8.3 ONSITE POWER SYSTEM

This section describes the onsite ac power system, onsite dc power system, and fire protection for cable systems.

8.3.1 Ac Power System

8.3.1.1 Description

The onsite ac power system includes all equipment and systems required to provide ac power to all unit auxiliaries and service loads under all conditions of plant operation. This consists of the 13.8-kV switchgear, 4.16-kV switchgear, 600-V load centers, MCCs, various distribution panels, UPS systems, cables and raceways, the standby diesel generators, and the system loads. The onsite ac power system is divided into two distinct categories: emergency or safety related and normal or nonsafety related. The equipment, systems, and loads required to safely shut down the reactor in case of DBA are designated nuclear safety related or Class 1E; the others are nonsafety related or non-Class 1E.

The onsite emergency ac power system is designed to meet the requirements of the general design criteria of 10CFR50, and the applicable regulatory guides. This system has adequate capacity, independence, redundancy, and testability to ensure power supply to all ESF systems under all conditions of plant operation. The onsite emergency ac power system is divided into three independent divisions that are electrically isolated and physically separated from each other. Each division has its own dedicated standby diesel generator that is separate from and independent of the standby diesel generator of any other division. Each division feeds a separate load group. The independence of the three systems is maintained throughout the distribution system and loads.

The onsite power system has adequate capacity to supply all emergency loads under all conditions of plant operation. Any two of the three divisions with their associated standby diesel generators are capable of supplying the emergency loads required to shut down the reactor in case of a DBA.

The redundancy of the onsite ac power system facilitates the ability to test any system in any one division during normal plant operation without compromising any safety function. The essential systems and components have features for test operation under normal plant operating conditions. The plant physical layout and equipment locations are designed to permit inspection under all operating conditions.

The equipment and systems of the plant onsite emergency ac power system are qualified for operating in their respective environmental conditions (temperature, pressure, humidity, and radiation) for the specified service life in accordance with the applicable regulatory guides. All Class 1E equipment and systems are Category I and are located in Category I structures.

The plant onsite ac power systems are shown on Figures 8.3-1 through 8.3-4. The Class 1E onsite emergency ac power system is normally energized from offsite power sources through the reserve Station service transformers. In case of LOOP, this system is energized from standby diesel generators. The nonsafety-related onsite ac power system is normally energized from the normal Station service transformer. In case of loss of power from the normal Station service transformer, this system is energized from offsite power sources through the reserve Station service transformers.

Originally, the failure modes and effects analysis (FMEA) for the ac power system was contained in the Unit 2 FMEA document, which is historical. FMEAs for plant systems are now performed and controlled by the design process.

8.3.1.1.1 Systems and Identification

<u>Safety-Related Systems and Identification</u>

The three divisions of the onsite emergency ac power system are designated as Divisions I, II, and III. Divisions I and II supply all the emergency unit auxiliary and service loads, divided into two redundant load groups. Division III supplies the high-pressure core spray (HPCS) system loads. The three divisions are readily identifiable by the following color coding:

Division I	Green
Division II	Yellow
Division III	Purple

All the equipment, cables, raceways, motors and other electrical loads, etc., associated with Division I are identified with green color coding. Similarly, Division II and III equipment, cables and raceways, motors and other electrical loads, are identified with yellow and purple color coding, respectively. The method of identification is described in Section 8.3.1.3.

Divisions I and II of the onsite emergency ac distribution system feed their redundant load groups as shown in Table 1 and Table 2, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14).

Division III feeds all the loads associated with the HPCS system, as listed in Table 3, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14). The plant safety-related loads are listed in Table 8.3-4, which also indicates their power sources.

Onsite Normal Ac Power Systems and Identification

The portions of the onsite ac power system that are required for normal operation of the plant, but not required for safe shutdown of the reactor in case of a DBA, are classified as nonsafety related or normal. These systems are identified by black or no-color coding. The normal ac system also encompasses two stub buses, which can be connected to the emergency Division I and Division II buses, respectively, in the absence of any DBA (Section 8.3.1.1.2, 4.16-kV Distribution System). The onsite normal ac power system feeds the nonsafety-related loads associated with, but not limited to, the following systems:

1. Main condensate and feedwater system.
2. Reactor recirculation system.
3. Condensate makeup and drawoff system.
4. Component cooling water system.
5. Plant cooling and ventilation system.
6. Service water system (nonsafety portion).
7. Circulating water system.
8. Reactor water cleanup system.
9. Other nonsafety-related auxiliary systems.

