL OR AFFILIATED LOADS SUPPLIED FROM CLASS 1E CHANNEL C OR D 4.16 KV BUS

LOAD	LOAD TYPE	CLASS 1E 4.16 V CHANNEL	BREAKER TRIP CIRCUIT CONTROL POWER	
			NORMAL	ALTERNATE
EMERGENCY SERVICE WATER PUMP 0P504C	DIVISIONAL	UNIT 1 CH. C SWGR. 1A203	CHANNEL A/ DIVISION I	CHANNEL C
RESIDUAL HEAT REMOVAL SERVICE WATER REMOVAL SERVICE WATER PUMP 1P506A	DIVISIONAL	UNIT 1 CH. C SWGR. 1A203	CHANNEL A/ DIVISION I	CHANNEL C
CONTROL STRUCTURE CHILLER COMPRESSOR 0K112A	DIVISIONAL	UNIT 1 CH. C SWGR. 1A203	CHANNEL A/ DIVISION I	CHANNEL C
EMERGENCY SERVICE WATER PUMP 0P504D	DIVISIONAL	UNIT 1 CH. D SWGR. 1A204	CHANNEL B/ DIVISION II	CHANNEL D
RESIDUAL HEAT REMOVAL SERVICE WATER PUMP 1P506B	DIVISIONAL	UNIT 1 CH. D SWGR. 1A204	CHANNEL B/ DIVISION II	CHANNEL D
CONTROL STRUCTURE CHILLER COMPRESSOR 0K112B	DIVISIONAL	UNIT 1 CH. D SWGR. 1A204	CHANNEL B/ DIVISION II	CHANNEL D
CONTROL ROD DRIVE PUMP 1P132B	AFFILIATED	UNIT 1 CH. D SWGR. 1A204	CHANNEL B/ DIVISION II	CHANNEL D
REACTOR BUILDING CHILLER COMPRESSOR 2K206A	AFFILIATED	UNIT 2 CH. C SWGR. 2A203	CHANNEL A/ DIVISION I	CHANNEL C
MECHANICAL VACUUM PUMP 2P105	AFFILIATED	UNIT 2 CH. C SWGR. 2A203	CHANNEL A/ DIVISION I	CHANNEL C
CONTROL ROD DRIVE PUMP 2P132B	AFFILIATED	UNIT 2 CH. D SWGR. 2A204	CHANNEL B/ DIVISION II	CHANNEL D
TURBINE BUILDING CHILLER COMPRESSOR 2K102B	AFFILIATED	UNIT 2 CH. D SWGR. 2A204	CHANNEL B/ DIVISION II	CHANNEL D

TABLE 8.1-5

CONTAINMENT RADIATION MONITORS SUPPLIED FROM CLASS 1E SYSTEM

LOAD	CLASS 1E 480 VAC	CLASS 1E 120 VAC
Containment Radiation Monitor 1C291A	Unit 1 Div. I 480 VAC MCC 1B217	Unit 1 Div I 120 VAC Dist. Panel 1Y216
Containment Radiation Monitor 1C291B	Unit 1 Div. II 480 VAC MCC 1B227	Unit 1 Div II 120 VAC Dist. Panel 1Y226
Containment Radiation Monitor 2C291A	Unit 2 Div. I 480 VAC MCC 2B217	Unit 2 Div I 120 VAC Dist. Panel 2Y216
Containment Radiation Monitor 2C291B	Unit 1 Div. II 480 VAC MCC 2B227	Unit 2 Div II 120 VAC Dist. Panel 2Y226

8.2 OFFSITE POWER SYSTEM

8.2.1 DESCRIPTION

8.2.1.1 Transmission System

The bulk power transmission system of PPL operates at 230 kV and 500 kV. Unit 1 of the Susquehanna Steam Electric Station supplies power to the 230 kV system through a 230 kV switchyard and Unit 2 supplies power to the 500 kV system through a separate 500 kV switchyard. The offsite power system for the plant is supplied through the 230 kV portion of the bulk power system. The bulk power supply system in the vicinity of Susquehanna Steam Electric Station is shown in Figure 8.2-2.

Dwg. D159760, Sh. 1 shows the Susquehanna 230 kV and 500 kV switchyards and the transmission lines associated with each yard and in the vicinity of the plant. The drawing shows the line arrangement with both units in operation. The two switchyards are physically separate and are tied together by a 230 kV yard tie line with a 230-500 kV transformer in the 500 kV yard.

Two independent offsite power sources are supplied to the Susquehanna plant via Transformer T10 and second source T20, and are shared by both units. One source is supplied from the Susquehanna T10 230 kV Switchyard located to the west of the plant; a single-circuit 230 kV line connects the Susquehanna T10 230 kV Switchyard to startup transformer #10 terminal equipment. The Susquehanna T10 230 kV Switchyard consists of three 230 kV bays, all of which can be expanded to a circuit breaker and a half configuration. A total of seven 230 kV circuit breakers are installed. Bay 1 is configured as a double bus double circuit breaker bay and terminates the Susquehanna 230 kV Line. Bay 2 is configured as a circuit breaker and a half bay and terminates the Mountain 230 kV Line and the Susquehanna T10 230 kV Tap to the Unit 1 Start Up Transformer #10. Bay 3 is configured as a double bus double circuit breaker bay and terminates the Montour 230 kV Line.

The Susquehanna T10 230 kV Switchyard is supplied by three 230 kV transmission lines, the Susquehanna T10-Mountain, the Montour-Susquehanna T10, and the Susquehanna-Susquehanna T10 lines. The Susquehanna T10-Mountain line and the Montour-Susquehanna 230 kV line share double circuit structures from the Susquehanna T10 230 kV Switchyard northeast to a point where the Mountain-Susquehanna 230 kV line branches off to the east. Four spans northeast and east of this point, the Susquehanna T10-Mountain 230 kV line and Susquehanna-Susquehanna T10 line begin sharing double circuit structures due east, to where the two circuits split as shown in Dwg. D159760, Sh. 1. The Susquehanna T10-Mountain 230 kV line extends north on double structures with the Susquehanna-Mountain 230 kV line and terminates in the Mountain Substation. The Susquehanna-Susquehanna T10 230 kV Line extends south on double circuit structures with the Susquehanna-Mountain 230 kV Line and terminates in the Susquehanna 230 kV Switchyard.

Two spans from the Susquehanna T10 230 kV Switchyard, the Montour-Susquehanna T10 230 kV line joins the Montour-Susquehanna 230 kV circuit on double circuit structures and extends to final termination point in the Montour Switchyard.

The total distance of the Susquehanna T10-Mountain line from the Susquehanna T10 230 kV Switchyard to the Mountain Substation is 18.9 miles. The total distance of the Montour-Susquehanna T10 line from the Montour Switchyard to the Susquehanna T10 230 kV

Switchyard is 29.9 miles. The total distance of the Susquehanna-Susquehanna T10 Line from Susquehanna 230 kV Switchyard to the Susquehanna T10 230 kV Switchyard is approximately 3 miles.

Several lines feed the Montour 230 kV Switchyard and Mountain 230-69 kV Substation (Figure 8.2-4). These lines offer a multitude of possible supplies for the Susquehanna startup transformer #10. Montour Switchyard is supplied directly by generation from the Montour Steam Electric Station. Other generating stations are indirectly linked by the bulk power grid system. The conductors for the Montour-Susquehanna T10, Susquehanna T10-Mountain lines and the conductors for the Susquehanna-Susquehanna T-10 Line are 1590 kcmil 45/7 ACSR and are supported by single string insulator assemblies. Maximum conductor tension is limited to 16,000 pounds on steel pole line sections and 21,900 pounds on lattice tower sections under maximum anticipated loading conditions.

The second offsite power source is supplied at 230 kV from the yard tie circuit between the Susquehanna 500 kV and 230 kV Switchyards south of the Susquehanna Steam Electric Station. The source is provided one span tap from the 230 kV yard tie circuit to startup transformer #20.

The yard tie line consists of 230 kV double circuit structures, in which both circuits are electrically tied together to form one high capacity 230 kV Line. The circuits are tied together to form a two conductor per phase single circuit line. The single span tap to transformer #20 is composed of single-conductor per phase line. The distance from the tap point west to the 500 kV yard is 1500 ft. The distance from the tap point east to the 230 kV yard is 1.6 miles. Maximum conductor tension is limited to 16,000 pounds in the yard tie line under maximum loading conditions.

The second offsite power supply is furnished by the multiple sources throughout the bulk power grid system through the 230 kV and 500 kV lines emanating from the Susquehanna 230 kV and 500 kV switchyards. See Figure 8.2-3.

All PPL EU transmission lines are engineered in accordance with PPL EU design criteria, which meets or exceeds design requirements set forth by the National Electric Safety Code (NESC) and other industry standards. PPL EU lines are designed to sustain extreme weather events such as high winds and heavy ice, lines also comply with the Army Corps of Engineers requirements for clearance over flood levels. Overhead shield wires or optical ground wires are employed on the transmission lines above the phase conductors to provide lightning protection. A relay protection system is used to protect the public safety and welfare, as well as equipment on the transmission system in the event of a fault.

No transmission lines cross over the Susquehanna 500 kV to 230 kV yard tie line or the two tap lines supplying transformers #10 and #20. The Montour-Susquehanna 230 kV Line crosses over both the Mountain-Susquehanna T10 230 kV line and the Montour-Susquehanna T10 230 kV Line where they share double circuit structures. The Susquehanna-Susquehanna T10 230 kV Line crosses over the Montour- Susquehanna 230 kV line. The Susquehanna-Lackawanna 500 kV Line crosses over the Montour-Susquehanna 230 kV Line and the Montour-Susquehanna T10 230 kV Line.

No single disturbance in the bulk power grid system will cause complete loss of offsite power to the Susquehanna SES. This is a basic system design criteria.

8.2.1.2 Transmission Interconnection

PPL is a member of PJM, Inc. which permits exchanges of power with neighboring utilities and provides emergency assistance under Independent System Operator (ISO) direction. Direct bulk power ties are between PPL and PECO Energy (formerly Philadelphia Electric), Luzerne Electric Division of UGI, Metropolitan Edison, Pennsylvania Electric, Jersey Central Power and Light, Public Service Electric and Gas, and Baltimore Gas and Electric Companies.

8.2.1.3 Switchyards

8.2.1.3.1 Startup Transformers #10 and #20

The Susquehanna T10 Tap 230 kV line from the Susquehanna T10 230 kV Switchyard and the 230 kV yard tie line supply power to startup transformers #10 and #20, respectively, through motor operated air break switches. High speed positive ground switches are installed between the motor operated air break switches (MOABs) and the startup transformers. The startup transformers and low side bus connections are discussed in Section 8.3.1. The startup transformer yards are physically separated from each other, the Unit 1 and #2 main transformer yards and the 230 kV and 500 kV switchyards can be seen on Dwg. D159760, Sh. 1. 1590 kcmil 45/7 ACSR conductors connect the air switches to the startup transformers. 13.8 kV cables are installed in underground conduit between the startup transformers and the turbine building. Non-segregated phase bus ducts establish the tie to the 13.8 kV startup buses within the turbine building. See Figure 8.2-3 for a one line diagram of the offsite power system.

Primary protection of the Susquehanna T10 Tap 230 kV line is provided by a microprocessor based phase and ground distance scheme with inherent ground overcurrent backup systems and fault locating capabilities. Backup protection of this circuit is provided by a microprocessor based phase distance and directional ground overcurrent schemes with fault locating capabilities. Both primary and backup schemes are continuously self-monitored and alarm to the Alarm Management System (AMS) at the Susquehanna T10 230 kV Switchyard. Line relay protection for the 230 kV Yard Tie circuit is provided by fully independent primary and backup relay systems. The primary protection system is a microprocessor-based line differential scheme, and the backup protection system is a microprocessor-based permissive overreaching transfer trip scheme with inherent two-zone phase-distance and directional ground-overcurrent protection in the event of channel failure. Both primary and backup systems and their associated communication channels are continuously self-monitoring for maximum reliability (security and dependability). These relaying schemes detect faults on the transmission line and isolate the power sources to the transformers by tripping the power circuit breakers (CBs) at the line terminals. Breaker failure relaying, applied at each line terminal, detects a failure to trip or failure to interrupt condition at the line terminal and trips all associated CBs necessary to isolate the line. Control power to the line relaying facilities is supplied from the local switchyard 125 V DC power supplies.

Startup transformers #10 and #20 are protected by high speed percentage differential, sudden pressure and overcurrent relaying. Direct transfer trip facilities are utilized as the primary relaying scheme to open the CBs at the transmission line remote terminals in the event of transformer trouble. Backup protection is provided by the high speed ground switch on the 230 kV side of the startup transformer. This switch is closed to place a positive fault on the 230 kV transmission line which will be detected by the remote line terminal relaying systems if the primary direct transfer trip scheme fails to function correctly. The motor operated air switch

automatically opens after the 230 kV system is de-energized to isolate the startup transformer from the transmission system and permit reclosing of the transmission line terminal CBs.

The impact of open phase conditions on the capability of startup transformer #10 and #20 was evaluated. The conditions analyzed consisted of single (one of three) and double (two of three) open phase conductors on the high voltage (230 kV) side of the startup transformer. An Open Phase Detection (OPD) system is installed on the startup transformer that detects an open phase condition on the high side of the transformer from the offsite 230 kV transmission system. The OPD system was installed based on the NEI Open Phase Condition Initiative.

A time delay undervoltage relay monitors the 13.8 kV startup bus voltage. On loss of offsite power the relay trips the startup bus incoming feeder breaker and initiates transfer of the bus loads to the other startup transformer through closure of the startup bus tie breaker. The time delay undervoltage relay also prevents unnecessary automatic trip of the incoming feeder breaker for short duration disturbances on the transmission line.
Power to transformer #10 and #20 switchgear, motor operated air break switches, and high speed ground switches is supplied from the station 125 V DC power supplies.

8.2.1.3.2 Susquehanna Unit 1 230 kV Main Transformer Leads

Overhead 1590 kcmil 45/7 ACSR conductors, bundled two per phase, tie the Unit 1 main stepup transformers, through a high voltage Disconnect switch-Synchronizing CB-Disconnect switch arrangement, to the 230 kV switchyard. The synchronizing breaker and disconnect switch arrangement is provided at the Susquehanna SES site to improve reliability in synchronization and flexibility of operating Unit 1. Steel pole structures support the strain bus and the 2.2-mile 230 kV tie with single string insulator assemblies. The tie line is capable of transmitting the full MVA output of the Unit 1 Generator.

Relay protection between the Unit 1 transformer and the synchronizing breaker is provided by high speed percentage differential relays which trip Unit 1 and the synchronizing breaker by the unit master trip lockout relays. A second protection scheme is provided by the Unit 1 overall differential relaying which also detects fault conditions between Unit 1 transformer and the synchronizing breaker. Fully independent primary and backup relay systems provide protection between the 230 kV synchronizing circuit breaker and the Susquehanna 230 kV Switchyard. The primary protection system is a microprocessor-based line differential relay scheme, and the backup protection system is a microprocessor-based permissive overreaching transfer trip scheme with inherent two-zone phase-distance and directional ground-overcurrent protection in the event of channel failure. Both primary and backup systems and their associated communication channels are continuously self-monitoring for maximum reliability (security and dependability). Breaker failure protection relaying is applied at each terminal to detect a failure to trip or failure to interrupt condition and to electrically isolate the faulty component. Direct transfer trip facilities are utilized to open the CB's at the transmission line remote terminals for a breaker failure operation. Two fully independent transfer trip channels are provided.

Control power to the synchronizing power circuit breaker and power to the onsite relaying equipment are provided by the plant 125 V DC power supplies.

8.2.1.3.3 Susquehanna 230 kV Switchyard

The Susquehanna 230 kV switchyard is an outdoor steel structure, comprised of 6 bay positions containing 14-230 kV power circuit breakers configured as follows: Bay 0-double bus double circuit breaker; Bay 1-full circuit breaker and a half; Bay 2 full circuit breaker and a half; Bay 3-double bus double circuit breaker; Bay 4-full circuit breaker and a half; Bay 5-two single circuit breaker terminals and one breaker connected to the north end of the East Bus for 230 kV Capacitor Bank 2. Terminating positions are provided for eight lines, one generator lead, one 230 kV capacitor bank and a yard tie to the 500 kV switchyard. The switchyard breakers can be operated by remote supervisory control from the PPL EU Transmission Control Center.

Service power to the 230 kV switchyard is provided by three single phase bus potential devices on each bus in the 230 kV switchyard. Alternate sources of station service power are provided by a local 12 kV distribution line with a backup diesel generator in the 230 kV switchyard. An automatic thrower scheme is employed to restore service power from an alternate source in the event of one source failure. Line protection equipment power is provided by 125 VDC and 24 VDC switchyard service batteries. The 125 VDC system is supplied by two (2) nominal station batteries functioning as one primary and one backup supply. The 125 VDC primary supply has two battery chargers and the backup supply has one battery charger. The 24 VDC system also has two (2) battery systems each sized to carry one half of the station load. One 24 VDC system has two chargers and the other system has one charger.

8.2.1.3.4 Susquehanna Unit 2 500 kV Main Transformer Leads

Unit 2 generator output is connected to the 500 kV switchyard by a 1400 ft. overhead 500 kV transmission line. 2493 kcmil 54/37 ACSR conductors bundled two per phase are supported by V-string insulator assemblies on steel pole H-frame structures.

The tie is capable of transmitting the full MVA generator operating output of Unit 2 to the 500 kV switchyard.

Relay protection for the connection between the Unit 2 transformer and the Susquehanna 500 kV switchyard is provided by high speed differential relays which trip Unit 2 and the two 500 kV switchyard generator breakers by the Unit master trip lockout relays for a fault in the connection. An overall differential protection scheme provides a second system to trip Unit 2 and the two CBs connected to the generator in the 500 kV switchyard for a fault on the transformer leads. Breaker failure protection is applied at each terminal to detect a failure to trip or failure to interrupt condition and to electrically isolate the faulty component.

8.2.1.3.5 Susquehanna 500 kV Switchyard

The 500 kV switchyard is an outdoor steel structure, comprised of four bays containing eight 500 kV circuit breakers. A 230 kV circuit breaker terminates the T21 230 kV yard tie. Each bay, except for Bay 5, can be developed into a full circuit breaker and a half configuration. Bay 2 and Bay 3 are configured as double bus-double circuit breaker bays with each bay containing two 500 kV circuit breakers. Bay 4 contains three 500 kV power circuit breakers arranged in a breaker and a half configuration. Bay 5 contains a single 500 kV power circuit breaker scheme. Bay 1 is not populated. The switchyard provides for ultimate future expansion to 5 bays. Terminating positions are provided for three lines, one 500 kV generator lead circuit, a circuit to a bank of three single phase 500-230 kV autotransformers and a capacitor bank circuit. Manual operation of the 500 kV generator lead synchronizing circuit breakers is by the plant control

room operator. The remaining CBs can be operated by remote supervisory control from the PPL EU Transmission Control Center.

Service power to the 500 kV switchyard is provided by two sources: one from the generating station, and the second from the tertiary winding of the yard tie autotransformers with an automatic low voltage thrower scheme in the event of one source failure. Primary and Backup Line protection equipment is powered by dual (primary & backup) 125V DC switchyard service batteries, each equipped with one full capacity battery charger. A third full capacity battery charger is provided with the ability to be connected to either of the above batteries. Further, during battery maintenance, replacement, or failure, the entire 125V DC station loads can be connected to the primary or backup DC battery system.

8.2.1.3.6 Montour and Mountain 230 kV Switchyards

Figure 8.2-4 shows a one line diagram of the off-site power system for Startup Transformer #10.

The Montour Switchyard is an outdoor steel structure comprised of six bay positions containing 14-230 kV power circuit breakers. Bays one through four are each arranged in a breaker and a half configuration. Bay 5 and 6 are initially developed as single bus single circuit breaker schemes. Two generating leads from the Montour Steam Electric Station and eight transmission lines are terminated in the yard. The switchyard breakers can be operated by remote supervisory control from the PPL EU Transmission Control Center.

The Mountain Substation is owned and operated by UGI Corporation Luzerne Electric Division. It is an outdoor steel structure with four bay positions each containing one 230 kV CB. Two CBs are arranged back to back between Susquehanna T10-Mountain and Mountain-Lackawanna 230 kV lines. The remaining two CBs are arranged back to back between Mountain-Stanton and Susquehanna–Mountain 230 kV lines. Between the CBs of the Susquehanna T10/Lackawanna terminal and the Susquehanna/Stanton terminals at Mountain is a normally open MOAB that can tie the bus section between the Susquehanna T10/Lackawanna 230 kV CBs to the bus section between the Susquehanna/Stanton 230 kV CBs. All the CBs and the MOAB can be operated by remote supervisory control from the UGI Corporation System Operator's office. CB and MOAB status is monitored by PPL EU Transmission Control Center.

8.2.1.4 Offsite Power System Monitoring

PPL's Transmission lines associated with the Susquehanna switchyard are patrolled twice a year. The first patrol is an overhead comprehensive inspection which thoroughly reviews the structures and associated supports, hardware, insulators and conductors. The second patrol is a more general overhead inspection of the transmission lines with focus on vegetation related issues within and along the rights of way of these lines.

Monitoring of the Unit 1 and Unit 2 offsite power sources in the plant control room is via a hardwired mimic bus arrangement which shows startup transformers #10 and #20, the transformer #10 and #20 motor operated air break switches, the Susquehanna T10 230 kV Switchyard, the 13.8 kV start-up buses, the 13.8 kV bus feeder breakers, and the 13.8 kV bus tie breaker. Annunciation signals abnormal tripping to the control room operator. Control and status indication are provided for the 230 kV MOAB switches and the 13.8 kV breakers. Potential indication for the PPL grid and 13.8 kV bus and status indication of the 230 kV high speed ground switches are provided.

A display is provided by the plant computer system which provides the operator with additional information about the offsite power sources. The display is a mimic bus arrangement, similar to the hardwired mimic bus.

Monitoring of the Unit 1 main generator output leads to the 230 kV switchyard is provided in the control room. A hardwired mimic bus arrangement provides control and status indication of the synchronizing CB. Annunciation signals an abnormal change in status of the synchronizing circuit breaker and any failure of the transmission line relaying systems or their associated communications channels. Annunciation accompanies a failure of the supervisory system. Manual control of the 230 kV switchyard is by a supervisory system from the PPL EU Transmission Control Center.
Monitoring of the Unit 2 main generator output leads is provided in the control room. A hardwired mimic bus arrangement provides control and status of the main generator synchronizing breakers along with potential indication. Annunciation signals an abnormal change in status of the synchronizing circuit breaker.

Manual control of the 500 kV switchyard is by a supervisory system from PPL EU Transmission Control Center except for the main generator synchronizing breakers which can be controlled only by the plant operator.

Preoperational and initial startup testing of all apparatus, equipment, relaying, and CBs is conducted at transformers #10 and #20 and the 500 kV and 230 kV switchyards to ensure compliance with design criteria and standards.

Protective relay testing, maintenance, and calibration in the 230 kV and 500 kV switchyards, Susquehanna T10 Switchyard and at transformers #10 and #20 will be performed in accordance with NERC, RFC, and PJM governing documents.

8.2.1.5 Industry Standards

The requirements, criteria and recommended practices set forth in the following documents are implemented in the design of the transmission system:

A. National Electric Safety Code, 7th Addition.

B. PJM Interconnection Protective Relaying Philosophy and Design Standards

C. NERC Reliability Standards TPL-001-4.

D. In general, high voltage circuit breakers are manufactured and tested in accordance with the latest recommendations and rules of the ANSI, IEEE, NEMA, and AEIC.

E. PPL Substation and Relay and Control Engineering Instruction Manuals, Engineering and Construction Standards, Operating Principles and Practices; Relay and Control Facilities 3/3/76 and sound engineering Principles. The design criteria include consideration of aesthetics, reliability, economics, and safety.

8.2.2 Analysis

8.2.2.1 Grid Availability

The offsite power sources provide adequate capacity and capability to start and operate safety related equipment. In addition, the sources provide both redundancy and electrical and physical independence such that no single event is likely to cause a simultaneous outage of both sources in such a way that neither can be returned to service in time to prevent fuel design limits and design conditions of the reactor coolant pressure boundary from being exceeded. Each of the circuits from the off-site transmission network to the safety related distribution buses has the capacity and capability to supply the assigned loads during normal and abnormal operating conditions, accident conditions and plant shutdown conditions.

The PPL bulk electric system is planned in accordance with established PPL bulk power planning criteria. These criteria are based on North American Electric Reliability Council (NERC) planning standards TPL-001-4 and administered by Reliability First Corporation (RFC), the NERC registered Regional Reliability Organization for this portion of the United States. RFC replaced and has taken responsibility for bulk electric system reliability that was formerly addressed by the Mid-Atlantic Area Council (MAAC) and other regional reliability entities such as ECAR and MAIN. The primary objective of RFC is to augment reliability through a continuing review of all planning in connection with additions or revisions to Bulk Electric System Generating Plant and Transmission facilities. RFC accomplishes these reviews through PJM, the Regional Transmission Organization responsible for planning and operating the bulk electric system. PPL, as a member of PJM, supports PJM in these roles. The PPL bulk electric system is designed to meet NERC reliability criteria documented in NERC Standards TPL-001-4.

Power flow and transient stability studies were conducted to demonstrate that the bulk electric system is in compliance with the NERC Standards. The power flow studies included an evaluation of all practical single contingency, including double circuit tower line, outage conditions and several abnormal system disturbance conditions.

Based upon historical operating data (1999-2008) for the northern PPL transmission network, the annual unplanned outage rate per 100 circuit miles for 500 kV and 230 kV lines is 1.46 and 1.50 outages respectively. Unplanned outages include 1) permanent interruptions where breakers are tripped by protective relays and remain open and 2) momentary outages where breakers are tripped by protective relays and reclose automatically to restore the line to service. The duration of the individual outages varies greatly (from seconds to time periods in excess of 8 hours) depending on the nature of the unplanned outage. The causes of unplanned outages during this time period is lightning related weather events. The major cause of unplanned sustained outages (greater than 3 minutes) during this time period is conductor failure.

8.2.2.2 Stability Analysis

Transient stability studies were conducted using a digital computer program. The initial study was conducted in 1976-77. A follow up study was conducted in 1980-81 and additional analyses were conducted in 1983, 1986, 1989, 1992, 1994, 1998, 2006, 2009, and 2012. These studies show that for various 230 kV and 500 kV bus and line faults, system stability and satisfactory recovery voltages are maintained resulting in uninterrupted supply to the offsite power system. Specifically, the system is stable for any three phase fault applied to a single 500 kV or 230 kV transmission facility cleared in normal clearing time and for any single phase to ground fault with delayed clearing. This satisfies the PPL Reliability Principles and Practices

and the NERC Reliability Standards TPL-001-4. The system is also stable for any three phase fault applied to any single 500 kV or 230 kV transmission facility associated with the Susquehanna plant and cleared with delay. A transient stability case list is included in Table 8.2-1.

The loss of either Susquehanna Unit 1 or Unit 2 represents the loss of the largest single supply to the PPL EU Transmission Zone. For the loss of either Susquehanna unit, grid stability and the integrity of supply to the offsite power system are maintained. Grid stability and the integrity of supply to the offsite power system are also maintained for the loss of any other single generating unit in the PPL EU Transmission Zone. Supply to at least one of the offsite power sources is also maintained for the following abnormal disturbances:

1. The sudden loss of all lines emanating from the Susquehanna 230 kV Switchyard,

2. The sudden loss of all lines emanating from the Susquehanna 500 kV Switchyard.

No single occurrence is likely to cause a simultaneous outage of all offsite sources during operating, accident, or adverse environmental conditions. For the extremely unlikely occurrence of a complete loss of offsite power due to a system blackout, it is expected that offsite power could be restored to Susquehanna within 4 hours. While the loss of all offsite power is improbable, such an event would not prevent the safe shutdown of the station because the onsite batteries and standby diesel generators are able to supply the necessary power to systems required for safe shutdown.

TABLE 8.2-1

SUSQUEHANNA UNIT #1 & #2
STABILITY CASE LIST
(SUMMER LIGHT LOAD CONDITIONS)

CASE	DESCRIPTION	RESULT 2019 UPDATE
	Fault Tests **R**equired to be Stable (8.2.1.5.C)	
R-1	3 phase fault at Susquehanna 500 kV on the Sunbury 500 kV line. Fault cleared in primary clearing time.	Stable
R-5	Phase-ground fault at Susquehanna 500 kV on Sunbury 500 kV line with Sunbury South 500 kV circuit breaker stuck. Clear remote terminal in primary time. Delayed clearing of Susquehanna.	Stable
R-6	3 phase fault at Susquehanna 230 kV on the Susquehanna 500/230 kV transformer. Fault clearing in primary clearing time.	Stable
R-7	3 phase fault at Montour 230 kV on Susquehanna 230 kV line. Fault cleared in normal primary clearing time.	Stable
R-13	Phase-ground fault at Susquehanna 500 kV on Susquehanna-Wescosville-Alburtis 500 kV line with Wescosville South 500 kV circuit breaker stuck. Clear remote terminal in primary time. Delayed clearing at Susquehanna.	Stable
R-18	3 phase fault at Susquehanna 230 kV on Harwood #1 & #2 Double Circuit. Fault cleared in primary clearing time.	Stable
	Fault Tests Not Required to be Stable (8.2.1.5.C)	
N-2	3 phase fault at Susquehanna 500 kV on the Sunbury 500 kV line with one breaker pole stuck at Sunbury. Clear Susquehanna in primary time. Delayed clearing at remote terminal.	Stable
N-3	3 phase fault at Susquehanna 500 kV on the Susquehanna-Wescosville-Alburtis 500 kV line with one Susquehanna 500/230 kV transformer breaker pole stuck. Clear remote terminal in primary time. Delayed clearing of Susquehanna.	Stable
N-4	3 phase fault at Susquehanna 500 kV on the Sunbury 500 kV line with one Susquehanna 500/230 kV transformer breaker pole stuck. Clear remote terminal in primary time. Delayed clearing of Susquehanna.	Stable
N-8	3 phase fault at Susquehanna 230 kV on Montour line with stuck west bus breaker. Clear remote terminal in primary time, clear Susquehanna with delay (lose Susquehanna-Susq T10 230 kV line).	Stable

TABLE 8.2-1

SUSQUEHANNA UNIT #1 & #2
STABILITY CASE LIST
(SUMMER LIGHT LOAD CONDITIONS)

CASE	DESCRIPTION	RESULT 2019 UPDATE
N-9	3 phase fault at Susquehanna 230 kV on Jenkins line with stuck east bus breaker. Primary clearing at remote terminal. Delayed clearing at Susquehanna (lose Susquehanna-Mountain 230 kV line).	Stable
N-10	3 phase fault at Susquehanna 230 kV on the 500/230 kV transformer with stuck west bus breaker pole. Clear two poles in primary time. Primary clearing at remote terminal (Susquehanna 500 kV Switchyard). Clear stuck pole in delayed clearing time (lose Susquehanna-Susq T10 230 kV line).	Stable
N-11	3 phase fault at Susquehanna 230 kV on Harwood #1 line with stuck tie breaker. Clear stuck breaker in delayed clearing time (lose Sunbury-Susquehanna 230 kV line).	Stable
N-12	3 phase fault at Susquehanna 230 kV on Harwood #2 line with stuck west bus breaker. Clear stuck breaker in delayed clearing time (lose Susquehanna-Susq T10 230 kV line).	Stable
N-14	Susquehanna-Wescosville-Alburtis 500 kV and Susquehanna-Harwood #1 & #2 Double Circuit 230 kV crossing failure (3 phase fault on all circuits). Automatically trip Susquehanna Unit #1. Clear Susquehanna-Wescosville-Alburtis 500 kV line in primary time. Clear Susquehanna-Harwood #1 #2 230 kV lines in primary time.	Stable
N-15	3 phase fault near E. Palmerton on all lines in E. Palmerton-Harwood RW corridor. Clear Susquehanna-Wescosville-Alburtis 500 kV line in primary time. Primary clearing of E. Palmerton-Harwood and Harwood-Siegfried 230 kV lines.	Stable
N-16	3 phase fault near Susquehanna on both lines in Sunbury-Susquehanna R/W corridor. Clear Sunbury-Susquehanna #2 500 kV line in primary time. Primary clearing of Sunbury-Susquehanna #1 230 kV line.	Stable
N-17	3 phase fault near Susquehanna 500 kV at Sunbury 230 kV line crossing. Trip Susquehanna-Wescosville-Alburtis 500 kV, Sunbury-Susquehanna #2 500 kV, and Unit #2 in primary time. Trip Sunbury-Susquehanna #1 230 kV in primary clearing time.	Stable
N-19	3 phase fault at Columbia-Frackville 230 kV line crossing. Trip Sunbury-Susquehanna #2 500 kV line in primary time. Trip Columbia-Frackville and Sunbury-Susquehanna #1 230 kV lines in primary time.	Stable

TABLE 8.2-1

SUSQUEHANNA UNIT #1 & #2
STABILITY CASE LIST
(SUMMER LIGHT LOAD CONDITIONS)

CASE	DESCRIPTION	RESULT 2019 UPDATE
N-20	3 phase fault on 230 kV side of Unit #1 main transformer. Trip Unit #1 main transformer. Trip Unit #1 and overtrip Unit #2 in primary time.	Stable
N-21	3 phase fault at Susquehanna 230 kV on Unit #1 generator leads with a stuck west bus breaker. Trip Unit #1 and Susquehanna T10 line.	Stable
N-23	Sudden loss of all lines from Susquehanna 230 kV Switchyard.	Stable
N-24	3 Phase fault on Susquehanna-Jenkins 230 kV line 80% towards Jenkins with pilot relaying out. Fault cleared in Zone 2 (backup) time at Susquehanna and Zone 1 time at Jenkins.	Stable

FIGURE 8.2-1 WAS REPLACED BY DWG. D159760, SH.1. THIS DOCUMENT WAS DETERMINED TO CONTAIN CRITICAL ENERGY INFRASTRUCTURE INFORMATION (CEII) AND IS BEING HANDLED AS A CONFIDENTIAL DOCUMENT PER CP 404.

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-1 REPLACED BY CONFIDENTIAL
DWG. D159760, SH. 1

FIGURE 8.2-1, Rev. 57

AutoCAD Figure 8_2_1.doc

FIGURE 8.2—2 WAS REPLACED BY DWG. D159760, SH.2. THIS DOCUMENT WAS DETERMINED TO CONTAIN CRITICAL ENERGY INFRASTRUCTURE INFORMATION (CEII) AND IS BEING HANDLED AS A CONFIDENTIAL DOCUMENT PER CP 404.

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-2 WAS REPLACED BY CONFIDENTIAL DWG. D159760, SH.2

FIGURE 8.2-2, Rev 57

AutoCAD: Figure Fsar 8_2_2.dwg

FIGURE 8.2–3 WAS REPLACED BY DWG. D159760, SH.3. THIS DOCUMENT WAS DETERMINED TO CONTAIN CRITICAL ENERGY INFRASTRUCTURE INFORMATION (CEII) AND IS BEING HANDLED AS A CONFIDENTIAL DOCUMENT PER CP 404.

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UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-3 WAS REPLACED BY CONFIDENTIAL DWG. D159760, SH.3

FIGURE 8.2-3, Rev 57

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FIGURE 8.2—4 WAS REPLACED BY DWG. D159760, SH.4. THIS DOCUMENT WAS DETERMINED TO CONTAIN CRITICAL ENERGY INFRASTRUCTURE INFORMATION (CEII) AND IS BEING HANDLED AS A CONFIDENTIAL DOCUMENT PER CP 404.

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FINAL SAFETY ANALYSIS REPORT

FIGURE 8.2-4 WAS REPLACED BY CONFIDENTIAL DWG. D159760 SH.4

FIGURE 8.2-4, Rev 51

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APPENDIX 8.2A
MID-ATLANTIC AREA COUNCIL (MAAC)

RELIABILITY PRINCIPLES AND STANDARDS FOR PLANNING THE BULK ELECTRIC SUPPLY SYSTEM OF MAAC GROUP

(As adopted on July 18, 1968, by the Executive Board constituted under the MAAC Agreement, dated December 26, 1967 and Revised March 30, 1990)

PRINCIPLES

The bulk electric supply system shall be planned and constructed in such manner that it can be operated so the more probable contingencies can be sustained with no loss of load. Less-probable contingencies will be examined to determine their effect on system performance. These standards apply only to those facilities which affect reliability of the MAAC system and not to facilities affecting the reliability of supply only to local system loads. Automatic load relief shall be provided to minimize the probability of the total shutdown of an area which becomes isolated by multiple contingencies, thereby facilitating rapid restoration of the interconnected systems.

RELIABILITY STANDARDS

I. Installed Generating Capacity Requirements

Sufficient megawatt generating capacity shall be installed to ensure that in each year for the MAAC system the probability of occurrence of load exceeding the available generating capacity shall not be greater, on the average, than one day in ten years. Among the factors to be considered in the calculation of the probability are the characteristics of the loads, the probability of error in load forecast, the scheduled maintenance requirements for generating units, the forced outage rates of generating units, limited energy capacity, the effects of connections to other pools, and network transfer capabilities within the MAAC systems.

II. Transmission Requirements

The bulk transmission system shall be developed so that it can be operated at all load levels to meet the following unscheduled contingencies without instability, cascading or interruption of load:

A. The loss of any single transmission line, generating unit, transformer, bus, circuit breaker, or single pole of a bipolar DC line in addition to normal scheduled outages of bulk electric supply system facilities without exceeding the applicable emergency rating of any facility or applicable voltage criteria. After the outage, the system must be capable of readjustment so that all equipment (on the MAAC and neighboring systems) will be loaded within normal ratings.

B. After occurrence of the outage and the readjustment of the system specified in A, the subsequent outage of any remaining generator or line without exceeding the short time emergency rating of any facility. After this outage, the system must be capable of readjustment so that all remaining equipment will be loaded within applicable emergency ratings and voltage criteria for the probable duration of the outage.

C. The loss of any double circuit line, bipolar DC line, faulted circuit breaker or the combination of facilities resulting from a line fault coupled with a stuck breaker in addition to normal scheduled generator outages without exceeding the short-time emergency rating of any facility or applicable voltage criteria. After the outage, the system must be capable of readjustment so that all equipment will be loaded within applicable emergency ratings for the probable duration of the outage.

In determining the bulk transmission requirements, recognition shall be given to the occurrence of similar contingencies in neighboring systems and their effect on the MAAC system.

III. General Requirements

Sufficient megavar capacity with adequate controls shall be installed in each system to supply the reactive load and loss requirements in order to maintain acceptable emergency transmission voltage profiles during all of the above contingencies.

Installation of generation and transmission facilities shall be coordinated to ensure that in each year for each member system the probability of occurrence of load exceeding the available capacity resources shall not be greater, on the average, than one day in ten years. Available capacity resources consist of the generating

capability available internal to the member system and the capacity that can be transmitted into the member system. (See Section VII.)

IV. Stability Requirements

The stability of the system shall be maintained without loss of load during and after the following types of contingencies occurring at the most critical location at all load levels.

A. A three-phase fault with normal clearing time.

B. Single phase-to-ground fault with a stuck breaker or other cause for delayed clearing.

C. The loss of any single facility with no fault.

V. Tests for Ability of MAAC System to Withstand Abnormal Disturbances

The MAAC group recognizes that it is impossible to anticipate or test for all the contingencies that can occur on the present and future MAAC system. These tests, therefore, serve primarily as a means to measure the ability of the system to withstand less probable contingencies, some of which may not be readily apparent. These tests are prescribed not on the basis of a high level of probability, but rather as a practical means to study the system for its ability to withstand disturbances beyond those which can reasonably be expected. The MAAC system, therefore, will be tested to determine the effect of various types of contingencies on system performance, including stability. Examples of less probable contingencies to be studied are:

A. Sudden loss of the entire generating capability of any station for any reason.

B. The outage of the most critical transmission line on any one of the interconnected systems as the result of a three-phase fault immediately following (i.e., before adjustment) the tripping of another critical line on the same or on an adjacent system.

C. Single phase-to-ground fault coupled with the malfunction of a protective device.

D. The sudden loss of all lines of one voltage emanating from a substation.

E. The sudden loss of all lines on a single right of way.

F. The sudden dropping of a large load or a major load center.

G. The occurrence of a multi-phase fault with delayed clearing.

Recognition should be given to the occurrence of similar contingencies in neighboring systems and their effect on the MAAC system.

VI. Relaying and Protective Devices

Independent devices shall be installed to the extent necessary to provide backup for the primary protective devices and components so as to limit equipment damage, to limit the shock to the system and to speed restoration of service. The design of a particular line's relay protective scheme shall recognize the need for an appropriate balance between dependability (assurance that relays will operate when required) and security (protection against relay operation when not required). In cases where requirements of Sections IVB and/or V are not met, additional security against the overtripping of critical facilities may be considered.

Relaying installed shall not restrict the normal or the necessary realizable network transfer capabilities of the system.

System preservation measures, such as underfrequency load shedding relays, shall be installed to provide additional insurance against widespread system disturbances. System preservation measures shall not be used to satisfy the contingencies listed under Sections I through IV.

VII. Network Transfer Capability

The amounts of power to be interchanged between areas within MAAC and between MAAC and neighboring pools shall be limited such that applicable ratings and stability, voltage and relay limitations are not exceeded.

A. Extended Period Transfer

The amount of power that can be delivered from one area to another for economy interchange in normal day-to-day operations shall be limited as follows:

1. With all transmission facilities in service and normal generator maintenance scheduling, all system components shall be within normal loading limits.

2. With the outage of any single facility, the provisions of Section 11 shall apply.

B. Capacity Emergency Transfer

The amount of power planned to be transferred from one area to another for capacity shortages shall be limited as follows:

1. With all transmission facilities in service and normal generator maintenance schedules, the loadings of all system components shall be within normal ratings, stability limits and normal voltage limits.

2. The interconnected systems shall then be able to absorb the initial power swing resulting from the sudden loss of any one transmission line or generating unit.

3. After the initial swing period, the loadings of all system components shall be within short time emergency ratings and voltage limits.

8.3 ON-SITE POWER SYSTEMS

8.3.1 AC POWER SYSTEMS

8.3.1.1 Description

The on-site AC power systems are divided into Class 1E and non-Class 1E systems. Dwgs. E-1, Sh. 1, E-1, Sh. 1A, and E-1, Sh. 2 show the single line of both systems with the Class 1E system identified by a dotted line enclosure.

The on-site AC power systems consist of main generators, main step-up transformers, unit auxiliary transformers, and diesel generators. The distribution system has nominal ratings of 13.8 kV, 4.16 kV, 480V, and 208/120V.

The off-site AC power system supplies power to plant systems through two start-up transformers.

8.3.1.2 Non-Class 1E AC System

The non-Class 1E portion of the on-site power systems provides AC power for non-nuclear safety related loads. A limited number of non-safety related loads are important to the power generating equipment integrity and are fed from the Class 1E distribution system through the isolation system as discussed in Section 8.1.6.1 (Regulatory Guide 1.75).

The non-Class 1E AC power system distributes power at 13.8 kV, 4.16 kV, 480V, and 208/120V voltage levels. These distribution levels are grouped into two symmetrical distribution systems emanating from the 13.8 kV buses.

All non-self-activated switchgears receive control power from the 125V DC control power sources. The 125V DC control power sources for the non-Class 1E 13.8 kV and 4 kV switchgear breakers and 480V load center breakers are shown in Tables 8.3-17 and 8.3-18 respectively.

8.3.1.2.1 Operation

The unit auxiliary transformer supplies all the non-Class 1E unit auxiliary loads except unit HVAC and Units 1 and 2 common loads, which are fed by the two startup transformers as shown on Dwgs. E-1, Sh. 1, E-1, Sh. 2, and E-4, Sh. 2.

