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 the Technical Specifications or Technical Requirements Manual. The test intervals specified in IEEE Standard 308-1974 may be replaced with performance-based, risk-informed test intervals in accordance with the Technical Specifications.

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.

<u>Analysis</u>:

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 Unit 1 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 Unit 1 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

Page 1 of 1

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