8.3.1.1.2 Power Supply Buses

13.8-kV Distribution System

The 13.8-kV distribution system is shown on Figure 8.3-1. There are five nonsafety-related and four safety-related 13.8-kV buses. The nonsafety-related buses are designated 2NPS-SWG001, 2NPS-SWG002, 2NPS-SWG003, 2NPS-SWG004, and 2NPS-SWG005. The safety-related buses are designated 2EPS*SWG001, 2EPS*SWG002, 2EPS*SWG003, and 2EPS*SWG004. Buses 2NPS-SWG001 and 2NPS-SWG003 supply 13.8-kV nonsafety-related motors, 2,500 hp and above, the nonsafety-related 4.16-kV buses via auxiliary Station transformers 2ATX-XS1 and 2ATX-XS3, and the 600-V normal load centers 2NJS-US1 through 2NJS-US4 and 2NJS-US7 through 2NJS-US10 via normal load center transformers. The 13.8-kV bus 2NPS-SWG001 also feeds safety-related 13.8-kV buses 2EPS*SWG001 and 2EPS*SWG002. The 13.8-kV bus 2NPS-SWG003 feeds safety-related 13.8-kV buses 2EPS*SWG003 and 2EPS*SWG004. Normal 13.8-kV bus 2NPS-SWG002 supplies power to the two auxiliary electric boilers.

The normal 13.8-kV buses 2NPS-SWG001 and 2NPS-SWG003 are normally energized from the normal Station service transformer 2STX-XNS1. In case of loss of power from the normal source, these buses are automatically transferred to the offsite power sources via reserve Station service transformers 2RTX-XSR1A and 2RTX-XSR1B, respectively. If one of the two reserve Station service transformers is out of service for maintenance, and 2NPS-SWG001 and 2NPS-SWG003 are to be transferred onto the remaining reserve Station service transformer upon loss of 2STX-XNS1 for unit trip or LOCA, then 13.8-kV buses are also automatically transferred onto the reserve Station service transformer in service, provided the breakers are lined up for this configuration. This transfer is accomplished in two modes, fast or slow. Automatic fast transfer from normal to reserve source occurs within 6 cycles after loss of normal power, except under conditions that would prohibit such transfer. Automatic transfer is prohibited under the following conditions:

1. Reserve Station service transformer 2RTX-XSR1A 13.8-kV side neutral grounding switch closed. This applies to reserve Station service transformer 2RTX-XSR1A and 13.8-kV circuit breaker 1-1 only. There is no neutral grounding switch on the 13.8-kV side of the reserve Station service transformer 2RTX-XSR1B (see Figure 8.3-1). The switch is closed when reserve Station service transformer 2RTX-XSR1A feeds 13.8-kV bus 2NPS-SWG002, which is solidly grounded.

2. Reserve Station service transformer electrical fault.

3. 13.8-kV switchgear (2NPS-SWG001 or 2NPS-SWG003) electrical fault.

4. 115-kV transfer trip.

5. Control switch ACB 1-16 in close.

If the automatic fast transfer is not accomplished within 6 cycles, an automatic slow transfer is provided after sufficient time delay to allow for decay of voltage on the de-energized bus and shedding of selected motors to prevent excessive surges upon restart of the equipment. The automatic slow transfer also occurs in case of sustained bus undervoltage condition.

Each bus has a manually-controlled air circuit breaker for access to its normal source and an automatically- or manually-controlled air circuit breaker for access to its reserve source. Each bus also has an automatically- or manually-controlled air circuit breaker for connection to the alternate reserve power source.

The 13.8-kV normal bus 2NPS-SWG002 is fed from one of the offsite power sources through auxiliary boiler transformer 2ABS-XI. An alternate feed to the auxiliary boiler transformer is provided through reserve transformer bus B as described in Section 8.2.1.4 under auxiliary boiler transformer.

During normal plant operation condition, transfer of any of the normal 13.8-kV buses from its normal reserve transformer source to the alternate reserve source can be performed by Opening the normal reserve source breaker and then Closing the alternate reserve source breaker.

During plant cold shutdown condition and refueling operations, transfer of any of the normal 13.8-kV buses from its normal reserve transformer source to the alternate reserve source can be performed by Opening the normal reserve source breaker and then Closing the alternate reserve source breaker in accordance with plant operating procedures.

One reserve Station service transformer, 2RTX-XSR1A or 2RTX-XSR1B, may feed both 2NPS-SWG001 and 2NPS-SWG003 as long as the total loading is below the continuous nameplate rating. This nameplate rating should not be exceeded in any case even after the completion of fast and or slow transfer of power to the offsite power source(s) at unit trip.

Recirculation Pump Trip System

The 13.8-kV safety-related buses 2EPS*SWG001 and 2EPS*SWG002 and 2EPS*SWG003, and 2EPS*SWG004 feed the reactor recirculation pumps 2RCS*P1A and 2RCS*P1B, respectively. The recirculation pump motors are not safety related. The only safety function of this safety-related 13.8-kV system is to trip the recirculation pumps when required. This is ensured by providing two safety-related circuit breakers in series for each of the recirculation pumps. Two breakers receive trip signals from two separate divisions of the RPS.

The 13.8-kV normal buses 2NPS-SWG004 and 2NPS-SWG005 are energized by two low-frequency motor generator (LFMG) sets, 2RCS-MG1A and 2RCS-MG1B, respectively, which furnish 15 Hz power supply to the recirculation pump motors on low-speed operation. These buses and LFMG sets are classified as nonsafety related.