The unit auxiliary transformer primary is connected to the main generator isolated phase bus duct tap (24 kV) while the secondary of the transformer is connected to two 13.8 kV unit auxiliary buses through a non-segregated phase bus.

During plant startup, shutdown, and post shutdown, power is supplied from the off-site power sources through the two startup transformers. In addition, capability is provided to transfer the unit auxiliary buses to the startup power source to maintain continuity of power at the unit auxiliary distribution system.

In addition to the loading conditions mentioned in the above paragraph, the 13.8 kV startup buses also supply the preferred power supplies to the Class 1E load groups through their respective 13.2 kV - 4.16 kV engineered safeguard transformers as discussed in Subsection 8.3.1.3 (Dwgs. E-1, Sh. 1 and E-1, Sh. 2).

The auxiliary bus feeder breakers from the unit auxiliary transformers and the startup tie bus section are interlocked to prevent supplying power to the startup bus from the unit auxiliary transformer.

A 13.8 kV tie bus is provided for the two startup buses. A separate (not in switchgear line-up) bus tie breaker is located in the tie bus. In the event of a loss of startup power supply to the 13.8 kV startup bus, an alarm is initiated and, a time delay undervoltage relay initiates the tripping of the 13.8 kV incoming breaker and the closing of the tie breaker, resulting in a slow transfer. However, this transfer is prevented if either auxiliary 13.8 kV bus is being fed from the undervoltage tie bus section. This condition is sensed by the closure of two (2) auxiliary "b" contacts in series, one from each of the unit auxiliary bus to tie-bus circuit breakers connected to a common tie bus section. Manual initiation of the tie breaker is also provided. However, the use of this manual control is administratively limited as an overriding means only. Under automatic operating conditions of the tie breaker, auxiliary switch "b" contacts of the startup transformer incoming breakers are also utilized as a permissive to close the tie breaker to prevent tying of the two startup transformers.

At the 4 kV ESF power distribution subsystem a three-way transfer system is provided to enable the ESF loads to connect to either of the two off-site power sources or to the standby diesel generators. Each ESF bus is normally connected to a preferred source which is one of four ES transformers connected to one of the two startup buses. During loss of one off-site power source, that is, upstream of the startup bus, the startup bus undervoltage relay will trip the feeder breaker to the ES transformer, causing a transfer at the 4 kV ESF bus. If power loss occurs between the 13 kV startup bus and the 4 kV ESF bus, a 4 kV transfer will occur. The 4 kV ESF bus transfer is initiated by the bus undervoltage relay, which trips the normal incoming breaker and subsequently closes the alternate incoming breaker. This is practically a dead bus transfer. If both off-site power sources are unavailable, the diesel generator breaker closes as soon as the diesel generator power is available.

The above transfer mechanism allows only one source breaker to be closed at any one time and to ensure this, breaker auxiliary switch contacts are used for interlocking. A manual live bus transfer is possible through a synchronizing device in which case an alternate source breaker is first closed and is followed by an automatic tripping of the preferred supply breaker. In this case the duration of the tie is merely a few cycles. Furthermore, the diesel generator can be tied with any one of the two off-site sources for an indefinite time under test condition but this does not in any way cause the two off site power systems to be tied together.

The plant security load center is double ended, each end being supplied from one of the 13 kV start-up buses through a stepdown transformer and is provided with a normally open tie breaker. Each bus is supplied from its own start-up source. Should one source be lost the undervoltage relay at the transformer secondary trips the bus incoming breaker. The bus undervoltage relay then initiates closure of the tie breaker provided the incoming breaker has successfully tripped. Upon return of the failed source the incoming breaker will not automatically close and can only be manually closed after the tie breaker has been tripped.

In all of the foregoing tie or transfer systems, there is no way that the two off-site power systems can be tied together at the on-site buses assuming loss of one off-site source.

The 13.8 kV switchgear provide power for large auxiliary loads and 480V load centers. The 13.8 kV switchgear feed double-ended 480V load centers. A manual tie breaker is provided for each set of load centers to intertie the two load centers in the event of failure of one load center transformer. Load centers generally supply power to 480V loads larger than 100 hp and power for their respective motor control centers. The motor control centers supply 480V loads smaller than 100 hp while 480V, 480/277V, 208/120V panels provide miscellaneous loads such as unit heaters, space heaters, lighting systems, etc.

8.3.1.2.2 Non-Class 1E Equipment Capacities

Refer to Dwgs. E-1, Sh. 1 and E-1, Sh. 2 for interconnections of the following equipment. Physical locations of each of the following equipment can be found in Section 1.2.

a) Unit Auxiliary Transformer

   33/44/55 MVA, 3Ø, OA/FA/FOA, 55°C

   37/49.3/61.6 MVA, OA/FA/FOA, 65°C

   23.0-13.8 kV Grd. Y/7.96 kV

   Z = 9.0% @ 33 MVA

b) Startup Transformer

   b1. Transformer T10

   45/60/75 MVA 3∅, ONAN/ONAF/ONAF

   225/129.9 - 13.8/7.97 kV

   Z = 15.0% @ 45 MVA

   LTC ±15% in 15/16% steps

   b2. Transformer T20

   45/60/75 MVA, 3∅, OA/FA/FA, 65°C

   225 Grd. Y/129.908 - 13.8Y/7.968 kV

   Z = 14.5% @ 45 MVA

   LTC ±15% in 15/16% steps

c) Engineered Safeguard Transformer

   10.5/13.12 MVA, 3∅, OA/FA, 55°C

   11.76/14.7 MVA, OA/FA, 65°C

13.2-4.16 kV Grd. Y/2.4 kV

Z = 6.8% @ 10.5 MVA

Diesel Generator E

1. Test Facility Transformer (Spare Engineered Safeguard Transformer with the same capacities)

2. 13.8 kV-480V transformer .75 MVA AA
13.2-.48 grd. Y/.277 kV
z = 6% @ .75 MVA

d) Unit Auxiliary 13.8 kV Switchgear

Buses	2000 A continuous rating, 750 MVA bracing
Incoming breakers	2000 A continuous rating, 750 MVA 3∅ Class 28,000 A sym interrupting rating
Feeder breakers	1200 A continuous rating 750 MVA 3∅/Class 28,000 A sym interrupting rating

e) Startup 13.8 kV Switchgear

Buses	3000 A continuous rating, 1,000 MVA bracing
Incoming breakers	3000 A continuous rating, 1,000 MVA 3∅ Class 37,000 A sym interrupting rating
Tie breaker	3000 A continuous rating, 1,000 MVA 3∅ Class 37,000 A sym interrupting rating
Feeder breakers	1200 A continuous rating, 1,000 MVA 3∅ Class 28,000 A sym interrupting rating

f) 4.16 kV Switchgear

Buses	1200 A continuous rating, 250 MVA bracing
Incoming breakers	1200 A continuous rating, 250 MVA 3∅/Class 29,000 A sym interrupting rating
Feeder breakers	1200 A continuous rating, 250 MVA 3∅ Class 29,000 A sym interrupting rating

g) 480V Load Centers

Transformers	1500/2000 kVA, 3∅, AA/FA, 13200-480V Grd. Y/277V
	-OR-
	1500/2000 kVA, 3∅, AA/FA, 13800-480V Grd. Y/277V
Control structure, Administration, Security and machine shop transformers only	1000/1333 kVA, 3∅, AA/FA 13200-480V Grd. Y/277V
Buses	3000 A continuous; 65,000 A bracing (1500/2000 kVA)
	1600 A continuous; 50,000 A bracing (1000/1333 kVA)
Incoming breakers	3000 A continuous, 65,000 A sym interrupting rating (1500/2000 kVA)
	1600 A continuous, 50,000 A sym interrupting rating (1000/1333 kVA)
Feeder breakers	600 A continuous, 30,000 A sym interrupting rating
Tie breakers	1600 A continuous, 50,000 A sym interrupting rating

h) 480V Motor Control Centers

Horizontal bus (main)	600 A (1000A*) continuous; 42,000 A bracing
Vertical bus	400 A (600A*) continuous; 42,000 A bracing
Breakers (Molded Case)	
150 A frame	25,000 A symmetrical interrupting rating
250 A frame	22,000 A symmetrical interrupting rating

* Diesel Generator E

i) 480V Power Distribution Panel

Bus	225 A rating, 14,000 A bracing
Branch breakers	100 A frame, 14,000 A interrupting rating

j) 208/120V AC Instrument AC Distribution Panels

Main breaker (molded case)	225 A continuous 22,000 A sym interrupting rating
Buses	225 A continuous
Branch breakers (molded case)	100 A frame size 10,000 A sym interrupting rating

8.3.1.3 Class 1E AC Power System

The Class 1E AC portion of the on-site power system is shown on Dwgs. E-1, Sh. 1 and E-1, Sh. 2.

The Class 1E AC system distributes power at 4.16 kV, 480V, and 208/120V to the safety related loads. The safety related loads are divided into four load groups per generating unit and are tabulated in Table 8.3-1. Each load group has its own distribution system and power supplies.

The 4.16 kV bus of each Class 1E load group channel is provided with connections to two off-site power sources designated as preferred and alternate power supplies. Diesel generators are provided as a standby power supply in the event of total loss of the preferred and alternate power supplies. Standby power supply is discussed in Subsection 8.3.1.4.

Preferred and alternate power supplies up to the 4.16 kV buses of the Class 1E power system are considered as non-Class 1E.

All non self-activated switchgears receive control power from the 125V DC control power sources. The 125V DC control power sources for the Class 1E 4.16 kV switchgear breakers and 480V load center breakers are shown in Tables 8.3-19 and 8.3-20 respectively.

In order to achieve adequate separation between channelized load group and divisionalized load group, two 125V DC control power supplies are provided for each 4.16 kV switchgear (refer to Table 8.3-19).

8.3.1.3.1 Power Supply Feeders

Each Class 1E 4.16 kV switchgear of a load group channel is provided with a preferred and an alternate (off-site) power supply feeder and one standby diesel generator feeder. Each bus is normally energized by the preferred power supply. If the preferred power source is not available at the 4.16 kV bus, automatic transfer is made to the alternate power source as described in Subsection 8.3.1.3.6. If both preferred and alternate power feeders become de-energized, the

safety-related loads on each bus are picked up automatically by the standby diesel generator assigned to that bus as described in Subsection 8.3.1.4.

8.3.1.3.2 Power Feeder Cables

Power feeder cables for the 4.16 kV system are aluminum or copper conductors, and are rated 5 kV, 90°C conductor temperature with high temperature insulation. The cables are provided with an overall flame resistant jacket covering. For the main plant's 480V system, cables of size #4/0 AWG and larger are aluminum or copper conductor; cables less than #4/0 AWG are copper conductor. In the Diesel Generator E building and the ties to the Diesel Generator A, B, C or D transfer points, all cables are copper conductor. Both types of cables are rated 600V, 90°C conductor temperature with ethylene-propylene insulation with a flame-resistant hypalon jacket covering. The conductors are sized to carry the maximum available short circuit current for the time required for the circuit breaker to clear the fault. All Class 1E cables have been designed for operation as discussed in Section 3.11.

The 4.16 kV switchgear and D.C. load centers are equipped with aluminum buses and silver-plated bolted connections. The D.C. Control centers are equipped with copper buses and silver-plated bolted connections. The 480V load centers and motor control centers are equipped with copper or aluminum busses and the bolted connections are silver-plated or alston 70 (respectively). All circuit breaker terminals are copper. For power cable terminations, Burndy compression aluminum terminals (HYLUG) are used. These terminals are of seamless tubular construction, tin-plated to resist corrosion, and factory filled with oxide inhibiting compound penetrox A. Compression adapters MAC ADAPT MPT series or equivalent are used for equipment/vendor supplied components having mechanical lugs which cannot be converted to accept a Burndy compression lug due to physical or practical limitations. A non-oxidizing lubricant such as D50H47 or equivalent will be applied on all contact surfaces at bolted joints to avoid damaging the silver-plated contact surfaces.

8.3.1.3.3 Bus Arrangements

The Class 1E AC system is divided into four load group channels per unit (load group Channels A, B, C, and D). Power supplies for each load group are discussed in Subsection 8.3.1.3.1. All Class 1E AC loads are divided among the four load groups so that any combination of three out of four load groups has the capability of supplying the minimum required safety loads.

The distribution system of each load group consists of one 4.16 kV bus, one 480V load center, four or five motor control centers, and several low voltage distribution panels. The bus arrangements are shown on Dwgs. E-1, Sh. 1, E-5, Sh. 1, E-5, Sh. 2, E-8, Sh. 4, E-8, Sh. 8, and Figure 8.3-9.

8.3.1.3.4 Loads Supplied from Each Bus

Table 8.3-1 provides a listing of all the loads supplied from each Class 1E bus.

8.3.1.3.5 Class 1E Isolated Swing Bus

Two redundant 480V swing buses are provided for each unit for the RHR injection valve motor operators, recirculation loop bypass valve motor operators, and recirculation discharge valve motor operators. The single line of the swing bus is shown on Figure 8.3-9.

A Class 1E 480V load center of one load group channel supplies the preferred power to the swing bus through the electrical isolation of a motor-generator (M-G) set. The alternate power is supplied directly from another redundant Class 1E 480V load center. The M-G set is used for electrically isolating two redundant load groups. Faults at the swing bus cannot be propagated onto more than one load group.

The swing buses are Class 1E motor control center constructions. An automatic transfer switch is provided for transferring the swing bus from the preferred to the alternate power source upon reduction or loss of voltage at the swing bus. If the undervoltage is caused by a fault at the swing bus, the transfer will be prevented even if the alternate power is available. The swing bus will be retransferred back to preferred power when the voltage is restored within acceptable limits.

The swing bus and transfer switch are designed so that for a loss of off-site power and any single failure, the minimum required ECCS flow to meet 10CFR50 Appendix K criteria is always available.

The following is a common mode-common cause failure analysis (CMCCFA) for the automatic transfer switches:

Figure 8.3-13 depicts a simplified single line diagram for the swing bus system to facilitate the analysis. Table 8.3-24 provides a step-by-step CMCCFA of the auto transfer switch by postulating the various major common causative factors (events).

Normal conservatism in design and manufacturing margins, mandatory requirements of QA/QC procedures, Initial Test Program, Preoperational Tests, applicable administrative procedures and maintenance programs as well as operator actions contribute to minimize the susceptibility of the auto transfer switch to the various common causative factors as analyzed in Table 8.3-24.

This analysis demonstrates that the transfer switch, as a component of the swing bus system design, will not degrade the independence and separation between the redundant Class 1E channels (load center channels A and C or B and D).

The test program (Section 14.2 and Technical Specification) for the 480V swing bus system (Figure 8.3-13) consists of:

a) Periodic inspection of wiring, insulation, and connections, etc., to assess the continuity of the components and system.

b) Periodic testing to verify the operability and functional performance of individual components in the system.

c) Periodic testing of operational sequence and operability of the system as a whole.

8.3.1.3.6 Manual and Automatic Interconnections Between Buses, Buses and Loads, and Buses and Supplies

No provision exists for automatically or manually connecting one Class 1E load group to the redundant Class 1E load group or for automatically transferring loads between load groups except the swing buses as discussed in Subsection 8.3.1.3.5. For each load group, one 4.16 kV feeder circuit breaker is provided for the normal incoming preferred power source, and another 4.16 kV feeder circuit breaker is connected to the alternate power source (see Subsection 8.3.1.3.1). The normal preferred power source to each bus is electrically interlocked with the alternate power source such that the bus can be connected to a single power source at any one time. In the event of loss of preferred power to the load group, undervoltage relays (less than or equal to 20 percent voltage) on the 4.16 kV switchgear will initiate an automatic transfer to the alternate power source if available. In the event of losing both preferred and alternate power supplies, the load group will be powered from the standby diesel generator.

See response to FSAR Question 40.6 for a description of the degraded grid voltage protection scheme. Restoration of power from standby power to the preferred source of offsite power is manually initiated in the control room on panel 0C653. When the standby power source is in synchronism with the offsite power source, the preferred offsite source incoming breaker is closed. Upon closing of this preferred source breaker, the standby source breaker will automatically trip. This tripping is initiated by the preferred offsite source breaker auxiliary switch contact interlock.

A similar procedure is used to restore power from standby to the alternate offsite power source.

8.3.1.3.7 Interconnections Between Safety Related and Non-Safety-Related Buses, Non-safety Related Loads, and Safety-Related Buses

Discussion of interconnections between safety related and non-safety related buses, non-safety related loads, and safety related buses is presented in Subsections 3.12.2 and 8.1.6.1.

8.3.1.3.8 Redundant Bus Separation

The engineered safety features switchgear, load centers, and motor control centers for the redundant Class 1E load groups are located in separate Seismic Category I rooms in the reactor building to ensure electrical and physical separation. Electrical equipment separation is discussed in Subsection 3.12.2 and Subsection 8.1.6.1. Equipment layout drawings can be found in Section 1.2.

8.3.1.3.9 Class 1E Equipment Capacities

a) 4.16 kV Switchgear

Buses	1200 A continuous rating, 250 MVA bracing

	Incoming breakers	1200 A continuous rating, 250 MVA 3Ø Class 29,000 A sym interrupting rating
	Feeder breakers	1200 A continuous rating, 250 MVA 3Ø Class 29,000 A sym (36,000A*) interrupting rating
b)	480V Load Centers	
	Transformers (Unit 1)	750/1000 kVA, 3Ø, AA/FA, 4160-480V Grd. Y/277V
	Transformer (Unit 2)	750 kVA, 3Ø, AA, 4160 480V Grd. Y/277V
	Buses	1200 A continuous, 30,000 A bracing
	Breakers	600 A frame size, 30,000 A sym interrupting rating
c)	480V Motor Control Centers	
	Buses	
	Horizontal (main)	600 A (1000A*) continuous, 42,000 A bracing
	Vertical	400 A continuous, (600 A*) 42,000 A bracing
	Breakers (molded case)	
	150 A frame	25,000 A sym interrupting rating
	250 A frame	22,000 A sym interrupting rating
d)	Automatic transfer switch	480V, 3Ø, 400 A continuous 31,000 A sym withstand capability
e)	208/120V AC Instrument AC Distribution Panels	
	Buses	225 A continuous 42,000 A sym interrupting rating
	Branch breakers	100 A frame size (molded case) 10,000 A sym interrupting rating

8.3.1.3.10 Automatic Loading and Load Shedding

When off-site power is available to the Class 1E 4.16 kV ESS Buses following a LOCA signal, the required ESF loads will be sequenced onto the Class 1E 4.16 kV ESS Buses because of voltage drop considerations in the onsite power system due to starting large ESF motors. The timing sequence for the ESF loads is shown in Table 8.3-1, except for the RHR and core spray pumps which is shown in Table 8.3-1b.

* Diesel Generator E
* Diesel Generator E

In the event of loss of preferred and alternate off-site power supplies, the Class 1E 4.16 kV buses will shed all loads except the 480V load centers and connect the standby Diesel Generator to the Class 1E bus. The load sequence timing is shown on Table 8.3-1. If Diesel Generator E is aligned and the preferred and alternate offsite power supplies are lost the 480V motor control center supplying the diesel auxiliaries automatically transfers to the Diesel Generator E 4.16 kV Bus when Diesel Generator E is running. However, if a slow bus transfer (bus voltage on transfer is less than 20%) at the Class 1E 4.16 kV bus is initiated to the alternate off-site power as a result of a loss of preferred off-site power, all loads are shed except the 480V load centers. Then the required ESF loads are sequenced onto the Class 1E 4.16 kV Buses. The timing sequence for ESF loads is shown in Table 8.3-1, except for the RHR and core spray pumps which is shown in Table 8.3-1b.

Tables 8.3-1 and 8.3-1b show the anticipated starting time of all ESF loads. Both Unit 1 and Unit 2 buses for a given diesel generator are normally supplied by the same off-site power supply. An individual timing unit is provided for each of the ESF loads with automatic start function. Failure to start one load will not affect the starting initiation of other loads.

The loading sequence for a simultaneous LOCA in one unit and a false LOCA in the other unit is shown in Table 8.3-1b. A false LOCA signal as used in this section refers to a non-mechanistic failure resulting in a LOCA signal in one reactor unit when a LOCA has not occurred in that unit.

The load starting transient on the diesel generators is reduced if the Unit 1, and Unit 2 load sequences do not start simultaneously.

If off-site power is available, the LOCA signal in one unit and false LOCA signal in the other will shed 2 RHR motors and 2 core spray motors of each unit and sequentially start 2 RHR and 2 core spray motors as shown in Table 8.3-1b. This is done in order not to exceed the utilization voltage limitation of connected equipment and to provide at least the minimum core cooling requirements of both units. Under the modified core cooling arrangement, 2 RHR pumps (one in each loop) and 2 core spray pumps (both in the same loop) will satisfy the minimum cooling requirements of each unit. Approximately ten minutes after the above event the operator will be able to determine which is the false-LOCA unit and shutdown non-essential loads in the non-LOCA unit. In case off-site power is not available, the loading is the same as discussed above, but the sequencing is slightly altered as shown in Table 8.3-1b.

All conditions discussed above support the safety function time limits depicted on Table 6.3-1.

8.3.1.3.11 Safety Related Equipment Identification

Subsection 8.3.1.11.3 provides information regarding the physical identification of Class 1E equipment.

8.3.1.3.12 Instrumentation and Control Systems for the Applicable Power Systems with the Assigned Power Supply Identified

The DC power supplies for the control of the redundant Class 1E equipment are physically and electrically separate and independent. Refer to Subsection 8.3.2 for a detailed discussion of the DC system.

8.3.1.3.13 Electric Circuit Protection Systems

Protective relay schemes and direct-acting trip devices on primary and backup circuit breakers are provided throughout the on-site 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

e) Maintain continuity of the power supply

Major types of protection measures employed include the following:

a) Bus Differential Relaying

A bus differential relay is provided for each Class 1E 4.16 kV bus. This relay provides high speed disconnecting of bus supply breakers to prevent propagation of internal bus fault to another bus.

b) Overcurrent Relaying

Each Class 1E 4.16 kV bus feeder circuit breaker is equipped with three extremely inverse-time overcurrent relays to sense and to protect the bus from an overcurrent condition.

The standby diesel generator feeder circuit breaker to the 4.16 kV bus is equipped with three voltage restrained overcurrent relays for feeder circuit protection. One diesel generator inverse time ground fault relay provides ground fault indication for the diesel generator including the 5 kV cables from the diesel generator to the 4.16 kV bus.

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

Each Class 1E 4.16 kV supply circuit breaker to a 480V load center transformer is protected by three overcurrent relays with long-time and instantaneous elements. An instantaneous overcurrent ground sensor relay provides sensitive ground fault indication.

c) Under/Overvoltage Relaying

Each 4.16 kV Class 1E bus is equipped with undervoltage relays to detect low voltage and initiate a transfer to the alternate source and provide undervoltage annunciation. Each 4 kV bus is provided with degraded grid voltage protection. Each 480V Class 1E load center bus is equipped with under/overvoltage relays for annunciation. The Diesel

Generator E 480V Class 1E motor control center is equipped with undervoltage relays for annunciation.

d) Diesel Generator Differential Relaying

Each diesel generator is equipped with differential relaying protection. This circuitry provides high speed disconnection to prevent severe damage in case of diesel generator internal faults.

e) 480V Load Center Protection

Each load center circuit breaker is equipped with integral, solid-state, dual magnetic, adjustable, direct-action trip devices providing inverse-time overcurrent protection. Motor feeders are equipped with long-time overcurrent and instantaneous short-circuit protection.

f) 480V Motor Control Center Protection

Molded-case circuit breakers provide inverse-time overcurrent and/or instantaneous short circuit protection for all connected loads. For motor circuits, the molded-case circuit breakers are equipped with an adjustable instantaneous magnetic trip function only. Motor thermal overload protection is provided by the heater element trip unit in each phase of the motor feeder circuit. The molded-case breakers for non-motor feeder circuits provide thermal inverse-time overcurrent protection and instantaneous short circuit protection. The thermal overload trip units for safety related motor-operated valves are normally bypassed except during maintenance tests.

The circuit protection system is designed so that fault isolation is secured with a minimum circuit interruption. 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. The protective devices are preoperationally tested in accordance with the requirements of Chapter 14. After the plant is in operation, periodic tests will be performed to verify the protective device calibration, setpoints, and correct operation in accordance with the requirements of Chapter 16.

8.3.1.3.14 Testing of the AC System During Power Operation

All Class 1E circuit breakers and motor starters, except for the electric equipment associated with Class 1E loads identified in Subsection 8.3.1.3.15, are testable during reactor operation. During periodic Class 1E system tests, subsystems of the ESF 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 480V load center circuit breakers and control circuits can also be tested independently while individual equipment is shut down. The load center circuit breakers can be placed in the test position and exercised without operation of the related equipment.

8.3.1.3.15 Class 1E Loads Not Testable During Power Operations

A. Feedwater Line Isolation Valves

The feedwater line isolation valves (HV-F032 A/B) are of the motor operated check valve type and are not testable with the feedwater flow present. Motor operation is not required for isolation. Only the outermost isolation valve is Class 1E powered and would be motor-operated for long-term isolation after isolation of the feedwater line.

Conformance with Regulatory Guide 1.22 Section D.4:

1. The feedwater isolation is not designed for isolation with feedwater flow present as the loss of flow would adversely affect operability of the plant.

2. Motor operation is not required for isolation.

3. The motor operator of the outermost isolation valve is fully testable during shutdown.

B. Main Steam Isolation Valves

The main steam isolation valves can be tested individually to the 90% open position at full power with the slow acting test solenoid valve. A fully closed test using the two fast acting main solenoids would require a reduction in reactor power.

Conformance with Regulatory Guide 1.22: See Subsections 7.3.2a.2.2.1.2 and 5.4.5.4.

C. ADS System - Safety/Relief Valves

The active components of the ADS system except the safety/relief valves and their associated solenoid valves are designed so they may be tested during plant power operation. The relief valve and associated solenoid are not tested during reactor power operation.

Conformance with Regulatory Guide 1.22:

1. The safety/relief valves are not tested during power operation because of resulting adverse affect on plant operation.

2. Because of low failure rates of valve actuation, the probability of failure is acceptably low without testing.

3. The safety/relief valves and associated solenoid valves can be tested during startup following shutdown.

D. Recirculation Loop Isolation Valves

The recirculation pump isolation valves are not tested during reactor power operations.

Conformance with Regulatory Guide 1.22 Section D.4:

1. Operation of a recirculation loop isolation valve would result in a reduction of circulation which would adversely affect the safety and operability of the plant.

2. The probability of failure is acceptably low without testing the valve motor during operation.

3. The valve and motor are fully testable during reactor shutdown.

8.3.1.4 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. An additional diesel generator (diesel generator E) complete with its accessories and fuel storage and transfer system can be substituted for any one of the 4 normally aligned diesel generators (A, B, C, or D) and aligned to the safety-related load group. Each diesel generator (A, B, C, or D) is rated 4000 kW at 0.8 pf for continuous operation and 4700 kW for 2000 hr operation. The additional diesel generator (E) is rated 5000 kW at 0.8 pf for continuous operation and 5500 kW for 2000 hr operation. The ratings for each diesel generator are calculated in accordance with the recommendation of Regulatory Guide 1.9 (discussed in Subsection 8.1.6.1). The diesel-generators can operate at loads of from 50 to 100 percent for unlimited periods without harm. Any diesel generator continuously operated at loads of less than 50 percent will be loaded in accordance with the manufacturer's recommendations to remove any built up combustion products. Question 040.82 and the response contain further information. Any diesel operating at loads of less than 50 percent for less than six hours will be loaded in accordance with manufacturer's recommendations to remove any built up combustion products. Question 040.82 and the response contain further information. Such operation will enhance engine performance and reliability.

The diesel generators are shared by the two units. There are a total of five diesel generators. Diesel Generators A, B, C and D are normally assigned to the safety-related load groups. Diesel Generator E is capable of being substituted for any of the Diesel Generators A, B, C or D without violating the independence of the redundant safety-related load groups. Only four diesel generators can be aligned to the safety-related load groups. When a diesel generator is aligned, it is connected to the 4.16 kV bus of the assigned load group per unit. The capacity of the aligned diesel generators (assuming one of the aligned diesels fails) is sufficient to operate the engineered safety features loads of one unit and those systems required for concurrent safe shutdown of the second unit.

There are no provisions for parallel operation of the aligned diesel generator of one load group with the aligned diesel generator of the redundant load group. The diesel generator circuit breaker and the off-site power incoming circuit breakers are interlocked to prevent feedback into the off-site power system. These interlocks are bypassed during load testing of the aligned diesel generator; however, only one unit is tested at any one time. During the test period, the diesel generator under test is manually synchronized to the preferred off-site power system. Upon receipt of a LOCA signal under the test condition, the diesel generator breaker is tripped but the aligned diesel generator continues to run. When not aligned, Diesel Generator E can be tested through a 13.8-4.16 kV test facility transformer which permits Diesel Generator E to be synchronized to the offsite power system. Cooling water under these conditions is provided by LOOP A and/or B of the

Emergency Service Water System. During the test, Diesel Generator E is under local manual control. A LOCA or a LOOP signal during the test, trips the 4.16 kV output breaker and closes the ESW LOOP A and B supply and return valves in the Diesel Generator E building.

Control power for Diesel Generator E is from a single 125V DC system in the Diesel Generator E building. When Diesel Generator E is aligned, loss of DC power is indicated on the BIS panel and group trouble alarm on panel 0C653 in the location of the diesel generator for which Diesel Generator E has been substituted.

The diesel generators are physically and electrically isolated from each other. Physical separation for fire and missile protection is provided between Diesel Generators A, B, C and D by separate rooms within a Seismic Category I structure. Diesel Generator E is protected in a separate Seismic Category I structure. Power and control cable for each of the diesel generators and associated switchgear are routed in separate raceways. Physical electrical equipment layout of the diesel generator rooms is shown on Dwgs. M-260, Sh. 1, M-261, Sh. 1, and M-5200, Sh. 1.

Auxiliaries required for starting and continuous operation of Diesel Generators A, B, C and D are fed by the Class 1E power load group associated with that diesel generator. Diesel Generator E has a separate Class 1E power system in the Diesel Generator E building for starting and continuous operation.
Control power for Diesel Generators A, B, C or D is provided by its corresponding 125V DC systems from both Unit 1 and Unit 2. These two power feeders are not redundant, but have been provided for ease of maintenance. Indication of which unit is supplying the DC control power is not provided in the control room. Manual switches are installed at the local panel to select the preferred power feeder. Since these diesel generators are shared by both units, either source of DC control power is adequate. Loss of DC power to the Diesel Generators A, B, C or D when aligned is indicated on the BIS panels as a group trouble alarm on panel 0C653 in the main control room.

Each diesel generator is provided with a local engine control panel, a generator-exciter control panel, a local 4.16 kV distribution panel, and a 480V motor control center in the diesel generator room. In addition, Diesel Generator E has a 125V DC motor control center.

a) Local Engine Control Panel - consists of a local annunciator, engine control devices, gauges, and control for diesel generator auxiliary equipment such as fuel oil transfer pump, standby jacket water pump, etc.

   The diesel generator control system is designed in such a manner that some control devices are mounted in the free standing control panel separate from the engine, while others are mounted directly on the engine, as required for reliable service. All devices that are essential to the start-up or power output of the diesel-generator set have been seismically qualified by analysis or test to acceleration levels consistent with their mounting location.

b) Generator-Exciter Control Panel - consists of generator excitation control equipment, generator protective relays and devices, etc.

c) 4.16 kV Distribution Panel - In the Diesel Generator A, B, C and D rooms, the panel provides connections for the aligned diesel generator feeders to Unit 1 and 2. Also houses potential transformers and current transformer, etc.

d) 480V Motor Control Center - provides power to all 480V auxiliary equipment related with that diesel generator. The MCC in Diesel Generator A, B, C or D room is equipped with an automatic transfer switch for connection to either Unit 1 or 2 480V Class 1E load center. These two load centers belong to the same load group channel as the diesel generator. The Diesel Generator E MCC is connected to an automatic transfer switch which can supply power from either offsite power source. In the event that both sources are lost and Diesel Generator E is operating, the MCC is transferred to the Diesel Generator E 4.16 kV bus and powered from a 4.16 kV-480V Class 1E transformer.

e) 125V DC motor control center - provides power to the Diesel Generator E emergency service water motor operated valves.

Physical separation of standby power system is discussed in Section 3.12.

Diesel Generator Transfer Scheme

Diesel Generator E is capable of being substituted for any one of Diesel Generators A, B, C or D. Substitution is accomplished by manually transferring control of Diesel Generator E to the control room using cabling from the substituted diesel generator and manually transferring Diesel Generator E 4.16 kV leads to the high voltage compartment of the substituted diesel generator.

All the cables transferred to Diesel Generator E are routed through two normally open switching points; one point located in each Diesel Generator A, B, C and D rooms and a corresponding switching point for Diesel Generators A, B, C and D in the Diesel Generator E building. This arrangement maintains the independency of the safety related load groups.

Diesel Generator E is connected directly to a Class 1E 4.16 kV bus in the Diesel Generator E building. Four cubicles on the 4.16 kV bus serve as the switching points for the Diesel Generator E 4.16 kV leads to the 4.16 kV buses located in each Diesel Generator A, B, C and D rooms. These buses are the corresponding switching points in the Diesel Generator A, B, C and D rooms.

The transfer of the controls of Diesel Generator E to the main control room is achieved by manually switching the control room instrumentation and control cables from the substituted diesel generator to the Diesel Generator E. Transfer panels in each Diesel Generator A, B, C or D room are used to perform the switching. Duplicate transfer panels located in the Diesel Generator E building are also used to perform the switching. This provides two isolation points for each transferred cable.

8.3.1.4.1 Automatic Starting Initiating Circuits

The four (4) aligned diesel generators are automatically started by any of the following conditions:

a) Total loss of power to the 4.16 kV Class 1E bus of either unit to which the diesel generator is connected.

b) Safety injection signal - low water level in the reactor, high drywell pressure, or manual actuation.

Two control/starting circuits are provided for each diesel generator. Each circuit is supplied via separate circuit breaker from the same 125 volt battery. Failure of one circuit that does not affect the other would not prevent the respective diesel generator from starting.

The diesel generators are ready to accept loads within 10 sec after the initiation of the start circuit.

8.3.1.4.2 Diesel Starting Mechanism and System

The diesel generator starting air system is described in Subsection 9.5.6. To ensure fast and reliable starting, each diesel engine is provided with immersion heaters in the engine jacket water and the lube oil system to maintain the engine coolant and lube oil temperature at an operable level. For Diesel Generators A, B, C and D, the electric jacket water immersion heater and the water circulating pump are interlocked for simultaneous operation when the jacket water temperature drops below the preset temperature. The electric lube oil immersion heater and the prelube circulating pump are interlocked for simultaneous operation when the engine is below 280 rpm. For Diesel Generator E, both the jacket water circulating pump and the prelube circulating pump start when the engine is below 280 rpm. The electric jacket water immersion heater and lube oil immersion heater are controlled by temperature switches. The heaters are interlocked with the corresponding circulating pump to prevent the heater from operating unless the pump is running. Refer to Subsections 9.5.5 and 9.5.7 for further description.

8.3.1.4.3 Alarm and Tripping Device

The protective and alarm logic diagrams for the diesel generator and its associated breakers are shown on Dwgs. E-31, Sh. 8 and E-31, Sh. 9.

While supplying loads following an automatic start, each diesel engine and related generator circuit breaker are tripped by protective devices under the following conditions only:

a) Engine overspeed

b) Lube oil low pressure

c) Generator differential

To prevent spurious tripping of the diesel generator due to malfunction of the engine lube oil low pressure trip device, four independent sensors are provided and connected in a coincidence one-out-of-two taken twice tripping logic. An individual tripping alarm is provided by the annunciator at each local control panel.

The starting circuit is also equipped with a "fail to start" relay operator that interrupts the starting of the diesel generator if a predetermined speed during test mode of operation is not reached within a limited time following a start initiation.

In addition to the above-listed trips, each generator circuit breaker is tripped by the following protective relays to disconnect the aligned generator from a faulty bus (the diesel generator continues to run):

a) Voltage restrained overcurrent

b) 4 kV bus differential.

Following a manual start of an aligned diesel generator, the diesel generator is in the test mode and ready for a load test. When so operated, in addition to the above-listed trips, the diesel engine and related generator circuit breaker are automatically tripped during test mode by the following protective devices:

Diesel Generator A-D Test Mode Trips and High Priority Alarm

a) Generator Loss of Field

b) Generator Overexcitation

c) Generator Reverse Power

d) Generator Underfrequency

e) Generator Overvoltage

f) Generator High Bearing Temperature

g) Turbo Lube Oil Pressure Low

h) Main and Connecting Rod Bearing High Temperature

i) Engine Vibration

j) Turbo Thrust Bearing Failure.

k) Engine Lube Oil Pressure Low

l) Engine Overspeed

m) Generator Differential

n) High Jacket Water Temperature

Diesel Generator E Test Mode Trips and High Priority Alarm

a) Engine Lube Oil Pressure LO-LO

b) Turbo Lube Oil Pressure LO-LO

c) Main and Connecting Bearing High Temperature

d) Engine Vibration

e) Turbo Thrust Bearing Failure

f) Jacket Water Temperature HI-HI

g) Engine Overspeed

h) Deleted

i) Generator Bearing High Temperature

j) Generator Reverse Power

k) Generator Loss of Field

l) Generator Overexcitation

m) Generator Differential

n) Generator Underfrequency

o) Generator Overvoltage

p) Emergency Service Water

q) Emergency Shutdown

r) Incomplete Sequence

An individual alarm is also provided for each of these abnormal conditions at the local control panel. A group alarm is provided in the main control room as a high priority alarm.

Other relays and devices are provided to annunciate abnormal diesel engine and generator conditions of the aligned diesel generator at the local control panel as following. These conditions are annunciated in the main control room as a low priority alarm.

Diesel Generator A-D Low Priority Alarm

a) Generator Field Ground

b) Generator Voltage Unbalance

c) Generator Neutral Overvoltage

d) Engine Lube Oil Pressure Low

e) Engine Lube Oil Pressure High

f) Crankcase Pressure High

g) Engine Lube Oil Temp Off Normal

h) Engine Crankcase Level Low

i) Auxiliary Standby Pump On

j) Jacket Water Temperature Off Normal

k) Jacket Water Low Pressure

l) Fuel Oil Pressure High

m) Fuel Oil Pressure Low
n) Fuel Strainer High Differential Pressure
o) Fuel Filter High Differential Pressure
p) Lube Oil Filter High Differential Pressure
q) Starting Air System Low Pressure or Malfunction
r) Air Header Temperature Control System Trouble
s) Voltage Regulator Transfer to Standby
t) Standpipe Level High
u) Standpipe Level Low
v) Day Tank Level High
w) Day Tank Level Low
x) Fuel Storage Tank Level Low
y) Fuel Storage Tank Level Low Low
z) MCC Not Proper for Auto Operation
aa) Control Switches Not Proper for Remote Auto Operation
bb) Lube Oil Circulating Pump Malfunction
cc) Lube Oil Heater Malfunction
dd) Jacket Water Circulating Pump Malfunction
ee) Jacket Water Heater Malfunction
ff) Diesel Generator Coolers ESW Loop A/B Isolation Valves Misalignment
gg) Diesel Generator Bay HVAC Trouble
hh) Turbo Lube Oil Pressure Low

Diesel Generator E Low Priority Alarm

a) Engine Lube Oil Pressure Low
b) Turbo Lube Oil Pressure Low
c) Engine Lube Oil Pressure High
d) Engine Crankcase Pressure High
e) Engine Crankcase Level Low
f) Engine Lube Oil Temp High/Low
g) Jacket Water Temp High/Low

h) Jacket Water Pressure Low

i) Jacket Water Standpipe Level Low

j) Jacket Water Standpipe Level High

k) Lube Oil Filter Differential Pressure High

l) Fuel Oil Pressure Low

m) Fuel Oil Pressure High

n) Fuel Oil Filter Differential Pressure High

o) Fuel Oil Strainer Differential Pressure High

p) Auxiliary Standby Pump On

q) Fuel Oil Day Tank Level Low
r) Fuel Oil Day Tank Level High

s) Fuel Oil Storage Tank Level Low

t) Pre-Lube Pump Malfunction

u) Lube Oil Heater Malfunction

v) Jacket Water Heater Malfunction

w) Jacket Water Circulating Pump Malfunction

x) Diesel Generator Bypassed or Inoperable

y) Generator Field Ground

z) Generator Voltage Unbalanced

aa) Generator Neutral Overvoltage

bb) Generator Overcurrent

cc) Fuel Oil Storage Tank Level Low Low

dd) Near Full Load

ee) Voltage Regulator Transfer to Standby

ff) Air Header Temperature Control System Trouble

gg) MCC Not Proper for Auto Operation

hh) Control Switches Not Proper for Remote Auto Operation

ii) Starting Air Pressure Low or System Malfunction

jj) Failure to Start

The following alarms are provided in the main control room annunciator for the diesel generators which are aligned:

a) Diesel generator tripped
b) High priority alarm (all trip conditions listed previously)
c) Low priority alarm (all abnormal conditions listed previously)
d) Diesel generator breaker tripped
e) Diesel generator fails to start
f) Diesel generator near full load
g) Diesel generator not in automatic mode.

When Diesel Generator E is not aligned, it can be tested through a test facility. Diesel Generators A, B, C or D do not have the capability of being tested when not aligned. When operating through the test facility, Diesel Generator E has the same automatic trips and individual alarms as an aligned diesel generator. However, the alarm conditions are only provided at the local control panel. High and low priority alarms are not annunciated in the main control room.

8.3.1.4.4 Breaker Interlocks

Interlocks have been provided in the closing and tripping of the 4.16 kV Class 1E circuit breakers to protect against the following conditions:

a) Automatic energizing of electric devices or loads during maintenance
b) Automatic closing of the diesel generator breaker to any energized or faulted bus
c) Connecting two sources out of synchronism

8.3.1.4.5 Control Permissive

A single key-operated switch at the local control panel is provided for each diesel generator to block automatic start signals when the aligned diesel is out of service for maintenance. An annunciator alarm in the main control room and an indication at the bypass-indication-system panel indicate when the switch is not in automatic position.

A pushbutton in the control room and a local pushbutton at the local control panel in the aligned diesel generator room/building are provided to allow manual start of the diesel when all protective systems are permissive. During periodic diesel generator tests of an aligned diesel generator,

permissives and interlocks are designed to permit manual synchronizing and loading of the diesel generator with either off-site power source.

A key-operated switch at the local control panel is provided for each diesel generator to regain speed and voltage control of the aligned diesel generator following a loss of and subsequent restoration of offsite power. This permits the aligned diesel generator to be synchronized to the offsite power source, while maintaining the diesel generator in the emergency mode of operation. An annunciator alarm in the main control room indicates when the switch is not in the normal position.

A transfer scheme is provided as described in Section 8.3.1.4. Proper alignment of the manual control switches on the transfer panels and the position of the 4.16 kV transfer switchgear is required to permit Diesel Generator E to be substituted for Diesel Generator A, B, C or D. Local indication and control room indication of the transfer scheme is provided to assure proper alignment.

The sequence for transferring the controls of Diesel Generator A, B, C or D to Diesel Generator E begins with the diesel generator being removed from service and ends with the diesel generator being placed in-service or aligned. The sequence begins by placing the "Enable-Disable" switch in the "Disable" position on the transfer panel of the diesel generator being taken out of service. This action removes all auto start signals from the diesel generator and gives an indication that the transfer scheme is misaligned. The remaining switching operation at the transfer panel and the repositioning of the 4.16 kV breaker and ESW valves occurs at the diesel generator being taken out of service. Next, the switching at the transfer panel and repositioning of the 4.16 kV breaker and ESW valves occurs at the diesel generator being put in-service or aligned. Finally, the sequence is completed by placing the "Enable-Disable" switch in the "Enable" position on the transfer panel of the diesel generator being put in service or aligned. This action removes the indication of a transfer scheme misalignment.