The 13.8-kV switchgear is rated for 1,000 MVA interrupting capacity. The nonsafety-related main breakers and the main buses are rated for 3,000 amps continuous duty, except for switchgear buses 2NPS-SWG004 and 2NPS-SWG005, which are rated for 1,200 amps.

The feeder breakers are rated for 1,200 amps continuous duty. The safety-related buses 2EPS*SWG001 through 2EPS*SWG004 are rated for 1,200 amps continuous duty.

Two normal dc buses 2BYS-SWG001A and 2BYS-SWG001B provide control power for the normal 13.8-kV buses. One of the dc sources supplies control power to the main and tie breakers and associated relaying. The other dc source supplies control power to the feeder breakers and the associated relaying. Each dc bus is fed by a separate battery. Each dc bus can be connected to the other dc source if required without paralleling the two dc sources.

The dc control power for safety-related buses 2EPS*SWG001 and 2EPS*SWG003 are supplied from dc MCC 2DMS*MCCA1; whereas dc MCC 2DMS*MCCB1 provides control power for buses 2EPS*SWG002 and 2EPS*SWG004. The dc MCCs belong to the redundant Divisions I and II, respectively, of the safety-related power distribution system. Nonsafety-related buses 2NPS-SWG004 and 2NPS-SWG005 receive control power from normal dc buses 2BYS-SWG001A and 2BYS-SWG001B. The Division III dc power supply is discussed in Section 8.3.2.

4.16-kV Distribution System

The 4.16-kV distribution system consists of the normal or nonsafety-related 4.16-kV distribution system and the emergency 4.16-kV distribution system. The normal 4.16-kV distribution system (Figure 8.3-1) consists of eight normal 4.16-kV switchgear buses, 2NNS-SWG011 through 2NNS-SWG018. Buses 2NNS-SWG014 and 2NNS-SWG011 are fed from normal 13.8-kV bus 2NPS-SWG001 via auxiliary transformer 2ATX-XSI. Buses 2NNS-SWG013 and 2NNS-SWG015 are fed from normal 13.8-kV bus 2NPS-SWG003 via auxiliary transformer 2ATX-XS3. Bus 2NNS-SWG012 is normally connected to bus 2NNS-SWG011 through a normally closed circuit breaker, and to bus 2NNS-SWG013 through a normally open circuit breaker. Buses 2NNS-SWG011, 2NNS-SWG012, and 2NNS-SWG013 supply 4.16-kV non-Class 1E motor loads. Buses 2NNS-SWG011 and 2NNS-SWG013 also feed the two LFMG sets (2RCS-MG1A and 2RCS-MG1B) for the reactor recirculation pump motors.

Two 4.16-kV buses, 2NNS-SWG014 and 2NNS-SWG015, designated as the plant stub buses, feed 4.16-kV motor loads, from 150 to 300 hp, and 600-V load center transformers for load centers 2NJS-US5 and 2NJS-US6. These two buses have some functions distinct from other normal 4.16-kV buses. They feed selected redundant normal plant loads. In case of loss of power from the 13.8-kV normal buses 2NPS-SWG001 and 2NPS-SWG003, and in the absence of a LOCA condition, these buses can be manually connected to the associated division emergency diesel generator buses 2ENS*SWG101 and 2ENS*SWG103, respectively. The stub buses, however, are physically separated and electrically isolated from the safety-related system in such a way that any failure in the normal distribution system will not interfere with the safety function of the emergency distribution system. Circuit breakers 101-11 (on bus 2ENS*SWG101) and 103-8 (on bus 2ENS*SWG103) will trip automatically under the following conditions:

1. LOCA signal (e.g., high drywell pressure or low reactor water level).

2. Sustained undervoltage on buses 2ENS*SWG101 and 2ENS*SWG103, respectively.

3. Overcurrent or ground fault on buses 2NNS-SWG014 and 2NNS-SWG015, respectively.

For a unit turbine generator trip condition, stub buses 2NNS-SWG014 and 2NNS-SWG015 are fed from offsite power sources through the normal 13.8-kV buses 2NPS-SWG001 and 2NPS-SWG003, respectively.

Normal switchgear buses 2NNS-SWG016, 2NNS-SWG017, and 2NNS-SWG018 are used to interconnect 4.16-kV tertiary windings of the reserve Station service transformers 2RTX-XSR1A and 2RTX-XSR1B, and auxiliary boiler transformer 2ABS-XI, respectively, to the 4.16-kV emergency buses.

The 4.16-kV normal switchgear is located in the normal switchgear building at el 261 ft. The switchgear is rated 250 MVA interrupting capability. The main and tie breakers are rated for 1,200 or 2,000 amps continuous duty. The normal 4.16-kV switchgear receives control power from two normal dc buses. One bus supplies control power to the main and tie breakers and associated relaying. The other dc bus supplies control power to the feeder breakers and associated relaying. Each dc bus has its own battery and can be connected to the alternate dc source without paralleling the dc sources.

The emergency 4.16-kV distribution system is illustrated on Figure 8.3-2. There are three 4.16-kV emergency switchgear buses, 2ENS*SWG101, 2ENS*SWG102, and 2ENS*SWG103. Bus 2ENS*SWG101 is dedicated to Division I of the Station emergency power distribution system; buses 2ENS*SWG103 and 2ENS*SWG102 are dedicated to Divisions II and III, respectively. Buses 2ENS*SWG101 and 2ENS*SWG103 feed all Station redundant safety-related loads, except the HPCS system loads. The HPCS system loads are fed by bus 2ENS*SWG102. All three divisions are normally energized from offsite power sources through the tertiary winding of the reserve Station service transformers, buses 2ENS*SWG101 and 2ENS*SWG102 from transformer 2RTX-XSR1A, and bus 2ENS*SWG103 from transformer 2RTX-XSR1B. The tertiary winding of the auxiliary boiler transformer 2ABS-X1 provides a backup for buses 2ENS*SWG101 and 2ENS*SWG103. Each switchgear has a breaker cubicle (101-10 and 103-2) for connection to the backup source. Bus 2ENS*SWG102 also has a breaker cubicle (102-5) for connection to the reserve transformer 2RTX-XSR1B, if required. The cubicle-only positions do not have a circuit breaker installed in them. They are interlocked with the normal power source breakers; breaker 101-10 can only be closed when breaker 101-13 is open, the breaker racked out and inserted into cubicle 101-10, and other conditions of transfer are satisfied. Similarly, breaker 103-2 can only be closed when breaker 103-4 is open, the breaker racked out and inserted into cubicle 103-2, and other conditions of transfer are satisfied; the same logic follows for breakers 102-5 and 102-4. The tertiary windings of the reserve Station service transformers are designed to carry the greater of the loads on buses 2ENS*SWG101 and 2ENS*SWG102 or

2ENS*SWG103 and 2ENS*SWG102, respectively, plus one stub bus load, to permit such transfers. The auxiliary boiler tertiary winding is sized to carry all the connected loads on either of the buses 2ENS*SWG101 or 2ENS*SWG103.

The transfer of a 4.16-kV emergency bus from the reserve transformer to the auxiliary boiler transformer feed can occur only by manual transfer initiated by the Operator in absence of any DBA condition. Necessary mechanical interlocks are provided so that auxiliary boiler transformers can only supply one emergency bus at a time.

Manual transfer from onsite to offsite source is accomplished by momentarily paralleling the incoming supply with the running supply from the standby diesel generator and then manually tripping the running supply.

Each of the three 4.16-kV emergency buses has a standby diesel generator to carry its loads in case of a LOOP or in case of a sustained degraded voltage condition on the offsite source. For the 4.16-kV emergency bus undervoltage trip functions, all three-phase voltages are monitored by individual phase undervoltage relays. To initiate a trip function, only two of the phase undervoltage relays need to operate. The diesel generator 2EGS*EG1 feeds bus 2ENS*SWG101, diesel generator 2EGS*EG2 feeds bus 2ENS*SWG102, and diesel generator 2EGS*EG3 feeds bus 2ENS*SWG103. Each emergency diesel generator is separate from and independent of the other diesel generators so that failure of one diesel generator will not impede the operation of the other diesel generators. In case of a loss of voltage or sustained degraded voltage from reserve transformer 2RTX-XSR1A, emergency bus 2ENS*SWG101 undervoltage relay picks up, trips the offsite power main breaker 101-13 and all feeder breakers, except the emergency 600-V load center breakers 101-14 and 101-2, and starts the emergency diesel generator 2EGS*EG1. When the generator attains its rated speed, voltage, and frequency, the generator breaker 101-1 closes. Within 10 sec from the starting signal, the load sequencing begins. Similarly, the emergency bus 2ENS*SWG103 is transferred to its emergency diesel generator 2EGS*EG3 upon loss of voltage or sustained degraded voltage from reserve transformer 2RTX-XSR1B. Upon loss of voltage or degraded voltage from reserve transformer 2RTX-XSR1A or 2RTX-XSR1B, the emergency bus 2ENS*SWG102 is also transferred to its emergency diesel generator 2EGS*EG2 in a similar way, except that no load shedding on the bus is required. If either of emergency buses 2ENS*SWG101 or 2ENS*SWG103 is powered from the auxiliary boiler transformer source and this source is subsequently lost, the bus will automatically be transferred to its emergency diesel generator. In case of a LOCA, the emergency diesel generators start and run on no-load so that they can pick up loads in the event a delayed LOOP should occur following a LOCA.