8.3.1.4.6 Loading Circuits

Upon automatic starting of an aligned diesel (emergency mode), connection of the diesel generator to the 4.16 kV bus is not made unless both off-site power sources are lost. As the generator reaches the predetermined voltage and frequency levels, control relays provide a permissive signal for the closing of the respective diesel generator breaker to the corresponding 4.16 kV bus. The diesel generator circuit breaker is closed within 10 sec after the receipt of the starting signal. The required safety related loads are connected in sequential order to the Class 1E buses as shown in Table 8.3-1. This prevents diesel generator instability and ensures voltage recovery thereby minimizing motor accelerating time. A fast-responding exciter and voltage regulator ensures voltage recovery of the diesel generator after each load step.

With one diesel generator unavailable, the remaining three in-service diesel generators have the capacity and capability to supply the required engineered safeguard features loads in one unit; the equipment needed to safely shutdown the second unit; and any more engineered safeguard features loads manually switched onto the diesel generators as illustrated in Tables 8.3-2 through Table 8.3-5a. These tables represent a worst case loading based on mechanical and electrical equipment availability. The plant operators may choose to run different equipment than that specified in the tables after 10 minutes. However, by procedure the loading of each diesel generator will be maintained below 4000 kW long term.

8.3.1.4.7 Testing

Preoperational Test

Diesel Generators A, B, C and D were tested at the site prior to reactor fuel loading in accordance with requirements of Chapter 14. Diesel Generator E was tested at the site prior to declaring it operational in accordance with requirements of Chapter 14.

Periodic Testing

After being placed in service, the standby power system is tested periodically to demonstrate continued ability to perform its intended function, in accordance with the requirements of Chapter 16.

8.3.1.4.8 Fuel Oil Storage and Transfer System

The diesel generator fuel oil system is described in Subsection 9.5.4.

8.3.1.4.9 Diesel Generator Cooling and Heating

The diesel generator cooling system is described in Subsection 9.5.5.

8.3.1.4.10 Instrumentation and Control Systems for Standby Power Supply

The instrumentation and control circuit of Diesel Generators A through D is provided with a manual selector switch for connection to either Unit 1 or 2 125V DC power supply. These two power supplies belong to the same load group channel to which the diesel generator is connected. Diesel Generator E has a separate 125V DC power supply in the Diesel Generator E building.

Since there are five diesel generators of which only four can be aligned for emergency operation at one time, the control room hardware can only operate the aligned diesel generators. The control room hardware performs the following operations:

a) Starting and stopping

b) Synchronization

c) Frequency and voltage adjustment

d) Manual or automatic voltage regulator selection

e) Isochronous and droop selection.

Control hardware is provided at each local control panel for the following operations of the aligned diesel generators:

a) Starting and stopping

b) Frequency and voltage adjustment

c) Manual or automatic diesel generator mode (key lock selector switch)

d) Automatic or manual voltage regulator selection

e) Normal or standby voltage regulator selection

f) Units 1 or 2 DC control power supply selection. (Only on Diesel Generator A through D)

Electrical metering instruments are provided in the control room for surveillance of the aligned diesel generator:

a) Voltage

b) Current

c) Frequency

d) Power output.

Electrical metering instruments are provided at the local control panel for surveillance of the aligned diesel generator:

a) Voltage

b) Current

c) Frequency

d) Power (watt) output

e) Reactive power (var) output.

8.3.1.4.11 Test Program

8.3.1.4.11.1 Class 1E Equipment Identification

The diesel-generator sets are designated Class 1E since they perform essential safety-related functions. Therefore, the equipment was qualified per IEEE 323-1971 and documented in Cooper Energy Services (CES) Report #CE-0188-1; for Diesel Generators A, B, C and D and qualified per IEEE 323-1974 and documented in SQRT binders M-607, M-618, M-619 and M-622 for Diesel Generator E. The diesel engine, synchronous generator, and auxiliaries, such as heat exchangers, air receivers, and fuel tanks were qualified.

8.3.1.4.11.2 Vendor Qualification Techniques and Documentation

All testing conducted by CES for the diesel-generator sets A, B, C and D and by M-K for Diesel Generator E provides the basis for data evaluation of future, ongoing, periodic, jobsite testing.

Testing and analyses completed to verify equipment performance capability were as follows:

a) Testing performed on the first generator of the CES contract included the following parameters, with testing procedures as outlined in IEEE 115. Refer to Electric Products test report for generator serial number 17402243-200 dated 5-20-76 for documentation of test results. Similar testing was performed for the Diesel Generator E, refer to Parsons Peebles test report for generator serial number 18306833-200.

1. Synchronous impedance curve.
2. Zero power factor saturation curve.
3. Losses (for efficiency calculation).
4. Direct-axis synchronous reactance.
5. Negative sequence reactance.
6. Direct-axis transient reactance.
7. Direct-axis transient open circuit time constant.
8. Open circuit saturation curve.
9. Start circuit test.

b) Testing performed on Generators A, B, C and D included the following parameters with testing procedure as outlined in IEEE 115. Refer to Electric Products test report for generator serial numbers 17402244/246-200 dated 6/22/76 for documentation of test results. Similar testing was performed for the Diesel Generator E, refer to Parson Peebles test report for generator serial number 18306833-200.

1. Insulation resistance.
2. High potential tests.
3. Winding resistance.
4. Overspeed.
5. Phase sequence rotation.
6. Mechanical balance.

c) Testing was performed on assembled engine-generator sets A, B, C and D per IEEE 387 and included the following. Refer to CES test procedure T1-T5 and to CES reports for engine serial numbers 7157-60 for documentation of test results. Similar testing was performed for Diesel Generator E, refer to M-K test procedure FT-6061 and to M-K report FT-6061-FR for engine serial number 7218.

1. High potential testing of control wiring.
2. Measurement of engine vibration.
3. Fast start capability.
4. Transient performance evaluation.
5. Steady state load capability.
6. Load rejection.

7. Number of starts from a single air receiver.

8. Performance evaluation of power factor discriminator and standby voltage regulator.

d) Functional auxiliaries, such as lube oil pumps, jacket water pumps, heaters, and coolers were evaluated to ensure proper operation during the assembled engine-generator set testing described in c above. The functional capability of the auxiliaries is documented in the test log section of the CES reports for engine serial numbers 7157-60 and M-K report FT-6061-FR for Diesel Generator E serial number 7218. The establishment of adequate pressures and temperatures in the lube oil, cooling water, and fuel oil systems confirms correct operation of auxiliaries.

e) Engine and generator control panels were assembled and tested with their respective engine-generator sets and evaluated for proper control and monitoring. Refer to CES reports for engine serial numbers 7157-60 and M-K report for engine serial number 7218 for test results. The achievement of engine-generator transient and steady state performance confirms correct operation of control panels.

f) To evaluate the seismic effects on the safe shutdown capability some tests have been performed, but most evaluations were achieved by analysis. Both CES and vendor furnished equipment, which are essential to the power output capability of the generator, have been seismically evaluated and determined adequate to meet the specified response spectra with no loss of functional or structural integrity. The documentation for the seismic analyses and tests is contained in SQRT binders maintained by Susquehanna Records Management System.

8.3.1.4.11.3 Performance In Service Environment

Actual performance requirements and service conditions are achievable in the field installation only. Simulation of performance is attained through computer techniques which comparatively analyze motor starting data taken during factory testing with motor load starting characteristics predicted for the essential pumps-motors to be started at the jobsite. Simulation of service environments, such as the predicted diesel generator room ambient temperature, would require an environmental chamber large enough to store the entire engine-generator set. In order to ascertain the ability of this equipment to perform in the predicted environment, operating experience and design experience are used. The varied types of engines designed, the varied installation applications, and the resultant experience gained have determined the capabilities of this equipment to perform under different service conditions. This experience is augmented by previous and ongoing R&D testing of a similar CES Type KSV engine where specific data may be needed relative to particular performance requirements. However, much of this data is proprietary.

As a result of this experience and testing, it is concluded the service conditions described in Section 3.11 can be accommodated while fulfilling the performance requirements. For example, installation elevations of up to 1500 feet are accommodated without any derating or design modification. The 676 feet elevation for the Susquehanna SES diesel-generator sets falls well within this range. To accommodate variance in combustion air temperature, coolers/heaters are supplied which either add heat to or take heat from combustion air as needed to provide the necessary manifold air temperature. The range of -19°F to +105°F air temperature is therefore accommodated.

In addition, all emergency service water heat exchangers are designed with fouling factors incorporated permitting the buildup of specified amounts of dirt or sludge while maintaining the necessary heat transfer characteristics under the most adverse load and cooling water temperature conditions. Particles or minerals in the service water are therefore accommodated in heat exchanger design.

Seismic effects are taken into account analytically and/or by test for all essential components and systems of the diesel-generator sets.

8.3.1.4.11.4 Periodic Test

Periodic exercising of the diesel generator sets shows availability and reliability. The diesel generator equipment will undergo periodic testing in accordance with the Technical Specifications. This testing is implemented as part of the surveillance test program.

Data taken during those tests will be compared to previous test data taken during similar load conditions. This will aid in the development of trends that may indicate equipment degradation and the prediction of maintenance intervals. Equipment maintenance histories will be kept for the diesel generators and completed surveillance testing and preventive maintenance will be documented in the history.

8.3.1.4.12 Control and Alarm Logic

A transfer switching scheme is provided for the diesel generators to permit Diesel Generator E to be substituted for Diesel Generator A, B, C or D. The transfer scheme transfers the control and alarm logic so that the logic is only functional for the diesel generators which are aligned for operation. The following analysis is only applicable to the diesel generators which are aligned.

The control and alarm logic for the diesel generators is shown on Dwg. E-31, Sh. 9. Conditions which render the diesel generator incapable of responding to an automatic emergency start are shown on Table 8.3-16. The following is an item by item analysis of each of these conditions:

General Note

The diesel generator will be tripped by (1) generator differential relay, (2) engine overspeed, and (3) low engine lube oil pressure (one-out-of-two taken twice logic) under emergency operation. For test operation, the diesel generator will be tripped by all conditions listed under "Diesel Generator High Priority" alarm as shown on Dwg. E-31, Sh. 9. Following a manual stop, no reset is necessary for subsequent emergency or test operation except the mode selector switch must be returned to "Remote" position. This condition is annunciated locally and in the control room. Following a trip, the control circuit must be reset. The diesel generator trip is also alarmed locally and in the control room.

There are two engine starting circuits for each diesel generator for added reliability. Each circuit is supplied from the same 125V battery system but through separate circuit breakers. Only one circuit is required for starting the diesel generator.

1) ID-B.1 Generator Differential Relay activated

A generator differential relay is provided for each diesel generator for internal fault protection. This relay will trip the diesel generator under any mode of operation. The diesel generator differential alarm is annunciated locally and repeated as a group alarm "Diesel Generator High Priority Trouble" in the main control room.

2) ID-B.2 Engine Overspeed Sensor activated

An overspeed sensor is provided for each diesel generator. Activation of any one switch from the sensor is alarmed, but will not prevent the diesel generator from starting or running.

3) ID-B.3 Engine Lube Oil Low Pressure Relay activated

Each of the control circuits have two independent engine lube oil low pressure switches arranged in a one out of two logic. Pressure switches are bypassed during engine starting. Therefore, alarm is initiated for any one pressure switch (or relay) activation. Disabling of the diesel generator can only be accomplished with one engine lube oil low pressure relay activated in each control circuit.

4) ID-B.4 Operating Mode Switch in “Local”

Operating mode switch (key locked) is put on "Local" for local testing and maintenance services only. "Local position" is annunciated in the main control room as "Diesel Generator not in Auto." Alarm is also indicated in the Bypass Indication System (BIS) on "Diesel Generator Switch in Local" (also in the main control room). Automatic bypass of the "Local" operating mode under emergency condition is not provided. Only one diesel generator will be placed in the "local" operating mode at any one time.

5) ID-B.5 Loss of 125VDC Engine Control Power

As discussed above, two separate control circuits are provided for each diesel generator. Loss of power to either circuit is indicated locally and annunciated in the main control room as "Diesel Generator High Priority." Indication is also provided at the BIS panel. Loss of either circuit will not prevent the diesel generator from starting or operating.

6) ID-B.6 Control Relay Malfunction

In order to minimize the effects of a control relay malfunction, most diesel generator control circuits have been designed with redundancy to prevent the disabling of a diesel generator. Where there are two redundant circuits, a single relay failure will not prevent the diesel generator from starting or operating.

7) ID-B.7 Engine & Generator Mechanical Trouble

Low priority and high priority trouble alarms are provided for engine and generator mechanical trouble as shown on Dwg. E-31, Sh. 9 and Table 8.3-16.

8) ID-B.8 Starting Air Control Solenoid Valve Failure

There are two starting air solenoid valves for each of the two starting circuits for each D/G. Loss of any three starting solenoids will not prevent the diesel generator from starting.

9) ID-B.9 Starting Air System Trouble

See (9) ID-B.9 and Section 9.5.6 for a complete starting air system discussion. The starting air pressure is monitored at all times with annunciation provided locally and in the main control room.

10) ID-B.10 Fuel Oil Control Solenoid Failure

One fuel oil control solenoid is provided in each of the two control circuits for each diesel-generator. A failure of either fuel oil control solenoid will not prevent the diesel generator from starting.

11) ID-B.11 Loss of 125V DC Generator Control Power

Loss of the generator control power will prevent the operation of the excitation system. Indication is provided at the Bypass Indication System as "DG FLD FLASH and Exciter Power Loss" (Main Control Room).

12) ID-B.12 Disabling of Engine and Generator Mechanical Parts During Maintenance Services

Before the diesel generator is taken out of the automatic mode for maintenance services, the operating mode selector switch must be in "Local" position as required by maintenance procedures. This will result in an alarm in the main control room as "Diesel Generator not in Auto" ("Diesel Generator Control Switch in LOCAL" in BIS panel).

13) ID-B.13 Transfer Switches and Circuit Breakers Not Aligned

A transfer scheme described in Section 8.3.1.4 requires all of the transfer switches and 4.16 kV breakers be positioned correctly for a diesel generator to be aligned for emergency operation. Any switch or breaker which is not in the correct position results in an alarm in the main control room as "Diesel Generator Not in Auto" ("Diesel Generator Supply/Control Power Loss" in BIS panel).

No alarms are specifically provided for monitoring of engine and generator mechanical parts under the subject condition.

<u>Conclusion</u>

No modifications are necessary as a result of this evaluation because adequate alarms and indications are provided in addition to the alarm redundancy of the control circuits.

8.3.1.5 Electrical Equipment Layout

Class 1E switchgear, load centers, motor control centers, and distribution panels of redundant load groups are physically identified and independent from each other in accordance with FSAR Section 3.12.

Standby diesel generators and associated equipment are in separate rooms of the Seismic Category I Diesel Generator A through D building. Each room is provided with a separate ventilation system. A separate seismic Category I Diesel Generator E building contains a diesel generator which can be manually switched to replace one of the Diesel Generators A, B, C or D. The building has a separate ventilation system.

Plant layout drawings are included in Section 1.2.

8.3.1.6 Reactor Protection System Power Supply

The reactor protection system (RPS) power supply is a non-Class 1E system. The normal 120V AC power to each of the two reactor protection systems is supplied, via a separate bus, by its own high inertia motor generator set. The drive motor is supplied from a 480V Class 1E motor control center. High inertia is provided by a flywheel. The inertia is sufficient to maintain voltage and frequency within 5 percent of rated values for at least 1.0 sec for switching or other transients of short duration on the input power to the drive motor. For a loss of power, the electrical distribution system acts very quickly to dynamically brake the rotating MG Set and trip the generator output breaker.
The alternate 120V AC power for each of the reactor protection systems is supplied by a non-Class 1E motor control center through a 480-120V, 1ø transformer. A selector switch is provided for the selection of the two power supplies. The switch also prevents paralleling the motor generator set with the alternate supply.

The electrical protective assembly (EPA), consisting of Class 1E protective circuitry is installed between the RPS and each of the power sources. The EPA provides redundant protection to the RPS and other systems which receive power from the RPS busses by acting to disconnect the RPS from the power source circuits.

The EPA consists of a circuit breaker with a trip coil driven by logic circuitry which senses line voltage and frequency and trips the circuit breaker open on the conditions of overvoltage, undervoltage and underfrequency. Provision is made for setpoint verification, calibration and adjustment under administrative control. After tripping, the circuit breaker must be reset manually. Trip setpoints are based on providing 115V AC, 60 Hz power at the RPS logic cabinets. The protective circuit functional range is ±10% of nominal AC voltage and -5% of nominal frequency.

The EPA assemblies are packaged in an enclosure designed to be wall mounted. The enclosures are mounted on a seismic Category I structure separately from the motor generator sets and separate from each other. Two EPAs are installed in series between each of the two RPS motor-generator sets and the RPS busses and between the auxiliary power sources and the RPS busses. The block diagram in Figure 7.2-9 provides an overview of the EPA units and their connections between the power sources and the RPS busses. The EPA is designed as a Class 1E electrical component to meet the qualification requirement of IEEE 344-1975. It is designed and fabricated to meet the quality assurance requirements of 10CFR50, Appendix B.

The enclosures containing the EPA assemblies are designed for normal ambient temperature between 40°F and 122°F. The assemblies are seismically qualified per IEEE 344-1975, to the Safe Shutdown Earthquake (SSE) and Operating Base Earthquake acceleration response spectra. The enclosure dimensions are approximately 16x20x8 inches and accommodate power cable sizes from 7 AWG to 250 MCM.

8.3.1.7 Class 1E 120V AC Instrumentation and Control Power Supply

Four Class 1E 120V AC instrumentation and control power supplies are provided for each unit to supply the two divisions of 120V AC engineered safety feature loads (there are two Division I panels, and two Division II panels). Each power supply consists of a 480-208/120V transformer and a distribution panel. The 480V power supply is energized from a corresponding Class 1E motor control center, which in turn, is energized from a different 4 kV bus (4 kV Buses A and C energize the Division I panels; Buses B and D energize the Division II panels).

There is no manual or automatic transfer between the four 120V AC Class 1E panels.

There is no automatic loading or load shedding of the panels.

Two independent Class 1E inverter backed 120V AC instrumentation power supply systems are provided for the following Control Room instrumentation to supplement other indications available to operators in event of station blackout and optimally support emergency procedures:

Instrumentation selected to meet the Station Blackout Rule is listed in Calculation EC-SBOR-0502. See FSAR Section 15.9 for a discussion of Station Blackout.

Reactor Vessel Level

Reactor Vessel Pressure

Suppression Pool Temperature Monitoring

Suppression Pool Level

Drywell Pressure

Drywell Temperature

RHR - Heat Exchanger Discharge Temperature

Drywell & Wetwell Spray Flow

Containment Instrument Gas Bottle Pressure

Each inverter is energized from a Class 1E 125V DC battery system and provides 120V AC via associated Class 1E distribution panel, to instrumentation loads continuously under normal operating condition and under DBA LOOP/LOCA condition(s) or 4 hours station blackout condition.

8.3.1.8 Non-Class 1E Instrument and Vital AC Power Supply

Non-Class 1E Instrument AC Power Supply

Two 208/120V non-Class 1E instrument AC power supplies (uninterruptible power supplies) per unit furnish reliable power to non-Class 1E miscellaneous instrument systems.

Each instrument AC power supply consists of one uninterruptible power supply (rectifier/charger, inverter, static transfer switch), a dedicated 250V DC sealed maintenance-free battery system, an external maintenance bypass switch panel, and a 208/120V distribution panel. Normally each distribution panel is supplied by a UPS. The preferred supply to the UPS is from a 480V Class 1E motor control center. The alternate supply is via a 480-208/120V transformer from another 480V Class 1E motor control center. A static transfer switch provides the automatic switchover in case of an overload or malfunction within the UPS. The external maintenance bypass switch can be positioned to bypass the UPS and supply the distribution panel directly from the alternate supply. Its position is controlled by plant procedures.

The supplies from the Class 1E 480V MCCs are affiliated circuits. Redundant breakers act as an isolation system between the Class 1E affiliated power supplies and the non-Class 1E loads.

Vital AC Power Supply

Two 208/120V non-Class 1E vital AC power supplies (uninterruptible power supplies) per unit supply essential non-Class 1E equipment such as the plant computer. Each vital AC power supply consists of one inverter, automatic transfer switch, manual bypass switch, and distribution panel(s). Normally, the distribution panel is supplied by the inverter.

The Unit 1 inverter is supplied by a separate Class 1E 250V DC subsystem as described in Subsection 8.3.2. The Unit 2 inverter is supplied by a separate non-Class 1E 250V DC subsystem. If the inverter is inoperable or is to be removed from service for maintenance or testing, a transfer to the backup supply is made through the manual bypass switch. The backup supply is a regulating type transformer from a 480V Class 1E motor control center. A transfer switch provides the automatic switch-over in case of inverter failure.

The supply from the Class 1E 480V MCC is an associated circuit. Redundant breakers act as an isolation system between the Class 1E power supply and non-Class 1E load.

8.3.1.9 Design Criteria for Class 1E Equipment

The following design criteria are applied to the Class 1E equipment.

MOTOR SIZE - Motor size (horsepower capability) is equal to or greater than the maximum horsepower required by the driven load under normal running, runout, or discharge valve (or damper) closed condition.

MINIMUM MOTOR ACCELERATING VOLTAGE

GENERAL DESIGN - The electrical system is designed so that the total voltage drop on the Class 1E motor circuits is less than 20 percent of the nominal motor voltage. The Class 1E motors are specified with accelerating capability at 80 percent nominal voltage at their terminals.

SPECIFIC DESIGN - Specific evaluations shall be performed for Class 1E equipment which have additional requirements imposed. The evaluations document the ability of the equipment to perform its safety function at the available terminal voltage. The specific evaluations, in conjunction with the general criteria for Class 1E equipment, confirm operability of Class 1E equipment.

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 terminal voltage.

MINIMUM MOTOR TORQUE MARGIN OVER PUMP TORQUE THROUGH ACCELERATING PERIOD - The minimum motor torque margin over pump torque through the accelerating period is determined by using actual pump torque curve and calculated motor torque curves at 80 and 100 percent terminal voltage. The minimum torque margin (accelerating torque) is such that the pump-motor assembly reaches nominal speed in less than 6.5 seconds. This margin is usually not less than 10 percent of the pump torque.

MOTOR INSULATION - Insulation systems are selected on the basis of the ambient conditions to which the insulation is exposed. For Class IE motors located within the containment, the insulation system is selected to withstand the postulated accident environment.
TEMPERATURE MONITORING DEVICES PROVIDED IN LARGE HORSEPOWER MOTORS - Six resistance temperature detectors (RTD) are provided in the motor stator slots, two per phase, for motors larger than 1500 hp. In normal operation, the RTD at the hottest location (selected by test) monitors the motor temperature and provides an alarm on high temperature. RTDs are provided for motors from 250 to 1500 hp. Each bearing that is not anti-friction type has a Dual Element Platinum RTD bearing temperature device to alarm 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 short circuit currents in medium voltage systems is determined in accordance with ANSI C37.010-1972 (ANSI C37.010 - 1982 for Diesel Generator E). The off-site power system, a single operating diesel generator, and running motor contributions are considered in determining the fault level. High voltage power circuit breaker interrupting capacity ratings are selected in accordance with ANSI C37.06-1971 (ANSI C37.06 - 1979 for Diesel Generator E).

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

Load center, motor control center, and distribution panel interrupting capacities are greater than the maximum short circuit current available at the point of application. The magnitude of short circuit currents in low-voltage systems is determined in accordance with ANSI C37.13-1973, and NEMA AB1. Low-voltage power circuit breaker interrupting capacity ratings are selected in accordance with ANSI C37.16-1970. Molded case circuit breaker interrupting capacities are determined in accordance with NEMA AB1.

ELECTRIC CIRCUIT PROTECTION - Electric circuit protection criteria are discussed in Subsection 8.3.1.3.13.

GROUNDING REQUIREMENTS - Equipment and system grounding are designed in accordance with IEEE 80-1961 and 142-1972.

8.3.1.10 Safety-related Logic and Schematic Diagrams

Safety-related logic and schematic diagrams are provided as listed in Section 1.7.

8.3.1.11 Analysis

A failure mode effects analysis for the AC power system is presented in Table 8.3-9.

8.3.1.11.1 General Design Criteria and Regulatory Guide Compliance

The following paragraphs analyze compliance with General Design Criteria 5, 17 and 18 for the Electric Power Systems. All Regulatory Guides are discussed in Subsections 3.13 and 8.1.6.1.

GENERAL DESIGN CRITERION 5, SHARING OF STRUCTURES, SYSTEMS, AND COMPONENTS

Structures, systems, and components important to safety are not shared between nuclear units unless the sharing does not significantly impair their ability to perform their safety function, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining unit.

The two preferred offsite power supplies are shared by both units. The capacity of each offsite power supply is sufficient to operate the engineered safety features of one unit and safe shutdown loads of the other unit.

The Unit 1 AC Distribution System is a shared system between both units, since the common equipment (Emergency Service Water, Standby Gas Treatment System, Control Structure HVAC, etc.) is energized only from the Unit 1 AC Distribution System. There are no Unit 2 specific loads energized from the Unit 1 AC Distribution System. The capacity of the Unit 1 AC Distribution System is sufficient to operate the engineered safety features of one unit and the safe shutdown loads of the other unit.

GENERAL DESIGN CRITERION 17, ELECTRIC POWER SYSTEMS

An on-site electric power system is provided to permit functioning of structures, systems, and components important to safety. With total loss of off-site power, the on-site power system provides sufficient capacity and capability to ensure that:

a) Specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences

b) The core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

Tables 8.3-1 to 8.3-5A list those loads important to safety under design conditions.

The on-site electric power system includes four load groups. The load groups are redundant in that three load groups are capable of ensuring (a) and (b) above. Sufficient independence is provided between redundant load groups to ensure that postulated single failures affect only a single load group and are limited to the extent of total loss of that load group. The redundant load groups remain intact to provide for the measures specified in (a) and (b) above.

During a loss of off-site power, the Class 1E system is automatically isolated from the off-site power system. This minimizes the probability of losing electric power from the on-site power supplies as a result of the loss of power from the transmission system.

Protection, such as voltage restraint overcurrent and 4.16 kV bus differential relays, is provided to trip the diesel generator circuit breaker, if abnormal conditions occur. This protection prevents damage to or shutdown of the diesel generator.

The turbine generator is automatically isolated from the switchyard following a turbine or reactor trip. Therefore, its loss does not affect the ability of either the transmission network or the on-site power supplies to provide power to the Class 1E system. Transmission system stability studies indicate that the trip of the most critical fully loaded generating unit does not impair the ability of the system to supply plant station service. Further discussion is provided in Subsection 8.2.2.

GENERAL DESIGN CRITERION 18, INSPECTION AND TESTING OF ELECTRICAL POWER SYSTEMS

The Class 1E system is designed to permit:

a) Periodic inspection and testing, during equipment shutdown, of wiring, insulation, connections, and relays to assess the continuity of the systems and the condition of components

b) During normal plant operation, periodic testing of the operability and functional performance of on-site power supplies, circuit breakers and associated control circuits, relays, and buses

c) During plant shutdown, testing of the operability of the Class 1E system as a whole, including the system's operational sequence, operation of signals of the engineered safety

features actuation system and the transfer of power between the off-site and the on-site power system.

8.3.1.11.2 Safety Related Equipment Exposed to Accident Environment

The detailed information on all Class 1E equipment that must operate in an accident environment during and/or subsequent to an accident is furnished in Section 3.11.

8.3.1.11.3 Physical Identification of Safety Related Equipment

Each circuit and raceway is given a unique alphanumeric identification, which distinguishes a circuit or raceway related to a particular voltage, function, channel, or load group. One alpha character of the identification is assigned to a load group on the basis of the following criteria:

SEPARATION GROUP CHANNEL A (Red Color Code) - Class 1E instrumentation, controls, and power cables, raceways, and equipment related to Channel A loads, DC subsystem A, 120V AC instrumentation and control channel A, Division I raceways.

SEPARATION GROUP CHANNEL B (Green Color Code) - Class 1E instrumentation, controls, and power cables, raceways, and equipment related to Channel B loads, DC subsystem B, 120V AC instrumentation and control channel B, Division II raceways.

SEPARATION GROUP CHANNEL C (Orange Color Code) - Class 1E instrumentation, controls, and power cables, raceways, and equipment related to Channel C loads, DC subsystem C, 120V AC instrumentation and control channel C.

SEPARATION GROUP CHANNEL D (Blue Color Code) - Class 1E instrumentation, controls, and power cables, raceways, and equipment related to Channel D loads, 120V AC instrumentation and control channel D.

SEPARATION GROUP CHANNEL H (Tan Color Code) - Class 1E instrumentation, controls, and power cables, raceways, and equipment related to the Diesel Generator E Channel H Loads, 120V AC instrumentation and Control Channel H.

SEPARATION GROUP N (Black Color Code) – Non-Class 1E instrumentation, controls, and power cables, raceways, and related equipment.

SEPARATION GROUP DIVISION I (Red/Brown Color Code) - Class 1E instrumentation, control, and power cables.

SEPARATION GROUP DIVISION II (Green/Brown Color Code) - Class 1E instrumentation, control, and power cables.

The affiliated cables are routed with the separation groups they are associated with. The affiliated cables are identified as follows:

a) Red/Brown - associated with separation group channel A or division I.

b) Green/Brown - associated with separation group channel B or division II.

c) Orange/Brown - associated with separation group channel C.

d) Blue/Brown - associated with separation group channel D.

e) Tan/Brown - Associated with separation group channel H.

Cable and raceway separation groups are summarized in Table 8.3-10 .

For identification of raceways and Class 1E cables refer to Section 3.12.

Design drawings provide distinct identification of Class 1E equipment. The applicable separation group or load group designation is also identified.

Electrical component identification is discussed in Subsection 1.8.6.

8.3.1.11.4 Independence of Redundant Systems Separation Criteria

This subsection establishes the criteria and the bases for preserving the independence of redundant Class 1E power systems. (For PGCC see Section 3.12.)

Raceway and Cable Routing

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

a) 480V AC, 120V AC, 125V DC and 250V DC power.

b) 120V AC, 125V DC, and 250V DC control and digital signal.

c) Low level signal.

The 480V AC power, 120V AC control, and digital alarm signal cables originated from the same 480V AC motor control center (MCC) are routed through a common shuttle tray and riser above the MCC. The shuttle tray covers the length of the MCC, and it is used to connect the MCC to the main raceway system via vertical tray risers. The cables are routed in accordance with the above raceway categories once they leave the shuttle tray and vertical tray risers.

The 480V AC power, control and digital alarm signal cables originated from the same motor operated valve (MOV) are routed in a common, unscheduled conduit to an adjacent unscheduled junction box when physical restraints prevent separate conduit entry to the MOV. The cables are routed in accordance with the above raceway categories once they leave the junction box.

Analysis:

When digital alarm signal (annunciator) circuits originate at Motor Control Centers (MCC) or Motor Operated Valves (MOV) where they may be in the proximity of high energy circuits, the annunciator circuits are routed only in non-Class 1E raceway. An impressed voltage or high energy on the annunciator circuit due to a failure of a high energy circuit at the MCC or MOV cannot propagate to redundant Class 1E circuits/systems.

Where the annunciator circuit originates at a Class 1E MCC or MOV, a failure of Class 1E circuits due to an impressed voltage or high energy on the annunciator circuit can only be caused by an initial failure of a Class 1E high energy circuit at the MCC or MOV. This failure is confined to a single channel/division and, therefore, satisfies the single failure criteria.

Where the annunciator circuits originate at a non-Class 1E MCC or MOV, a failure of Class 1E circuits can only be caused by annunciator circuits routed in common raceway. The initial failure of a non-Class 1E high energy circuit at the MCC or MOV must cause multiple failures of annunciator circuits at the point of common routing. The analysis for this type of failure mode is shown in Section 8.1.6.1 (Regulatory Guide 1.75 (1/75), Part 7).

These conditions do not invalidate the separation exemption of Section 8.1.6.1 (Regulatory Guide 1.75 (1/75), Part 7) because of the extremely remote possibility of resulting in a common mode failure.

15 kV and 5 kV class cables are normally routed in conduits only; however, solid bottom tray with solid top covers or wireway may be utilized.

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

Refer to Subsection 3.12.3.4.2 for description of physical separation of raceway and cable routing.

8.3.1.11.5 Administrative Responsibilities and Controls for Ensuring Separation Criteria

The separation group identification described in Subsection 8.3.1.11.3 facilitates and ensures the maintenance of separation in the routing of cables and the connections. At the time of the cable routing assignment during design, those persons responsible for cable and raceway scheduling ensure that the separation group designation on the scheme to be routed is compatible with a single-line-diagram load group designation and other schemes previously routed. Extensive use of computer facilities assists in ensuring separation correctness. Each cable and raceway is identified in the computer program, and the identification includes the applicable separation group designation. Auxiliary programs are made available specifically 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 (discussed in Subsection 8.3.1.11.3 and Section 3.12) assists field personnel in this effort.

8.3.2 DC POWER SYSTEMS

8.3.2.1 Description

The DC power systems are divided into Class 1E and non-Class 1E systems.

8.3.2.1.1 Class 1E DC Power System

The Class 1E DC system is shown on Dwgs. E-11, Sh. 1, E-11, Sh. 11, and E-13, Sh. 1. The DC system for each generating unit consists of four 125V DC subsystems, two 250V DC subsystems, and two ±24V DC subsystems. The Diesel Generator E building has a 125V DC subsystem.

8.3.2.1.1.1 125V DC Subsystems

Four Class 1E 125V DC power subsystems provided for each unit are located in separate rooms in the control structure. These four subsystems are identified as channels A, B, C, and D. Each subsystem provides the control power for its associated Class 1E AC power load group channel: 4.16 kV switchgear, 480V load centers, and standby diesel generator as discussed in Subsection 8.3.1. Also these DC subsystems provide DC power to the engineered safety feature valve actuation, diesel generator auxiliaries, and plant alarm and indication circuits.

The Diesel Generator E 125V DC power subsystem is located in the basement of the Diesel Generator E building. The subsystem is identified as Channel H and provides DC power to ESW valves and control power to Class 1E 4.16 kV switchgear and the standby diesel generator in the Diesel Generator E building.

Each 125V DC subsystem consists of one load center, one Class 1E and one non-Class 1E distribution panel, one 125V battery bank, and one battery charger. The non-Class 1E distribution panel is connected to the Class 1E DC power supply through an isolation system. The isolation system is defined in Section 8.1.6.1 (Regulatory Guide 1.75) The battery charger of each system is supplied with 480V Class 1E AC power from the motor control center associated with the same load group channel. One spare 125V battery charger is provided for both generating units.

The Diesel Generator E 125V DC subsystem consists of one switchboard, one motor control center, one non-Class 1E distribution panel, one 125V battery bank and one battery charger. The non-Class 1E distribution panel is isolated from the Class 1E DC power supply by an isolation system described in Section 8.1.6.1 (Regulatory Guide 1.75). The battery charger is supplied from a 480V Class 1E motor control center in the Diesel Generator E building.
Each 125V DC subsystem and the Diesel Generator E 125V DC subsystem includes a shunt fox for measuring battery float current.

The 125V dc subsystem charger output voltage can be regulated at two different control points. One is a variable resistor located inside the cabinet and is used for rough voltage settings. The other is a screwdriver adjusted potentiometer located on the front of the cabinet, and is used for fine adjustments. By setting both controls at their maximum positions, the charger output voltage would be 145.2 volts. The diesel generator E 125V dc subsystem battery charger has one control point and the charger output voltage can be adjusted to 145 volts. All equipment or devices connected to the 125V DC supply are rated 105V to 144V DC, unless plant specific analyses have been performed to justify other voltage levels.

There are no overvoltage protection devices provided for the 125V DC subsystem. There is an overvoltage alarm in the control room for the 125V dc subsystem. "The 125V DC power is distributed through circuit breaker type distribution panels. The 125V DC loads are shown in Table 8.3-6A, 8.3-6B, 8.3-6C, 8.3-6D, 8.3-6E, 8.3-6F, 8.3-6G, 8.3-6H, and 8.3-6I."

Common System are required for both Unit 1 and Unit 2 operation. Those common loads which require 125V DC are provided with two sources of control power, through a manual transfer switch. The Class 1E loads are capable of being transferred between the Unit 1 and corresponding Unit 2 source.

The failure mode and effect analysis for the 125V DC subsystem is shown in Table 8.3-21.

8.3.2.1.1.2 250V DC Subsystems

Two Class 1E 250V DC subsystems are provided for each unit and identified as Divisions I and II as shown on Dwg. E-11, Sh. 1. The 250V DC subsystems are located in separate rooms in the control structure. The two subsystems supply the DC power required for larger loads such as DC motor driven pumps and valves, inverters for plant computer and vital 120V AC power supplies. Table 8.3-7A, 8.3-7B, 8.3-7C, and 8.3-7D show the worst case LOCA loading profile on Class 1E 250V DC batteries 1D650, 1D660, 2D650, and 2D660 respectively for four hours after loss of AC power. Table 8.3-7F, 8.3-7G, 8.3-7H and 8.3-7I show the Station Blackout (SBO) loading profile on Class 1E 250V DC batteries 1D650, 1D660, 2D650 and 2D660 respectively for four hours after beginning of SBO. The operating time detailed in the tables represents the time span of operation, to the nearest minute, as established within the battery loading calculations.

A 2,000 amp fuse is provided at each pole of the 250V DC battery output for short circuit protection.

The Division I 250V DC subsystem is provided with one 250V battery bank, one load center, two equal capacity chargers, either of which can meet the requirements for recharging the battery and motor control centers. The Division II 250V DC subsystem is provided with one 250V battery bank, one distribution load center, one battery charger, and motor control centers.

Each 250V DC subsystem includes a shunt box for measuring battery float current.

The 250V DC battery chargers are supplied by 480V Class 1E AC motor control centers.

One spare 250V battery charger is provided for both generating units.

There is no load shedding provided for any of these non-Class 1E loads.

All 250V DC motor control centers (MCC), including non-Class 1E, are seismically qualified. However, the Class 1E MCC's are located in a seismic Category I structure while the non-Class 1E MCC's are located in a non-seismic Category I structure (Turbine Building).

The charger output voltage can be regulated at two different control points. One is a variable resistor located inside the cabinet and is used for rough voltage settings. The other is a screwdriver adjusted potentiometer located on the front of the cabinet, and is used for fine adjustments. By setting both controls at their maximum positions, the charger output voltage would be 290.4 volts. All equipment or devices connected to the 250V DC supply are rated 210V to 288V DC, unless plant specific analyses have been performed to justify other voltage levels. There are no overvoltage protective devices provided for the 250V DC subsystem. There is an overvoltage alarm in the control room for the 250V DC subsystem.

The 250V DC power is distributed through DC motor control centers except for the inverters, which are fed directly from the distribution load centers.

The non-Class 1E 250V DC loads are supplied by a non-Class 1E DC motor control center. Unit 1 non-Class 1E DC motor control centers are connected to the Class 1E DC distribution load center through an isolation system as defined in Section 8.1.6.1 (Regulatory Guide 1.75). Unit 2 non-Class 1E 250V dc motor control centers are connected to non-Class 1E distribution load centers. The non-Class 1E 250V DC loads consist mainly of emergency turbine generator auxiliaries.

The failure mode and effect analysis for the 250V DC subsystem is shown in Table 8.3-22.

8.3.2.1.1.3 ±24V DC Subsystems

Two ±24V DC subsystems are provided for each unit for radiation monitoring circuits. These two subsystems are located in separate rooms in the control structure and are identified as Divisions I and II. Each ±24V DC subsystem consists of two 24V battery banks, two chargers, and a circuit breaker type distribution panel.

For Unit 2 a transfer switch provides a means of 'Alternate' power (Class 1E) to either charger during regularly scheduled bus outages.
The 24V DC chargers are supplied by 120V Class 1E instrument AC power panels. The ±24V DC loads are shown in Table 8.3-8. One spare 24V DC battery charger is provided for both generating units.

Transfer switches are provided on both units as a means of supplying alternate Class 1E power to either 24V DC battery charger during regularly scheduled bus outages.

The 24V DC subsystem is equipped with overvoltage relays for tripping of the chargers and annunciation. Additional undervoltage relays provide annunciation. All 24V DC equipment and devices in Susquehanna SES are rated for 19 to 29.5V DC.

8.3.2.1.1.4 Class 1E Station Batteries and Battery Chargers

Refer to Subsection 8.3.2.1.1.5 for all Class 1E DC system equipment ratings. The battery chargers are full wave, silicon controlled rectifiers. The housings are freestanding, NEMA Type I, and are ventilated. The chargers are suitable for equalizing the batteries. The chargers are in compliance with all applicable NEMA, and ANSI standards.

The capacity of each battery charger, is based on the largest combined demand of all the steady-state loads and the charger current required to restore the battery from the design minimum charged state to the fully charged state after a design basis event discharge to the fully charged state within 24 hours for Division I and II 250 VDC subsystems and class 1E 125 VDC subsystems; within 12 hours for class 1E 24 VDC subsystems, and within 8 hours for class 1E Diesel Generator E 125 VDC subsystem.

The battery chargers are constant voltage type with capability of operating as battery eliminators, and would function properly with battery disconnection being a normal condition. The battery

eliminator feature is incorporated as a precautional measure to protect against inadvertent disconnection of the battery. There are no planned modes of operation which would require battery disconnection. Variation of the charger output voltage has been determined by testing to be less than 1% with or without the battery connected. Maximum output ripple for the 24V and 125V DC chargers is 30 millivolts RMS with or without the battery, and 200 millivolts for the 250V chargers. For the Diesel Generator E the maximum output ripple for the 125V DC charger is 100 millivolts with the battery connected and 300 millivolts with the battery disconnected.

The failure mode and effect analysis for the ±24V DC subsystem is shown in Table 8.3-23.

Each 125V, 250V, and ±24V battery bank has sufficient capacity without its charger to independently supply the required loads for 4 hr as shown in Tables 8.3-6A, 8.3-6B, 8.3-6C, 8.3-6D, 8.3-6E, 8.3-6F, 8.3-6G, 8.3-6H, 8.3-6I, 8.3-7A, 8.3-7B, 8.3-7C, 8.3-7D, 8.3-7F, 8.3-7G, 8.3-7H, 8.3-7I, and 8.3-8 respectively.

In accordance with IEEE 485-1978 initial rated battery capacity for Class 1E batteries is 25 percent greater than required. This margin allows replacement of the battery to be made when its capacity has decreased to 80 percent of its rated capacity (100 percent of design load).

8.3.2.1.1.5 Class 1E DC System Equipment Ratings

a) 125V DC Subsystems:

Battery (Channels A, B, C, D)	60 lead-calcium cells 825 amp-hr (8 hrs to 1.75V per cell @ 77°F)
Battery (DG 'E' 125V dc)	60 lead-calcium cells 825 amp-hr (8 hrs to 1.75 V per cell @ 77°F)
Charger	AC input - 480V, 3ø DC output - 100 A continuous rating - 200A continuous rating for Diesel Generator E charger Load Center:
Main bus (horizontal)	1600 A continuous rating, 25,000 A short circuit bracing
Vertical bus	1200 A continuous rating, 25,000 A short circuit bracing
Breakers	600 A frame size, 2 poles 25,000 A interrupting rating
Distribution Panel:	
Main bus	225 A continuous rating, 50,000 A short circuit bracing
Breakers	100 A frame size, 2 poles (molded case) 10,000 A interrupting rating

Switchboard (Diesel Generator E):

Main Bus	600 A continuous rating, 25,000 A circuit rating
Breakers	20,000 A interrupting rating
Fuse	200,000 A interrupting rating Motor Control Center (Diesel Generator E):
Main Bus (Horizontal)	600 A continuous rating 42,000 A short circuit rating
Vertical Bus	600 A continuous rating 42,000 A short circuit rating
Breakers	10,000 A interrupting rating

b) 250V DC Subsystems

Battery 120 lead - calcium cells	1800 amp-hr (8 hrs to 1.75V per cell @ 77°F)
Chargers	AC input - 480 V, 3ø DC output - 300 A continuous
Load Center	
Main bus (horizontal)	1600 A continuous rating 25,000 A short circuit bracing
Vertical bus	1,200 A continuous rating 25,000 A short circuit bracing
Control Center	
Breakers	600 A continuous rating 25,000 A interrupting rating Control Center
Main bus (horizontal)	600 A continuous rating 10,000 A short circuit bracing
Vertical bus	600 A continuous rating 10,000 A short circuit bracing
Breakers (molded case)	100 A, 225 A and 600 A frame rating sizes, 2 poles, 10,000 A interrupting

c) ±24 Volt Subsystems

Battery 2 groups of 12 lead-calcium cells. 75 amp-hr (8 hrs to 1.75V per cell @ 77°F)

Chargers	AC input - 120 V, 1ø DC output - 25 amp continuous
Distribution Panels	
Main bus	100 A continuous 50,000 A short circuit bracing
Breakers (molded case)	100 A frame size, 2 poles, 50,000 A interrupting rating

8.3.2.1.1.6 Inspection, Maintenance, and Testing

Testing of the DC power systems is performed prior to plant operation in accordance with the requirements of Chapter 14. In-service tests and inspections of the DC power systems including batteries, chargers, and auxiliaries are specified in the Technical Specifications and Technical Requirements Manual.

The Battery Duty load profiles of 125 and 250V DC station batteries are specified in tables 8.3-6J and 8.3-7E respectively. These Battery Duty load profiles are used for in-service test; and envelope their respective LOCA/LOOP load profiles while maintaining battery terminal voltage greater than 105 or 210 volts as applicable.

8.3.2.1.1.7 Separation and Ventilation

For each Class 1E DC subsystem, the battery bank, chargers, and DC switchgear are located in separate rooms of the Seismic Category I control structure. In the Diesel Generator E building the battery bank is located in a separate battery room. The batteries are ventilated by a system that is designed to preclude the possibility of hydrogen accumulation. Section 9.4 contains a description of the battery room ventilation system.

8.3.2.1.1.8 Non-Class 1E DC System

Generally, non-Class 1E DC loads are connected to a Class 1E DC system through a non-Class 1E DC distribution panel. These cases are discussed in Subsections 8.3.2.1.1.1 and 8.3.2.1.1.2.

The Non-Class 1E common loads are provided with two sources of 125V DC control power through a manual transfer switch. These loads are primarily fed from two different Unit 1 sources. Some Non-Class 1E loads are fed from a Unit 1 or Unit 2 source.

A non-Class 1E 125V DC system is provided for the remote river water intake pump house 4.16 kV switchgear control. This 125V DC system consists of a distribution panel, two 25A chargers, 60 lead-calcium cells and is rated 50 Ah at 8 hr discharge rate based on a terminal voltage of 1.75V per cell when discharged.

A central non-Class 1E 125V DC power system is located in the Unit 1 and Unit 2 turbine buildings and provides the 125V DC alternate power source to their respective 120V AC/125V DC emergency lighting systems. Each 125V DC emergency lighting power system consists of a

distribution-monitoring panel, 250AMP battery charger, a 60 cell lead acid battery, battery monitor and local annunciator panel. The Unit 1 and Unit 2 batteries meet the requirements of the "Building Regulations for Protection from Fire1 and Panic", Commonwealth of Pennsylvania, Department of Labor and Industry when discharged to a terminal voltage of 1.75 volts per cell. The Emergency Lighting System is required to maintain illumination for 1 hour per state regulation.

A Non -Class 1E 125V DC power system is located in the control structure and provides DC power to Hardened Containment Vent equipment for beyond design basis external events. This DC system consists of a 2 kW battery charger, 20 multi cell battery units and provides 24 hour operational capacity when discharged to a terminal voltage of 1.85 volts per cell.

8.3.2.2 Analysis

8.3.2.2.1 Compliance with General Design Criteria, Regulatory Guides, and IEEE Standards

The following paragraphs analyze compliance of the Class 1E DC power systems with General Design Criteria 17 and 18, Regulatory Guides 1.6, 1.32, 1.41, 1.81, and 1.93, and IEEE 308, 450, 484 and 485. An * beside the effective date of the Regulatory Guide or IEEE standard listed indicates the guide or standard applicable to the plant is applicable to Diesel Generator E.

a) General Design Criterion 17, Electric Power Systems

Consideration of Criterion 17 leads to the inclusion of the following factors in the design of the DC power systems:

1) Separate Class 1E 125V DC subsystems (A through D) supply control power to their respective Class 1E AC load groups. The four load groups are subgrouped to form two divisionalized load groups (Division I and II) for those ESF loads requiring one-out-of-two load groups to meet the design basis requirements. Some divisionalized loads powered from the Class 1E 4 kV Buses C and D are supplied DC control power from the Class 1E 125V DC Channels A and B, respectively (i.e., RHRSW, ESW, CRD, CS Chiller).

2) The AC power for the battery chargers in each of these DC subsystems is supplied from the same AC load group for which the DC subsystem supplies the control power.

3) Two independent 250V DC subsystems are provided to ensure the availability of the DC power system for maintaining the reactor integrity during postulated accidents.

4) The Class 1E DC subsystems including batteries, chargers, DC switchgear, and distribution equipment are physically separate and independent.

5) Sufficient capacity, capability, independence, redundancy, and testability are provided in the Class 1E DC subsystems, ensuring the performance of safety functions assuming a single failure.

b) General Design Criterion 18, Inspection and Testing of Electric Power Systems

Each of the Class 1E subsystem is designed to permit:

1) Inspection and testing of wiring, insulation, and connections during equipment shutdown to assess the continuity of the subsystem and the condition of its components.

2) Periodic testing of the operability and functional performance of the components of the subsystems during normal plant operation.

The Class 1E DC subsystems are periodically inspected and tested to assess the condition of the battery cells, charger, and other components in accordance with Chapter 16. Preoperational testing is discussed below in assessment of compliance with Regulatory Guide 1.41.

c) Regulatory Guide 1.6 (1/71)*

The design of the DC system complies with Regulatory Guide 1.6. Separate Class 1E 125V DC subsystems (A through D) supply control power to their respective Class 1E AC load groups. The four load groups are subgrouped to form two divisionalized load groups (Division I and II) for those ESF loads requiring one-out-of-two load groups to meet the design basis requirements. Some divisionalized loads powered from the Class 1E 4 kV Buses C and D are supplied DC control power from the Class 1E 125V DC Channels A and B, respectively (i.e., RHRSW, ESW, CRDC, CS Chiller). Loss of any one of the subsystems does not prevent the minimum safety function from being performed. The 125V DC subsystem chargers are supplied from the same AC load group for which the DC subsystem supplies the control power. Each of the four 125V DC subsystems, including battery bank, charger, and distribution system, is independent of other 125V DC subsystems. In addition to the four DC subsystems, the Diesel Generator E building 125V DC subsystem includes a battery bank, charger and distribution system for operation of Diesel Generator E. The DC subsystem is independent of the other four DC subsystems. Thus, sufficient independence and redundancy exist between the 125V DC subsystems to ensure performance of minimum safety functions, assuming a single failure.

Two independent Class 1E 250V DC subsystems are provided. Each subsystem is independent of the other. Sufficient independence and redundancy exist in these subsystems so that a single failure in the 250V DC subsystems does not prevent the performance of minimum safety functions.

Two independent Class 1E ±24V DC subsystems are provided. Each subsystem is independent of the other. Sufficient independence and redundancy exist in these subsystems so that a single failure in the ±24V DC subsystems does not prevent the performance of minimum safety functions.

d) Regulatory Guide 1.32 (3/76) (Diesel Generators A-D)

The battery charger capacity for each of the Class 1E DC subsystem complies with this Regulatory Guide.

Each Class 1E battery charger has sufficient capacity to supply the largest combined demand of the various steady-state loads and the charging current required to restore the battery from the design minimum charge state to the fully charged state irrespective of the status of the plant during which these demands occur.

e) Regulatory Guide 1.32 (2/77) (Diesel Generator E)

The battery charger capacity for each of the Class 1E DC subsystem complies with this Regulatory Guide.

The Class 1E battery charger has sufficient capacity to supply the largest combined demand of the various steady-state loads and the charging current required to restore the battery from the design minimum charge state to the fully charged state irrespective of the status of the plant during which these demands occur.

The test interval for the battery modified performance discharge test and the service test is in accordance with the Technical Specifications.

f) Regulatory Guide 1.41(3/73)*

The Class 1E DC subsystems have been designed in accordance with Regulatory Guides 1.6 and 1.32 and testing capabilities are provided in accordance with the guidance of Regulatory Guide 1.41 and will be preoperationally tested as described in Chapter 14.

g) Regulatory Guide 1.81 (1/75)*

The requirements of the Regulatory Guide are met. Each generating unit is provided with separate and independent on-site DC electric power systems capable of supplying power to the control systems of engineered safety features loads and loads such as valves, and actuators, required for attaining a safe and orderly cold shutdown of the unit, assuming a single failure.

The common systems which are required for both Unit 1 and 2 operation, are provided with two sources of 125V DC control power, through a manual transfer switch. The Class 1E loads will be capable of being transferred between the Unit 1 and corresponding Unit 2 source. The non-Class 1E loads are primarily fed from two different Unit 1 sources. Some non-1E loads are fed from a Unit 1 or Unit 2 source.

h) Regulatory Guide 1.93 (12/74)*

Compliance is discussed in Subsection 8.1.6.1.

i) IEEE Standard 308-1974

The Class 1E DC systems provide power to Class 1E loads and for control and switching of Class 1E systems. Physical separation and electrical isolation are provided to prevent the occurrence of common mode failures. The design of the Class 1E DC systems includes the following:

1) The plant's 125V DC system is separated into four subsystems. The Diesel Generator E 125V DC system is a separate subsystem.

2) The 250V DC and ±24V DC systems are each separated into two subsystems.

3) The safety action by each group of loads are independent of the safety actions provided by their redundant counterparts

4) Each DC subsystem includes power supplies that consist of one battery bank and one or two chargers as required for capacity as shown on Dwgs. E-11, Sh. 1, E-11, Sh. 11, and E-13, Sh. 1. .

5) The batteries are not interconnected.

Each Class 1E distribution circuit is capable of transmitting sufficient energy to start and operate all required loads in that circuit. Distribution circuits to redundant equipment are independent of each other. The distribution system is monitored to the extent that it is shown to be ready to perform its intended function. The DC auxiliary devices required to operate equipment of a specific AC load group are supplied from the same load group.

Each battery supply is continuously available during normal operations and following the loss of power from the AC system to start and operate all required loads.

The 125V DC and 250V DC subsystems are ungrounded; thus, a single ground fault does not cause immediate loss of the faulted system. Ground detection and alarm is provided for each DC subsystem so that ground faults can be located and removed. The ±24V DC subsystem is grounded.

Equipment of the Class 1E DC system is protected and isolated by fuses or circuit breakers for short circuit or overload protection. The following instrumentation is provided to monitor the status of each of the DC subsystems:

1) 125V DC and 250V DC subsystems:

System undervoltage

System overvoltage

System ground

Battery availability

Battery charger trouble - AC undervoltage; DC overvoltage charger failure; charger output breaker trip

Load center breaker trip (250V DC subsystem only)

All above alarms are annunciated as a group alarm in the main control room.

2) ±24V DC subsystems:

Positive bus low voltage

Negative bus low voltage

Positive bus high voltage

Negative bus high voltage

Battery availability

Battery charger trouble - AC failure; charger failure; charger output breaker trip

All above alarms are annunciated in the main control room as ±24V DC system trouble, a group alarm for each battery bank and its associated system.

The batteries are maintained in a fully charged condition and have sufficient stored energy to operate all necessary circuit breakers and to provide an adequate amount of energy for all required emergency loads for four hours after loss of AC power.

Each battery charger has an input AC and output DC circuit breaker for isolation of the charger. Each battery charger power supply is designed to prevent the AC supply from becoming a load on the battery due to a power feedback as the result of the loss of AC power to the chargers.

The battery charger AC supply breaker can be periodically opened to verify the load carrying ability of the battery.

The batteries, battery chargers, and other components of the DC subsystems are housed in the control structure, which is a Seismic Category I structure. The Diesel Generator E 125V DC subsystem is housed in the Diesel Generator E building which is a seismic Category I structure.

The periodic testing and surveillance requirements for the Class 1E batteries are detailed in Chapter 16.

j) IEEE Standard 308-1980 (Diesel Generator E)

The Diesel Generator E Class 1E DC power system provides power to the Class 1E loads and control and switching of Class 1E systems in the Diesel Generator E building. The Diesel Generator E Class 1E DC power system has the same capabilities, availability and instrumentation as the plant's Class 1E DC power system described in Section 8.3.2.2.1.i.

k) IEEE Standard 450-1995

The recommended practices of IEEE 450 for maintenance, testing, and replacement of batteries are followed with the following exceptions: The Technical Requirements Manual

provides the acceptance criteria and the surveillance period of the battery visual inspection, specific gravity, electrolyte temperature, and connection resistance; and the acceptance criteria for cell voltage. The acceptance criteria and surveillance period for electrolyte level, voltage, pilot cell temperature, service test, and performance discharge test are per the Technical Specifications. In addition, the acceptance criteria and surveillance period of the battery float current are per the Technical Specifications. Battery float current is representative of the batter state of charge.

l) IEEE Standard 450-1995 (Diesel Generator E)

The recommended practices of IEEE 450 for maintenance, testing, and replacement of the Diesel Generator E Class 1E batteries are followed, with the following exceptions: The Technical Requirements Manual provides the acceptance criteria and the surveillance period of the battery visual inspection, specific gravity, electrolyte temperature, and connection resistance; and the acceptance criteria for cell voltage. The acceptance criteria and surveillance period for electrolyte level, voltage, pilot cell temperature, service test, and performance discharge test are per the Technical Specifications. In addition, the acceptance criteria and surveillance period of the battery float current are per the Technical Specifications. Battery float current is representative of the batter state of charge.

m) IEEE Standard 484 (1975 version for the plant Class 1E batteries, 1981 version for Diesel Generator E)

The recommended practices for installation design and installation of the plant Class 1E batteries are in accordance with IEEE 484-1975. The recommended practices for installation design and installation of the Diesel Generator E Class 1E batteries are in accordance with IEEE 484-1981.

n) IEEE Standard 485-1978

The recommended practices of IEEE 485 for sizing the Class 1E batteries were followed.

8.3.2.2.2 Physical Identification of Safety Related Equipment

Physical identification of Class 1E equipment is discussed in Subsection 8.3.1.11.3.

8.3.2.2.3 Independence of Redundant Systems

The general considerations for the independence of Class 1E DC power subsystems are described in Section 8.1.6.1 (Regulatory Guide 1.75). The physical separation criterion is discussed in Section 3.12.

8.3.3 FIRE PROTECTION FOR CABLE SYSTEMS

8.3.3.1 Cable Derating and Cable Tray Fill

The power and control cable insulation is designed for a conductor temperature of 90°C. Allowable current carrying capacity of the cable is based on not exceeding the insulation design temperature

while the surrounding air is at an ambient temperature of 65.5°C for the primary containment and 50°C or 40°C for all other areas depending on location. The design operating conditions of all Class 1E cables are discussed in Section 3.11.

The power cable ampacities are established in accordance with IPCEA Publications P-54-440 and P-46-426, and the NEC, as described below:

Duct and Embedded Conduit

In selecting IPCEA ampacity tables, a load factor of 100 percent and an earth thermal resistivity (RHO) of 90 are assumed.

In general, ampacities of 15kV power cables in duct are in accordance with IPCEA P-46-426 ratings for triplexed concentric stranded rubber insulated cable in duct in 20°C ambient earth. For those cable sizes not included in IPCEA P-46-426 ampacity tables, ampacity values are calculated for each application based on the actual installation configuration.

Ampacities of 5kV power cables in duct are in accordance with IPCEA P-46-426 ratings for 8kV triplexed concentric stranded rubber insulated cable in duct 20°C ambient earth.

In general, ampacities of 600V single-conductor and multi-conductor power cables in duct are in accordance with IPCEA P-46-426 ratings for 1kV triplexed and three-conductor concentric stranded rubber insulated cables, respectively, in duct in 20°C ambient earth. For those cables not included in IPCEA P-46-426 ampacity tables, ampacities are based on the National Electrical Code (NEC) Allowable Ampacities of Insulated Conductors Rated 0-2000V, 60°C to 90°C (140°F to 194°F), Not More Than Three Conductors in Raceway or Cable or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F). These NEC ampacity values are then adjusted for duct in 20°C ambient earth, in accordance with IPCEA P-46-426.

Ampacities of 15kV, 5kV, and 600V power cables in embedded conduit are based on the ampacities in duct 20°C ambient earth, derated in accordance with IPCEA P-46-426 for 40°C, 50°C, and 65.5°C ambient temperatures.

Ampacities in duct and embedded conduit are additionally derated for more than three current-carrying conductors in the same conduit in accordance with the adjustment factors of the National Electrical Code.

Exposed Conduit

In general, ampacities of 15kV power cables in exposed conduit are in accordance with IPCEA P-46-426 ratings for triplexed concentric stranded rubber insulated cable in conduit in 40°C air. For those cable sizes not included in IPCEA P-46-426 ampacity tables, ampacity values will be calculated for each application based on the actual installation configuration.

Ampacities of 5kV power cables in exposed conduit are in accordance with IPCEA P-46-426 ratings for 8kV triplexed concentric stranded rubber insulated cable in conduit in 40°C air.

In general, ampacities of 600V single-conductor and multi-conductor power cables in exposed conduit are in accordance with IPCEA P-46-426 ratings for 1kV triplexed and three-conductor

concentric stranded rubber insulated cables, respectively, in conduit in 40°C air. For those cables not included in IPCEA P-46-426 ampacity tables, ampacities are based on the National Electrical Code (NEC) Allowable Ampacities of Insulated Conductors Rated 0 - 2000V, 60°C to 90°C (140°F to 194°F), Not More Than Three Conductors in Raceway or Cable or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F). These NEC ampacity values are then adjusted for conduit in 40°C ambient air, in accordance with IPCEA P-46-426.

Ampacities of 15kV, 5kV, and 600V power cables are derated in accordance with IPCEA P-46-426 for 50°C and 65.5°C ambient temperatures.

Ampacities of 15kV, 5kV, and 600V power cables in exposed or enclosed groups of conduits in air are derated in accordance with the grouping factors of IPCEA P-46-426, when the spacing between the conduit surfaces in not greater than the conduit diameter or less than 1/4 of the conduit diameter.

Ampacities are additionally derated for more than three current-carrying conductors in the same conduit in accordance with the adjustment factors of the National Electrical Code.

Cable Tray

In general, ampacities of 15kV power cables in cable tray are in accordance with IPCEA P-54-440 ratings for single-conductor shielded and jacketed cable in 40°C air. For those cable sizes not included in IPCEA P-54-440 ampacity tables, ampacity values are in accordance with NEC Table 310-69 ratings for Type MV 5001-15000 volt insulated single conductor cable in 40°C air, derated by a factor of 0.75 for uncovered cable tray in accordance with NEC Article 318-13(b)(1).

Ampacities of 5kV power cables in cable tray are in accordance with IPCEA P-54-440 ratings for 2001-5000 volt single-conductor shielded and jacketed cable in 40°C air.

Ampacities of 600V single-conductor and multi-conductor power cables in cable tray are in accordance with the ratings in the applicable Tables in IPCEA P-54-440 for 600V cables, in 40°C air.

Correction factors for the number of conductors in the cable and for the actual cable diameter are applied in accordance with IPCEA P-54-440.

Ampacity values listed in IPCEA P-54-440 are for five discrete values of calculated depth of cables in tray. The ampacity value for any cable depth value other than the values stated in the IPCEA P-54-440 tables are determined by linear interpolation. The linear interpolation is performed for values of cable depth, X, applicable to percent fills greater than or equal to 30% for cable tray with 3" cable loading depth and percent fills greater than or equal to 18% for cable tray with 5" cable loading depth.

The percent fill of the cable tray is converted to an equivalent calculated depth of cable in tray from the formula:

$$\text{Calculated depth (X)} \quad \frac{\%\ \text{Fill}}{100} \times \frac{4}{\Pi} \times d$$

where: d = the useable cable loading depth of the cable tray (inches)

Ampacities of 15kV, 5kV, and 600V power cables in cable tray are derated in accordance with IPCEA P-46-426 for 50°C, and 65.5°C ambient temperatures.

Ampacities for 15kV, 5kV, and 600V cables are additionally derated for the presence of tray covers, in accordance with the National Electrical Code.

Wrapped Raceway

See Fire Protection Review Report (FPRR) Section 4.11, for wrapped raceway derating factors.

For control circuits, minimum #14 AWG conductors are generally used.

Instrumentation cable is also designed for a conductor temperature of 90°C. Operating currents of these cables are low (usually mA or mV) and will not cause the design temperature to be exceeded at maximum design ambient temperature.

In general, cable tray fill is limited to 30 percent fill by cross-sectional area. In cases where the limitation is exceeded, a review will be performed for each case for the adequacy of the design.

In general conduit fill is in compliance with Tables I and II, Chapter 9, National Electrical Code, 1975 (National Electric Code, 1981 for Diesel Generator E). In cases where these values are exceeded, a review is performed for each case to insure the adequacy of the design.

Power cables, control cables, and instrumentation cables are defined as follows:

Power Cables

Power cables are those cables that provide electrical energy for motive power or heating to all 13.8 kV AC, 4.16 kV AC, 480V AC, 120V AC, 250V DC, and 125V DC loads.

Control Cables

Control cables, for the purpose of derating, are generally 120V AC, 250V DC, 125V DC, and 24V DC circuits between components responsible for the automatic or manual initiation of auxiliary electrical functions and the electrical indication of the state of auxiliary components.

Instrumentation Cables

Instrumentation cables are those cables conducting low-level instrumentation and control signals. These signals can be analog or digital. Typically, these cables carry signals from thermocouples, resistance temperature detectors, transducers, neutron monitors, etc.

8.3.3.2 Fire Detection for Cable Systems

Fire detection systems are discussed in Subsection 9.5.1.

8.3.3.3 Fire Barriers and Separation Between Redundant Trays

Electrical equipment and cabling has been arranged to minimize the propagation of fire from one separation group to another. Physical separation of cabling systems is discussed in Subsection 3.12.2.

Where the minimum physical separation cannot be met as specified in Subsection 3.12.2, and a fire barrier is selected as the alternative, a 1/4 in. Haysite ETR-FR-C is installed. The bolts and hardware used to secure the Haysite panel to the tray support are coated after installation with 1/8 in. of fireproofing material Dynatherm's Flamemastic 71A compound.

8.3.3.4 Fire Stops

Fire stops and seals are provided for cable penetrations in the floor for vertical runs of raceways, at each access opening in ceilings and at fire-rated wall penetrations. The fire stops are furnished to provide a method of sealing off air spaces around cable penetrations. The properties of materials and qualification tests are discussed in Subsection 9.5.1.

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

Equipment Number	Description	Rating Each, hp	Operating kW Each	Number Connected								Loading Sequence (Notes 3 and 6)			
				Diesel Gen A		Diesel Gen C		Diesel Gen B		Diesel Gen D		Unit 1 - DBA		Unit 2 - Shutdown	
				Unit 1 1A201 Bus	Unit 2 2A201 Bus	Unit 1 1A203 Bus	Unit 2 2A203 Bus	Unit 1 1A202 Bus	Unit 2 2A202 Bus	Unit 1 1A204 Bus	Unit 2 2A204 Bus	Minimum Required Number (Note 16)	Time From DBA	Minimum Required Number (Note 16)	Time
ESF LOADS															
1P 206 A,B,C,D 2P 206 A,B,C,D	Reactor Core Spray Pumps	700	552	1	1	1	1	1	1	1	1	2**	20.5 sec	--	--
1P 202 A,B,C,D 2P 202 A,B,C,D	RHR Pumps	2000	1429 1415 (2P202B) (ONLY)	1	1	1	1	1	1	1	1	2 for 10 min. 1 beyond 10 min.	13 sec	1	30 min*
1P 506 A,B 2P 506 A,B	RHR Service Water Pumps	600	463	--	1	1	--	--	1	1	--	1	10 min*	1	10 min*
1V 211 A,B,C,D 2V211 A,B,C,D	Core Spray Pump Room Unit Coolers	2	2.0	1	1	1	1	1	1	1	1	2**	20.5 sec	--	--
	Motor Operated Valves (Note 1)	Set										Set	10 sec	Set	10 sec
1V 222 A,B 2V 222 A,B	Engineered Safeguards Switchgear & L.C. Room Unit Coolers	15	13	1	1	--	--	1	1	--	--	1	70 sec (80 sec)	1	130 sec (145 sec)
OV 116 A,B	Control Structure Battery Room Exhaust Fans	5	4.5	--	--	1	--	--	--	1	--	1	70 sec (7 min)	--	--
1V 210 A,B,C,D 2V 210 A,B,C,D	RHR Pump Room Unit Coolers	10	9	1	1	1	1	1	1	1	1	2 for 10 min. 1 beyond 10 min.	13 sec	1	30 min* (Note 15)
1V 208 A,B 2V 208 A,B	RCIC Pump Room Unit Coolers	1.5	1.5	1	1	1	1	--	--	--	--	--	20 sec (10 sec)	1	60 sec (10 sec)
1V 209 A,B 2V 209 A,B	HPCI Pump Room Unit Coolers	1.5	1.5	--	--	--	--	1	1	1	1	1 for 60 min.	20 sec (10 sec)	--	10 sec
1D 613, 1D 623 1D 633, 1D 643 2D 613, 2D 623 2D 633, 2D 643	Battery Chargers, 125V D.C.	--	16,16 16,16 16,16 16,16	2	--	2	--	2	--	2	--	3	10 sec	3	10 sec
OV 512 A,B,C,D	Diesel Generator Room Ventilation Supply Fans	40	33	1	--	1	--	1	--	1	--	3	130 sec	--	--
0P 514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	2.5	2.5	1	--	1	--	1	--	1	--	3	10 sec	--	--
0V 201 A,B	Reactor Building Recirc Fans	75	61	1	--	--	--	1	--	--	--	1	10 sec (20 sec)	--	--
0P 504 A,B,C,D	Emergency Service Water Pumps	450	357 346 (OP504D) (ONLY)	1	--	1	--	1	--	1	--	2	40,40 44,48 sec	--	--
0V 109 A,B	Standby Gas Treatment System Exhaust Fans	50	42	--	--	1	--	--	--	1	--	1	10 sec	--	--

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

Equipment Number	Description	Rating Each, hp	Operating kW Each	Number Connected								Loading Sequence (Notes 3 and 6)			
				Diesel Gen A		Diesel Gen C		Diesel Gen B		Diesel Gen D		Unit 1 - DBA		Unit 2 - Shutdown	
				Unit 1 1A201 Bus	Unit 2 2A201 Bus	Unit 1 1A203 Bus	Unit 2 2A203 Bus	Unit 1 1A202 Bus	Unit 2 2A202 Bus	Unit 1 1A204 Bus	Unit 2 2A204 Bus	Minimum Required Number (Note 16)	Time From DBA	Minimum Required Number (Note 16)	Time
0V 115 A,B & 0V 117 A,B	Control and Computer Rooms Air Cond. Unit Fans	40	33	--	--	2	--	--	--	2	--	2	70 sec (3 min 40 sec)	--	--
0K 507 A1,A2 B1,B2 C1,C2 D1,D2	Diesel Generator Starting Air Compressors	10	9	2	--	2	--	2	--	2	--	6 for 10 min.	10 sec	--	--
1Y 216,226,236,246, 2Y 216,226,236,246	120 V Instrument A.C. Dist. Panels	--	24,24,24, 24,24,24, 24, 24 See Note 10	1	1	1	1	1	1	1	1	2	10 sec	2	10 sec
0V 521 A,B,C,D	Engineered Safeguards Service Water Pump House Supply Fans	5	4.4	2	--	--	--	2	--	--	--	2	40,40 44,48 sec	--	--
0P 162 A,B	Control Structure Chilled Water Circulating Pumps	30	25	--	--	1	--	--	--	1	--	1	3 min 10 sec (3 min 40 sec)	--	--
0V 101 A,B	Control Structure Emergency Outside Air Supply Fans	20	17	--	--	1	--	--	--	1	--	1	70 sec (70 sec)	--	--
0K 112 A,B	Control Structure Water Chiller Compressors	351	279	--	--	1	--	--	--	1	--	1	4 min 1 sec (4 min 31 sec)	--	--
0E 145 A,B	Control Structure Air Cond. Unit Heating Coils	--	130	--	--	1	--	--	--	1	--	1	70 sec (3 min 40 sec)	--	--
0V 118 A,B	Standby Gas Treatment System Equip. Room Exhaust Fans	5	4.5	--	--	1	--	--	--	1	--	1	10 sec	--	--
1E 219/1E 220 2E 219/2E 220	Standby Liquid Cont. Tank Heater	--	10/40	--	--	2	2	--	--	--	--	1	10 sec	1	10 sec
1P 208 A,B 2P 208 A,B	Standby Liquid Cont. Inj. Pumps	40	34	1	1	1	1	--	--	--	--	--	--	--	--
1D 653 A,B 1D 663 2D 653 A, B 2D 663	Battery Chargers - 250V D.C.	--	56,56,44 20,20,40	1	1	1	1	1	1	--	--	1 for 60 min.	10 sec	1	10 sec
0V 144 A,B	Standby Gas Treatment System Equip. Room Heating Unit Fans	5	4.5	--	--	1	--	--	--	1	--	1	10 sec	--	--
0V 103 A,B	Control Structure Air Cond.Unit Fans	50	42	--	--	1	--	--	--	1	--	1	70 sec (3 min 40 sec)	--	--
0P 122 A,B	Control Structure Chiller Comp Oil Pumps	1.5	1.4	--	--	1	--	--	--	1	--	1	10 sec	--	--
0E 101 A,B	Standby Gas Treatment System Heaters	--	90/30	--	--	1	--	--	--	1	--	1	10 sec (40 sec)	--	--

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

Equipment Number	Description	Rating Each, hp	Operating kW Each	Number Connected								Loading Sequence (Notes 3 and 6)			
				Diesel Gen A		Diesel Gen C		Diesel Gen B		Diesel Gen D		Unit 1 - DBA		Unit 2 - Shutdown	
				Unit 1 1A201 Bus	Unit 2 2A201 Bus	Unit 1 1A203 Bus	Unit 2 2A203 Bus	Unit 1 1A202 Bus	Unit 2 2A202 Bus	Unit 1 1A204 Bus	Unit 2 2A204 Bus	Minimum Required Number (Note 16)	Time From DBA	Minimum Required Number (Note 16)	Time
0P 171 A,B	Control Structure Chiller Emergency Condenser Water Circ Pumps	20	17	--	--	1	--	--	--	1	--	1	3 min 10 sec (3 min 40 sec)	--	--
1E 440 A,B,C,D 2E 440 A,B,C,D	Containment Hydrogen Recombiners	--	75	1	1	1	1	1	1	1	1	2	1.2 days*	--	--
0E 143 A,B	Control Structure Emergency Outside Air Supply Unit Heating Coils	--	30	--	--	1	--	--	--	1	--	1	70 sec	--	--
1V 506 A,B 2V 506 A,B	RHR Service Water Pump House Supply Fans	5	4.6	2	--	--	--	2	--	--	--	1	10 min * (Note 15)	1	10 min* (Note 15)
0P 531 A,B,C,D	Diesel Generator Standby Jacket Water Pumps	30	25	1	--	1	--	1	--	1	--	--	--	--	--
0P 533 A,B,C,D	Diesel Generator Standby Lube Oil Pumps	50	42	1	--	1	--	1	--	1	--	--	--	--	--
1V 411-417 A&B 2V 411-417 A&B	Drywell Unit Area Coolers	5/10	4.7/8.6	--	--	7	7	--	--	7	7	2	3hr*	--	--
1V 418 A&B 2V 418 A&B	Recirc Fan	2.5/5	2.6/4.4	--	--	1	1	--	--	1	1	1	3hr*	--	--
0E 144 A,B	Standby Gas Treatment Equipment Room Heater	--	30	--	--	1	--	--	--	1	--	1	10 sec	--	--
0C 577 A,B,C,D	Diesel Generator HVAC Panels	--	4	1	--	1	--	1	--	1	--	3	10 sec	--	--
0C 578,579	ESSW Pump House HVAC Control Panels	--	3.8	1	--	--	--	1	--	--	--	1	10 sec	--	--
0E 508 A,B,C,D	Diesel Generator Jacket Water Heaters	--	15	1	--	1	--	1	--	1	--	--	--	--	--
0E 525 A,B,C,D	Diesel Generator Lube Oil Heaters	--	9	1	--	1	--	1	--	1	--	--	10 sec (Note 7)	--	--
0E 570 A,B,C,D	Diesel Generator Space Heaters	--	4.5	1	--	1	--	1	--	1	--	--	--	--	--
0P 112 A,B	Control Structure Chiller Refrigerant Transfer Pumps	2	2.2	--	--	1	--	--	--	1	--	--	--	--	--
0P 530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	5	4.5	1	--	1	--	1	--	1	--	--	--	--	--
0P 532 A,B,C,D	Diesel Generator Pre-Lube Pumps	10	9	1	--	1	--	1	--	1	--	--	--	--	--
1C 226 A,B 2C 226 A,B	Hydrogen and Oxygen Analyzer Panels	--	1	1	1	--	--	1	1	--	--	1	10 min* (Note 14)	--	--
1C 291 A,B 2C 291 A,B	Containment Particle Radiation Analyzer Panels	--	1.2	1	1	--	--	1	1	--	--	--	--	--	--

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

Equipment Number	Description	Rating Each, hp	Operating kW Each	Number Connected								Loading Sequence (Notes 3 and 6)			
				Diesel Gen A		Diesel Gen C		Diesel Gen B		Diesel Gen D		Unit 1 - DBA		Unit 2 - Shutdown	
				Unit 1 1A201 Bus	Unit 2 2A201 Bus	Unit 1 1A203 Bus	Unit 2 2A203 Bus	Unit 1 1A202 Bus	Unit 2 2A202 Bus	Unit 1 1A204 Bus	Unit 2 2A204 Bus	Minimum Required Number (Note 16)	Time From DBA	Minimum Required Number (Note 16)	Time
2D 288, 289	SPDS - UPS (Alternate Power Supply)	--	11/7	--	1	--	--	--	1	--	--	--	--	--	--
2K 210 A,B	Compressor Motor For Emergency Switchgear and L.C. Room Cooling	60	48	--	1	--	--	--	1	--	--	--	--	1	4 min 20 sec
1S 246, 247 2S 246, 247	LPCI Swing Bus Isolation System M-G Sets	150	13	1	1	--	--	1	1	--	--	1	10 sec	1	10 sec
1X 210,220,230,240 2X 210,220,230,240	Engineered Safeguards Load Center Transformer Losses	--	15	1	1	1	1	1	1	1	1	3	10 sec	3	10 sec
0V512E1, E2	Diesel Generator E Room Ventilation Supply Fans	40	30	See Note 9								2	130 sec	--	--
0V512E3.E4	Diesel Generator E Room Ventilation Exhaust Fans	40	30	See Note 9								2	190 sec	--	--
0P530E	Diesel Generator E Jacket Water Circulating Pump	7.5	6	See Note 9								--	--	--	--
0P514E	Diesel Generator E Diesel Oil Transfer Pump	3	2	See Note 9								1	10 sec	--	--
0E508E	Diesel Generator E Jacket Water Heater	--	25	See Note 9								--	--	--	--
0E525E	Diesel Generator E Lube Oil Heater	--	15	See Note 9								--	--	--	--
0E570E	Diesel Generator E Space Heater	--	6	See Note 9								--	--	--	--
0P532E	Diesel Generator E Pre-Lube Pump	15	11	See Note 9								--	--	--	--
0P531E	Diesel Generator E Standby Jacket Water Pump	40	30	See Note 9								--	--	--	--
0P533E	Diesel Generator E Standby Lube Oil Pump	75	56	See Note 9								--	--	--	--
0D596	Diesel Generator E Battery Charger	--	20	See Note 9								1	10 sec	--	--
0V511E	Diesel Generator E Battery Room Exhaust Fan	3	2	See Note 9								1	10 sec	--	--
0Y565	Diesel Generator E Distribution Panel	--	15	See Note 9								1	10 sec	--	--
0LP5B	Diesel Generator E Essential Lighting Panel	--	30	See Note 9								1	10 sec	--	--

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

				Number Connected								Loading Sequence (Notes 3 and 6)			
				Diesel Gen A		Diesel Gen C		Diesel Gen B		Diesel Gen D		Unit 1 - DBA		Unit 2 - Shutdown	
Equipment Number	Description	Rating Each, hp	Operating kW Each	Unit 1 1A201 Bus	Unit 2 2A201 Bus	Unit 1 1A203 Bus	Unit 2 2A203 Bus	Unit 1 1A202 Bus	Unit 2 2A202 Bus	Unit 1 1A204 Bus	Unit 2 2A204 Bus	Minimum Required Number (Note 16)	Time From DBA	Minimum Required Number (Note 16)	Time
0X565	Diesel Generator E Transformer Losses	--	10	See Note 9								1	10 sec	--	--
Non-ESF Loads (Note 12)															
1P 111 2P 111	Turbine Generator Auxiliary (Turning gear oil pump)	40	32	--	1	--	--	1	--	--	--	--	30 sec	--	30 sec
1P 132 A,B 2P 132 A,B	CRD Water Pumps	300	215/163	1	1	--	--	--	--	1	1	--	--	--	10 min*
	Essential Lighting	--	Set	52	44	44	--	56	32	64.67	10	--	10 sec	--	10 sec
0X604	Cont. Struc. Transformer	--	--	--	--	--	--	--	--	2	--	--	10 sec	--	--
1P 210 A,B 2P 210 A,B	Reactor Bldg. Close Cooling Water Pumps	30	25	1	--	1	--	--	1	--	1	--	10 sec	--	10 sec
1D 666/2D 666	Vital A. C. Uninterruptible Power Supply (Alternate Supply)	--	32/27	--	--	--	--	--	--	1	1	--	4 hrs* (Note 13)	--	4 hrs*
1P 109A-H,J 1S 103/1S 104 2P 109A-H,J 2S103/2S 104	Turbine Generator Auxiliaries (Turning Gear and Lift Pumps)	127.5	119	--	1	--	--	1	--	--	--	--	10 min*	--	10 min*
1K 107 A,B 2K 107 A,B	Instrument Air Compressor	100	82	--	1	--	1	1	--	1	--	--	10 min 10 sec*	--	10 min 10 sec*
1P 103 A,B 2P 103 A,B	Turbine Bldg. Cooling Water Pumps	15	13	1	1	--	--	1	1	--	--	--	--	--	10 sec
1D 656 2D 656	Computer Uninterruptible Power Supply (Alternate Supply)	--	75	--	--	1	1	--	--	--	--	--	--	--	4 hrs*
0S 108	Control Structure Passenger Elevator	30	2.5	--	--	1	--	--	--	--	--	--	10 sec	--	--
1S 204 2S 204	React. Bldg. Service Elevators	50	3.7	--	--	--	--	--	--	1	1	--	10 sec	--	10 sec
1C 142 A,B 2C 142 A,B	Containment Instrument Air Dryers-Compressed Air System	--	12	--	1	--	1	1	--	1	--	--	-- 10 min 10 sec*	--	-- 10 min 10 sec*
1K 205 A,B 2K 205 A,B	Containment Instrument Gas Compressors	15	13	1	--	1	--	--	1	--	1	--	--	--	--
1P 105 2P 105	Main Condenser Vacuum Pump	300	201	--	--	--	1	1	--	--	--	--	--	--	--
1S 106 A,B,C 2S 106 A,B,C	RFPT Turning Gear	1.5	1.6	2	1	--	--	1	2	--	--	--	20 min*	--	20 min*
OLP 16	ESSW Pump House Lighting Panel	--	75	1	--	--	--	--	--	--	--	--	--	--	--

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

				Number Connected								Loading Sequence (Notes 3 and 6)			
				Diesel Gen A		Diesel Gen C		Diesel Gen B		Diesel Gen D		Unit 1 - DBA		Unit 2 - Shutdown	
Equipment Number	Description	Rating Each, hp	Operating kW Each	Unit 1 1A201 Bus	Unit 2 2A201 Bus	Unit 1 1A203 Bus	Unit 2 2A203 Bus	Unit 1 1A202 Bus	Unit 2 2A202 Bus	Unit 1 1A204 Bus	Unit 2 2A204 Bus	Minimum Required Number (Note 16)	Time From DBA	Minimum Required Number (Note 16)	Time
0P 170 A,B	Control Structure Chiller Condenser Water Circulating Pumps	20	17	--	--	1	--	--	--	1	--	--	--	--	--
0P 595 A1, A2,B1,B2	RHR Spray Pond Drain Pumps	5	5	2	--	--	--	2	--	--	--	--	--	--	--
0PP 509,511	ESSW Pump House Distribution Panels	--	150 150	1	--	--	--	1	--	--	--	--	--	--	--
1X290/ 1BC 290 & 1BC 291A	30KVA Transformer / Standby Liquid & Oxygen and Hydrogen Analyzer Heat Tracing Panels	--	10	1	--	--	--	--	--	--	--	--	10 sec	--	--
1BC 291B/ 1X 291B	Oxygen and Hydrogen Analyzer - Heat Tracing Panel	--	12	--	--	--	--	--	--	1	--	--	10 sec	--	--
2BC 290/ 2X 290	Standby Liquid Heat Tracing Control Panel	--	4	--	1	--	--	--	--	--	--	--	--	--	10 sec
2BC 291 A,B/ 2X 291 A,B	Oxygen and Hydrogen Analyzer Heat Tracing Panels	--	7	--	1	--	--	--	--	-	1	--	--	--	10 sec
1K 102 A,B 2K 102 A,B	Turbine Building Chillers	1080	847	1	1	--	--	1	--	--	1	--	--	--	--
1K 104 2K 104	Main Turbine L.O. Reservoir Vapor Extractor	7.5	6	1	--	--	--	--	1	--	--	--	10 sec	--	10 sec
1K 105 2K 105	Main Turbine L.O. Reservoir Oil Mist Eliminator	3	2.4	1	--	--	--	--	1	--	--	--	10 sec	--	10 sec
1K 206 A,B 2K 206 A,B	Reactor Building Chillers	904	709	1	--	--	1	1	1	--	--	--	--	--	--
1V 223	Remote Shutdown Panel Room Transfer Fan	0.75	0.7	1	--	--	--	--	--	--	--	--	--	--	--
1S 237 A,B 2S 237 A,B	Reactor Protection System M-G Sets	25	27	1	1	--	--	1	1	--	--	--	10 min*	--	10 min*
0X 201,203, 211,213	Engineered Safeguards Transformer Auxiliaries	--	2.8 2.8 0.9 0.9	1	--	2	--	1	--	--	--	--	10 sec (note 7)	--	--

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

Equipment Number	Description	Rating Each, hp	Operating kW Each	Number Connected								Loading Sequence (Notes 3 and 6)			
				Diesel Gen A		Diesel Gen C		Diesel Gen B		Diesel Gen D		Unit 1 - DBA		Unit 2 - Shutdown	
				Unit 1 1A201 Bus	Unit 2 2A201 Bus	Unit 1 1A203 Bus	Unit 2 2A203 Bus	Unit 1 1A202 Bus	Unit 2 2A202 Bus	Unit 1 1A204 Bus	Unit 2 2A204 Bus	Minimum Required Number (Note 16)	Time From DBA	Minimum Required Number (Note 16)	Time
1X 800, 1Y 688	UPS/SPDS Dist. Pnls.	--	5	1	--	--	--	--	--	--	--	--	10 sec	--	--
1X 801 1Y 689	UPS/SPDS Dist. Pnls.	--	3	--	--	--	--	1	--	--	--	--	10 sec	--	--
1D130,1D240 2D130,2D240	UPS/120V Instrument AC Distribution Panel	--	39/34 39/34 39/34 39/34	See Note 8 & 10	Note 8 & 10	1	1	Note 8 & 10	Note 8 & 10	1	1	--	10 sec	--	10 sec
1PP100	30KVA Transformer / TB1 & SGTS VERMS		30/30	1	---	--	--	--	--	--	--	--	10 sec		
2X199	30 KVA Transformer / TB2 & SGTS VERMS	--	30/30	--	--	--	--	--	1	--	--	--	10sec		
1X297	20 KVA Transformer / RB1 & SGTS VERMS	--	20/20	1	--	--	--	--	--	--	--	--	10 sec		
2X297	20 KVA Transformer / RB2 & SGTS VERMS	--	20/20	--	--	--	--	--	1	--	--	--	10 sec		

<u>NOTES</u>:

*Manual Initiation
**Same Loop

1. MOV Loads are not included in diesel generator loading because of small magnitude and short duration.

2. Diesel generators A, B, C, and D are rated as follows: 4000 KW continuous
   4700 KW -- 2000 hrs

   Diesel Generator E is rated as follows: 5000 KW continuous
   5500 KW - 2000 hrs

3. Loading Sequence based on loss of offsite power. Unit 1 LOCA and Unit 2 shutdown is assumed. Loading sequence of the RHR and Core Spray Pumps with offsite power available is different as indicated in Table 8.3-1b.