The emergency 4.16-kV switchgear is rated for 250 MVA interrupting capacity. All breakers are rated for 1,200 amps continuous duty. Each of the Division I and II switchgear has two dc control power buses supplied by its associated divisional emergency dc power system. Class 1E battery 2BYS*BAT2A feeds bus 2ENS*SWG101 via Class 1E 125-V dc switchgear 2BYS*SWG002A. Class 1E battery 2BYS*BAT2B feeds bus 2ENS*SWG103 via Class 1E 125-V dc switchgear 2BYS*SWG002B. One control bus supplies control power to the main breakers, associated relaying, and control circuits; the other bus supplies control power for the feeder breakers, associated relaying, and control circuits. The two control buses are supplied by two separate cables originated at the same breaker on the dc bus. The two cables are routed separately. Each control bus can be connected to the other dc feeder via a pullout fuse block arrangement. For the Division III (HPCS) switchgear, Class 1E battery 2BYS*BAT2C feeds bus 2ENS*SWG102 via the Class 1E 125-V dc distribution panel located in 2CES*IPNL414. This control bus supplies control power to the main and feeder breakers, associated relaying, and control circuits. An additional bus, from a separate breaker in 2CES*IPNL414, supplies 125-V dc to Class 1E panel 2EGS*PNL028 for additional Division III protective relaying circuits.

Emergency 4.16-kV switchgear buses are electrically independent and physically isolated from each other so that any failure in one division will not jeopardize the safety function of any other division. Emergency 4.16-kV switchgear buses are located in separate rooms in the emergency switchgear room at el 261 ft in the control building, a Category I structure.

600-V Distribution System

The 600-V distribution system consists of the normal and emergency 600-V load centers, 600-V MCCs, and 600-V power distribution panels. The load centers feed the MCCs, 600-V distribution panels, 600-V motor loads from 50 to 200 hp, and other loads from 60 to 475 kW. The MCCs feed plant auxiliary motor loads from 1/2 to 50 hp, MOVs from about 1/6 to 50 hp, and other miscellaneous loads. The 600-V distribution panels feed 120/240-V and 120/208-V distribution panels through 600-V to 120/240-V distribution transformers, plant UPS systems, lighting loads, and other miscellaneous loads.

The plant normal 600-V distribution system is illustrated on Figure 8.3-3. All normal load centers feed nonsafety-related loads. The normal load centers, 2NJS-US1 through 2NJS-US4 and 2NJS-US7 through 2NJS-US10, are double-ended, split bus design and are fed from the normal 13.8-kV switchgear buses. The normal load center transformers are rated as follows:

1. 2NJS-US1 through 2NJS-US4 and 2NJS-US7 through 2NJS-US10 are rated for 1,500/2,025 kVA, (80°/150°C temperature rise).

2. 2NJS-US5 and 2NJS-US6 are rated 1,000/1,350 kVA, (80°/150°C temperature rise).

The load center breakers are rated for a minimum of 22,000 amps symmetrical short-circuit capability. The normal stub bus load centers 2NJS-US5 and 2NJS-US6 with their associated MCCs have the distinct function of feeding selected plant loads such as the UPS systems, battery chargers, etc. These load centers are double ended without tie breakers and are normally fed from the 4.16-kV stub buses 2NNS-SWG014 and 2NNS-SWG015. Each normal 600-V load center can receive dc control power from either of the normal dc buses 2BYS-SWG001A and 2BYS-SWG001B.

The 600-V emergency distribution system is illustrated on Figure 8.3-4. The emergency 600-V load centers 2EJS*US1 and 2EJS*US3 are fed from their respective divisional 4.16-kV switchgear buses 2ENS*SWG101 and 2ENS*SWG103. These load centers are indoor metal-enclosed type with drawout circuit breakers. The load centers are double ended without any bus tie breaker. The load center transformers are rated at 1,500/2,025 kVA (80°/150°C temperature rise). The feeder breakers are rated for 22,000 amps interrupting capability. The emergency load centers feed plant emergency motor loads from 150 to 180 hp, other emergency loads from 60 to 120 kW, emergency MCCs, and 600-V emergency power distribution panels belonging to their respective divisions. There is no load center associated with Division III. The Division III 4.16-kV emergency bus 2ENS*SWG102 supplies Division III emergency MCC 2EHS*MCC201 through 4160/600-V distribution transformer 2EJS*X2. The emergency load centers receive dc control power from their respective divisional 125-V dc buses.

The emergency MCCs 2EHS*MCC101, 2EHS*MCC102, and 2EHS*MCC103 feed Division I emergency motor loads from 1/2 to 50 hp including MOVs from about 1/6 hp, heaters, and other miscellaneous loads. MCCs 2EHS*MCC301, 2EHS*MCC302, and 2EHS*MCC303 feed similar emergency loads belonging to Division II. Division III MCC 2EHS*MCC201 feeds all Division III 600-V to 120-V power distribution panels through 600-V to 120/240-V distribution transformers in addition to Division III HPCS motor and other loads.