4. Diesel generator starting time of 10 sec is assumed.

5. Deleted

Table 8.3-1

Assignment of ESF and Selected Non-ESF Loads to Diesel Generators and ESS Buses

NOTES:

6. Timing shown in parenthesis applies to the backup load when it has a different starting time than the primary load. Backup loads will operate when power is lost to the primary load.

7. Load tripped automatically within 10 min.

8. Normal supply to 1D130 & 2D130 is from Diesel Generator D, alternate supply is from Diesel Generator B.
   Normal supply to 1D240 & 2D240 is from Diesel Generator C, alternate supply is from Diesel Generator A.

   When Diesel Generators C or D are unavailable, 1D130 et al should be shown as loads on their alternate supply.

   Operating Kw of 1D240 is shown as UPS + Dist Panel Load/Dist Panel Load; eg. 39/34: (39 = UPS Load + Panel Load and 34 = Panel Load)

9. This load is connected to the Diesel Generator E bus. Where indicated in the Loading Sequence portion of Table 8.3-1, the load will operate when Diesel Generator E is substituted for Diesel Generators A, B, C or D.

10. The maximum allowable loads will be used to load the diesel generators. The maximum allowable loads are based on the equipment rating as documented in the diesel generators load calculation.

11. Intentionally left blank.

12. Selected non-ESF loads are connected to the diesel backed buses to provide protection to non-ESF equipment. The non-ESF loads are not required for mitigation of a design basis accident of one unit and concurrent safe shutdown of the second unit. The non-ESF load timing is still shown to provide information for when the load is started from the time of DBA.

13. The preferred source for Vital AC UPS is fed by diesel generator B backed up bus. If diesel generator B fails then the source of power will be from a battery bank which is sized to supply the load for four hours. After four hours, the UPS will be transferred to the alternate source which is fed by diesel generator D backed up bus.

14. Due to its intermittent operation, it is not considered a load on the diesel generator.

15. Fan starts automatically following manual initiation of related pump.

16. The Design Basis Accident (DBA) specifically utilized for the compilation of “Minimum Required Number” is a complete shear on the suction side of the recirculation pipe.

17. Only one Loop RHRSW with on RHRSW pump running is required to remove decay heat for both units. For purposes in demonstrating diesel loading as a result of the RHRSW alignment, the FSAR Diesel loading tables show two RHRSW pumps in operation, one for the unit with a DBA and one for the shutdown unit which indicate the maximum possible RHRSW pumps per diesel loading.

Table 8.3-1a

Diesel Generator Loading (Note 1)
Diesel Generators A, B, C, and D In Service
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				Diesel Generator D			
		Demand, kW				Demand, kW				Demand, kW				Demand, kW		
	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond
Unit 1 DBA Loads																
Reactor Core Spray Pumps	1	552	552	552	1	552	-	-	1	552	552	552	1	552	-	-
RHR Pumps	1	1429	-	-	1	1429	1429	1429	1	1429	-	-	1	1429	-	-
RHR Service Water Pumps*	-	-	-	-	-	-	-	-	1	-	-	-	1	-	463	463
Core Spray Pump Room Unit Coolers	1	2	2	2	1	2	-	-	1	2	2	2	1	2	-	2
Motor Operated Valve	Set				Set				Set				Set			
Engineered Safeguards Switchgear and L.C. Room Unit Coolers	1	13	13	13	1	-	-	-	-	-	-	-	-	-	-	-
RHR Pump Room Unit Coolers	1	9	-	-	1	9	9	9	1	9	-	-	1	9	-	-
RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	-	-	-	-	1	-	-	-	-	-	-	-
HPCI Pump Room Unit Coolers	-	-	-	-	1	1.5	1.5	1.5	-	-	-	-	1	-	-	-
Battery Chargers, 125V D.C.	1	16	16	16	1	16	16	16	1	16	16	16	1	16	16	16
120V Instrument A. C. Dist. Panels	1	24	24	24	1	24	24	24	1	24	24	24	1	24	24	24
Standby Liquid Cont. Tank Heater	-	-	-	-	-	-	-	-	2	10	10	10	-	-	-	-
Standby Liquid Cont. Inj. Pumps	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Drywell Area Unit Cooler	-	-	-	-	-	-	-	-	7	-	-	9.4	7	-	-	-
CRD Area Recirc. Fan	-	-	-	-	-	-	-	-	1	-	-	2.6	1	-	-	-
Battery Chargers, 250V	1	56	56	56	1	44	44	44	1	56	56	56	-	-	-	-
Containment Hydrogen Recombiners	1	-	-	75	1	-	-	-	1	-	-	75	1	-	-	-
RHR Service Water Pump House Supply Fans (RHRSWP)	1	-	-	-	1	-	4.6	4.6	-	-	-	-	-	-	-	-
Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
LPCI Swing Bus Isolation System M -G Sets	1	13	13	13	1	13	13	13	-	-	-	-	-	-	-	-
Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	15	15	15	1	15	15	15	1	15	15	15
Unit 2 Forced Shutdown Loads																
RHR Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1	-	1429	1429
RHR Service Water Pumps *	1	-	-	-	1	-	463	463	-	-	-	-	-	-	-	-
Motor Operated Valves	Set				Set				Set				Set			
Engineered Safeguards Switchgear and L.C. Room Unit Coolers	1	13	13	13	1	-	-	-	-	-	-	-	-	-	-	-

Table 8.3-1a

Diesel Generator Loading (Note 1)
Diesel Generators A, B, C, and D In Service
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				Diesel Generator D			
		Demand, kW				Demand, kW				Demand, kW				Demand, kW		
	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond
RHR Pump Room Unit Coolers	1	-	-	-	1	-	-	-	1	-	9	9	1	-	-	-
RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	-	-	-	-	1	-	-	-	-	-	-	-
HPCI Pump Room Unit Coolers	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
Battery Chargers, 125V D.C.	1	16	16	16	1	16	16	16	1	16	16	16	1	16	16	16
120V Instrument A.C. Dist. Panels	1	24	24	24	1	24	24	24	1	24	24	24	1	24	24	24
Standby Liquid Cont. Tank Heater	-	-	-	-	-	-	-	-	2	10	10	10	-	-	-	-
Standby Liquid Cont. Inj. Pumps	1	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-
Battery Chargers, 250V D. C.	1	20	20	20	1	40	40	40	1	20	20	20	-	-	-	-
Containment Hydrogen Recombiners	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-
RHR Service Water Pump House Supply Fan (RHRSWP)	1	-	4.6	4.6	1	-	-	-	-	-	-	-	-	-	-	-
Drywell Area Unit Coolers	-	-	-	-	-	-	-	-	7	60.2	60.2	60.2	7	60.2	60.2	60.2
CRD Area Recirc. Fans	-	-	-	-	-	-	-	-	1	4.4	4.4	4.4	1	-	-	-
Core Spray Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
Core Spray Pump Room Unit Coolers	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
SPDS- UPS	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Compressor Motor for Emergency SWGR and L.C. Room Cooling	1	48	48	48	1	-	-	-	-	-	-	-	-	-	-	-
Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
LPCI Swing Bus Isolation System M-G Sets	1	13	13	13	1	13	13	13	-	-	-	-	-	-	-	-
Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	15	15	15	1	15	15	15	1	15	15	15
Unit 1 & 2 Common Loads																
Control Structure Battery Room Exhaust Fans	-	-	-	-	-	-	-	-	1	4.5	4.5	4.5	1	-	-	-
Diesel Generator Room Ventilation Supply Fans	1	33	33	33	1	33	33	33	1	33	33	33	1	33	33	33
Diesel Generator Diesel Oil Transfer Pumps	1	2.5	2.5	2.5	1	2.5	2.5	2.5	1	2.5	2.5	2.5	1	2.5	2.5	2.5
Reactor Building Recirc. Fans	1	61	61	61	1	-	-	-	-	-	-	-	-	-	-	-
Emergency Service Water Pumps	1	357	357	357	1	357	357	357	1	357	357	357	1	346	346	346

Table 8.3-1a

Diesel Generator Loading (Note 1)
Diesel Generators A, B, C, and D In Service
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				Diesel Generator D			
		Demand, kW				Demand, kW				Demand, kW				Demand, kW		
	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond
Standby Gas Treatment System Exh. Fan	-	-	-	-	-	-	-	-	1	42	42	42	1	42	42	42
Control and Computer Rooms Air Cond. Unit Pump	-	-	-	-	-	-	-	-	2	66	66	66	2	-	-	-
Diesel Generator Starting Air Compressors	2	18	-	-	2	18	-	-	2	18	-	-	2	18	-	-
Engineered Safeguards Service Water Pump House Supply Fans (ESWP)	2	9	9	9	2	9	9	9	-	-	-	-	-	-	-	
Control Structure Chilled Water Circulating Pumps	-	-	-	-	-	-	-	-	1	25	25	25	1	-	-	-
Control Structure Emergency Outside Air Supply Fans	-	-	-	-	-	-	-	-	1	17	17	17	1	-	-	-
Control Structure Water Chiller Compressors	-	-	-	-	-	-	-	-	1	279	279	279	1	-	-	-
Control Structure Air Cond. Unit Heating Coils	-	-	-	-	-	-	-	-	1	130	130	130	1	-	-	-
Standby Gas Treatment System Equipment Room Exhaust Fans	-	-	-	-	-	-	-	-	1	4.5	4.5	4.5	1	4.5	4.5	4.5
Standby Gas Treatment System Equip. Room Heating Unit Heater Fans	-	-	-	-	-	-	-	-	1	4.5	4.5	4.5	1	4.5	4.5	4.5
Control Structure Air Cord. Unit Fans	-	-	-	-	-	-	-	-	1	42	42	42	1	-	-	-
Control Structure Chiller Comp. Oil Pump	-	-	-	-	-	-	-	-	1	1.4	1.4	1.4	1	-	-	-
Standby Gas Treatment System Heater	-	-	-	-	-	-	-	-	1	90	90	90	1	90	90	90
Control Structure Chiller Chiller Emerg. Condenser Circ. Pump	-	-	-	-	-	-	-	-	1	17	17	17	1	-	-	-
Control Structure Emergency Outside Air Supply Unit Heating Coils	-	-	-	-	-	-	-	-	1	30	30	30	1	-	-	-
Diesel Generator Standby Jacket Water Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
Diesel Generator Standby Lube Oil Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
Standby Gas Treatment Equipment Room Heater	-	-	-	-	-	-	-	-	1	30	30	30	1	30	30	30

Table 8.3-1a

Diesel Generator Loading (Note 1)
Diesel Generators A, B, C, and D In Service
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				Diesel Generator D			
	Number Connected	Demand, kW 0-10 Min	Demand, kW 10-60 Min &	Demand, kW 60 Min Beyond	Number Connected	Demand, kW 0-10 Min	Demand, kW 10-60 Min &	Demand, kW 60 Min Beyond	Number Connected	Demand, kW 0-10 Min	Demand, kW 10-60 Min &	Demand, kW 60 Min Beyond	Number Connected	Demand, kW 0-10 Min	Demand, kW 10-60 Min &	Demand, kW 60 Min Beyond
Unit 1 & 2 Common Loads																
Diesel Generator HVAC Panels	1	4	4	4	1	4	4	4	1	4	4	4	1	4	4	4
ESSW Pump House HVAC Control Panels	1	3.8	3.8	3.8	1	3.8	3.8	3.8	-	-	-	-	-	-	-	-
Diesel Generator Jacket Water Heaters	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
Diesel Generator Lube Oil Heaters	1	9	-	-	1	9	-	-	1	9	-	-	1	9	-	-
Diesel Generator Space Heaters	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
Control Structure Chiller Refrigerant Transfer Pumps	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-
Diesel Generator Jacket Water Circulating Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
Diesel Generator Pre-Lube Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
ESF LOAD TOTAL		2778.3	1317.9	1392.9		2649.8	2536.4	2536.4		3469	2013	2100		2745.7	2618.7	2620.7
Non-ESF Loads																
Turbine Generator Gear Oil PP	1	32	32	32	1	32	32	32	-	-	-	-	-	-	-	-
CRD Water Pumps, Unit 2	1	-	215	163	-	-	-	-	-	-	-	-	1	-	-	-
Essential Lighting	Set	96	96	96	Set	89	89	89	Set	44	44	44	Set	77	77	77
Cont. Struc. Transformer 0X604	-	-	-	-	-	-	-	-	-	-	-	-	1	2	2	2
Vital A.C. Uninterruptible Power Supply	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	32
Turbine Generator Bearing Auxiliaries Lift PP & Turning Gear Motor	1	-	119	119	1	-	119	119	-	-	-	-	-	-	-	-
Instrument Air Compressors	1	-	82	82	1	-	82	82	1	-	-	-	1	-	-	-
Turbine Bldg. Cooling Water Pumps	2	26	26	26	2	26	26	26	-	-	-	-	-	-	-	-
Reactor Bldg. Close Cooling Water Pumps	1	25	25	25	1	25	25	25	1	25	-	-	1	25	-	-
Computer Uninterruptible Power Supply (Alternate Supply)	-	-	-	-	-	-	-	-	2	-	-	75	-	-	-	-
Control Structure Passenger Elevator	-	-	-	-	-	-	-	-	1	2.5	2.5	2.5	-	-	-	-
Reactor Bldg. Service Elevators	-	-	-	-	-	-	-	-	-	-	-	-	2	8	8	8
Instrument Air Dryers Compressed Air System	1	-	-	-	1	-	-	-	1	-	12	12	1	-	12	12

Table 8.3-1a

Diesel Generator Loading (Note 1)
Diesel Generators A, B, C, and D In Service
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				Diesel Generator D			
		Demand, kW				Demand, kW				Demand, kW				Demand, kW		
	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond
Containment Instrument Gas Compressors	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-
RFPT Turning Gear	3	-	4.8	4.8	3	-	4.8	4.8	-	-	-	-	-	-	-	-
Main Condenser Vacuum Pump	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-
ESSW Pump House Lighting Panel	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control Structure Chiller Condenser Water Circulating Pumps	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-
RHR Spray Pond Drain Pumps	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
ESSW Pump House Distribution Panels	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Standby Liquid & Oxygen and Hydrogen Analyzer Heat Tracing Panels	3	21	21	21	-	-	-	-	-	-	-	-	2	19	19	19
Turbine Building Chillers	2	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
Main Turbine L.O. Reservoir Vapor Extractor	1	6	6	6	1	6	6	6	-	-	-	-	-	-	-	-
Main Turbine L.O. Reservoir Oil Mist Eliminator	1	2.4	2.4	2.4	1	2.4	2.4	2.4	-	-	-	-	-	-	-	-
Reactor Building Chillers	1	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-
Remote Shutdown Panel Room Transfer Fan	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reactor Protection System M-G Sets	2	-	54	54	2	-	54	54	-	-	-	-	-	-	-	-
Engineered Safeguards Transformer Auxiliaries	1	2.8	-	-	2	3.7	-	-	1	0.9	-	-	-	-	-	-
UPS/SPDS Distribution Panels	1	5	5	5	1	3	3	3	-	-	-	-	-	-	-	-
UPS/120V Instrument AC Distribution Panel	2	-	0	0	2	-	0	0	2	78	78	78	2	78	78	78
30 KVA Transformer TB1 & SGTS VERMS	1	30	30	30	-	-	-	-	-	-	-	-	-	-	-	-
Units 1 and 2 HCVS Power Supplies	-	-	-	-	-	-	-	-	1	5.1	5.1	5.1	-	-	-	-

Table 8.3-1a

Diesel Generator Loading (Note 1)
Diesel Generators A, B, C, and D In Service
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				Diesel Generator D			
		Demand, kW				Demand, kW				Demand, kW				Demand, kW		
	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond
30 KVA Transformer / TB2 VERMS	-	-	-	-	1	30	30	30	-	-	-	-	-	-	-	-
20 KVA Transformer / RB1 VERMS	1	20	20	20	-	-	-	-	-	-	-	-	-	-	-	-
20 KVA Transformer / RB2 VERMS	-	-	-	-	1	20	20	20	-	-	-	-	-	-	-	-
DIESEL LOAD		3044.5	2056.1	2079.1		2886.9	3029.6	3029.6		3624.5	2154.6	2316.6		2954.7	2814.7	2848.7
4.16KV Cable Losses		11.75	11.75	11.75		11.25	11.25	11.25		9.48	9.48	9.48		13.63	13.63	13.63
Total Diesel Load		3056.25	2067.85	2090.85		2898.15	3040.85	3040.85		3633.98	2164.08	2326.08		2968.33	2828.33	2862.33

Note: This table represents all loads connected to diesel generators without regard to which loads are actually running (only one RHR pump can be connected to a diesel generator).
Refer to Table 8.3 2 through 8.3.5a for actual running load. No running loads exceed 4000 kw.
* See Note 17 of Table 8.3-1 for information on running RHRSW Pumps.

TABLE 8.3-1b

Supplement to Table 8.3-1

PAGE 1 of 1

EVENT	POWER SUPPLY AVAILABLE								
	2 Offsite Power Supplies			1 Offsite Power Supply			Standby Diesel Generator		
	0 sec	7.0 Sec Unit 1 7.0 Sec Unit 2	15 sec	0 sec	7.0 Sec Unit 1 7.0 Sec Unit 2	15 sec	0 sec	13 sec	20.5 Sec
LOCA in one unit (either unit)	RHR A RHR B	RHR C RHR D	CS A CS B CS C CS D	RHR A RHR B	RHR C RHR D	CS A CS B CS C CS D		RHR A RHR B RHR C RHR D	CS A CS B CS C CS D
LOCA in one unit and false LOCA in other unit	RHR 1A RHR 1B	RHR 2C RHR 2D	CS 1A CS 1C CS 2B CS 2D	RHR 1A RHR 1B	RHR 2C RHR 2D	CS 1A CS 1C CS 2B CS 2D		RHR 1A RHR 1B RHR 2C RHR 2D	CS 1A CS 1C CS 2B CS 2D

NOTES:

1. Time Shown from LOCA (or false LOCA).
2. With 2 offsite power supplies available, Loads A & C are on one supply while B & D are on the other.

Table 8.3-1c

Diesel Generator E Loading
Diesel Generator E In Service for A or B or C or D
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator E Substituted for Diesel Generator A				Diesel Generator E Substituted for Diesel Generator B				Diesel Generator E Substituted for Diesel Generator C				Diesel Generator E Substituted for Diesel Generator D			
		Demand, kW				Demand, kW				Demand, kW				Demand, kW		
	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond
Total Diesel Load From Table 8.3-1a		3056.25	2067.85	2090.85		2898.15	3040.85	3040.85		3633.98	2164.08	2326.08		2968.33	2828.33	2862.33
Diesel Generator A, B, C, & D Loads Affected by Diesel Generator E Substitution																
Diesel Generator Diesel Oil Transfer Pumps	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)
Diesel Generator Starting Air Compressors	2	(18)	--	--	2	(18)	--	--	2	(18)	--	--	2	(18)	--	--
Diesel Generator Jacket Water Heaters	1	15	15	15	1	15	15	15	1	15	15	15	1	15	15	15
Diesel Generator Lube Oil Heaters	1	--	9	9	1	--	9	9	1	--	9	9	1	--	9	9
Diesel Generator Space Heaters	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5
Diesel Generator Jacket Water Circulating Pumps	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5
Diesel Generator Pre-Lube Pumps	1	9	9	9	1	9	9	9	1	9	9	9	1	9	9	9
Diesel Generator E Loads																
Diesel Generator E Diesel Oil Transfer Pump	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2
Diesel Generator E Jacket Water Heater	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diesel Generator E Lube Oil Heater	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diesel Generator E Space Heater	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diesel Generator E Pre-Lube Pump	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diesel Generator E Standby Jacket Water Pump	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diesel Generator E Standby Lube Oil Pump	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diesel Generator E Battery Charger	1	20	20	20	1	20	20	20	1	20	20	20	1	20	20	20
Diesel Generator E Battery Room Exhaust Fan	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2

Table 8.3-1c

Diesel Generator E Loading
Diesel Generator E In Service for A or B or C or D
Unit 1 – Design Basis Accident; Unit 2 – Forced Shutdown

Loads	Diesel Generator E Substituted for Diesel Generator A				Diesel Generator E Substituted for Diesel Generator B				Diesel Generator E Substituted for Diesel Generator C				Diesel Generator E Substituted for Diesel Generator D			
		Demand, kW				Demand, kW				Demand, kW				Demand, kW		
	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond	Number Connected	0-10 Min	10-60 Min &	60 Min Beyond
Diesel Generator E Distribution Panel	1	15	15	15	1	15	15	15	1	15	15	15	1	15	15	15
Diesel Generator E Essential Lighting Panel	1	30	30	30	1	30	30	30	1	30	30	30	1	30	30	30
Diesel Generator E Transformer Losses	1	10	10	10	1	10	10	10	1	10	10	10	1	10	10	10
Diesel Generator E Room Ventilation Supply Fans	2	60	60	60	2	60	60	60	2	60	60	60	2	60	60	60
Diesel Generator E Room Ventilation Exhaust Fans	2	60	60	60	2	60	60	60	2	60	60	60	2	60	60	60
Diesel Generator E Jacket Water Circulating Pump	1	--	--	--	1	--	--	--								
DIESEL LOAD		3267.75	2306.35	2329.35		3109.65	3279.35	3279.35		3845.48	2402.58	2564.58		3179.83	3066.83	3100.83
4.16 KV Cable Losses (A,B,C,D)		-11.75	-11.75	-11.75		-11.25	-11.25	-11.25		-9.48	-9.48	-9.48		-13.63	-13.63	-13.63
4.16 KV Cable Losses (E)		14.54	14.54	14.54		13.76	13.76	13.76		9.96	9.96	9.96		13.79	13.79	13.79
Total Diesel Load		3270.54	2309.14	2332.14		3112.16	3281.86	3181.86		3845.96	2403.06	2565.06		3179.99	3066.99	3100.99

TABLE 8.3-2

DIESEL GENERATOR LOADING

DIESEL A UNAVAILABLE
UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator B				Diesel Generator C				Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
Unit 1 DBA Loads														
1P206 A,B,C,D	Reactor Core Spray Pumps	1	1	552	552	552	1	552	-	-	1	552	552	552
1P202 A,B,C,D	RHR Pumps	1	1	1429	1429	1429	1	1429	-	-	1	1429	-	-
1P506 A,B**	RHR Service Water Pumps	-	-	-	-	-	1	-			1	-	463	463
1V211 A,B,C,D	Core Spray Pump Room Unit Coolers	1	1	2	2	2	1	2	-	-	1	2	2	2
	Motor Operated Valves	Set	Set				Set				Set			
1V222 A,B	Engineered Safeguards Switchgear & L.C. Room Unit Coolers	1	1	13	13	13	-	-	-	-	-	-	-	-
1V210 A,B,C,D	RHR Pump Room Unit Coolers	1	1	9	9	9	1	9	-	-	1	9	-	-
1V208 A,B	RCIC Pump Room Unit Coolers	1	-	-	-	-	1	1.5	1.5	1.5	-	-	-	-
1V209 A,B	HPCI Pump Room Unit Coolers	-	1	-	-	-	-	-	-	-	1	1.5	1.5	1.5
1D613, 623, 633, 643	Battery Chargers, 125V D.C.	1	1	16	16	16	1	16	16	16	1	16	16	16
1Y216, 226, 236, 246	120V Instrument A.C. Dist. Panels	1	1	24	24	24	1	24	24	24	1	24	24	24
1E219/1E220	Standby Liquid Cont. Tank Heater	-	-	-	-	-	2	10	10	10	-	-	-	
1P208 A,B	Standby Liquid Cont. Inj. Pump	1	-	-	-	-	1	-	-	-	-	-	-	-
1D653 A, 1D653 B, 1D663	Battery Chargers, 250V D.C.	1	1	44	44	44	1	102	102	102	-	-	-	-
1E440 A,B,C,D	Containment Hydrogen Recombiners	1	1	-	-	75	1	-	-	-	1	-	-	75
1V506 A,B	RHR Service Water Pump House Supply Fans (RHRSWP)	1	1	-	4.6	4.6	-	-	-	-	-	-	-	-
1C226 A,B	Hydrogen and Oxygen Analyzer Panels	1	1	-	-	-	-	-	-	-	-	-	-	-
1C291 A,B	Containment Particle Radiation Analyzer Panels	1	1	-	-	-	-	-	-	-	-	-	-	-
1S246, 247	LPCI Swing Bus Isolation System M-G Sets	1	1	13	13	13	-	-	-	-	-	-	-	-
1X210, 220, 230, 240	Engineered Safeguards Load Center Transformer Losses	1	1	15	15	15	1	15	15	15	1	15	15	15
1V411-417A,B	Drywell Area Unit Coolers & Recirc. Fans	-	-	-	-	-	7	-	-	9.4	7	-	-	-
1V 418 A,B	CRD Area Recirc. Fan	-	-	-	-	-	1	-	-	2.6	1	-	-	-
Unit 2 Forced Shutdown Loads														
2P202 A,B,C,D	RHR Pumps	1	1	-	-	-	1	-	1429	1429	1	-	-	-
1P506 A,B**	RHR Service Water Pumps	1	1	-	463	463	-	-	-	-	-	-	-	-
	Motor Operated Valves	Set	Set				Set				Set			

TABLE 8.3-2

DIESEL GENERATOR LOADING

DIESEL A UNAVAILABLE
UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator B				Diesel Generator C				Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
2V222 A,B	Engineered Safeguards Switch-gear & L.C. Room Unit Coolers	1	1	13	13	13	-	-	-	-	-	-	-	-
2V210 A,B,C,D	RHR Pump Room Unit Coolers	1	1	-	-	-	1	-	9	9	1	-	-	-
2V208 A,B	RCIC Pump Room Unit Coolers	1	-	-	-	-	1	1.5	1.5	1.5	-	-	-	-
2V209 A,B	HPCI Pump Room Unit Coolers	-	1	-	-	-	-	-	-	-	1	-	-	-
2D613, 623, 633, 643	Battery Chargers, 125V D.C.	1	1	16	16	16	1	16	16	16	1	16	16	16
2Y216, 226, 236, 246	120V Instrument A.C. Dist. Panels	1	1	24	24	24	1	24	24	24	1	24	24	24
2E219/2E220	Standby Liquid Cont. Tank Heater	-	-	-	-	-	2	10	10	10	-	-	-	-
2P208 A,B	Standby Liquid Cont. Inj. Pumps	1	-	-	-	-	1	-	-	-	-	-	-	-
2D653 A, 2D653 B, 663	Battery Chargers 250V D.C.	1	1	40	40	40	1	40	40	40	-	-	-	-
2E440 A,B,C,D	Containment Hydrogen Recombiners	1	1	-	-	-	1	-	-	-	1	-	-	
2V506 A,B	RHR Service Water Pump House Supply Fans (RHRSWP)	1	1	-	-	-	-	-	-	-	-	-	-	-
2V411 - 417A,B	Drywell Area Unit Coolers	-	-	-	-	-	7	60.2	60.2	60.2	7	60.2	60.2	60.2
2V418 A,B	CRD Area Recirc. Fans	-	-	-	-	-	1	4.4	4.4	4.4	1	-	-	-
2P206 A,B,C,D	Core Spray Pumps	1	1	-	-	-	1	-	-	-	1	-	-	-
2V211 A,B,C,D	Core Spray Pump Room Unit Coolers	1	1	-	-	-	1	-	-	-	1	-	-	-
2D288, 289	SPDS - UPS	1	1	-	-	-	-	-	-	-	-	-	-	-
2K210 A,B	Compressor Motor for Emergency SWGR and L.C. Room Cooling	1	1	48	48	48	-	-	-	-	-	-	-	-
2C226 A,B	Hydrogen and Oxygen Analyzer Panels	1	1	-	-	-	-	-	-	-	-	-	-	-
2C291 A,B	Containment Particle Radiation Analyzer Panels	1	1	-	-	-	-	-	-	-	-	-	-	-
2S246, 247	LPCI Swing Bus Isolation System M-G Sets	1	1	13	13	13	-	-	-	-	-	-	-	-
2X210, 220, 230, 240	Engineered Safeguards Load Center Transformer Losses	1	1	15	15	15	1	15	15	15	1	15	15	15

TABLE 8.3-2

DIESEL GENERATOR LOADING

DIESEL A UNAVAILABLE
UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator B				Diesel Generator C				Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
Unit 1 and 2 Common Loads														
0P514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	1	2.5	2.5	2.5	1	2.5	2.5	2.5	1	2.5	2.5	2.5
0V201 A,B	Reactor Building Recirc. Fans	1	1	61	61	61	-	-	-	-	-	-	-	-
0P504 B,C,D	Emergency Service Water Pumps	1	1	357	357	357	1	*357	-	-	1	346	346	346
0V109 A,B	Standby Gas Treatment System Exh. Fan	-	-	-	-	-	1	42	42	42	1	42	42	42
0V115 A,B, 117 A,B	Control and Computer Rooms Air Cond. Unit Fans	-	-	-	-	-	2	-	-	-	2	66	66	66
0K507 A1, A2, B1, B2, C1, C2, D1, D2	Diesel Generator Starting Air Compressors	2	2	18	-	-	2	18	-	-	2	18	-	-
0V521 A,B,C,D	Engineered Safeguards Service Water Pump House Supply Fans (ESWP)	2	2	9	9	9	-	-	-	-	-	-	-	-
0P162 A,B	Control Structure Chilled Water Circulating Pumps	-	-	-	-	-	1	-	-	-	1	25	25	25
0V101 A,B	Control Structure Emergency Outside Air Supply Fans	-	-	-	-	-	1	17	17	17	1	-	-	-
0K112 A,B	Control Structure Water Chiller Compressors	-	-	-	-	-	1	-	-	-	1	279	279	279
0E145 A,B	Control Structure Air Cond. Unit Heating Coils	-	-	-	-	-	1	130	130	130	1	-	-	-
0V118 A,B	Standby Gas Treatment System Equip. Room Exhaust Fans	-	-	-	-	-	1	4.5	4.5	4.5	1	4.5	4.5	4.5
0V144 A,B	Standby Gas Treatment System Equip. Room Heating Unit Fans	-	-	-	-	-	1	4.5	4.5	4.5	1	4.5	4.5	4.5
0V103 A,B	Control Structure Air Cond. Unit Fans	-	-	-	-	-	1	-	-	-	1	42	42	42
0P122 A,B	Control Structure Chiller Comp Oil Pump	-	-	-	-	-	1	-	-	-	1	1.4	1.4	1.4
0V116 A,B	Control Structure Battery Room Exhaust Fans	-	-	-	-	-	1	4.5	4.5	4.5	1	-	-	-
0V512 A,B,C,D	Diesel Generator Room Ventilation Supply Fans	1	1	33	33	33	1	33	33	33	1	33	33	33
0C886 A,B	Standby Gas Treatment	-	-	-	-	-	1	90	90	90	1	90	90	90

* Actual pump runout less than 357 kW.
** See Note 17 of Table 8.3-1 for information on running RHRSW Pumps

TABLE 8.3-2

DIESEL GENERATOR LOADING

DIESEL A UNAVAILABLE
UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator B				Diesel Generator C				Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
	System Heater													
0P171 A,B	Control Structure Chiller Emerg. Condenser Circulating Pumps	-	-	-	-	-	1	-	-	-	1	17	17	17
0E143 A,B	Control Structure Emergency Outside Air Supply Unit Heating Coil	-	-	-	-	-	1	30	30	30	1	-	-	-
0P531 A,B,C,D	Diesel Generator Standby Jacket Water Pumps	1	1	-	-	-	1	-	-	-	1	-	-	-
0P533 A,B,C,D	Diesel Generator Standby Lube Oil Pumps	1	1	-	-	-	1	-	-	-	1	-	-	-
0E144 A,B	Standby Gas Treatment Equipment Room Heater	1	1	-	-	-	1	30	30	30	1	30	30	30
0C577 A,B,C,D	Diesel Generator HVAC Panels	1	1	4	4	4	1	4	4	4	1	4	4	4
0C578, 579	ESSW Pump House HVAC Control Panels	1	1	3.8	3.8	3.8	-	-	-	-	-	-	-	-
0E508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	1	-	-	-	1	-	-	-	1	-	-	-
0E525 A,B,C,D	Diesel Generator Lube Oil Heaters	1	1	9	-	-	1	9	-	-	1	9	-	-
0E570 A,B,C,D	Diesel Generator Space Heaters	1	1	-	-	-	1	-	-	-	1	-	-	-
0P112 A,B	Control Structure Chiller Refrigerant Transfer Pumps	-	-	-	-	-	1	-	-	-	1	-	-	-
0P530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	1	1	-	-	-	1	-	-	-	1	-	-	-
0P532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	1	-	-	-	1	-	-	-	1	-	-	-
	TOTAL ESF LOADS			2783.3	3223.9	3298.9		3107.6	2169.6	2181.6		3177.6	2175.6	2250.6

TABLE 8.3-2

DIESEL GENERATOR LOADING

DIESEL A UNAVAILABLE
UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator B				Diesel Generator C				Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
Non-ESF Loads														
1P111, 2P111	Turbine-Generator Turning Gear Oil PP	1	1	32	32	32	-	-	-	-	-	-	-	-
2P132 A,B	CRD Water Pumps, Unit #2	1	-	-	-	-	-	-	-	-	1	-	215	163
	Essential Lighting Emergency Lights	Set	Set	89	89	89	Set	44	44	44	Set	77	77	77
0X604	Cont. Struc. Transformer	-	-	-	-	-	-	-	-	-	1	2	2	2
1D666/2D666	Vital A.C. Uninterruptible Power Supply	-	-	-	-	-	-	-	-	-	2	-	-	32
1P/2P109 A-H,J 1S/2S103, 104	Turbine Generator Bearing Lift PP and Turning Gear	1	1	-	119	119	-	-	-	-	-	-	-	-
1P/2P210 A,B	Reactor Bldg. Closed Cooling Wtr. PP	1	1	25	25	25	1	25	25	25	1	25	-	-
1K/2K107 A,B	Instrument Air Compressors	1	1	-	82	82	1	-	82	82	1	-	-	-
1P/2P103 A,B	Turbine Bldg. Cooling Water Pumps	2	2	26	26	26	-	-	-	-	-	-	-	-
1D656, 2D656	Computer Uninterruptible Power Supply	-	-	-	-	-	2	-	-	75	-	-	-	-
0S108	Control Structure Passenger Elevator	-	-	-	-	-	1	2.5	2.5	2.5	-	-	-	-
1S204, 2S204	Reactor Bldg. Service Elevators	-	-	-	-	-	-	-	-	-	2	8	8	8
1C/2C142 A,B	Instrument Air Dryers	1	1	-	-	-	1	-	-	-	1	-	12	12
1K/2K205 A,B	Containment Instrument Gas Compressors	1	1	-	-	-	1	-	-	-	1	-	-	-
1S/2S106 A,B,C	RFPT Turning Gear	3	3	-	4.8	4.8	-	-	-	-	-	-	-	-
1P105, 2P105	Main Condenser Vacuum Pump	-	1	-	-	-	1	-	-	-	-	-	-	-
0LP16	ESSW Pump House Lighting Panel	1	-	-	-	-	-	-	-	-	-	-	-	
0P170 A,B	Control Structure Chiller Condenser Water Circulating Pumps	-	-	-	-	-	1	-	-	-	1	-	-	-
0P595 A1, A2, B1, B2	RHR Spray Pond Drain Pumps	2	2	-	-	-	-	-	-	-	-	-	-	-
0PP509, 511	ESSW Pump House Distribution Panels	1	1	-	-	-	-	-	-	-	-	-	-	-

TABLE 8.3-2

DIESEL GENERATOR LOADING

DIESEL A UNAVAILABLE
UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator B				Diesel Generator C				Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
1X290/2X290 1X291 B/ 2X291 A,B	Standby Liquid & Oxygen and Hydrogen Analyzer Heat Tracing Panels	3	-	-	-	-	-	-	-	-	2	19	19	19
1K/2K102 A,B	Turbine Building Chillers	2	1	-	-	-	-	-	-	-	1	-	-	-
1K/2K104	Main Turbine L.O. Reservior Vapor Extractor	1	1	6	6	6	-	-	-	-	-	-	-	-
1K/2K105	Main Turbine L.O. Reservior Oil Mist Eliminator	1	1	2.4	2.4	2.4	-	-	-	-	-	-	-	-
1K206 A,B	Reactor Building Chillers	1	2	-	-	-	1	-	-	-	-	-	-	-
1V223	Remote Shutdown Panel Room Transfer Fan	1	-	-	-	-	-	-	-	-	-	-	-	-
1S/2S237 A,B	Reactor Protection System M-G Sets	2	2	-	54	54	-	-	-	-	-	-	-	-
0X201, 203, 211, 213	Engineered Safeguards Transformer Auxiliaries	1	2	3.7	-	-	1	0.9	-	-	-	-	-	-
1X800, 1X801	UPS/SPDS Distribution Panels	1	1	3	3	3	-	-	-	-	-	-	-	-
1D130/2D130 1D240/2D240	UPS/120V Instrument AC Distribution Panel	2	2	-	-	-	2	78	78	78	2	78	78	78
(Each UPS is fed by preferred or alternate source. Diesel Generator C, D are preferred source and Diesel Generator A, B are alternate source.)														
1PP100	30 KVA Transformer / TB1 & SGTS VERMS	1	-	-	-	-	-	-	-	-	-	-	-	-
2X199	30 KVA Transformer / TB2 VERMS	-	1	30	30	30	-	-	-	-	-	-	-	-
1X297	20 KVA Transformer / RB1 VERMS	1	-	-	-	-	-	-	-	-	-	-	-	-
2X297	20 KVA Transformer / RB2 VERMS	-	1	20	20	20	-	-	-	-	-	-	-	-
1D667, 2D667	Units 1 and 2 HCVS Power Supplies	-	-	-	-	-	1	5.1	5.1	5.1				
				3020.4	3717.1	3792.1		3263.1	2406.2	2493.2		3386.6	2586.6	2641.16
	4.16 kV Cable Losses			+ 11.25	+ 11.25	+ 11.25		+ 9.48	+ 9.48	+ 9.48		+ 13.63	+ 13.63	+ 13.63
	TOTAL DIESEL LOAD			3031.65	3728.35	3803.35		3272.58	2415.68	2502.68		3400.23	2600.23	2655.23

TABLE 8.3-2a

DIESEL GENERATOR E LOADING

DIESEL A UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL B, OR C OR D

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator E Substituted for Diesel Generator B				Diesel Generator E Substituted for Diesel Generator C				Diesel Generator E Substituted for Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
	Total Diesel Load from Table 8.3-2	D/G Unavailable		3031.65	3728.35	3803.35		3272.58	2415.68	2502.68		3400.23	2600.23	2655.23
Diesel Generator B, C & D Loads Affected by Diesel Generator E Substitution														
OP514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.50)
OK507 A1,A2,B1,B2, C1,C2,D1,D2	Diesel Generator Starting Air Compressors	2	2	(18)	-	-	2	(18)	-	-	2	(18)	-	-
OE508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	1	15	15	15	1	15	15	15	1	15	15	15
OE525 A,B,C,D	Diesel Generator Lube Oil Heaters	1	1	-	9	9	1	-	9	9	1	-	9	9
OE570 A,B,C,D	Diesel Generator Space Heaters	1	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5
OP530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	1	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5
OP532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	1	9	9	9	1	9	9	9	1	9	9	9
Diesel Generator E Loads														
OV512 E1,E2	Diesel Generator E Room Ventilation Supply Fans	-	2	60	60	60	2	60	60	60	2	60	60	60
OV512 E3,E4	Diesel Generator E Room Ventilation Exhaust Fans	-	2	60	60	60	2	60	60	60	2	60	60	60
OP530E	Diesel Generator E Jacket Water Circulating Pump	-	1	-	-	-	-	-	-	-	-	-	-	-
OP514E	Diesel Generator E Diesel Oil Transfer Pump	-	1	2	2	2	1	2	2	2	1	2	2	2
OE508E	Diesel Generator E Jacket Water Heater	-	1	-	-	-	1	-	-	-	1	-	-	-
OE525E	Diesel Generator E Lube Oil Heater	-	1	-	-	-	1	-	-	-	1	-	-	-
OE570E	Diesel Generator E Space Heater	-	1	-	-	-	1	-	-	-	1	-	-	-
OP532E	Diesel Generator E Pre-Lube Pump	-	1	-	-	-	1	-	-	-	1	-	-	-

TABLE 8.3-2a

DIESEL GENERATOR E LOADING

DIESEL A UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL B, OR C OR D

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number#	LOADS	D/G A Unavailable	Diesel Generator E Substituted for Diesel Generator B				Diesel Generator E Substituted for Diesel Generator C				Diesel Generator E Substituted for Diesel Generator D			
				Demand, kW				Demand, kW				Demand, kW		
		Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
OP531E	Diesel Generator E Standby Jacket Water Pump	-	1	-	-	-	1	-	-	-	1	-	-	-
OP533E	Diesel Generator E Standby Lube Oil Pump	-	1	-	-	-	1	-	-	-	1	-	-	-
OD596	Diesel Generator E Battery Charger	-	1	20	20	20	1	20	20	20	1	20	20	20
OV511 E	Diesel Generator E Battery Room Exhaust Fan	-	1	2	2	2	1	2	2	2	1	2	2	2
OY565	Diesel Generator E Distribution Panel	-	1	15	15	15	1	15	15	15	1	15	15	15
OLP5B	Diesel Generator E Essential Lighting Panel	-	1	30	30	30	1	30	30	30	1	30	30	30
OX565	Diesel Generator E Transformer Losses	-	1	10	10	10	1	10	10	10	1	10	10	10
				3243.15	3966.85	4041.85		3484.08	2654.18	2741.18		3611.73	2838.73	2893.73
	4.16kV Cable Losses (B,C,D)			(11.25)	(11.25)	(11.25)		(9.48)	(9.48)	(9.48)		(13.63)	(13.63)	(13.63)
	4.16kV Cable Losses (E)			13.76	13.76	13.76		9.96	9.96	9.96		13.79	13.79	13.79
	TOTAL DIESEL LOAD			3245.66	3969.36	4044.36		3484.56	2654.66	2741.66		3611.89	2838.89	2893.89