The main incoming and bus tie breakers for Division I and II MCCs are molded case, nonautomatic type and have a continuous rating of 800 amps (mains) and 600 amps (ties). The branch circuit molded case circuit breakers in MCCs have a symmetrical short-circuit capability of 14,000 amps (minimum) for combination motor control units, or 22,000 amps (minimum) for feeder tap units. The 600-V distribution panels use breakers of 18,000 or 22,000 amps (minimum), interrupting capability for branch circuit protection depending on panel requirements.

The intent of dual feeds to the load centers and MCCs is to increase availability of power source to these buses. The feeder cables are routed separately.

The MCCs feeding various plant redundant loads are of two-bus design to increase reliability of power supply. The MCCs feeding one group of load only are of single-bus design.

For the MCCs that are of two-bus design, each feeder is sized to carry the entire MCC loads with the tie breaker closed.

Key interlocks are provided to ensure that no more than two out of three breakers (two feeder breakers and one tie breaker) are closed at any time, other than for the momentary paralleling during the transfer of supply power. Normally there are two keys; however, during parallel operation a third key is used.

Normally the load center transformers do not operate in parallel. However, momentarily parallel operation to transfer the unit sub on to the alternate transformer is acceptable. For a single-bus configuration, one load center transformer feeds the load center (see Figure 8.3-2). For the load centers with a two-bus configuration (normally open tie circuit breakers), one load center transformer normally feeds each bus, and if one of the two transformers fails, the remaining transformer is generally capable of carrying the entire load center load. However, normal load centers 2NJS-US3, -US7, and -US9 may have conditions which, in the absence of administrative load reductions, will require that two transformers must be in service.

Emergency lighting panels 2LAC*PNL100A and 2LAC*PNL300B feed safety-related 600-V, 120/208-V, 3-phase and 120/240-V, 1-phase loads, including the safety-related UPS systems, safety-related battery chargers, and emergency lighting belonging to their respective divisions.

The emergency load centers, MCCs, and 600-V distribution panels of Divisions I, II, and III are physically isolated from and electrically independent of each other so that any single failure in one division will not impede the safety function of any other division.

<u>120/240-V Distribution System</u>

The plant 120/240-V distribution system provides power for the plant instrumentation and control systems, plant auxiliary motor loads below 1/2 hp, including MOVs below 1/6 hp, lighting loads, and other miscellaneous 120-V auxiliary loads. The system consists of the 600-V to 120/240-V and 600-V to 120/208-V dry-type distribution transformers, 120/208-V and 120/240-V distribution panels, and 120-V UPS system. The plant normal 120/240-V distribution system is illustrated on Figure 8.3-3. The emergency 120/240-V distribution system is illustrated on Figure 8.3-4. The distribution transformers and their associated panels are located near the loads they feed in different areas of the plant. The distribution panels are of NEMA-12 or NEMA-3R construction; branch circuits are protected by molded-case circuit breakers or with fusible switches.

The emergency 120/208-V or 120/240-V distribution panels of each of Divisions I, II, and III feed emergency lighting loads, emergency heating and ventilation loads, and emergency instrumentation and control loads. The 120/208-V or 120/240-V distribution system of any other division is physically isolated from and electrically independent of the 120/208-V or 120/240-V distribution system of any other division. The emergency instrumentation and control circuits may, in certain instances, feed nonsafety-related instrumentation and control equipment or circuits. In all such cases, appropriate isolation devices have been provided so that any failure in the nonsafety-related circuit will not impede the performance of the safety-related system.

<u>Uninterruptible Power Supply System</u>

The plant UPS system provides 120/208-V ac 3-phase normal and 120-V ac 1-phase normal and 120-V ac 1-phase emergency power supply to all plant service loads and instrumentation and control loads for which UPS is required. Each UPS system has a normal ac source and a bypass ac source from the plant 600-V distribution system, and a backup dc source from the plant 125-V dc distribution system except for 2VBB-UPS1H, which utilizes an integral 48-V dc storage battery as its backup source. The UPS is normally fed from its normal ac source. In case of loss of normal ac source, the UPS is automatically fed from the backup dc source. In case of any fault in the inverter, the UPS loads are fed from the bypass or an alternate ac source. The UPS system is shown schematically on Figure 8.3-5. The UPS output voltage is maintained within ±2 percent of 120/208-V for all of the UPSs except 2VBB-UPS1A, 2VBB-UPS1B, 2VBB-UPS1G, 2VBB-UPS1C, 2VBB-UPS1D, 2VBB-UPS1H, 2VBA*UPS2C, and 2VBA*UPS2D. For UPS 2VBB-UPS1A, 2VBB-UPS1B, 2VBB-UPS1G, 2VBB-UPS1C, 2VBB-UPS1D, and 2VBB-UPS1H, the output voltage is maintained within ±3 percent. The output voltage for 2VBA*UPS2C and 2VBA*UPS2D is factory set at 121.6-V ±2 percent. The output frequency is maintained within ±0.5 Hz of 60 Hz. The output voltage harmonic content will not exceed 5 percent of the fundamental. The transfer of the load from normal ac source to the alternate ac source in case of inverter trouble is automatic and is accomplished by a make-before-break static transfer switch so that no interruption of supply to UPS loads occurs due to such transfers. Each UPS system has a maintenance bypass circuit that enables servicing of either the static transfer switch or the rectifier inverter without affecting the UPS output.