TABLE 8.3-3

DIESEL GENERATOR LOADING

DIESEL B UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT: UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				D/G B	Diesel Generator C				Diesel Generator D			
		Demand kW				Unavailable	Demand, kW				Demand, kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
	UNIT 1 DBA LOADS													
1P206 A,B,C,D	Reactor Core Spray Pumps	1	552	552	552	1	1	552	552	552	1	552	-	-
1P202 A,B,C,D	RHR Pumps	1	1429	1429	1429	1	1	1429	-	-	1	1429	-	-
1P506 A,B**	RHR Service Water Pumps	-	-	-	-	-	1	-	463	463	1	-	-	-
1V211 A,B,C,D	Core Spray Pump Room Unit Coolers	1	2	2	2	1	1	2	2	2	1	2	-	-
	Motor Operated Valves	Set				Set	Set				Set			
1V222 A,B	Engineered Safeguards Switchgear & L.C. Unit Coolers	1	13	13	13	1	-	-	-	-	-	-	-	-
1V210 A,B,C,D	RHR Pump Room Unit Coolers	1	9	9	9	1	1	9	-	-	1	9	-	-
1V208 A,B	RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	-	1	-	-	-	-	-	-	-
1V209 A,B	HPCI Pump Room Unit Coolers	-	-	-	-	1	-	-	-	-	1	1.5	1.5	1.5
1D613,623,633, 643	Battery Chargers, 125V DC	1	16	16	16	1	1	16	16	16	1	16	16	16
1Y216,226,236, 246	120V Instrument, A.C. Dist. Panels	1	24	24	24	1	1	24	24	24	1	24	24	24
1E219/1E220	Standby Liquid Cont. Tank Heater	-	-	-	-	-	2	10	10	10	-	-	-	-
1P208 A,B	Standby Liquid Control Inj. Pumps	1	-	-	-	-	1	-	-	-	-	-	-	-
1D635 A,B 663	Battery Chargers, 250 D.C.	1	56	56	56	1	1	56	56	56	-	-	-	-
1E440 A,B,C,D	Containment Hydrogen Recombiners	1	-	-	75	1	1	-	-	75	1	-	-	-
1V506 A,B	RHR Service Water Pump House Supply Fans (RHRSWP)	1	-	4.6	4.6	1	-	-	-	-	-	-	-	-
1V411 – 417 A,B	Drywell Area Unit Cooler	-	-	-	-	-	7	-	-	9.4	7	-	-	-

TABLE 8.3-3

DIESEL GENERATOR LOADING

DIESEL B UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT: UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A Demand kW				D/G B Unavailable	Diesel Generator C Demand, kW				Diesel Generator D Demand, kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
1V418 A,B	CRD Area Recric. Fans	-	-	-	-	-	1	-	-	2.6	1	-	-	-
1C226 A,B	Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1C291 A,B	Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1S246, 247	LPCI Swing Bus Isolation System M-G Sets	1	13	13	13	1	-	-	-	-	-	-	-	-
1X210,220,230, 240	Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	1	15	15	15	1	15	15	15
	Unit 2 Forced Shutdown Load													
2P202 A,B,C,D	RHR Pumps	1	-	-	-	1	1	-	-	-	1	-	1429	1429
2P506 A,B**	RHR Service Water Pumps	1	-	463	463	1	-	-	-	-	-	-		
	Motor Operated Valves	Set				Set	Set				Set			
2V222 A,B	Engineered Safeguards Switchgear & L.C. Unit Coolers	1	13	13	13	1	-	-	-	-	-	-	-	-
2V210 A,B,C,D	RHR Pump Room Unit Coolers	1	-	-	-	1	1	-	-	-	1	-	9	9
2V208 A,B	RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	-	1	-	-	-	-	-	-	-
2V209 A,B	HPCI Pump Room Unit Coolers	-	-	-	-	1	-	-	-	-	1	-	-	-
2D613, 623, 633, 643	Battery Chargers, 125V D.C.	1	16	16	16	1	1	16	16	16	1	16	16	16
2Y216, 226, 236, 246	120V Instrument A.C. Dist Panels	1	24	24	24	1	1	24	24	24	1	24	24	24
2E219/2E220	Standby Liquid Control Tank Heater	-	-	-	-	1	2	10	10	10	-	-	-	-
2P208 A,B	Standby Liquid Control Injection Pump	1	-	-	-	-	1	-	-	-	-	-	-	-
2D653 A,B 2D663	Battery Chargers, 250V D.C.	1	20	20	20	1	1	20	20	20	1	-	-	-

TABLE 8.3-3

DIESEL GENERATOR LOADING

DIESEL B UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT: UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				D/G B	Diesel Generator C				Diesel Generator D			
		Demand kW				Unavailable	Demand, kW				Demand, kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
2E440 A,B,C,D	Containment Hydrogen Recombiners	1	-	-	-	1	1	-	-	-	1	-	-	-
2V506 A,B	RHR Service Water Pump House Supply Fans (RHRSWP)	1	-	-	-	1	-	-	-	-	-	-	-	-
2V411-417A,	Drywell Area Unit Coolers	-	-	-	-	7	7	60.2	60.2	60.2	7	60.2	60.2	60.2
2V418 A,B	CRD Area Recirc. Fans	-	-	-	-	-	1	4.4	4.4	4.4	1	-	-	-
2P206 A,B,C,D	Core Spray Pumps	1	-	-	-	1	1	-	-	-	1	-	-	-
2V211 A,B,C,D	Core Spray Pump Room Unit Coolers	1	-	-	-	1	1	-	-	-	1	-	-	-
2D288, 289	SPDS – UPS	1	-	-	-	1	-	-	-	-	-	-	-	-
2K210 A,B	Compressor Motor for Emergency SWGR and L.C. Room Cooling	1	48	48	48	1	-	-	-	-	-	-	-	-
2C226 A,B	Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
2C291 A,B	Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
2S246, 247	LPCI Swing Bus Isolation System M-G Sets	1	13	13	13	1	-	-	-	-	-	-	-	-
2X210, 220, 230, 240	Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	1	15	15	15	1	15	15	15
	Unit 1 and 2 Common Loads													
OV116 A,B	Control Structure Battery Room Exhaust Fans	-	-	-	-	-	1	4.5	4.5	4.5	1	-	-	-
OV512 A,B,C,D	Diesel Generator Room Ventilation Supply Fans	1	33	33	33	1	1	33	33	33	1	33	33	33
OV514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	2.5	2.5	2.5	1	1	2.5	2.5	2.5	1	2.5	2.5	2.5
OV201 A,B	Reactor Building Recir. Fans	1	61	61	61	1	-	-	-	-	-	-	-	-

TABLE 8.3-3

DIESEL GENERATOR LOADING

DIESEL B UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT: UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A Demand kW				D/G B Unavailable	Diesel Generator C Demand, kW				Diesel Generator D Demand, kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
OP504 A,B,C,D*	Emergency Service Water Pumps	1	357	357	357	1	1	357	357	357	1	363*	363*	363*
OV109 A,B	Standby Gas Treatment System Exh Fan	-	-	-	-	-	1	42	42	42	1	42	42	42
OV115 A,B OV117 A,B	Control and Computer Rooms Air Cond. Unit Fans	-	-	-	-	-	2	66	66	66	2	-	-	-
OK507 A1, A2 B1, B2 C1, C2, D1, D2	Diesel Generator Starting Air Compressors	2	18	-	-	2	2	18	-	-	2	18	-	-
OV521 A,B,C,D	Engineered Safeguards Service Water Pump House Supply Fans	2	9	9	9	2	-	-	-	-	-	-	-	-
OP162 A,B	Control Structure Chilled Water Circulating Pumps	-	-	-	-	-	1	25	25	25	1	-	-	-
OV101 A,B	Control Structure Emergency Outside Air Supply Fans	-	-	-	-	-	-	17	17	17	1	-	-	-
OK112 A,B	Control Structure Water Chiller Compressors	-	-	-	-	-	1	279	279	279	1	-	-	-
OE145 A,B	Control Structure Air Cond. Unit Heating Coils	-	-	-	-	-	1	130	130	130	1	-	-	-
OV118 A,B	Standby Gas Treatment System Equipment Room Exhaust Fans	-	-	-	-	-	1	4.5	4.5	4.5	1	4.5	4.5	4.5
OV144 A,B	Standby Gas Treatment System – Equip. Room Unit Heater Fans	-	-	-	-	-	1	4.5	4.5	4.5	1	4.5	4.5	4.5
OV103 A,B	Control Structure Air Cond. Unit Fans	-	-	-	-	-	1	42	42	42	1	-	-	-
OP122 A,B	Control Structure Chiller Comp. Oil Pump	-	-	-	-	-	1	1.4	1.4	1.4	1	-	-	-
OC886 A,B	Standby Gas Treatment System Heater	-	-	-	-	-	1	90	90	90	1	90	90	90
OP171A,B	Control Structure Chiller Emerg. Condenser Circ. Pumps	-	-	-	-	-	1	17	17	17	1	-	-	-
OE143A,B	Control Structure Emergency Outside Air Supply Unit Heating Coil	-	-	-	-	-	1	30	30	30	1	-	-	-
OP531 A,B,C,D	Diesel Generator Standby Jacket Water Pumps	1	-	-	-	1	1	-	-	-	1	-	-	-

*Actual pump runout kW

TABLE 8.3-3

DIESEL GENERATOR LOADING

DIESEL B UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT: UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				D/G B	Diesel Generator C				Diesel Generator D			
		Demand kW				Unavailable	Demand, kW				Demand, kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
OP533 A,B,C,D	Diesel Generator Standby Lube Oil Pumps	1	-	-	-	1	1	-	-	-	1	-	-	-
OE144 A,B	Standby Gas Treatment Equip. Room Heater	-	-	-	-	-	1	30	30	30	1	30	30	30
OC577 A,B,C,D	Diesel Generator HVAC Panels	1	4	4	4	1	1	4	4	4	1	4	4	4
OC578, 579	ESSW Pump House HVAC Control Panels	1	3.8	3.8	3.8	1	-	-	-	-	-	-	-	-
OE508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	-	-	-	1	1	-	-	-	1	-	-	-
OE525 A,B.C,D	Diesel Generator Lube Oil Heaters	1	9	-	-	1	1	9	-	-	1	9	-	-
OE570 A,B,C,D	Diesel Generator Space Heaters	1	-	-	-	1	1	-	-	-	1	-	-	-
OP112 A,B	Control Structure Chiller Refrigerant Transfer Pumps	-	-	-	-	-	1	-	-	-	1	-	-	-
OP530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	1	-	-	-	1	1	-	-	-	1	-	-	-
OP532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	-	-	-	1	1	-	-	-	1	-	-	-
			______	______	______			______	______	______		______	______	______
	ESF Loads. Total		2778.3	3218.9	3293.9			3469	2467	2554		2764.2	2183.2	2183.2
	Non-ESF Loads													
2P111, 1P111	Turbine Generator Turning Gear Oil PP	1	32	32	32	1	-	-	-	-	-	-	-	-
2P132A	CRD Water Pumps. Unit 2 Essential Lighting	1 Set	- 96	215 96	163 96	- Set	- Set	- 44	- 44	- 44	1 Set	- 77	- 77	- 77
0X604	Cont. Struc. Transformer	-	-	-	-	-	-	-	-	-	1	2	2	2
1D/2D666	Vital A.C. Uninterruptible Power Supply	-	-	-	-	-	-	-	-	-	2	-	-	64
1P/2P109 – A-H,J 1S/2S103,104	Turbine Generator Bearing Lift Pump & Turning Gear	1	-	119	119	1	-	-	-	-	-	-	-	-

TABLE 8.3-3

DIESEL GENERATOR LOADING

DIESEL B UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT: UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				D/G B	Diesel Generator C				Diesel Generator D			
		Demand kW				Unavailable	Demand, kW				Demand, kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
1K/2K107A,B 1P/2P103A,B	Instrument Air Compressors Turbine Bldg. Cooling Water Pumps	1 2	- 26	82 26	82 26	1 2	1 -	- -	- -	- -	1 -	- -	82 -	82 -
1P/2P210 A,B	Reactor Bldg. Close Cooling Wtr. PP. 1	1	25	25	25	1	1	25	-	-	1	25	25	25
1D656, 2D656	Computer Uninterruptible Power Supply (Alternate Supply	-	-	-	-	-	2	-	-	75	-	-	-	-
OS108	Control Structure Passenger Elevator	-	-	-	-	-	-	2.5	2.5	2.5	-	-	-	-
1S204, 2S204	Reactor Bldg. Service Elevators	-	-	-	-	-	-	-	-	-	2	8	8	8
1C/2C142 A,B	Instrument Air Dryers Compressed Air System	1	-	-	-	1	1	-	12	12	1	-	-	-
1K/2K205 A,B	Containment Instrument Gas Compressor	1	-	-	-	1	1	-	-	-	1	-	-	-
1S/2S106 A,B,C	RFPT Turning Gear	3	-	4.8	4.8	3	-	-	-	-	-	-	-	-
1P105, 2P105	Main Condenser Vacuum Pump	-	-	-	-	1	1	-	-	-	-	-	-	-
OLP16	ESSW Pump House Lighting Panel	1	-	-	-	-	-	-	-	-	-	-	-	-
OP170 A,B	Control Structure Chiller Condenser Water Circulating Pumps	-	-	-	-	-	1	-	-	-	1	-	-	-
OP595 A1, A2 B1, B2	RHR Spray Pond Drain Pumps	2	-	-	-	2	-	-	-	-	-	-	-	-
OPP509, 511	ESSW Pump House Distribution Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1X291 B/2X291 A,B 1X/2X290	Standby Liquid & Oxygen And Hydrogen Analyzer Heat Tracing Panels	3	21	21	21	-	-	-	-	-	2	19	19	19
1K/2K102 A,B	Turbine Building Chillers	2	-	-	-	1	-	-	-	-	1	-	-	-
1K/2K104	Main Turbine L.O. Reservoir Vapor Extractor	1	6	6	6	1	-	-	-	-	-	-	-	-
1K/2K105	Main Turbine L.O. Reservoir Oil Mist Eliminator	1	2.4	2.4	2.4	1	-	-	-	-	-	-	-	-

TABLE 8.3-3

DIESEL GENERATOR LOADING

DIESEL B UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT: UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				D/G B	Diesel Generator C				Diesel Generator D			
		Demand kW				Unavailable	Demand, kW				Demand, kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
1K/2K206 A,B	Reactor Building Chillers	1	-	-	-	2	1	-	-	-	-	-	-	-
1V223	Remote Shutdown Panel Room Transfer Fan	1	-	-	-	-	-	-	-	-	-	-	-	-
1S/2S237 A,B	Reactor Protection System M-G Sets	2	-	54	54	2	-	-	-	-	-	-	-	-
OX201,203,211, 213	Engineered Safeguards Transformer Auxiliaries	1	2.8	-	-	2	1	0.9	-	-	-	-	-	-
1X800, 1X801	UPS/SPDS Distribution Panels	1	5	5	5	1	-	-	-	-	-	-	-	-
1D/2D130,240	UPS/120V Instrument AC Distribution Panel	2	-	-	-	2	2	78	78	78	2	78	78	78
Each UPS is fed by preferred or alternate source. Diesel Generator C,D are preferred source and Diesel Generator A,B are alternate source.														
1PP100	30KVA Transformer / TB1 & SGTS VERMS	1	30	30	30	-	-	-	-	-	-	-	-	-
2X199	30KVA Transformer / TB2 VERMS	-	-	-	-	1	-	-	-	-	-	-	-	-
1X297	20KVA Transformer / RB1 VERMS	1	20	20	20	-	-	-	-	-	-	-	-	-
2X297	20KVA Transformer / RB2 VERMS	-	-	-	-	1	-	-	-	-	-	-	-	-
1D667, 2D667	Units 1 and 2 HCVS Power Supplies	-	-	-	-	-	1	5.1	5.1	5.1	-	-	-	-
			______	______	______			______	______	______		______	______	______
	4.16 kV Cable Losses Total Diesel Load		3044.5 11.75 3056.25	3957.1 11.75 3968.85	3980.1 11.75 3991.85			3624.50 9.48 3633.98	2608.60 9.48 2618.08	2770.60 9.48 2780.08		2973.2 13.63 2986.83	2474.2 13.63 2487.83	2538.2 13.63 2551.83

***See Note 17 of Table 8.3-1 for information on running RHRSW Pumps

TABLE 8.3-3a

DIESEL GENERATOR E LOADING

DIESEL B UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL A, C OR D

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

		Diesel Generator E Substituted for Diesel Generator A				D/G B	Diesel Generator E Substituted for Diesel Generator C				Diesel Generator E Substituted for Diesel Generator D			
			Demand, kW			Unavailable		Demand, kW				Demand, kW		
Equipment Number#	LOADS	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
	Total Diesel Load from Table 8.3-3		3056.25	3968.85	3991.85	D/G Unavailable		3633.98	2618.08	2780.08		2986.83	2487.83	2551.83
Diesel Generator B, C & D Loads Affected by Diesel Generator E Substitution														
OP514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	(2.5)	(2.5)	(2.5)	1	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)
OK507 A1,A2,B1, B2,C1,C2,D1,D2	Diesel Generator Starting Air Compressors	2	(18)	-	-	2	2	(18)	-	-	2	(18)	-	-
OE508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	15	15	15	1	1	15	15	15	1	15	15	15
OE525 A,B,C,D	Diesel Generator Lube Oil Heaters	1	-	9	9	1	1	-	9	9	1	-	9	9
OE570 A,B,C,D	Diesel Generator Space Heaters	1	4.5	4.5	4.5	1	1	4.5	4.5	4.5	1	4.5	4.5	4.5
OP530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	1	4.5	4.5	4.5	1	1	4.5	4.5	4.5	1	4.5	4.5	4.5
OP532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	9	9	9	1	1	9	9	9	1	9	9	9
Diesel Generator E Loads														
OV512 E1,E2	Diesel Generator E Room Ventilation Supply Fans	2	60	60	60	-	2	60	60	60	2	60	60	60
OV512 E3,E4	Diesel Generator E Room Ventilation Exhaust Fans	2	60	60	60	-	2	60	60	60	2	60	60	60
OP530 E	Diesel Generator E Jacket Water Circulating Pump	1	-	-	-	-	1	-	-	-	1	-	-	-
OP514 E	Diesel Generator E Diesel Oil Transfer Pump	1	2	2	2	-	1	2	2	2	1	2	2	2
OE508 E	Diesel Generator E Jacket Water Heater	1	-	-	-	-	1	-	-	-	1	-	-	-
OE525 E	Diesel Generator E Lube Oil Heater	1	-	-	-	-	1	-	-	-	1	-	-	-
OE570 E	Diesel Generator E Space Heater	1	-	-	-	-	1	-	-	-	1	-	-	-
OP532 E	Diesel Generator E Pre-Lube Pump	1	-	-	-	-	1	-	-	-	1	-	-	-

TABLE 8.3-3a

DIESEL GENERATOR E LOADING

DIESEL B UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL A, C OR D

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

		Diesel Generator E Substituted for Diesel Generator A				D/G B Unavailable	Diesel Generator E Substituted for Diesel Generator C				Diesel Generator E Substituted for Diesel Generator D			
			Demand, kW					Demand, kW				Demand, kW		
Equipment Number#	LOADS	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min & Beyond
OP531 E	Diesel Generator E Standby Jacket Water Pump	1	-	-	-	-	1	-	-	-	1	-	-	-
OP533 E	Diesel Generator E Standby Lube Oil Pump	-	-	-	-	-	1	-	-	-	1	-	-	-
OD596	Diesel Generator E Battery Charger	1	20	20	20	-	1	20	20	20	1	20	20	20
OV511 E	Diesel Generator E Battery Room Exhaust Fan	1	2	2	2	-	1	2	2	2	1	2	2	2
OY565	Diesel Generator E Distribution Panel	1	15	15	15	-	1	15	15	15	1	15	15	15
OLP5B	Diesel Generator E Essential Lighting Panel	1	30	30	30	-	1	30	30	30	1	30	30	30
OX565	Diesel Generator E Transformer Losses	1	10	10	10	-	1	10	10	10	1	10	10	10
			3267.75	4207.35	4230.35			3845.48	2856.58	3018.58		3198.33	2726.33	2790.33
	4.16kV Cable Losses (A,C,D)		(11.75)	(11.75)	(11.75)			(9.48)	(9.48)	(9.48)		(13.63)	(13.63)	(13.63)
	4.16kV Cable Losses (E)		14.54	14.54	14.54			9.96	9.96	9.96		13.79	13.79	13.79
	TOTAL DIESEL LOAD		3270.54	4210.14	4233.14			3845.96	2857.06	3019.06		3198.49	2726.49	2790.49

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TABLE 8.3-4
DIESEL GENERATOR LOADING

DIESEL C UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				D/G C	Diesel Generator D			
			Demand kW				Demand kW			Unavailable		Demand kW		
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
	Unit 1 DBA Loads													
1P206 A, B, C, D	Reactor Core Spray Pumps	1	552	-	-	1	552	552	552	1	1	552	552	552
1P202 A, B, C, D	RHR Pumps	1	1429	-	-	1	1429	1429	1429	1	1	1429	-	-
1P506 A, B	RHR Service Water Pumps**	-	-	-	-	-	-	-	-	1	1	-	463	463
1V211 A,B,C,D	Core Spray Pump Room Unit Coolers Motor Operated Valves	1 Set	2	-	-	1 Set	2	2	2	1 Set	1 Set	2	2	2
1V222 A,B	Engineered Safeguards Switchgear & L.C. Room Unit Coolers	1	13	13	13	1	-	-	-	-	-	-	-	-
1V210 A,B,C,D	RHR Pump Room Unit Coolers	1	9	-	-	1	9	9	9	1	1	9	-	-
1V208 A,B	RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	1	-	-	-	-	-	-	-	-
1V209 A,B	HPCI Pump Room Unit Coolers	-	-	-	-	1	1.5	-	-	-	1	1.5	1.5	1.5
1D613, 623, 633, 643	Battery Chargers, 125V D.C.	1	16	16	16	1	16	16	16	1	1	16	16	16
1Y216, 226, 236, 246	120V Instrument A.C. Dist. Panels	1	24	24	24	1	24	24	24	1	1	24	24	24
1E219, 220	Standby Liquid Cont Tank Heater	-	-	-	-	-	-	-	-	2	-	-	-	-
1P208 A, B	Standby Liquid Cont Injection Pumps	1	-	-	-	-	-	-	-	1	-	-	-	-
1D653 A, 1D653 B, 663	Battery Chargers, 250V D.C.	1	102	102	102	1	44	44	44	-	-	-	-	-
1E440 A, B, C, D	Containment Hydrogen Recombiners	1	-	-	-	1	-	-	75	1	1	-	-	75
1V506 A, B	RHR Service Water Pump House Supply Fan (RHRSWP)	1	-	-	-	1	-	4.6	4.6	1	-	-	-	-
1V411 – 417 A,B,	Drywell Area Unit Cooler	-	-	-	-	-	-	-	-	7	7	-	-	9.4
1V418 A,B	CRD Area Recirc. Fan	-	-	-	-	-	-	-	-	1	1	-	-	2.6
1C226 A, B	Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1C291 A, B	Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1S246, 247	LPCI Swing Bus Isolation System M-G Sets	1	13	13	13	1	13	13	13	-	-	-	-	-
1X210, 220, 230, 240	Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	15	15	15	1	1	15	15	15

TABLE 8.3-4
DIESEL GENERATOR LOADING

DIESEL C UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				D/G C	Diesel Generator D			
			Demand kW				Demand kW			Unavailable		Demand kW		
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
	Unit 2 Forced Shutdown Loads													
2P202 A,B,C,D	RHR Pumps	1	-	1429	1429	1	-	-	-	1	1	-	-	-
2P506 A, B	Rhr Service Water Pumps** Motor Operated Valves	1 Set	-			1 Set	-	463	463	- Set	- Set	-	-	-
2V222 A, B	Engineered Safeguards Switchgear & L.C. Room Unit Coolers	1	13	-	-	1	13	13	13	-	-	-	-	-
2V210 A,B,C,D	RHR Pump Room Unit Coolers	1	-	9	9	1	-	-	-	1	1	-	-	-
2V208 A,B	RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	-	-	-	-	1	-	-	-	-
2V209 A,B	HPCI Pump Room Unit Coolers	-	-	-	-	1	-	-	-	-	1	-	-	-
2D613, 623, 633, 643	Battery Chargers, 125V D.C.	1	16	16	16	1	16	16	16	1	1	16	16	16
2Y216, 226, 236, 246	120V Instrument A.C. Dist. Panels	1	24	24	24	1	24	24	24	1	1	24	24	24
2E219, 220	Standby Liquid Cont Tank Heater	-	-	-	-	-	-	-	-	2	-	-	-	-
2P208, A,B	Standby Liquid Control Injection Pumps	1	-	-	-	-	-	-	-	1	-	-	-	-
2D653 A, 2D653 B, 663	Battery Chargers, 250V D.C.	1	40	40	40	1	40	40	40	1	-	-	-	-
2E440 A,B,C,D	Containment Hydrogen Recombiners	1	-	-	-	1	-	-	-	1	1	-	-	-
2V506 A,B	RHR Service Water Pump House Supply Fan	1	-	4.6	4.6	1	-	-	-	-	-	-	-	-
2V411-417 A,B	Drywell Area Unit Cooler	-	-	-	-	-	-	-	-	7	7	60.2	60.2	60.2
2V148 A,B	CRD Area Recirc. Fans	-	-	-	-	-	-	-	-	1	1	4.4	4.4	4.4
2P206, A,B,C,D	Core Spray Pumps	1	-	-	-	1	-	-	-	1	1	-	-	-
2V211 A,B,C,D	Core Spray Pumps Room Unit Coolers	1	-	-	-	1	-	-	-	1	1	-	-	-
2D288, 289	SPDS – UPS	1	-	-	-	1	-	-	-	-	-	-	-	-
2K210 A,B	Compressor Motor for Emergency SWGR and L. C. Room Cooling	1	48	48	48	1	-	-	-	-	-	-	-	-
2C226 A,B	Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
2C291 A,B	Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
2S246, 247	LPCI Swing Bus Isolation System M-G Sets	1	13	13	13	1	13	13	13	-	-	-	-	-

TABLE 8.3-4
DIESEL GENERATOR LOADING

DIESEL C UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				D/G C	Diesel Generator D			
			Demand kW				Demand kW			Unavailable		Demand kW		
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
2X210, 220, 230, 240	Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	15	15	15	1	1	15	15	15
	<u>Unit 1 & 2 Common Loads</u>													
OV116 A,B	Control Structure Battery Room Exhaust Fans	-	-	-	-	-	-	-	-	1	1	4.5	4.5	4.5
OV512 A,B,C,D	Diesel Generator Room Ventilation Supply Fans	1	33	33	33	1	33	33	33	1	1	33	33	33
OP514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	2.5	2.5	2.5	1	2.5	2.5	2.5	1	1	2.5	2.5	2.5
OV201 A,B	Reactor Building Recirc. Fans	1	61	61	61	1	-	-	-	-	-	-	-	-
OP504, A*,B,C,D	Emergency Service Water Pumps	1	357*	357*	357'	1	357	357	357	1	1	346	346	346
OV109 A,B	Standby Gas Treatment System Exhaust Fan	-	-	-	-	-	-	-	-	1	1	42	42	42
OV115 A,B, 117 A,B	Control and Computer Rooms Air Cond Unit Fans	-	-	-	-	-	-	-	-	2	2	66	66	66
OK507 A1, A2 B1, B2, C1, C2, D1, D2	Diesel Generator Starting Air Compressors	2	18	-	-	2	18	-	-	2	2	18	-	-
OV521, A,B,C,D	Engineered Safeguards Service Water Pump House Supply Fans	2	4.4	4.4	4.4	2	9	9	9	-	-	-	-	-
OV162 A,B	Control Structure Chilled Water Circulating Pumps	-	-	-	-	-	-	-	-	1	1	25	25	25
OV101 A,B	Control Structure Emergency Outside Air Supply Fans	-	-	-	-	-	-	-	-	1	1	17	17	17
OK112 A,B	Control Structure Water Chiller Compressors	-	-	-	-	-	-	-	-	1	1	279	279	279
OE145 A,B1	Control Structure Air Cond. Unit Heating Coils	-	-	-	-	-	-	-	-	1	1	130	130	130
OV118 A,B	Standby Gas Treatment System Equipment Room Exhaust Fans	-	-	-	-	-	-	-	-	1	1	4.5	4.5	4.5
OV144 A,B	Standby Gas Treatment System Equipment Room Unit Heater Fans	-	-	-	-	-	-	-	-	1	1	4.5	4.5	4.5

* Actual pump runout less than 357 kW.
* See Note 17 of Table 8.3-1 for information on running RHRSW Pumps

TABLE 8.3-4
DIESEL GENERATOR LOADING

DIESEL C UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				D/G C	Diesel Generator D			
		Demand kW				Demand kW				Unavailable	Demand kW			
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
OV103 A,B	Control Structure Air Cond. Unit Fans	-	-	-	-	-	-	-	-	1	1	42	42	42
OP122 A,B	Control Structure Chiller Comp. Oil Pump	-	-	-	-	-	-	-	-	1	1	1.4	1.4	1.4
OC886 A,B	Standby Gas Treatment System Heater	-	-		-	-	-	-	-	1	1	90	90	90
OP171 A,B	Control Structure Chiller Emerg. Condenser Circ. Pumps	-	-	-	-	-	-	-	-	1	1	17	17	17
OE143 A,B	Control Structure Emergency Outside Air Supply Unit Heating Coil	-	-	-	-	-	-	-	-	1	1	30	30	30
OP531 A,B,C,D	Diesel Generator Standby Jacket Water Pumps	1	-	-	-	1	-	-	-	1	1	-	-	-
OP533 A,B,C,D	Diesel Generator Standby Lube Oil Pumps	1	-	-	-	1	-	-	-	1	1	-	-	-
OE144 A,B	Standby Gas Treatment Equipment Room Heater	-	-	-	-	-	-	-	-	1	1	30	30	30
OC577 A,B,C,D	Diesel Generator HVAC Panels	1	4	4	4	1	4	4	4	1	1	4	4	4
OC578, 579	ESSW Pump House HVAC Control Panels	1	3.8	3.8	3.8	1	3.8	3.8	3.8	-	-	-	-	-
OE508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	-	-	-	1	-	-	-	1	1	-	-	-
OE525, A,B,C,D	Diesel Generator Lube Oil Heaters	1	9	-	-	1	9	-	-	1	1	9	-	-
OE570 A,B,C,D	Diesel Generator Space Heaters	1	-	-	-	1	-	-	-	1	1	-	-	-
OP112 A,B	Control Structure Chiller Refrigerant Transfer Pumps	-	-	-	-	-	-	-	-	1	1	-	-	-
OP530, A,B.C,D	Diesel Generator Jacket Water Circulating Pumps	1	-	-	-	1	-	-	-	1	1	-	-	-
OP532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	-	-	-	1	-	-	-	1	1	-	-	-
	ESF Loads, Total		2839.7	2250.3	2250.3		2662.8	3101.9	3176.9			3363.5	2361.5	2448.5
	Non-ESF Loads													
1P111/2P111	Turbine Generator Turning Gear Oil PP	1	32	32	32	1	32	32	32	-	-	-	-	-
2P132 A,B	CRD Water Pumps, Unit #2	1	-	215	163	-	-	-	-	-	1	-	-	-
	Essential Lighting	Set	96	96	96	Set	89	89	89	Set	Set	77	77	77
0X604	Cont. Struc. Transformer	-	-	-	-	-	-	-	-	-	1	2	2	2
1D666/2D666	Vital A.C. Uninterruptable Power Supply	-	-	-	-	1	-	-	-	-	2	-	-	32
1P/2P109 A-H, J 1S/2S103, 104	Turbine Generator Bearing Lift PPS & Turning Gear Motors	1	-	119	119	1	-	119	119	-	-	-	-	-

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TABLE 8.3-4
DIESEL GENERATOR LOADING

DIESEL C UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				D/G C	Diesel Generator D			
			Demand kW				Demand kW			Unavailable		Demand kW		
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
1K/2K107 A,B	Instrument Air Compressors	1	-	82	82	1	-	82	82	1	1	-	-	-
1P103 A,B 2P103 A,B	Turbine Bldg. Cooling Water Pumps	2	26	26	26	2	26	26	26	-	-	-	-	-
1P/2P210 A,B	Reactor Bldg. Closed Cooling Wtr. Pumps	1	25	25	25	1	25	25	25	1	1	25	-	-
1D656/2D656	Computer Uninterruptable Power Supply (Alternate Supply)	-	-	-	-	-	-	-	-	2	-	-	-	-
OS108	Control Structure Passenger Elevator	-	-	-	-	-	-	-	-	1	-	-	-	-
1S204, 2S204	Reactor Bldg. Service Elevators	-	-	-	-	-	-	-	-	-	2	8	8	8
1C/2C142 A,B	Instrument Air Dyers-Compressed Air System	1	-	-	-	1	-	-	-	1	1	-	12	12
1K/2K205 A,B	Containment Instrument Gas Compressors	1	-	-	-	1	-	-	-	1	1	-	-	-
1S/2S106 A,B,C	RFPT Turning Gear	3	-	4.8	4.8	3	-	4.8	4.8	-	-	-	-	-
1P105, 2P105	Main Condenser Vacuum Pump	-	-	-	-	1	-	-	-	1	-	-	-	-
OLP16	ESSW Pump House Lighting Panel	1	-	-	-	-	-	-	-	-	-	-	-	-
OP170 A,B	Control Structure Chiller Condenser Water Circulating Pump	-	-	-	-	-	-	-	-	1	1	-	-	-
OP595 A1, A2 B1, B2	RHR Spray Pond Drain Pumps	2	-	-	-	2	-	-	-	-	-	-	-	-
OPP509, 511	ESSW Pump House Distribution Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1X/2X290, 1X291 B, 2X291 A,B	Standby Liquid & Oxygen and Hydrogen Analyzer Heat Tracing Panels	3	21	21	21	-	-	-	-	-	2	19	19	19
1K/2K102 A,B	Turbine Building Chillers	-	-	-	-	-	-	-	-	-	1	-	-	-
1K/2K104	Main Turbine L.O. Reservoir Vapor Extractor	1	6	6	6	1	6	6	6	-	-	-	-	-
1K/2K105	Main Turbine L.O. Reservoir Oil Mist Eliminator	1	2.4	2.4	2.4	1	2.4	2.4	2.4	-	-	-	-	-
1K/2K206 A, B	Reactor Building Chillers	1	-	-	-	2	-	-	-	1	-	-	-	-
1V223	Remote Shutdown Panel Room Transfer Fan	1	-	-	-	-	-	-	-	-	-	-	-	

TABLE 8.3-4
DIESEL GENERATOR LOADING

DIESEL C UNAVAILABLE

UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				D/G C	Diesel Generator D			
		Demand kW				Demand kW				Unavailable	Demand kW			
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10--60 Min.	60 Min. & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
Equipment No.	Loads													
1S/2S237 A,B	Reactor Protection System M-G Sets	2	-	54	54	2	-	54	54	-	-	-	-	-
OX201, 203, 211, 213	Engineered Safeguards Transformer Auxiliaries	1	2.8	-	-	2	3.7	-	-	1	-	-	+	-
1X800, 801	UPS/SPDS Distribution Panels	1	5	5	5	1	3	3	3	-	-	-	-	-
1D/2D130 1D/2D240	UPS/120V Instrument AC Distribution Panel	2	0	68	68	2	-	-	-	2	2	78	78	78
Each UPS is fed by preferred or alternate source. Diesel Generator C, D are preferred source and Diesel Generator A, B are alternate source														
1PP100	30 KVA Transformer / TB1 & SGTSs	1	30	30	30	-				-	-	-	-	-
2X199	30 KVA Transformer / TB2 VERMS	-	-	-	-	1	30	30	30	-	-	-	-	-
1X297	20 KVA Transformer / RB1 VERMS	1	20	20	20	-	-	-	-	-	-	-	-	-
2X297	20 KVA Transformer / RB2 VERMS	-	-	-	-	1	20	20	20	-	-	-	-	-
1D667, 2D667	Units 1 and 2 HCVS Power Supplies	-	-	-	-	-	-	-	-	-	-	-	-	-
			3105.9	3056.5	3004.5		2899.9	3595.10	3670.1			3572.5	2557.5	2676.5
	4.16 kV Cable Losses		11.75	11.75	11.75		11.25	11.25	11.25			13.63	13.63	13.63
	Total Diesel Load		3117.65	3068.25	3016.25		2911.15	3606.35	3681.35			3586.13	2571.13	2690.13

TABLE 8.3-4a

DIESEL GENERATOR E LOADING

DIESEL C UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL A OR B OR D

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number	Loads	Diesel Generator E Substituted for Diesel Generator A				Diesel Generator E Substituted for Diesel Generator B				D/G C Unavailable	Diesel Generator E Substituted for Diesel Generator D			
		Number Connected	Demand, kW			Number Connected	Demand, kW			Number Connected	Number Connected	Demand, kW		
			0-10 Min.	10-60 Min.	60 Min. & Beyond		0-10 Min.	10-60 Min.	60 Min. & Beyond			0-10 Min.	10-60 Min.	60 Min. & Beyond
Total Diesel Load from Table 8.3-4			3117.65	3068.25	3016.25		2911.15	3606.35	3681.35			3586.13	2571.13	2690.13
Diesel Generator A, B, & D Loads Affected by Diesel Generator E Substitution														
OP514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)	1	1	(2.5)	(2.5)	(2.5)
OK507 A1,A2,B1, B2,C1,C2,D1,D2	Diesel Generator Starting Air Compressors	2	(18)	-	-	2	(18)	-	-	2	2	(18)	-	-
OE508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	15	15	15	1	15	15	15	1	1	15	15	15
OE525 A,B,C,D	Diesel Generator Lube Oil Heaters	1	-	9	9	1	-	9	9	1	1	-	9	9
OE570 A,B,C,D	Diesel Generator Space Heaters	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	1	4.5	4.5	4.5
OP530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	1	4.5	4.5	4.5
OP532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	9	9	9	1	9	9	9	1	1	9	9	9
Diesel Generator E Loads														
OV512 E1,E2	Diesel Generator E Room Ventilation Suppply Vans	2	60	60	60	2	60	60	60	-	2	60	60	60
OV512 E3,E4	Diesel Generator E Room Ventilation Exhaust Fans	2	60	60	60	2	60	60	60	-	2	60	60	60
OP530 E	Diesel Generator E Jacket Water Circulating Pump	1	-	-	-	1	-	-	-	-	1	-	-	-
OP514 E	Diesel Generator E Diesel Oil Transfer Pump	1	2	2	2	1	2	2	2	-	1	2	2	2
OE508 E	Diesel Generator E Jacket Water Heater	1	-	-	-	1	-	-	-	-	1	-	-	-
OE525 E	Diesel Generator E Lube Oil Heater	1	-	-	-	1	-	-	-	-	1	-	-	-
OE570 E	Diesel Generator E Space Heater	1	-	-	-	1	-	-	-	-	1	-	-	-

TABLE 8.3-4a

DIESEL GENERATOR E LOADING

DIESEL C UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL A OR B OR D

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number	Loads	Diesel Generator E Substituted for Diesel Generator A				Diesel Generator E Substituted for Diesel Generator B				D/G C Unavailable	Diesel Generator E Substituted for Diesel Generator D			
			Demand, kW				Demand, kW					Demand, kW		
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond
OP532 E	Diesel Generator E Pre-Lube Pump	1	-	-	-	1	-	-	-	-	1	-	-	-
OP531 E	Diesel Generator E Standby Jacket Water Pump	1	-	-	-	1	-	-	-	-	1	-	-	-
OP553 E	Diesel Generator E Standby Lube Oil Pump	-	-	-	-	-	-	-	-	-	-	-	-	-
OD596	Diesel Generator E Battery Charger	1	20	20	20	1	20	20	20	-	1	20	20	20
OV511 E	Diesel Generator E Battery Room Exhaust Fan	1	2	2	2	1	2	2	2	-	1	2	2	2
OV565	Diesel Generator E Distribution Panel	1	15	15	15	1	15	15	15	-	1	15	15	15
OLP5B	Diesel Generator E Essential Lighting Panel	1	30	30	30	1	30	30	30	-	1	30	30	30
OX565	Diesel Generator E Transformer Losses	1	10	10	10	1	10	10	10	-	1	10	10	10
			3329.15	3306.75	3254.75		3122.65	3844.85	3919.85			3797.63	2809.63	2928.63
	4.16kV Cable Losses (A,B,D)		(11.75)	(11.75)	(11.75)		(11.25)	(11.25)	(11.25)			(13.63)	(13.63)	(13.63)
	4.16kV Cable Losses (E)		14.54	14.54	14.54		13.76	13.76	13.76			13.79	13.79	13.79
	TOTAL DIESEL LOAD		3331.94	3309.54	3257.54		3125.16	3847.36	3922.36			3797.79	2809.79	2928.79

TABLE 8.3-5

DIESEL GENERATOR LOADING
DIESEL D UNAVAILABLE
UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

Equipment No.	Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				D/G D
			Demand kW				Demand kW				Demand kW			Unavailable
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
	Unit 1 DBA Loads													
1P206 A, B, C,D	Reactor Core Spray Pumps	1	552	552	552	1	552	-	-	1	552	552	552	1
1P202 A, B, C,D	RHR Pumps	1	1429	1429	1429	1	1429	-	-	1	1429	-	-	1
1P506 A,B	RHR Service Water Pumps**	-	-	-	-	-	-	-	-	1	-	463	463	1
1V211 A,B,C,D	Core Spray Pump Room Unit Coolers Motor Operated Valves	1 Set	2	2	2	1 Set	2	-	-	1 Set	2	2	2	1 Set
1V222 A,B	Engineered Safeguards Switchgear & L.C Room Unit Coolers	1	13	13	13	1	-	-	-	-	-	-	-	-
1V210, A,B,C,D	RHR Pump Room Unit Coolers	1	9	9	9	1	9	-	-	1	9	-	-	1
1V208 A,B	RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	1	-	-	-	1	-	-	-	-
1V209 A,B	HPCI Pump Room Unit Coolers	-	-	-	-	1	1.5	1.5	1.5	-	-	-	-	1
1D613, 623, 633, 643	Battery Chargers, 125V D.C.	1	16	16	16	1	16	16	16	1	16	16	16	1
1Y216, 226, 236, 246	120V Instrument A.C. Dist Panels	1	24	24	24		24	24	24		24	24	24	
1E219/1E220	Standby Liquid Cont. Tank Heater	-	-	-	-	-	-	-	-	2	10	10	10	1
1P208 A,B	Standby Liquid Injection Control Pumps	1	-	-	-	-	-	-	-	1	-	-	-	1
1D635 A,B; 1D663	Battery Chargers, 250V D.C.	1	56	56	56	1	44	44	44	1	56	56	56	-
1E440 A,B,C,D	Containment Hydrogen Recombiners	1	-	-	75	1	-	-	-	1	-	-	75	1
1V506 A,B	RHR Service Water Pump House Supply Fans (RHRSWP)	1	-	4.6	4.6	1	-	-	-	-	-	-	-	1
1V411-417 A,B	Drywell Area Unit Coolers	-	-	-	-	-	-	-	-	7	-	-	9.4	7
1V418 A,B	CRD Area Recirc. Fans	-	-	-	-	-	-	-	-	1	-	-	2.6	1
1C226 A,B	Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1C291 A,B	Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-

TABLE 8.3-5

DIESEL GENERATOR LOADING
DIESEL D UNAVAILABLE
UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				Diesel Generator C				D/G D
			Demand kW				Demand kW				Demand kW			Unavailable
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
1S246, 247	LPIC Swing Bus Isolation System M-G Sets	1	13	13	13	1	13	13	13	-	-	-	-	-
1X210, 220, 230, 240	Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	15	15	15	1	15	15	15	1
	Unit 2 Forced Shutdown Loads													
2P202 A,B,C,D	RHR Pumps	1	-	-	-	1	-	1415	1415	1	-	-	-	1
2P506 A,B	RHR Service Water Pumps** Motor Operated Valves	1 Set	-	463	463	1 Set	-	-	-	-	-	-	-	- Set
2V222 A,B	Engineered Safeguards Switchgear & L. C. Room Unit Coolers	1	13	13	13	1	-	-	-	-	-	-	-	-
2V210 A,B,C,D	RHR Pump Room Unit Coolers	1	-	-	-	1	-	9	9	1	-	-	-	1
2V208 A,B	RCIC Pump Room Unit Coolers	1	1.5	1.5	1.5	-	-	-	-	1	-	-	-	-
2V209 A,B	HPCI Pump Room Unit Coolers	-	-	-	-	1	-	-	-	-	-	-	-	1
2D613, 623, 633, 643	Battery Chargers, 125V D.C.	1	16	16	16	1	16	16	16	1	16	16	16	1
2Y216, 226, 236, 246	120V Instrument A.C. Dist. Panels	1	24	24	24	1	24	24	24	1	24	24	24	
2E219/2E220	Standby Liquid Cont. Tank Heater	-	-	-	-	-	-	-	-	2	10	10	10	-
2P208 A,B	Standby Liquid Cont Injection Pumps	1	-	-	-	-	-	-	-	1	-	-	-	-
2D653 A,B, 663	Battery Chargers, 250V D.C.	1	20	20	20	1	40	40	40	1	20	20	20	-
2E440 A,B,C,D	Containment Hydrogen Recombiners	1	-	-	-	1	-	-	-	1	-	-	-	1
2V506 A,B	RHR Service Water Pump House Supply Fans (RHRSWP)	1	-	-	-	1	-	4.6	4.6	-	-	-	-	-
2V411-417 A,B	Drywell Area Unit Coolers	-	-	-	-	7	-	-	-	7	60.2	60.2	60.2	7
2V418 A,B	CRD Area Recirc. Fans	-	-	-	-	-	-	-	-	1	4.4	4.4	4.4	1
2P206 A,B,C,D	Core Spray Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1

**See Note 17 of Table 8.3-1 for information on running RHRSW Pumps

TABLE 8.3-5

DIESEL GENERATOR LOADING
DIESEL D UNAVAILABLE
UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

Equipment No.	Loads	Diesel Generator A				Diesel Generator B				Diesel Generator C				D/G D
			Demand kW				Demand kW				Demand kW			Unavailable
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
2V211 A,B,C,D	Core Spray Pump Room Unit Coolers	1	-	-	-	1	-	-	-	1	-	-	-	1
2D288, 2D289	SPDS – UPS	1	-	-	-	1	-	-	-	-	-	-	-	-
2K210 A,B	Compressor Motor for Emergency SWGR and L.C. Room Cooling	1	48	48	48	1	-	-	-	-	-	-	-	-
2C226 A,B	Hydrogen and Oxygen Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
2C291 A,B	Containment Particle Radiation Analyzer Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
2S246, 2S247	LPCI Swing Bus Isolation System M-G Sets	1	13	13	13	1	13	13	13	-	-	-	-	-
2X210, 220, 230, 240	Engineered Safeguards Load Center Transformer Losses	1	15	15	15	1	15	15	15	1	15	15	15	1
	Unit 1 & 2 Common Loads													
OV116 A,B	Control Structure Battery Room Exhaust Fans	-	-	-	-	-	-	-	-	1	4.5	4.5	4.5	1
OV512 A,B,C,D	Diesel Generator Room Ventilation Supply Fans	1	33	33	33	1	33	33	33	1	33	33	33	1
OP514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	2.5	2.5	2.5	1	2.5	2.5	2.5	1	2.5	2.5	2.5	1
OV201 A,B	Reactor Building Recirc Fans	1	61	61	61	1	-	-	-	-	-	-	-	-
OP504 A,B,C,D	Emergency Service Water Pumps	1	357	357	357	1	357*	357*	357*	1	357	357	357	1
OV109 A,B	Standby Gas Treatment System Exhaust Fan	-	-	-	-	-	-	-	-	1	42	42	42	1
OV115 A,B 117 A,B	Control and Computer Rooms Air Cond Unit Fans	-	-	-	-	-	-	-	-	2	66	66	66	2
OK507 A1, A2, B1, B2, C1, C2,D1, D2	Diesel Generator Starting Air Compressors	2	18	-	-	2	18	-	-	2	18	-	-	2
OV521 A,B,C,D	Engineered Safeguards Service Water Pump House Supply Fans (ESWP)	2	9	9	9	2	4.4	4.4	4.4	-	-	-	-	1

*Actual pump runout less than 357 kW.