The plant normal UPS system is shown on Figure 8.3-3. This consists of one 7-kVA, 120-V, 1-phase unit (2VBB-UPS1H), two 10-kVA, 120-V, 1-phase units (2VBB-UPS3A and 2VBB-UPS3B), three 80-kVa, 120/208-V, 3-phase UPS units (2VBB-UPS1A, 2VBB-UPS1B, and 2VBB-UPS1G), and two 75-kVA, 120/208-V, 3-phase UPS units (2VBB-UPS1C and 2VBB-UPS1D) and their associated distribution panel(s).

The branch circuits are protected by fused disconnect switches and/or molded-case circuit breakers.

One 7-kVA UPS 2VBB-UPS1H feeds a gaseous effluent radiation monitor in the main stack; one 80-kVA UPS (2VBB-UPS1A) feeds the radwaste computer hardware and other selected nonsafety-related instrumentation and control loads; the other 80-kVA UPS (2VBB-UPS1B) feeds local nonsafety-related radiation monitoring microprocessors, selected communication system loads, selected lighting loads, and selected nonsafety-related instrumentation and control loads; two 75-kVa UPSs 2VBB-UPS1C and 2VBB-UPS1D feed selected lighting loads and communication system loads; and one 80-kVa UPS 2VBB-UPS1G feeds the remaining plant computer loads. Two 10-kVA UPSs (2VBB-UPS3A and 2VBB-UPS3B) feed all RPS logic trip channel loads and main steam line isolation valves (MSIV) control solenoids through their associated distribution panels 2VBS*PNLA100 and 2VBS*PNLB100, and associated subpanels. The RPS and the MSIV are fail-safe systems (de-energize to operate), i.e., failure of the power supply causes a reactor scram and isolation and, therefore, UPS feeding these systems are classified as nonsafety related.

The power supply to the redundant trip systems is through their respective Class 1E electrical power assemblies that act as isolation devices between safety-related RPS devices and nonsafety-related power sources. Refer to Section 8.3.1.1.3 for details.

The plant emergency UPS system consists of four 25-kVA, 120-V, 1-phase UPS units (2VBA*UPS2A and 2VBA*UPS2C for Division I and 2VBA*UPS2B and 2VBA*UPS2D for Division II) and their associated distribution panels and manual transfer switches (Figure 8.3-4). UPS 2VBA*UPS2A/2VBA*UPS2C are normally fed from Division I 600-V power distribution panel 2EJS*PNL100A; Division I 600-V emergency lighting panel 2LAC*PNL100A provides their alternate ac source, and Division I 125-V dc switchgear bus 2BYS*SWG002A provides their backup dc source. UPS 2VBA*UPS2B/2VBA*UPS2D are normally fed from the Division II 600-V emergency power distribution panel 2EJS*PNL300B; Division II 600-V emergency lighting panel 2LAC*PNL300B provides their alternate ac source, and Division II 125-V dc switchgear bus 2BYS*SWG002B provides their backup dc source. For each division, one of the redundant UPS units is normally in service, with the other UPS unit maintained as an energized standby unit with no operating loads.

The plant emergency UPS system feeds emergency core cooling system (ECCS) instrumentation/control loads. It does not feed any emergency diesel generator control panel.

The emergency UPSs 2VBA*UPS2A and 2VBA*UPS2B are located in the emergency switchgear room in the control building at el 261 ft. The emergency UPSs 2VBA*UPS2C and 2VBA*UPS2D are located in the divisional cable spreading rooms at el 237 ft of the control building. The control building is a Category I structure.

Standby Ac Power System

The plant onsite ac power system has a standby ac power system to provide power supply for operation of the plant emergency systems and ESFs during and following the emergency shutdown of the reactor in the event of a LOCA and LOOP or any other DBA and LOOP. The standby ac power system consists of three standby diesel generators, one dedicated to each of the three independent divisions of the plant emergency distribution system (Figure 8.3-2). Standby diesel generator 2EGS*EG1 is connected to Division I 4.16-kV emergency bus 2ENS*SWG101 and feeds Division I emergency loads. Standby diesel generator 2EGS*EG3 is connected to Division II 4.16-kV emergency bus 2ENS*SWG103 and feeds all Division II emergency loads. Similarly, diesel generator 2EGS*EG2 is connected to Division III 4.16-kV emergency bus 2ENS*SWG102 and feeds all Division III (HPCS) loads.

Under normal plant operating conditions the diesel generators are maintained in a standby status. The engine is kept warm by circulating warm jacket water and warm lube oil to increase its first-try starting reliability. In the event of a LOOP or degraded offsite voltage condition, the diesel generators automatically start, accelerate to rated speed, voltage, and frequency, within 10 sec from the starting signal, and start picking up loads sequentially.