TABLE 8.3-5

DIESEL GENERATOR LOADING
DIESEL D UNAVAILABLE
UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

Equipment No.	Loads	Diesel Generator A Demand kW				Diesel Generator B Demand kW				Diesel Generator C Demand kW				D/G D Unavailable
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
OP162 A,B	Control Structure Chilled Water Circulating Pumps	-	-	-	-	-	-	-	-	1	25	25	25	1
OV101 A,B	Control Structure Emergency Outside Air Supply Fans	-	-	-	-	-	-	-	-	1	17	17	17	1
OK112 A,B	Control Room Water Chiller Compressors	-	-	-	-	-	-	-	-	1	279	279	279	1
OE145 A,B	Control Structure air Con. Unit Heating Coils	-	-	-	-	-	-	-	-	1	130	130	130	1
OV118 A,B	Standby Gas Treatment System Equipment Room Exhaust Fan	-	-	-	-	-	-	-	-	1	4.5	4.5	4.5	1
OV144 A,B	Standby Gas Treatment System Equipment Room Heating Unit Fans	-	-	-	-	-	-	-	-	1	4.5	4.5	4.5	1
OV103 A,B	Control Structure Air Cond. Unit Fans	-	-	-	-	-	-	-	-	1	42	42	42	1
OP122 A,B	Control Structure Chiller Comp Oil Pump	-	-	-	-	-	-	-	-	1	1.4	1.4	1.4	-
OC886 A,B	Standby Gas Treatment System Heater	-	-	-	-	-	-	-	-	1	90	90	90	1
OP171 A,B	Control Structure Chiller Emerg Condenser Circulating Pumps	-	-	-	-	-	-	-	-	1	17	17	17	1
OE143 A,B	Control Structure Emergency Outside Air Supply Unit Heating Coil	-	-	-	-	-	-	-	-	1	30	30	30	1
OP531 A,B,C,D	Diesel Generator Standby Jacket Water Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1
OP533 A,B,C,D	Diesel Generator Standby Lube Oil Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1
OE144 A,B	Standby Gas Treatment Equipment Room Heating	-	-	-	-	-	-	-	-	1	30	30	30	1
OC577 A,B,C,D	Diesel Generator HVAC Panels	1	4	4	4	1	4	4	4	1	4	4	4	1
OC578, 579	ESSW Pump House HVAC Control Panels	1	3.8	3.8	3.8	1	3.8	3.8	3.8	-	-	-	-	-
OE508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	-	-	-	1	-	-	-	1	-	-	-	1

TABLE 8.3-5

DIESEL GENERATOR LOADING
DIESEL D UNAVAILABLE
UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

Equipment No.	Loads	Diesel Generator A Demand kW				Diesel Generator B Demand kW				Diesel Generator C Demand kW				D/G D Unavailable
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
OE525 A,B,C,D	Diesel Generator Lube Oil Heaters	1	9	-	-	1	9	-	-	1	9	-	-	1
OE570 A,B,C,D	Diesel Generator Space Heaters	1	-	-	-	1	-	-	-	1	-	-	-	1
OP112 A,B	Control Structure Chiller Refrigerant Transfer Pumps	-	-	-	-	-	-	-	-	1	-	-	-	1
OP530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1
OP532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	-	-	-	1	-	-	-	1	-	-	-	1
			2778.3	3218.9	3293.9		2645.2	2054.8	2054.8		3469	2467	2554	
	Non-ESF Loads													
1P/2P111	Turbine Generator Turning Gear Oil Pumps	1	32	32	32	1	32	32	32	-	-	-	-	-
2P132 A,B	CRD Water Pumps Unit 2 Essential Lighting	1 Set	- 96	215 96	163 96	- Set	- 89	- 89	- 89	1 Set	- 44	- 44	- 44	1 Set
1D/2D666	Vital A. C. Uninterruptable Power Supply	-	-	-	-	1	-	-	-	-	-	-	-	2
1P/2P109 A-H,J 1S/2S103, 104	Turbine Generator Bearing Lift Pump & Turning Gear Motor	1	-	119	119	1	-	119	119	-	-	-	-	-
1K/2K107 A,B	Instrument Air Compressors	1	-	82	82	1	-	82	82	1	-	-	-	1
1P103, A,B 2P103A, B	Turbine Bldg. Cooling Water Pumps	2	26	26	26	2	26	26	26	-	-	-	-	-
1P210 A,B 2P210 A,B	Reactor Bldg. Closed Cooling Water Pumps	1	25	25	25	1	25	25	25	1	25	-	-	1
1D656, 2D656	Computer Uninterruptable Power Supply (Alternate Supply)	-	-	-	-	-	-	-	-	2	-	-	75	-

TABLE 8.3-5

DIESEL GENERATOR LOADING
DIESEL D UNAVAILABLE
UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				Diesel Generator C				D/G D
			Demand kW				Demand kW				Demand kW			Unavailable
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
OS108	Control Structure Passenger Elevator	-	-	-	-	-	-	-	-	1	2.5	2.5	2.5	-
1S204, 2S204	Reactor Bldg Service Elevators	-	-	-	-	-	-	-	-	-	-	-	-	2
1C/2C142 A,B	Instrument Air Dryers Compressed Air Systems	1	-	-	-	1	-	-	-	1	-	12	12	1
1K/2K205 A, B	Containment Instrument Gas	1	-	-	-	1	-	-	-	1	-	-	-	1
1S/2S106 A,B,C	RFPT Turning Gear	3	-	4.8	4.8	3	-	4.8	4.8	-	-	-	-	-
1P105, 2P105	Main Condenser Vacuum Pump	-	-	-	-	1	-	-	-	1	-	-	-	-
OLP16	ESSW Pump House Lighting Panel	1	-	-	-	-	-	-	-	-	-	-	-	-
OP170 A,B	Control Structure Chiller Condenser Water Circulating Pumps	-	-	-	-	-	-	-	-	1	-	-	-	1
OP595 A1, A2 B1, B2	RHR Spray Pond Drain Pumps	2	-	-	-	2	-	-	-	-	-	-	-	-
OPP509, 511	ESSW Pump House Distribution Panels	1	-	-	-	1	-	-	-	-	-	-	-	-
1X/2X290 2X291 A 1X/2X291 B	Standby Liquid & Oxygen and Hydrogen Analyzer Heat Tracing Panels	3	21	21	21	-	-	-	-	-	-	-	-	2
1K/2K102 A,B	Turbine Building Chillers	2	-	-	-	1	-	-	-	-	-	-	-	1
1K/2K104	Main Turbine L.O. Reservoir Vapor Extractor	1	6	6	6	1	6	6	6	-	-	-	-	-
1K/2K105	Main Turbine L.O. Reservoir Oil Mist Eliminator	1	2.4	2.4	2.4	1	2.4	2.4	2.4	-	-	-	-	-
1K/2K206 A,B	Reactor Building Chillers	1	-	-	-	2	-	-	-	1	-	-	-	-

TABLE 8.3-5

DIESEL GENERATOR LOADING
DIESEL D UNAVAILABLE
UNIT 1 – DESIGN BASIS ACCIDENT; UNIT 2 – FORCED SHUTDOWN

		Diesel Generator A				Diesel Generator B				Diesel Generator C				D/G D
			Demand kW				Demand kW				Demand kW			Unavailable
Equipment No.	Loads	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
1V223	Remote Shutdown Panel Room Transfer Fan	1	-	-	-	-	-	-	-	-	-	-	-	-
1S/2S237 A,B	Reactor Protection System M-G Sets	2	-	54	54	2	-	54	54	-	-	-	-	-
2X201, 203, 211, 213	Engineered Safeguards Transformer Auxiliaries	1	2.8	-	-	2	3.7	-	-	1	0.9	-	-	-
1X800, 801	UPS/SPDS Distribution Panels	1	5	5	5	1	3	3	3	-	-	-	-	-
1D/2D130, 240	UPS/120V Instrument AC Distribution Panel	2	-	-	-	2	0	68	68	2	78	78	78	2
Each UPS is Fed by preferred or alternate source. Diesel Generator C, D are preferred source and Diesel Generator A, B are alternate source.														
1PP100	30KVA Transformer / TB1 & SGTS VERMS	1	30	30	30	-				-	-	-	-	-
2X199	30 KVA Transformer / TB2 VERMS	-	-	-	-	1	30	30	30	-	-	-	-	-
1X297	20 KVA Transformer / RB1 VERMS	1	20	20	20	-	-	-	-	-	-	-	-	-
2X297	20 KVA Transformer / RB2 VERMS	-	-	-	-	1	20	20	20	-	-	-	-	-
1D667, 2D667	Units 1 and 2 HCVS Power Supplies	-	-	-	-	-	-	-	-	1	5.1	5.1	5.1	
			3044.5	3957.1	3980.1		2882.3	2616	2616		3624.5	2608.6	2770.6	
	4.16 kV Cable Losses		11.75	11.75	11.75		11.25	11.25	11.25		9.48	9.48	9.48	
	Total Diesel Load		3056.25	3968.85	3991.85		2893.55	2627.25	2627.25		3633.98	2618.08	2780.08	

TABLE 8.3-5a

DIESEL GENERATOR E LOADING

DIESEL D UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL A OR B OR C

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number	Loads	Diesel Generator E Substituted for Diesel Generator A				Diesel Generator E Substituted for Diesel Generator B				Diesel Generator E Substituted for Diesel Generator C				D/G D Unavailable
			Demand, kW				Demand, kW				Demand, kW			
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
Total Diesel Load from Table 8.3-5			3056.25	3968.85	3991.85		2893.55	2627.25	2627.25		3633.98	2618.08	2780.08	
Diesel Generator A, B & C Loads Affected by Diesel Generator E Substitution														
OP514 A,B,C,D	Diesel Generator Diesel Oil Transfer Pumps	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)	1	(2.5)	(2.5)	(2.5)	1
OK507 A1,A2,B1, B2,C1,C2,D1,D2	Diesel Generator Starting Air Compressors	2	(18)	-	-	2	(18)	-	-	2	(18)	-	-	2
OE508 A,B,C,D	Diesel Generator Jacket Water Heaters	1	15	15	15	1	15	15	15	1	15	15	15	1
OE525 A,B,C,D	Diesel Generator Lube Oil Heaters	1	-	9	9	1	-	9	9	1	-	9	9	1
OE570 A,B,C,D	Diesel Generator Space Heaters	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1
OP530 A,B,C,D	Diesel Generator Jacket Water Circulating Pumps	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1	4.5	4.5	4.5	1
OP532 A,B,C,D	Diesel Generator Pre-Lube Pumps	1	9	9	9	1	9	9	9	1	9	9	9	1
Diesel Generator E Loads														
OV512 E1,E2	Diesel Generator E Room Ventilation Supply Fans	2	60	60	60	2	60	60	60	2	60	60	60	-
OV512 E3,E4	Diesel Generator E Room Ventilation Exhaust Fans	2	60	60	60	2	60	60	60	2	60	60	60	-
OP530 E	Diesel Generator E Jacket Water Circulating Pump	1	-	-	-	1	-	-	-	1	-	-	-	-
OP514 E	Diesel Generator E Diesel Oil Transfer Pump	1	2	2	2	1	2	2	2	1	2	2	2	-
OE508 E	Diesel Generator E Jacket Water Heater	1	-	-	-	1	-	-	-	1	-	-	-	-
OE525 E	Diesel Generator E	1	-	-	-	1	-	-	-	1	-	-	-	-

TABLE 8.3-5a

DIESEL GENERATOR E LOADING

DIESEL D UNAVAILABLE
DIESEL GENERATOR E SUBSTITUTED FOR DIESEL A OR B OR C

UNIT 1 - DESIGN BASIS ACCIDENT; UNIT 2 - FORCED SHUTDOWN

Equipment Number	Loads	Diesel Generator E Substituted for Diesel Generator A				Diesel Generator E Substituted for Diesel Generator B				Diesel Generator E Substituted for Diesel Generator C				D/G D Unavailable
			Demand, kW				Demand, kW				Demand, kW			
		Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected	0-10 Min.	10-60 Min.	60 Min. & Beyond	Number Connected
OE570 E	Lube Oil Heater Diesel Generator E	1	-	-	-	1	-	-	-	1	-	-	-	-
OP532 E	Space Heater Diesel Generator E	1	-	-	-	1	-	-	-	1	-	-	-	-
OP531 E	Pre-Lube Pump Diesel Generator E	1	-	-	-	1	-	-	-	1	-	-	-	-
OP533 E	Standby Jacket Water Pump Diesel Generator E	1	-	-	-	1	-	-	-	1	-	-	-	-
OD596	Standby Lube Oil Pump Diesel Generator E	1	20	20	20	1	20	20	20	1	20	20	20	-
OV511 E	Battery Charger Diesel Generator E	1	2	2	2	1	2	2	2	1	2	2	2	-
OY565	Battery Room Exhaust Fan Diesel Generator E	1	15	15	15	1	15	15	15	1	15	15	15	-
OLP5 B	Distribution Panel Diesel Generator E	1	30	30	30	1	30	30	30	1	30	30	30	-
OX565	Essential Lighting Panel Diesel Generator E	1	10	10	10	1	10	10	10	1	10	10	10	-
	Transfer Losses													
			3267.75	4207.35	4230.35		3105.05	2865.75	2865.75		3845.48	2856.58	3018.58	
	4.16kV Cable Losses (A,B,C)		(11.75)	(11.75)	(11.75)		(11.25)	(11.25)	(11.25)		(9.48)	(9.48)	(9.48)	
	4.16kV Cable Losses (E)		14.54	14.54	14.54		13.76	13.76	13.76		9.96	9.96	9.96	
	TOTAL DIESEL LOAD		3270.54	4210.14	4233.14		3107.56	2868.26	2868.26		3845.96	2857.06	3019.06	

TABLE 8.3-6A
125V DC LOAD CYCLE 1D610

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	0 – 240
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	0 – 240
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	0 – 240
12.	480V LOAD CENTER (NON-CLASS 1E)	0 – 240
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP INVERTER	0 – 240
15.	BOP ESS RELAY PANELS	0 – 240
16.	480 VOLT BREAKER TRIP (SPRING CHARGE MOTORS)	0 - 1
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6B
125V DC LOAD CYCLE 1D620

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	0 – 240
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	0 – 240
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	0 – 240
12.	480V LOAD CENTER (NON-CLASS 1E)	N/A
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP INVERTER	0 – 240
15.	BOP ESS RELAY PANELS	0 – 240
16.	480 VOLT BREAKER (SPRING CHARGE MOTORS)	N/A
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6C
125V DC LOAD CYCLE 1D630

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	0 – 240
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	N/A
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	N/A
12.	480V LOAD CENTER (NON-CLASS 1E)	0 – 240
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP INVERTER	N/A
15.	BOP ESS RELAY PANELS	N/A
16.	480 VOLT BREAKER (SPRING CHARGE MOTORS)	0 – 1
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6D
125V DC LOAD CYCLE 1D640

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	0 – 240
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	0 – 240
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	N/A
12.	480V LOAD CENTER (NON-CLASS 1E)	N/A
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP INVERTER	N/A
15.	BOP ESS RELAY PANELS	N/A
16.	480 VOLT BREAKER (SPRING CHARGE MOTORS)	N/A
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6E
125V LOAD CYCLE 2D610

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	0 – 1
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	0 – 240
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	0 – 240
12.	480V LOAD CENTER (NON-CLASS 1E)	0 – 240
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP INVERTER	0 – 240
15.	BOP ESS RELAY PANELS	0 – 240
16.	480 VOLT BREAKER (SPRING CHARGE MOTORS)	0 – 1
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6F
125V DC LOAD CYCLE 2D620

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	N/A
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	0 – 240
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	0 – 240
12.	480V LOAD CENTER (NON-CLASS 1E)	0 – 240
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP (SBO) INVERTER	0 – 240
15.	BOP ESS RELAY PANELS	0 – 240
16.	480 VOLT BREAKER (SPRING CHARGE MOTORS)	N/A
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6G
125V DC LOAD CYCLE 2D630

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	0 – 1
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	N/A
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	N/A
12.	480V LOAD CENTER (NON-CLASS 1E)	0 – 240
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP INVERTER	N/A
15.	BOP ESS PANELS	N/A
16.	480 VOLT BREAKER (SPRING CHARGE MOTORS)	0 – 1
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6H
125V DC LOAD CYCLE 2D640

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	UNIT PROTECTION RELAY & IND LTS	N/A
2.	4KV SWITCHGEAR	0 – 240
3.	480V LOAD CENTER (CLASS 1E)	0 – 240
4.	D/G CONTROL RELAY PANEL	0 – 240
5.	D/G STANDBY BOOSTER OIL PUMP	0 – 1
6.	CONTROL STRUCTURE H/V PANEL	0 – 240
7.	RHR EMERGENCY SW PANEL	0 – 240
8.	MISC NSSS PANELS	0 – 240
9.	MISC BOP PANELS	0 – 240
10.	MISC PANELS (NON-CLASS 1E)	0 – 240
11.	13KV SWITCHGEAR (NON-CLASS 1E)	N/A
12.	480V LOAD CENTER (NON-CLASS 1E)	0 – 240
13.	ANNUNCIATOR PANELS	0 – 240
14.	LOOP INVERTER	N/A
15.	BOP ESS RELAY PANELS	N/A
16.	480 VOLT BREAKER (SPRING CHARGE MOTORS)	N/A
17.	U/V & O/V ALARM RELAYS	0 – 240

TABLE 8.3-6I
125 VDC LOAD CYCLE CHANNEL “H” (0D597)

LOAD DESCRIPTION		OPERATING TIME (MINUTES)
1.	D/G CONTROL PANELS	0 - 240
2.	4KV SWITCHGEAR	0 – 1
3.	480 V MCC (CLASS 1E)	0 – 1
4.	D/G STANDBY FUEL OIL PUMP	0 – 240
5.	125V DC MCC (CLASS 1E)	0 – 240
6.	125V DC DISTRIBUTION PANEL (NON-CLASS 1E)	0 – 240

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Table 8.3-6J

125 VDC Battery Duty Load Profiles

UNIT 1							
1D610		1D620		1D630		1D640	
Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes
1	300	1	300	1	294	1	297
239	115	239	115	239	73	239	76
UNIT 2							
2D610		2D620		2D630		2D640	
Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes
1	323	1	250	1	297	1	300
3	96	239	110	239	80	239	83
10	110						
46	96						
2	110						
178	96						
UNIT COMMON							
0D595							
Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes
1	253						
239	75						
Reference: FSAR Section 8.3.2.1.1.6							

TABLE 8.3-7A

Unit 1 250V DC Load Cycle Div I (1D650)
Worst Case LOCA Profile

Equipment Number	Load Description	Operating Time (Minutes)
1D656	Computer UPS	0 – 30
1P110	Turbine Generator Emergency Seal Oil Pump	0 – 30
1P125B	RFPT B Emergency Oil Pump	0 – 30
1P125C	RFPT C Emergency Oil Pump	0 – 30
1P155A	Reactor Recirculation Pump ‘A’ M-G Set Emergency	0 – 30
1P219	RCIC Barometric Condenser Vacuum Pump	0 – 240
1P220	RCIC Vacuum Tank Condensate Pump	0 – 240
FV149F019	RCIC Min Flow Valve to Suppression Pool	0 – 1
HV149F008	RCIC Turbine Steam Supply Outboard Isolation Valve	1 – 2
HV149F010	RCIC Pump Suction CST Supply Valve	0 – 2
HV149F012	RCIC Pump Discharge Valve	N/A
HV149F013	RCIC Injection Valve	0 – 2
HV149F022	RCIC Test to CST Isolation Valve	N/A
HV149F031	RCIC Pump Suction Suppression Pool Supply Valve	0 – 1
HV149F059	RCIC Turbine Exhaust Valve to Suppression Pool	N/A
HV149F060	RCIC Vacuum Pump Discharge Valve to Suppression Pool	N/A
HV149F062	RCIC Turbine Exhaust Outboard Vacuum Breaker Valve	1 – 2
HV15012	RCIC Turbine Trip & Throttling Valve	N/A
HV150F045	RCIC Turbine Steam Supply Valve	0 – 1
HV150F046	RCIC Lube Oil Cooler Water Supply Valve	0 – 1
HV155F079	HPCI Turbine Exhaust Inboard Vacuum Breaker Valve	0 - 1

TABLE 8.3-7B

Unit 1 250V DC Load Cycle Div II (1D660)
Worst Case LOCA Profile

Equipment Number	Load Description	Operating Time (Minutes)
1D666	Vital AC UPS	0 – 240
1P112	Turbine Generator Emergency Bearing Oil Pump	0 – 30
1P125A	RFPT A Emergency Lube Oil Pump	0 – 30
1P155B	Reactor Recirculation Pump ‘B’ M-G Set Emergency	0 – 30
1P213	HPCI Pump Turbine Auxiliary Oil Pump	0 - 1
1P215	HPCI Vacuum Tank Drain Pump Condensate	0 – 240
1P216	HPCI Barometric Condenser Vacuum Pump	0 – 240
HV141F019	Main Steam Line Outboard Drain Valve	0 - 1
HV144F004	RWCU Inlet Outboard Isolation Valve	0 - 1
HV149F084	RCIC Turbine Exhaust Inboard Vacuum Breaker Valve	1 – 2
HV151F008	RHR Shutdown Cooling Suction Outboard Isolation Valve	N/A
HV151F023	RHR Reactor Head Spray Flow Control Valve	N/A
HV151F049	RHR Radwaste Line Outboard Isolation Valve	N/A
HV155F001	HPCI Turbine Steam Supply Valve	0 - 1
HV155F003	HPCI Turbine Steam Supply Outboard Isolation Valve	0 – 2
HV155F004	HPCI Pump Suction CST Supply Valve	0 – 2
HV155F006	HPCI Injection Valve	0 – 2
HV155F007	HPCI Pump Discharge Valve	N/A
HV155F008	HPCI Test Line to CST Isolation Valve	N/A
HV155F011	HPCI/RCIC Test Line to CST Isolation Valve	N/A
HV155F012	HPCI Min Flow Valve to Suppression Pool	0 - 1
HV155F042	HPCI Pump Suction Suppression Pool Supply Valve	0 – 4
HV155F066	HPCI Turbine Exhaust Valve to Suppression Pool	N/A
HV155F075	HPCI Turbine Exhaust Outboard Vacuum Breaker Valve	0 – 2
HV156F059	HPCI L-O Cooling Water Valve	0 – 2
HV15768	Suppression Pool Water Filter Pump Suction Outboard Isolation Valve	N/A

TABLE 8.3-7C

Unit 2 250V DC Load Cycle Div I (2D650)
Worst Case LOCA Profile

Equipment Number	Load Description	Operating Time (Minutes)
2D288	SPDS UPS	0 - 240
2P219	RCIC Barometric Condenser Vacuum Pump	0 - 240
2P220	RCIC Vacuum Tank Condensate Pump	0 - 240
FV249F019	RCIC Min Flow Valve to Suppression Pool	0 – 1
HV249F008	RCIC Turbine Steam Supply Outboard Isolation Valve	1 - 2
HV249F010	RCIC Pump Suction From CST	0 - 2
HV249F012	RCIC Pump Discharge Valve	N/A
HV249F013	RCIC Injection Valve	0 - 2
HV249F022	RCIC Test to CST Isolation Valve	N/A
HV249F031	RCIC Pump Suction Suppression Pool Supply Valve	0 – 1
HV249F060	RCIC Vacuum Pump Discharge Valve to Suppression Pool	N/A
HV249F062	RCIC Turbine Exhaust Outboard Vacuum Breaker Valve	1 - 2
HV25012	RCIC Turbine Trip & Throttling Valve	N/A
HV250F045	Steam Supply to RCIC Pump Turbine	0 – 1
HV250F046	RCIC Lube Oil Cooler Water Supply Valve	0 – 1
HV255F079	HPCI Turbine Exhaust Inboard Vacuum Breaker Valve	0 - 1
HV256F059	HPCI L-O Cooling Water Isolation Valve	N/A

TABLE 8.3-7D

Unit 2 250V DC Load Cycle Div II (2D660)
Worst Case LOCA Profile

Equipment Number	Load Description	Operating Time (Minutes)
2D289	SPDS UPS	0 – 240
2P213	HPCI Pump Turbine Auxiliary Oil Pump	N/A
2P215	HPCI Vacuum Tank Drain Pump Condensate	0 – 240
2P216	HPCI Barometric Condenser Vacuum Pump	0 – 240
HV241F019	Main Steam Line Outboard Drain Valve	0 – 1
HV244F004	RWCU Inlet Outboard Isolation Valve	0 – 1
HV249F084	RCIC Turbine Exhaust Inboard Vacuum Breaker Valve	1 – 2
HV251F008	RHR Shutdown Cooling Suction Outboard Isolation Valve	N/A
HV251F023	RHR Reactor Head Spray Flow Control Valve	N/A
HV251F049	RHR Discharge to Radwaste Outboard Isolation Valve	N/A
HV255F001	HPCI Turbine Steam Supply Valve	N/A
HV255F003	HPCI Turbine Steam Supply Outboard Isolation Valve	0 – 2
HV255F004	HPCI Pump Suction CST Supply Valve	0 – 2
HV255F006	HPCI Injection Valve	0 – 1
HV255F007	HPCI Pump Discharge Valve	N/A
HV255F008	HPCI Test Line to CST Isolation Valve	0 – 1
HV255F011	HPCI/RCIC Test Line to CST Isolation Valve	0 – 1
HV255F012	HPCI Min Flow Valve to Suppression Pool	N/A
HV255F042	HPCI Pump Suction Suppression Pool Supply Valve	0 – 3
HV255F066	HPCI Turbine Exhaust Valve to Suppression Pool	N/A
HV255F075	HPCI Turbine Exhaust Outboard Vacuum Breaker Valve	0 – 1
HV256F059	HPCI L-O Cooling Water Isolation Valve	0 – 2
HV25768	Suppression Pool Water Filter Pump Suction Outboard Isolation Valve	N/A

Table 8.3-7E

250 VDC Battery Duty Load Profiles

UNIT 1				UNIT 2			
1D650		1D660		2D650		2D660	
Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes	Time in Minutes	Load in Amperes
1	800	1	930	1	270	1	700
9	610	1	700	9	245	9	410
20	535	28	350	230	155	230	150
210	27	210	175	--	--	--	--
Reference FSAR Section 8.3.2.1.1.6							

Note: Ampere values shown in Table 8.3-7E for 1D660 envelop or equal the batter ampere values in the design calculations. The calculated ampere values include consideration of load sequence and of the impact of interaction between battery voltage and load. Ampere values shown in Table 8.3-7B are based on 250 VDC at the battery terminals.

TABLE 8.3-7F

Unit 1 250V DC Load Cycle Div I (1D650)
SBO Profile

Equipment Number	Load Description	Operating Time (Minutes)
1D656	Computer UPS	0 – 30
1P110	Turbine Generator Emergency Seal Oil Pump	0 – 30
1P125B	RFPT B Emergency Oil Pump	0 – 30
1P125C	RFPT C Emergency Oil Pump	0 – 30
1P155A	Reactor Recirculation Pump ‘A’ M-G Set Emergency	0 – 30
1P219	RCIC Barometric Condenser Vacuum Pump	0 – 240
1P220	RCIC Vacuum Tank Condensate Pump	0 – 2, 5 - 240
FV149F019	RCIC Min Flow Valve to Suppression Pool	0 – 1, 5 – 6
HV149F008	RCIC Turbine Steam Supply Outboard Isolation Valve	N/A
HV149F010	RCIC Pump Suction CST Supply Valve	N/A
HV149F012	RCIC Pump Discharge Valve	N/A
HV149F013	RCIC Injection Valve	0 – 2, 5 - 6
HV149F022	RCIC Test to CST Isolation Valve	N/A
HV149F031	RCIC Pump Suction Suppression Pool Supply Valve	N/A
HV149F059	RCIC Turbine Exhaust Valve to Suppression Pool	N/A
HV149F060	RCIC Vacuum Pump Discharge Valve to Suppression Pool	N/A
HV149F062	RCIC Turbine Exhaust Outboard Vacuum Breaker Valve	N/A
HV15012	RCIC Turbine Trip & Throttling Valve	N/A
HV150F045	RCIC Turbine Steam Supply Valve	0 – 2, 5 - 6
HV150F046	RCIC Lube Oil Cooler Water Supply Valve	0 – 2, 5 - 6
HV155F079	HPCI Turbine Exhaust Inboard Vacuum Breaker Valve	N/A

TABLE 8.3-7G

Unit 1 250V DC Load Cycle Div II (1D660) SBO Profile

Equipment Number	Load Description	Operating Time (Minutes)
1D666	Vital AC UPS	0 – 240
1P112	Turbine Generator Emergency Bearing Oil Pump	0 – 45
1P125A	RFPT A Emergency Lube Oil Pump	0 – 45
1P155B	Reactor Recirculation Pump ‘B’ M-G Set Emergency	0 – 45
1P213	HPCI Pump Turbine Auxiliary Oil Pump	0 – 7
1P215	HPCI Vacuum Tank Drain Pump Condensate	0 – 240
1P216	HPCI Barometric Condenser Vacuum Pump	0 – 240
HV141F019	Main Steam Line Outboard Drain Valve	0 – 1
HV144F004	RWCU Inlet Outboard Isolation Valve	0 – 1
HV149F084	RCIC Turbine Exhaust Inboard Vacuum Breaker Valve	N/A
HV151F008	RHR Shutdown Cooling Suction Outboard Isolation Valve	N/A
HV151F023	RHR Reactor Head Spray Flow Control Valve	N/A
HV151F049	RHR Radwaste Line Outboard Isolation Valve	N/A
HV155F001	HPCI Turbine Steam Supply Valve	0 – 1
HV155F003	HPCI Turbine Steam Supply Outboard Isolation Valve	N/A
HV155F004	HPCI Pump Suction CST Supply Valve	N/A
HV155F006	HPCI Injection Valve	0 – 2
HV155F007	HPCI Pump Discharge Valve	N/A
HV155F008	HPCI Test Line to CST Isolation Valve	5 – 7
HV155F011	HPCI/RCIC Test Line to CST Isolation Valve	5 – 6
HV155F012	HPCI Min Flow Valve to Suppression Pool	0 – 1, 5 – 7
HV155F042	HPCI Pump Suction Suppression Pool Supply Valve	N/A
HV155F066	HPCI Turbine Exhaust Valve to Suppression Pool	N/A
HV155F075	HPCI Turbine Exhaust Outboard Vacuum Breaker Valve	N/A
HV156F059	HPCI L-O Cooling Water Valve	0 – 2, 5 – 6
HV15768	Suppression Pool Water Filter Pump Suction Outboard Isolation Valve	N/A

TABLE 8.3-7H

Unit 2 250V DC Load Cycle Div I (2D650)
SBO Profile

Equipment Number	Load Description	Operating Time (Minutes)
2D288	SPDS UPS	0 - 240
2P219	RCIC Barometric Condenser Vacuum Pump	0 - 240
2P220	RCIC Vacuum Tank Condensate Pump	0 – 2, 5 - 240
FV249F019	RCIC Min Flow Valve to Suppression Pool	0 – 1, 5 - 6
HV249F008	RCIC Turbine Steam Supply Outboard Isolation Valve	N/A
HV249F010	RCIC Pump Suction From CST	N/A
HV249F012	RCIC Pump Discharge Valve	N/A
HV249F013	RCIC Injection Valve	0 – 2, 5 - 6
HV249F022	RCIC Test to CST Isolation Valve	N/A
HV249F031	RCIC Pump Suction Suppression Pool Supply Valve	N/A
HV249F060	RCIC Vacuum Pump Discharge Valve to Suppression Pool	N/A
HV249F062	RCIC Turbine Exhaust Outboard Vacuum Breaker Valve	N/A
HV25012	RCIC Turbine Trip & Throttling Valve	N/A
HV250F045	Steam Supply to RCIC Pump Turbine	0 – 2, 5 - 6
HV250F046	RCIC Lube Oil Cooler Water Supply Valve	0 – 2, 5 - 6
HV255F079	HPCI Turbine Exhaust Inboard Vacuum Breaker Valve	N/A
HV256F059	HPCI L-O Cooling Water Isolation Valve	N/A

TABLE 8.3-7I

Unit 2 250V DC Load Cycle Div II (2D660)
SBO Profile

Equipment Number	Load Description	Operating Time (Minutes)
2D289	SPDS UPS	0 – 240
2P213	HPCI Pump Turbine Auxiliary Oil Pump	0 - 7
2P215	HPCI Vacuum Tank Drain Pump Condensate	0 – 240
2P216	HPCI Barometric Condenser Vacuum Pump	0 – 240
HV241F019	Main Steam Line Outboard Drain Valve	0 – 1
HV244F004	RWCU Inlet Outboard Isolation Valve	0 – 1
HV249F084	RCIC Turbine Exhaust Inboard Vacuum Breaker Valve	N/A
HV251F008	RHR Shutdown Cooling Suction Outboard Isolation Valve	N/A
HV251F023	RHR Reactor Head Spray Flow Control Valve	N/A
HV251F049	RHR Discharge to Radwaste Outboard Isolation Valve	N/A
HV255F001	HPCI Turbine Steam Supply Valve	0 - 1
HV255F003	HPCI Turbine Steam Supply Outboard Isolation Valve	N/A
HV255F004	HPCI Pump Suction CST Supply Valve	N/A
HV255F006	HPCI Injection Valve	0 – 2
HV255F007	HPCI Pump Discharge Valve	N/A
HV255F008	HPCI Test Line to CST Isolation Valve	5 - 7
HV255F011	HPCI/RCIC Test Line to CST Isolation Valve	5 - 6
HV255F012	HPCI Min Flow Valve to Suppression Pool	0 – 1, 5 - 7
HV255F042	HPCI Pump Suction Suppression Pool Supply Valve	N/A
HV255F066	HPCI Turbine Exhaust Valve to Suppression Pool	N/A
HV255F075	HPCI Turbine Exhaust Outboard Vacuum Breaker Valve	N/A
HV256F059	HPCI L-O Cooling Water Isolation Valve	0 – 2, 5 - 6
HV25768	Suppression Pool Water Filter Pump Suction Outboard Isolation Valve	N/A

TABLE 8.3-8[1]

±24 VDC LOAD CYCLE

Load Description		Amps
1.	Process radiation monitors	4.16
2.	Source range monitors, intermediate range monitors, and trip aux units	14.58
	Total	18.74

[1] Typical for ±24 VDC System. Units 1 & 2 ± 24 Vdc loads are similar.

TABLE 8.3-9

AC POWER FAILURE MODE EFFECTS ANAYSIS

ID No.	Component Name	Function	Failure Mode	Effect On Subsystem	Effect on Safety Function
1	Offsite Power Source Through Engineered Safeguards Transformer 101	Supplies preferred power to Units 1 & 2 load group Channel A	Loss of power	Loss of preferred power to Units 1 & 2 load group A.	No effect - offsite power through engineered safeguards transformer 201 supplies backup
		Supplies alternate power to Units 1&2 load group Channel D	Loss of power	Loss of backup power to Units 1&2 load group D.	No effect - diesel generators provide standby power.
1a	Offsite Power Source Through Engineered Safeguards Transformer 111	Supplies preferred power to Unit 1 load group Channel C and Unit 2 load group Channel C.	Loss of power	Loss of preferred power to Unit 1 load group C and Unit 2 load group C.	No effect - offsite power through engineered safeguards transformer 211 supplies backup.
		Supplies alternate power to Unit 1 load group Channel B and Unit 2 load group Channel B.	Loss of power	Loss of backup power to Unit 1 load group B and Unit 2 load group B.	No effect - diesel generators provide standby power.
2	Offsite Power Source Through Engineered Safeguards Transformer 201.	Supplies preferred power to Units 1&2 load group Channel D.	Loss of power	Loss of preferred power to Units 1&2 load group D.	No effect - offsite power through engineered safeguards transformer 101 supplies backup.
		Supplies alternate power to Units 1&2 load group Channel A.	Loss of power	Loss of backup power to Units 1&2 load group A.	No effect - diesel generators provide standby power.
2a	Offsite Power Source Through Engineered Safeguards Transformer 211	Supplies preferred power to Unit 1 load group Channel B and Unit 2 load group Channel B.	Loss of power	Loss of preferred power to Unit 1 load group B and Unit 2 load group B.	No effect - offsite power through engineered safeguards transformer 111 supplies backup.
		Supplies alternate power to Unit 1 load group Channel C and Unit 2 load group Channel C.	Loss of power	Loss of backup power to Unit 1 load group C and Unit 2 load group C.	No effect - diesel generators provide standby power.
	Load Group "A"				
3	4.16 Kv Bus 1A201	Provide power to all loads belonging to load group "A"	Fault	Loss of power to all load group "A" loads.	No effect - redundant equipment from load groups B,C,&D provide the required function.
3a	Circuit Breaker 52-20101	Provides preferred power to load group "A".	Fails open	Loss of preferred power to load group "A".	No effect - automatic transfer to alternate offsite power by closing breaker 52-20109 (see ID No. 11)

TABLE 8.3-9

AC POWER FAILURE MODE EFFECTS ANAYSIS

ID No.	Component Name	Function	Failure Mode	Effect On Subsystem	Effect on Safety Function
4	Circuit Breaker 52-20102	Provides power to RHR pump 1P202A	Fails open	Loss of power to RHR pump 1P202A.	No effect - three redundant RHR pumps from load groups B,C,&D provide the required safety function.
5	Circuit Breaker 52-20103	Provides power to reactor chiller 1K206A	Fails open	Loss of power to reactor chiller 1K206A.	No effect - non-Class 1E equipment.
6	Circuit Breaker 52-20104	Provides standby power to bus 1A201	Fails to close	Failed to provide standby power to load group "A".	No effect - safety functions are provides by redundant equipment supplied by load groups B,C,&D.
7	Circuit Breaker 52-20105	Provides power to core spray pump 1P206A	Fails open	Loss of power to core spray pump 1P206A.	No effect - three redundant core spray pumps from load groups B,C,&D provide the required safety functions.
8	Circuit Breaker 52-20106	Provides power to 480 V load center 1B210	Fails open	Loss of power to all load group "A" 480 V loads.	No effect - safety functions are provided by redundant equipment supplied by load groups B,C,&D.
9	Circuit Breaker 52-20107	Provides power to CRD water pump 1P132A	Fails open	Loss of power to CRD water pump 1P132A (2P132A).	No effect - non-Class 1E equipment.
10	Circuit Breaker 52-20108	Provides power to the emergency service water pump 0P504A	Fails open	Loss of power to the emergency service water pump 0P504A	No effect - three redundant emergency service water pumps from load groups B,C&D provide the required safety function.
11	Circuit Breaker 52-20109	Provide alternate preferred offsite power to bus 1A201	Fails to close	Loss of alternate preferred offsite power to load group "A".	No effect - diesel generator provides the standby power (see ID No. 6)
12	Circuit Breaker 52-20110	Provides power to turbine building chiller 1K102A	Fails open	Loss of power to turbine building chiller 1K102A	No effect - non-Class 1E equipment.
	Load Group "C"				
13	4.16 Kv Bus 1A203	Provides power to all loads belonging to load group "C"	Fault	Loss of power to all load group "C" loads	No effect - redundant equipment from load groups A,B,&D provide the required safety function.

TABLE 8.3-9

AC POWER FAILURE MODE EFFECTS ANAYSIS

ID No.	Component Name	Function	Failure Mode	Effect On Subsystem	Effect on Safety Function
13a	Circuit Breaker 52-20301	Provides preferred power to load group "C"	Fails open	Loss of preferred power to load group "C"	No effect - automatic transfer to alternate offsite power by closing breaker 52-20309 (See ID #21)
14	Circuit Breaker 52-20302	Provides power to RHR pump 1P202C	Fails open	Loss of power to RHR pump 1P202C	No effect - three redundant RHR pumps from load groups A,B,&D provide the required safety function.
15	Circuit Breaker 52-20303	Provides emergency service water pump OP504C	Fails open	Loss of power to emergency service water pump OP504C	No effect - three redundant emergency service water pumps from load groups A,B,&D provide the required safety function.
16	Circuit Breaker 52-20304	Provides standby power to bus 1A203	Fails to close	Failure to provide standby power to load group "C"	No effect - safety functions are provided by redundant equipment supplied by load groups A,B,&D.
17	Circuit Breaker 52-20305	Provides power to core spray pump 1P206C	Fails open	Loss of power to core spray pump 1P206C	No effect - three redundant core spray pumps from load groups A,B,&D provide the required safety function.
18	Circuit Breaker 52-20306	Provides power to 480 V load center 1B230	Fails open	Loss of power to all load group "C" 480 V loads	No effect - safety functions are provided by redundant equipment supplied by load groups A,B,&D.
19	Circuit Breaker 52-20307	Spare			
20	Circuit Breaker 52-20308	Provides power to the RHR service water pump 1P506A.	Fails open	Loss of power to RHR service water pump 1P506A	No effect - redundant RHR service water pump 1P506B provides the required safety function.
21	Circuit Breaker 52-20309	Provides alternate preferred offsite power to bus 1A203.	Fails to close	Loss of alternate preferred offsite power to load group "C".	No effect - diesel generator provides the standby power (see ID No. 16)

TABLE 8.3-9

AC POWER FAILURE MODE EFFECTS ANAYSIS

ID No.	Component Name	Function	Failure Mode	Effect On Subsystem	Effect on Safety Function
22	Circuit Breaker 52-20310	Provides power to control structure chiller 0K112A.	Fails open	Loss of power to the control structure chiller 0K112A	No effect - the redundant control structure chiller 0K112B provides the required safety function.
	Load Group "B"				
23	4.16 Kv Bus 1A202	Provide power to all loads belonging to load group "B"	Fault	Loss of power to all load group "B" loads.	No effect - redundant equipment from load groups A,C,&D provides the required safety function.
23A	Circuit Breaker 52-20201	Provides preferred power to load group "B"	Fails open	Loss of preferred power to load group "B"	No effect - automatic transfer to alternate offsite power by closing breaker 52-20209 (ID No. 31).
24	Circuit Breaker 52-20202	Provides power to RHR pump 1P202B	Fails open	Loss of power to RHR pump 1P202B	No effect - three redundant RHR pumps from load groups A,C,&D provide the required safety function.
25	Circuit Breaker 52-20203	Provides power to reactor building chiller 1K206B	Fails open	Loss of power to reactor building chiller 1K206B	No effect - non-Class 1E equipment.
26	Circuit Breaker 52-20204	Provides standby power to bus 1A202	Fails to close	Failure to provide standby power to load group "B"	No effect - safety functions are provided by redundant equipment supplied by load groups A,C,&D.
27	Circuit Breaker 52-20205	Provides power to core spray pump 1P206B.	Fails open	Loss of power to core spray pump 1P206B.	No effect - three redundant core spray pumps from load groups A,C,&D provide the required safety function.
28	Circuit Breaker 52-20206	Provides power to 480 V load center 1B220.	Fails open	Loss of power to all load group "B" 480 V loads.	No effect - safety functions are provided by redundant equipment supplied by load groups A,C,&D.
29	Circuit Breaker 52-20207	Spare			

TABLE 8.3-9

AC POWER FAILURE MODE EFFECTS ANAYSIS

ID No.	Component Name	Function	Failure Mode	Effect On Subsystem	Effect on Safety Function
30	Circuit Breaker 52-20208	Provides power to emergency service water pump 0P504B.	Fails open	Loss of power to emergency service water pump 0P504B	No effect - three redundant service water pumps from load groups A,C,&D provide the required safety function.
31	Circuit Breaker 52-20209	Provides alternate preferred offsite power to bus 1A203.	Fails to close	Loss of alternate preferred offsite power to load group "B".	No effect - diesel generator provides the standby power (See ID No. 26)
32	Circuit Breaker 52-20210	Provides power to condensate vacuum pump 1P105	Fails open	Loss of power to condensate vacuum pump 1P105	No effect - non-Class 1E equipment.
33	Circuit Breaker 52-20211	Provides power to turbine building chiller 1K102B.	Fails open	Loss of power to turbine building chiller 1K102B.	No effect - non-Class 1E equipment.
	Load Group "D"				
34	4.16 Kv Bus 1A204	Provides power to all loads belonging to load group "D"	Fault	Loss of power to all load group "D" loads.	No effect - redundant equipment from load groups A,B,&C provide the required safety function.
35	Circuit Breaker 52-20401	Provides preferred power to load group "D".	Fails open	Loss of preferred power to load group "D".	No effect - automatic transfer to alternate offsite power by closing breaker 52-20409 (See ID No. 43).
36	Circuit Breaker 52-20402	Provides power to RHR pump 1P202D	Fails open	Loss of power to RHR pump 1P202D.	No effect - three redundant RHR pumps from load groups A,B&C provide the required safety function.
37	Circuit Breaker 52-20403	Provides power to emergency service water pump 0P504D	Fails open	Loss of power to emergency service water pump 0P504D.	No effect - three redundant emergency service water pumps from load groups A,B,&C provide the required safety function.
38	Circuit Breaker 52-20404	Provides standby power to bus 1A204	Fails to close	Failure to provide standby power to load group "D".	No effect - safety functions are provided by redundant equipment supplied by load groups A,B,&C.

TABLE 8.3-9

AC POWER FAILURE MODE EFFECTS ANAYSIS

ID No.	Component Name	Function	Failure Mode	Effect On Subsystem	Effect on Safety Function
39	Circuit Breaker 52-20405	Provides power to core spray pump 1P206D	Fails open	Loss of power to core spray pump 1P206D.	No effect - three redundant core spray pumps from load groups A,B,&C provide the required safety function.
40	Circuit Breaker 52-20406	Provides power to 480 V load center 1B240.	Fails open	Loss of power to all load group "D" 480 V loads.	No effect - safety functions are provided by redundant equipment supplied by load groups A,B,&C.
41	Circuit Breaker 52-20407	Provides power to CRD pump 1P132B	Fails open	Loss of power to CRD pump 1P132B.	No effect - non-Class 1E equipment.
42	Circuit Breaker 52-20408	Provides power to RHR service water pump 1P506B.	Fails open	Loss of power to RHR service water pump 1P506B.	No effect - redundant RHR service water pump 1P506A provides the required safety function.
43	Circuit Breaker 52-20409	Provides alternate preferred power supplies to bus 1A204	Fail to close	Loss of alternate preferred offsite power to load group "D".	No effect - diesel generator provides the standby power (See ID No. 38)
44	Circuit Breaker 52-20410	Provides power to control structure chiller 0K112B	Fails open	Loss of power to control structure chiller 0K112B.	No effect - redundant control structure chiller 0K112A provides the required safety function.
45	Circuit Breaker 52-20411	Spare			

TABLE 8.3-10

ROUTING TABLE

Cable Separation Group Cables Permitted in Selected Raceways	Raceway Separation Group Non-Class IE	Div I	Div II	Chan A	Chan B	Chan C	Chan D	Chan H
Non-Class IE	Yes	No	No	No	No	No	No	No
Div I	No	Yes	No	Yes	No	No	No	(See Note 2)
Div I Affiliated	No	Yes	No	Yes	No	No	No	(See Note 2)
Div II	No	No	Yes	No	Yes	No	No	(See Note 2)
Div II Affiliated	No	No	Yes	No	Yes	No	No	(See Note 2)
Chan. A	No	Yes	No	Yes	No	No	No	(See Note 2)
Chan. A Affiliated	No	Yes	No	Yes	No	No	No	(See Note 2)
Chan. B	No	No	Yes	No	Yes	No	No	(See Note 2)
Chan. B Affiliated	No	No	Yes	No	Yes	No	No	(See Note 2)
Chan. C	No	No	No	No	No	Yes	No	(See Note 2)
Chan. C Affiliated	No	No	No	No	No	Yes	No	(See Note 2)
Chan. D	No	No	No	No	No	No	Yes	(See Note 2)
Chan. D Affiliated	No	No	No	No	No	No	Yes	(See Note 2)
Chan. H	No	--------------(See Note 2)--------------------------						Yes
Chan. H Affiliated	No	--------------(See Note 2)--------------------------						Yes

	RPS A1	RPS A2	RPS B1	RPS B2
RPS A1	Yes	No	No	No
RPS A2	No	Yes	No	No
RPS B1	No	No	Yes	No
RPS B2	No	No	No	Yes

TABLE 8.3-10

Notes:

1. To determine raceways in which cable may be routed, read across from selected cable until "yes" appears. Column heading is raceway required.

2. Channel H and Channel H Affiliated cables and raceway are unique to the diesel generator E facility. Channel H cables are isolated from all other Channels/Divisions cable by a double break scheme when diesel generator E is not substituted. When diesel generator E is substituted for a channelized diesel generator A, B, C or D, the double break scheme permits the Channel H and Channel H Affiliated cables to be connected to only the Channel/Division cables of the substituted diesel generator. In this condition, the Channel H and Channel H Affiliated cables and their raceways have the same separation requirements as the Channel/Division of the substituted diesel generator.

Table 8.3-16

DIESEL GENERATOR AUTO START CIRCUIT FAILURE EFFECTS ANALYSIS (1)

Security-Related Information
Table Withheld Under 10 CFR 2.390

TABLE 8.3-17

125V DC Control Power Source For Non-Class 1E 13.8 KV and 4.16 KV Switchgear

ALL BKRS In 13.8 KV SWGR	125V DC DIST PNL BKR NO.	DIV/ CHAN	125V DC LOAD CENTER BKR NO.	DIV/ CHAN	125V DC BATTERY BANK NO.	DIV/ CHAN	P/ AL	REF. DWG.
0A103	1D615-31	(N)	1D612-13	(A)	1D610	(A)	P	Fig. 8.3-5
(N)	1D635-31	(N)	1D632-13	(C)	1D630	(C)	AL	E-11SH1
0A104	1D625-31	*(N)*	1D622-13	(B)	1D620	(B)	P	E-26SH1 &
(N)	1D645-31	(N)	1D642-13	(D)	1D640	(D)	AL	SH3
0A105 (N)	1D615-29	*(N)*	1D612-13	(A)	1D610	(A)	P	
1A101	1D615-32	(N)	1D612-13	(A)	1D610	(A)	P	Fig. 8.3-5
(N)	1D635-32	(N)	1D632-13	(C)	1D630	(C)	AL	E-11SH1
1Al02	1D625-32	(N)	1D622-13	(B)	1D620	(B)	P	E-26SH1 &
(N)	1D645-32	(N)	1D642-13	(D)	1D640	(D)	AL	SH3
2A101	2D615-32	(N)	2D612-13	(A)	2D610	(A)	P	Fig. 8.3-5
(N)	2D635-32	(N)	2D632-13	(C)	2D630	(C)	AL	E-11SH2
2A102	2D625-32	(N)	2D622-13	(B)	2D620	(B)	P	E-26SHI &
(N)	2D645-32	(N)	2D642-13	(D)	2D640	(D)	AL	SH5
0A501 (N)	0D512-04	(N)	-		0D510	(N)	P	E-11SHS
0A502	0DS12-06	(N)	-		0F510	(N)	AL	
125V DC <u>SWITCHBOARD BKR.</u>								
0A550 (N)	0D599-04	(N)	0D597-09	(H)	0D5915	(H)	-	E-11SH11 Fig. 8.3-5A

NOTES:
1. (N) - Non Class IE Equipment
2. P/A1 - Preferred or Alternate Power Source (to be manually transferred through a knife switch)
3. Ref. Dwgs. are located in Sect. 1.7

TABLE 8.3-18

125V DC CONTROL POWER SOURCE
FOR
NON-CLASS 1E 480V L.C.

ALL BKRS OF 480V L.C	125V DC DIST PNL BKR		125V DC LOAD CENTER BKR		125V DC BATTERY BANK		P/ AL	REF. DWG.
	NO.	DIV/ CHAN	NO.	DIV/ CHAN	NO.	DIV/ CHAN		
1B100 1B110 (N)	1D615-21 1D625-21	(N) (N)	1D612-13 1D622-13	(A) (B)	1D610 1D620	(A) (B)	P AL	
1B120 1B130 (N)	1D635-21 1D645-21	(N) (N)	1D632-13 1D642-13	(C) (D)	1D630 1D640	(C) (D)	P AL	
1B140 1B150 (N)	1D615-23 1D625-23	(N) (N)	1D612-13 1D622-13	(A) (B)	1D610 1D620	(A) (B)	P AL	Fig. 8.3-5 E-11 SH1 E-26 SHI & SH3
1B160 1B170 (N)	1D635-23 1D645-23	(N) (N)	1D632-13 1D642-13	(C) (D)	1D630 1D640	(C) (D)	P AL	
1B180 1B190 (N)	1D615-25 1D625-25	(N) (N)	1D612-13 1D622-13	(A) (B)	1D610 1D620	(A) (B)	P AL	
1B250 1B260 (N)	1D615 22 1D625-22	(N) (N)	1D612-13 1D622-13	(A) (B)	1D610 1D620	(A) (B)	P AL	
1B270 1B280 (N)	1D635-22 1D645-24	(N) (N)	1D632-13 1D642-13	(C) (D)	1D630 1D640	(C) (D)	P AL	
1B810 1B820 (N)	1D615-24 1D625-24	(N) (N)	1D612-13 1D622-13	(A) (B)	1D610 1D620	(A) (B)	P AL	
1B810 1B820 (N)	1D615-24 1D625-24	(N) (N)	1D612-13 1D622-13	(A) (B)	1D610 1D620	(A) (B)	P AL	

TABLE 8.3-18

125V DC CONTROL POWER SOURCE
FOR
NON-CLASS 1E 480V L.C.

ALL BKRS OF 480V L.C	125V DC DIST PNL BKR		125V DC LOAD CENTER BKR		125V DC BATTERY BANK		P/ AL	REF. DWG.
	NO.	DIV/ CHAN	NO.	DIV/ CHAN	NO.	DIV/ CHAN		
0B330	1D615-27	(N)	1D612-13	(A)	1D610	(A)	P	Fig. 8.3-5 E-11 SH1
0B340 (N)	1D625-27	(N)	1D622-13	(B)	1D620	(B)	AL	E-26 SH1 & SH3
0B610	1D615-28	(N)	1D612-13	(A)	1D610	(A)	P	
0B620 (N)	1D625-28	(N)	1D622-13	(B)	1D620	(B)	AL	
0B700	1D635-24	(N)	1D632-13	(C)	1D630	(C)	P	
0B710 (N)	ID645-26	*(N)*	1D642-13	(D)	1D640	(D)	AL	
0B570	0D583-02	(N)	125V DC FUSE BOX 0D582-<u>CLF</u> 100A	(N)	0D580	(N)	P	E-11S H8
0B580 (N)	0D583-06	(N)	0D582-<u>CLF</u> 100A	(N)	0D580	(N)	AL	E-26S H7
2B100	2D615-21	(N)	2D612-13	(A)	2D610	(A)	P	
2B110 (N)	2D625-21	(N)	2D622-13	(B)	2D620	(B)	AL	
2B120	2D635-21	(N)	2D632-13	(C)	2D630	(C)	P	
2B130 (N)	2D645-21	(N)	2D642-13	(D)	2D640	(D)	AL	
2B140	2D615-23	(N)	2D612-13	(A)	2D610	(A)	P	Fig. 8.3-5
2B150 (N)	2D625-23	(N)	2D622-13	(B)	2D620	(B)	AL	E-11 SH2
2B160	2D635-23	(N)	2D632-13	(C)	2D630	(C)	P	E-26 SH1 SH5
2B170 (N)	2D645-23	(N)	2D642-13	(D)	2D640	(D)	AL	

TABLE 8.3-18

125V DC CONTROL POWER SOURCE
FOR
NON-CLASS 1E 480V L.C.

ALL BKRS OF 480V L.C	125V DC DIST PNL BKR		125V DC LOAD CENTER BKR		125V DC BATTERY BANK		P/ AL	REF. DWG.
	NO.	DIV/ CHAN	NO.	DIV/ CHAN	NO.	DIV/ CHAN		
2B180	2D615-25	(N)	2D612-13	(A)	2D610	(A)	P	
2B190 (N)	2D625-25	(N)	2D622-13	(B)	2D620	(B)	AL	
2B250	2D615-22	(N)	2D612-13	(A)	2D610	(A)	P	
2B260 (N)	2D625-22	(N)	2D622-14	(B)	2D620		AL	
2B270	2D635-22	(N)	2D632-13	(C)	2D630	(C)	P	Fig. 8.3-5
2B280 (N)	2D645-24	(N)	2D642-13	(D)	2D640	(D	AL	E-11 SH2
2B810	2D615-24	(N)	2D612-13	(A)	2D610	(A)	P	E-11 SH1 SH5
2B820 (N)	2D625-24	(N)	2D622-13	(B)	2D620	(B)	AL	

NOTE:
1. (N) Non-class 1E equipment
2. P/AL Preferred or alternate power source (to be manually transferred through a knife switch)
3. REF. DWGS. Are located in Sect. 1.7

TABLE 8.3-19

125 DC CONTROL POWER SOURCE
FOR
CLASS 1E 4.16 KV SWITCHGEAR

4.16kV SWGR-KRS		125V DC DIST PNL BKR NO.	DIV/ CHAN	125V DC LOAD CENTER BKR NO.	DIV/ CHAN	125V DC BATTERY BANK NO.	DIV/ CHAN	P/ AL	REF. DWG.
	01,02,04,05								
1A201	06&09	1D614-31	(A)	1ID612012	(A)	1D610	(A)	P	
(A)&(I)	03,07,08	2D614-35	(A)	2D612012	(A)	2D610	(A)	AL	
	10&11	1ID614-34	(I)	1D612012	(A)	1D610	(A)	P	Fig. 8.3-5
		2D614-32	(I)	2D612012	(A)	2D610	(A)	AL	
	01,02,04,05								
1A202	06&09	1D624-31	(B)	1D622-12	(B)	1D620	(B)	P	E-11 SH. 1&2
(B)&(II)	03,07,08	2D624-35	(B)	2D622-12	(B)	2D620	(B)	AL	
	10&11	1D624-34	(II)	1D622-12	(B)	1D620	(B)	P	E-26 SH. 1
		2D624-32	(II)	2D622-12	(B)	2D620	(B)	AL	
	01,02,04,05								
1A203	06&09	1D634-31	(C)	1D632-12	(C)	1D630	(C)	P	SH. 2
(C)&(I)	03,07,08 &	2D634-32	(C)	2D632-12	(C)	2D630	(C)	AL	& SH. 4
	10	1ID614-36	(I)	1D612-12	(A)	1D610	(A)	P	
		2D614-38	(I)	2D612-12	(A)	2D610	(A)	AL	
	01,02,04,05								
1A204	06&09	1D644-31	(D)	1D642012	(D)	1D640	(D)	P	
(D)&(II)	03,07,08	2D644-32	(D)	2D642-12	(D)	2D640	(D)	AL	
	10&11	1D624-36	(II)	1D622-12	(B)	1D620	(B)	P	
		2D624-38	(II)	2D622-12	(B)	2D620	(B)	AL	
	01,02,04,05								
2A201	06&09	2D614-31	(A)	2D612-12	(A)	2D610	(A)	P	
(A)&(I)	03,07,08&								
	10	2D614-34	(I)	2D612-12	(A)	2D610	(A)	P	Fig. 8.3-5
	01,02,04,05								
2A202	06&09	2D624-031	(B)	2D622-12	(B)	2D620	(B)	P	E-11 Sh.2
(B)&(II)	03,07,&08	2D624-34	(II)	2D622-12	(B)	2D620	(B)	P	E-26 Sh.1
2A203	01,02,04,05	2D634-31	(C)	2D632-12	(C)	2D630	(C)	P	& SH. 4
(C)&(I)	06&08	2D614-36	(I)	2D612-12	(A)	2D610	(A)	P	
	03,07&09								
2A204	01,02,04,05	2D644-31	(D)	2D642-12	(D)	2D640	(D)	P	
(D)&(II)	06&08	2D624-36	(II)	2D622-12	(B)	2D620	(B)	P	
	03,07&09								
0A510A	01,02	1D614-37	(A)	1D612-12	(A)	ID610	(A)	P	
		2D614-37	(A)	2D612-12	(A)	2D610	(A)	AL	
0A510B	01,02	ID624-37	(B)	1D622-12	(B)	1D620	(B)	P	
		2D624-37	(B)	2D622-12	(B)	2D620	(B)	AL	
0A510C	01,02	1D634-37	(C)	1D632-12	(C)	1D630	(C)	P	
		2D634-37	(C)	2D632-12	(C)	2D630	(C)	AL	

TABLE 8.3-19

125 DC CONTROL POWER SOURCE
FOR
CLASS 1E 4.16 KV SWITCHGEAR

4.16kV SWGR-KRS		125V DC DIST PNL BKR NO.	125V DC DIST PNL BKR DIV/ CHAN	125V DC LOAD CENTER BKR NO.	125V DC LOAD CENTER BKR DIV/ CHAN	125V DC BATTERY BANK NO.	125V DC BATTERY BANK DIV/ CHAN	P/ AL	REF. DWG.
0A510D	01,02	1D644-37 2D644-37	(D) (D)	1D642-12 2D642-12	(D) (D)	1D640 2D640	(D) (D)	P AL	
0A510	01,02 03,04 05,06	---		0D597-05	(H)	0D595	(H)	P	E-11 SH. 11

NOTES: 1. (N)-Non Class IE Equipment

2. P/A-Preferred or alternate power source (to manually transferred through a selector switch)

TABLE 8.3-20

125V DC CONTROL POWER SOURCE FOR CLASS 1E 480V LC

ALL BKRS OF 480V ESS L.C.	125V DC DIST PNL BKR		125V DC LOAD CENTER BKR		125V DC BATTERY BANK		REF. DWG.
	NO.	DIV/ CHAN	NO.	DIV/ CHAN	NO.	DIV/ CHAN	
1B210 (A)	1D614-24	(A)	1D612-12	(A)	1D610	(A)	Fig. 8.3-5
1B220 (B)	1D624-26	(B)	1D622-12	(B)	1D620	(B)	E-11 Sh. 1 E-26 Sh. 1&2
1B230 (C)	1D634-24	(C)	1D632-12	(C)	1D630	(C)	
1B240 (D)	1D644-24	(D)	1D642-12	(D)	1D640	(D)	
2B210 (A)	2D614-24	(A)	2D612-12	(A)	2D610	(A)	
2B220	2D624-26	(B)	2D622-12	(B)	2D620	(B)	E-11 Sh. 2 E-26, Sh. 1&4
2B230 (C)	2D634-24	(C)	2D632-12	(C)	2D630	(C)	
2B240 (D)	2D644-24	(D)	2D642-12	(D)	2D640	(D)	
0B565-11	--		0D597-04	(H)	0D595	(H)	E-11 Sh. 11

NOTE 1: Ref dwgs. are located in Sect 1.7

Table 8.3-21

Failure Mode and Effect Analysis - 125 V DC System (4 Channels) per Unit

Security-Related Information
Table Withheld Under 10 CFR 2.390

Table 8.3-22 (REF: Dwg. E-11, Sh.1)
FAILURE MODE AND EFFECT ANALYSIS – 250 V DC SYSTEM (2 Divisions) per Unit

Security-Related Information
Table Withheld Under 10 CFR 2.390

Table 8.3-23

FAILURE MODE AND EFFECT ANALYSIS – 24 V DC SYSTEM (2 Divisions)

(Reference: DWG. E-13, Sh. 1)

Security-Related Information
Table Withheld Under 10 CFR 2.390

Table 8.3-24

COMMON MODE – COMMON CAUSE FAILURE ANALYSIS – AUTO TRANSFER SWITCH

Security-Related Information
Table Withheld Under 10 CFR 2.390

TABLE 8.3-25

Separation Methods and Requirements Within Junction Boxes and Field Installed Pull Boxes

Separation Between		Separation Group (1)	Separation Method
1E HE	1E HE	Non-Compatible Ch/Div.	HB
1E HE	N-1E HE	Non-Compatible Ch/Div.	HB
1E INST	1E HE	Compatible Ch/Div.	VB
1E INST	1E HE	Non-Compatible Ch/Div.	HB
1E INST	N-1E HE	Non-Compatible Ch/Div.	HB
N-1E INST	1E HE	Non-Compatible Ch/Div.	HB
N-1E INST	N-1E HE	---	HB
1E INST	1E CNTRL	Compatible Ch/Div.	--
1E INST	1E CNTRL	Non-Compatible Ch/Div.	VB(2)
1E INST	N-1E CNTRL	Non-Compatible Ch/Div.	VB(2)
1E INST	1E INST	Non-Compatible Ch/Div.	(3)
1E INST	N-1E INST	Non-Compatible Ch/Div.	(3)
N-1E INST	1E CNTRL	Non-Compatible Ch/Div.	VB(2)
N-1E INST	N-1E CNTRL	---	--
1E CNTRL	1E HE	Compatible Ch/Div.	--
1E CNTRL	1E HE	Non-Compatible Ch/Div.	HB
1E CNTRL	1E CNTRL	Non-Compatible Ch/Div.	(3)
1E CNTRL	N-1E HE	Non-Compatible Ch/Div.	HB
N-1E CNTRL	1E HE	Non-Compatible Ch/Div.	VB/HB(4)
N-1E CNTRL	N-1E HE	---	-/HB(4)

Abbreviations: CNTRL - Control or Low Energy Power Circuit

HE - High Energy Circuit: 5kV and 480Vac power circuits. 120Vac, 125Vdc, and 250Vdc circuits with a circuit rating of greater than 20 amperes.

VB - Voltage Barrier: A single steel plate separating circuits of different voltage levels or separating non-high energy circuits of non-compatible separation groups.

HB - High Energy Barrier: Two steel plates separated by a thermal insulating material equivalent to one inch of air space.

TABLE 8.3-25 (Continued)

Notes:

1. Compatibility is per Table 8.3-10.
2. Steel Barrier is preferred, non-metallic barrier per Section 8.1.6.1.n.14 permissible (except for RPS) where physical restraints make a steel barrier installation infeasible. Where a voltage barrier is used, compliance to the 6 inch separation criteria of Section 8.1.6.1.n.14 is required.
3. Separation per Section 8.1.6.1.n.14.
4. High energy barrier required where non-Class 1E control cable is an annunciator circuit.

FIGURE 8.3-1-1 REPLACED BY DWG. E-1, SH. 1

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
FINAL SAFETY ANALYSIS REPORT

FIGURE 8.3-1-1 REPLACED BY DWG. E-1, SH. 1

FIGURE 8.3-1-1, Rev. 56

AutoCAD Figure 8_3_1_1.doc

FIGURE 8.3-1-2 REPLACED BY DWG. E-1, SH. 1A

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FIGURE 8.3-1-2 REPLACED BY DWG. E-1, SH. 1A

FIGURE 8.3-1-2, Rev. 55

AutoCAD Figure 8_3_1_2.doc

FIGURE 8.3-1-2A REPLACED BY DWG. E-1, SH. 2

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FIGURE 8.3-1-2A REPLACED BY DWG. E-1, SH. 2

FIGURE 8.3-1-2A, Rev. 55

AutoCAD Figure 8_3_1_2A.doc

FIGURE 8.3-2 REPLACED BY DWG. E-4, SH. 2

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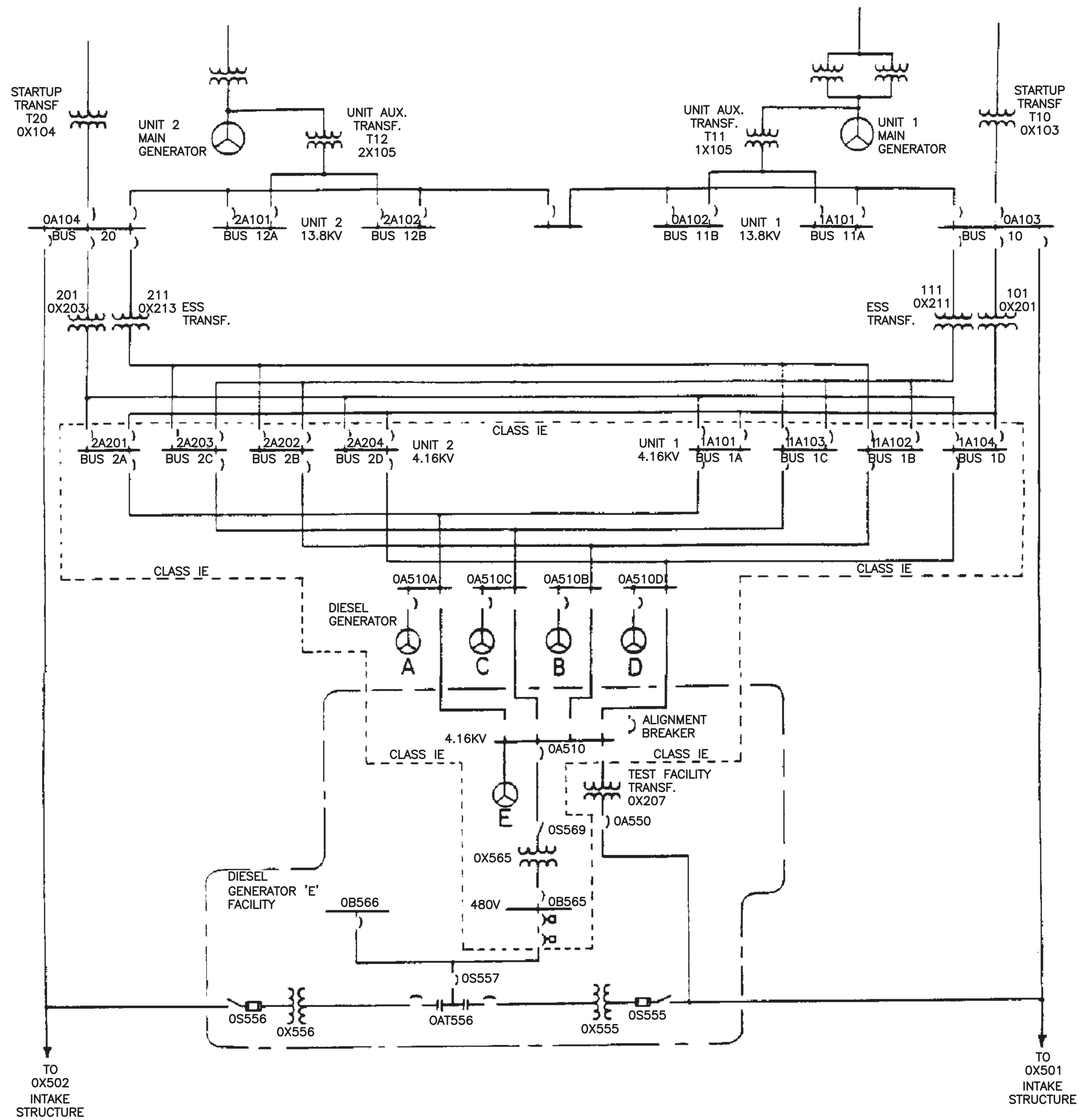
FIGURE 8.3-2 REPLACED BY DWG. E-4, SH. 2

FIGURE 8.3-2, Rev. 55

AutoCAD Figure 8_3_2.doc



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PREFERRED POWER SUPPLIES
TO DIESEL GENERATOR 'E'
CLASS IE POWER SYSTEM

FIGURE 8.3-2A, Rev 49

AutoCAD: Figure Fsar 8.3-2A.dwg

FIGURE 8.3-3 REPLACED BY DWG. E-5, SH. 1

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FIGURE 8.3-3 REPLACED BY DWG. E-5, SH. 1

FIGURE 8.3-3, Rev. 55

AutoCAD Figure 8_3_3.doc

FIGURE 8.3-4 REPLACED BY DWG. E-5, SH. 2

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FIGURE 8.3-4 REPLACED BY DWG. E-5, SH. 2

FIGURE 8.3-4, Rev. 55

AutoCAD Figure 8_3_4.doc

FIGURE 8.3-4A REPLACED BY DWG. E-5, SH. 5

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FIGURE 8.3-4A REPLACED BY DWG. E-5, SH. 5 FIGURE 8.3-4A, Rev. 49

AutoCAD Figure 8_3_4A.doc

FIGURE 8.3-5 REPLACED BY DWG. E-11, SH. 1

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SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
FIGURE 8.3-5 REPLACED BY DWG. E-11, SH. 1 FIGURE 8.3-5, Rev. 55

AutoCAD Figure 8_3_5.doc

THIS FIGURE HAS BEEN
REPLACED BY DWG.
E-11, Sh. 11

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Figure 8.3-5A replaced by dwg. E-11, Sh. 11 FIGURE 8.3-5A, Rev. 55

AutoCAD Figure 8_3_5A.doc

FIGURE 8.3-6 REPLACED BY DWG. E-13, SH. 1

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FIGURE 8.3-6 REPLACED BY DWG. E-13, SH. 1

FIGURE 8.3-6, Rev. 55

AutoCAD Figure 8_3_6.doc

FIGURE 8.3-7 REPLACED BY DWG. E-8, SH. 4

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FIGURE 8.3-7 REPLACED BY DWG. E-8, SH. 4

FIGURE 8.3-7, Rev. 48

AutoCAD Figure 8_3_7.doc

FIGURE 8.3-8 REPLACED BY DWG. E-8, SH. 8

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SUSQUEHANNA STEAM ELECTRIC STATION
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FIGURE 8.3-8 REPLACED BY DWG. E-8, SH. 8

FIGURE 8.3-8, Rev. 48

AutoCAD Figure 8_3_8.doc

Security-Related Information

Figure Withheld Under 10 CFR 2.390

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
480 VOLT SWING BUSES
FIGURE 8.3-9

FIGURE 8.3-10 REPLACED BY DWG. M-260, SH. 1

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FIGURE 8.3-10 REPLACED BY DWG. M-260, SH. 1

FIGURE 8.3-10, Rev. 55

AutoCAD Figure 8_3_10.doc

FIGURE 8.3-10A REPLACED BY DWG. M-261, SH. 1

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FIGURE 8.3-10A REPLACED BY DWG. M-261, SH. 1

FIGURE 8.3-10A, Rev. 55

AutoCAD Figure 8_3_10A.doc

FIGURE 8.3-10B REPLACED BY DWG. M-5200, SH. 1

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FIGURE 8.3-10B REPLACED BY DWG. M-5200, SH. 1

FIGURE 8.3-10B, Rev. 55

AutoCAD Figure 8_3_10B.doc

FIGURE 8.3-11 REPLACED BY DWG. E-31, SH. 8

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FINAL SAFETY ANALYSIS REPORT

FIGURE 8.3-11 REPLACED BY DWG. E-31, SH. 8

FIGURE 8.3-11, Rev. 56

AutoCAD Figure 8_3_11.doc

FIGURE 8.3-12 REPLACED BY DWG. E-31, SH. 9

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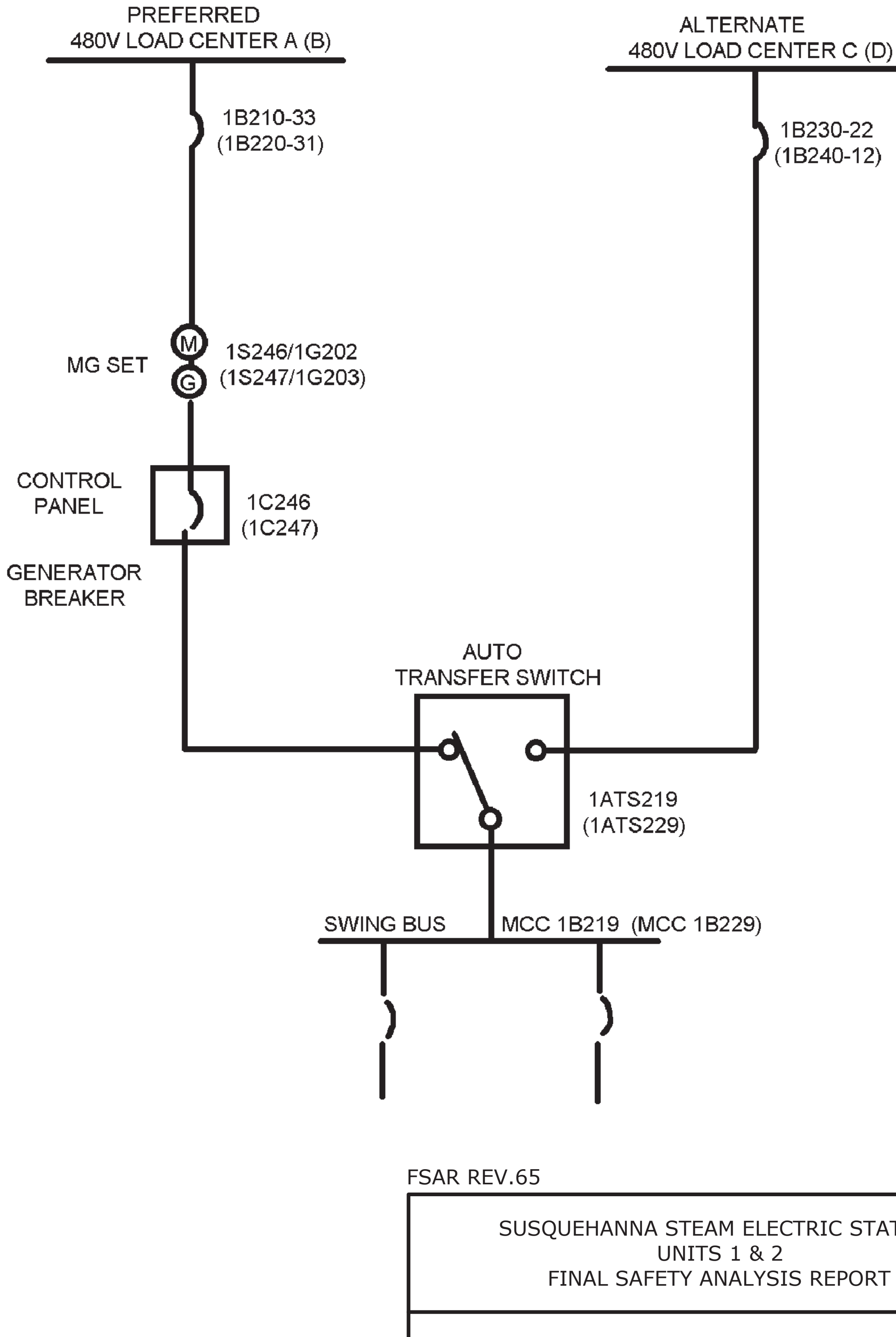
SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 & 2 FINAL SAFETY ANALYSIS REPORT
FIGURE 8.3-12 REPLACED BY DWG. E-31, SH. 9 FIGURE 8.3-12, Rev. 56

AutoCAD Figure 8_3_12.doc



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SUSQUEHANNA STEAM ELECTRIC STATION
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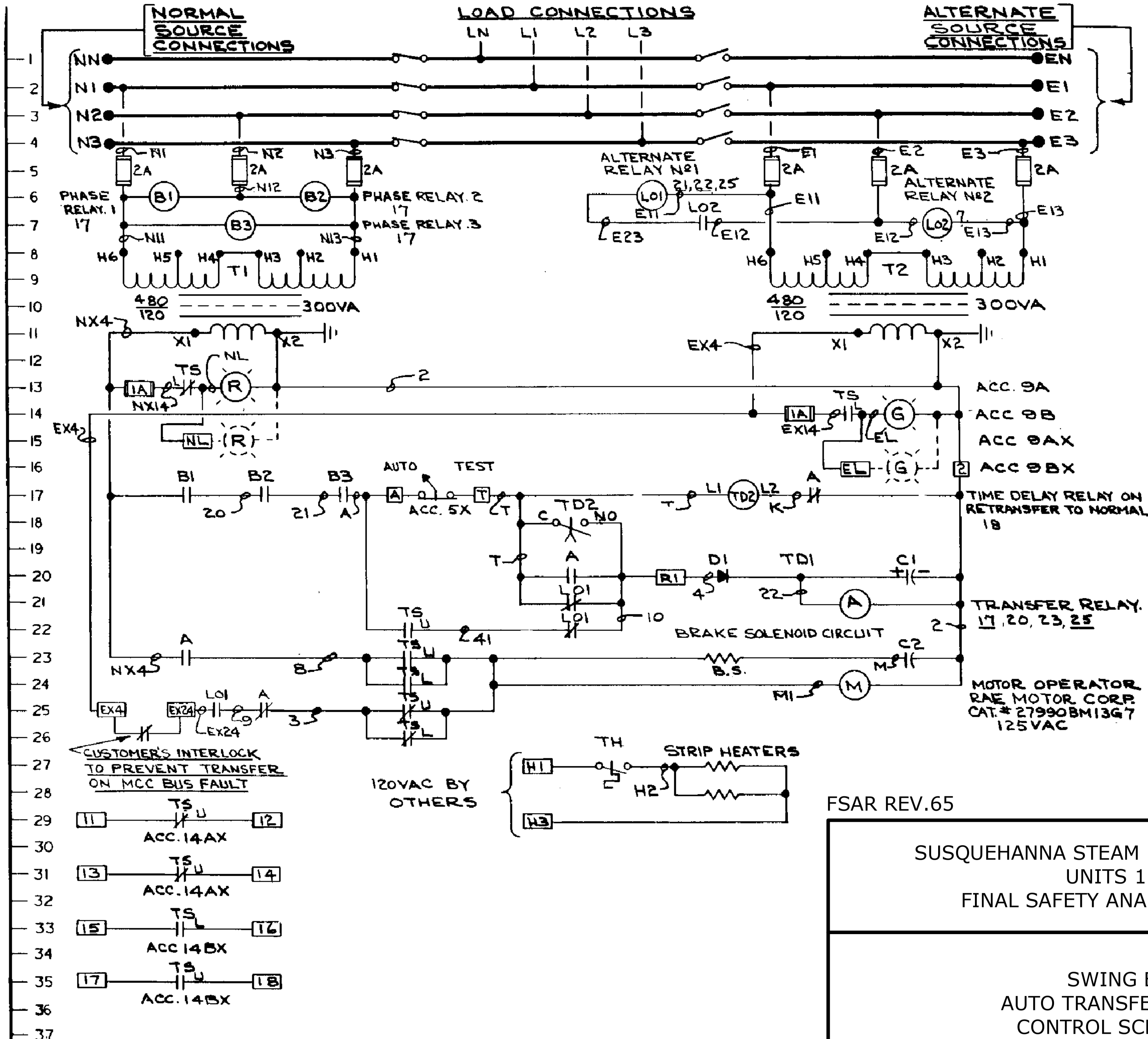
SINGLE LINE DIAGRAM
FOR 480V SWING BUS SYSTEM

FIGURE 8.3-13, Rev 49

AutoCAD: Figure Fsar 8_3_13.dwg



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SUSQUEHANNA STEAM ELECTRIC STATION
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SWING BUS
AUTO TRANSFER SWITCH
CONTROL SCHEMATIC

FIGURE 8.3-14, Rev 49

AutoCAD: Figure Fsar 8_3_14.dwg

FIGURE 8.3-15 REPLACED BY DWG. E-31, SH. 5

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SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
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FIGURE 8.3-15 REPLACED BY DWG. E-31, SH. 5

FIGURE 8.3-15, Rev. 56

AutoCAD Figure 8_3_15.doc