In case of a LOCA, the diesel generators automatically start, accelerate to rated speed, voltage, and frequency, and run on no-load. Should subsequent LOOP occur, the diesel generator will then energize the bus. Each standby diesel generator is capable of being started or stopped manually from the diesel generator control room, as well as from the main control room.

The Station standby power system is designed to meet the following functional design bases:

1. Each onsite emergency power distribution system has a dedicated standby diesel generator which is physically separated from and electrically independent of any other diesel generator so that failure in one diesel generator will not jeopardize the safety function of any other diesel generator.

2. Each standby diesel generator's continuous rating is determined based on its worst-case starting and continuous load duty under the following conditions:

    a. Simultaneous LOOP and LOCA.

    b. LOOP with subsequent LOCA.

    c. LOCA with subsequent LOOP.

d. Simultaneous LOOP and unit trip.

Tables 1, 2, 4, 5, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14) provide Division I and II diesel generator load tabulations and load summaries. Table 3, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14) is a listing of Division III (HPCS) diesel generator loads.

3. Each standby diesel generator is capable of starting and accelerating to rated speed, in the required sequence, all the emergency shutdown loads and the ESF loads connected to it.

4. In case of unavailability of any one diesel generator, the remaining two diesel generators will be capable of feeding all the loads necessary for safe shutdown of the unit in the event of any DBA and LOOP.

5. Each standby diesel generator fuel oil system has a storage capacity suitable for operating each standby diesel generator for 7 days. The fuel oil storage is Category I.

6. Each standby diesel generator is capable of being manually paralleled with the plant offsite power sources. These are not used for supplying power to the grid.

7. Standby diesel generators are located in the diesel generator building which is a Category I structure. Each diesel generator is separated by Category I walls.

The capacity rating of the standby diesel generators for the three independent divisions of the plant emergency distribution system differs because of the difference in loads associated with the three divisions. Divisions I and II feed all plant emergency loads, except the HPCS loads, divided into redundant load groups. Division III feeds all HPCS system loads.

<u>Standby Diesel Generators - Divisions I and II</u>

The Division I and II standby diesel engines are 600-rpm, 16-cylinder, 4-stroke engines having the following ratings:

Continuous rating:	8,760 hr	4,400 kW
Short-term rating:	2,000 hr	4,750 kW
	2 hr	4,840 kW

The generators are synchronous type rated for 5,938 kVA, 4,160 V, 3-phase, 60 Hz, 600 rpm, 0.8 power factor, Class F insulation.

Each of the Division I and II diesel generators is required to start and carry the loads given in Tables 1, 2, 4, 5, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14) in the sequence stated therein. The generator total load is calculated under the following conditions:

1. Simultaneous LOOP and LOCA.

2. LOOP with a subsequent LOCA.

3. LOCA with subsequent LOOP.

4. Simultaneous LOOP and unit trip.

The most severe starting and accelerating duty occurs during Condition 2, the ultimate load after about 2.5 hr being about 4,514 kW. The 2000-hr rating of the diesel generators thus exceeds the maximum required load.

Each diesel generator starts, accelerates to rated speed, voltage, and frequency, and starts load sequencing within 10 sec of the receipt of the starting signal. During the period of load sequencing, each diesel generator maintains its voltage and frequency within 80 and 95 percent of nominal, respectively. The voltage and frequency are restored to within 90 and 98 percent of nominal, respectively, within 40 percent of each load sequence time. The voltage is reestablished at nominal voltage prior to each subsequent load sequence. During recovery from transients caused by step load increases or resulting from a full load rejection, the speed of each diesel generator will not exceed nominal speed plus 75 percent of the difference between nominal speed and overspeed trip setpoint of 660 rpm.

Each diesel generator has the following auxiliary systems to ensure reliable and safe operation:

1. Fuel oil storage and transfer system.

2. Cooling water system.

3. Starting air system.

4. Lubrication system.

5. Combustion air intake and exhaust system.

These auxiliary systems are described in Sections 9.5.4 through 9.5.8. The auxiliary systems of each diesel generator are physically separated from and electrically independent of the auxiliary systems of any other diesel generator so that any failure in one diesel generator system will not jeopardize the safety function of any other diesel generator.

Automatic Starting and Loading Systems The Division I and II standby diesel generators start automatically in case of a LOOP, a LOCA, or both. The autoconnected loads to each diesel generator do not exceed the 2000-hr rating of 4750 kW. The sequence of events following any of these conditions is as follows:

1. Loss of Offsite Power The LOOP condition appears in case of a complete loss of voltage or degraded voltage on emergency buses 2ENS*SWG101 or 2ENS*SWG103. Under any of these conditions, the bus undervoltage relays pick up and the following sequence of events takes place:

   0-10 sec Offsite power supply breaker 101-13 or 103-4 trips. All loads on the emergency buses 2ENS*SWG101 or 2ENS*SWG103 are tripped, except the loads fed through the 600-V load centers. Diesel generators start and accelerate to rated speed, voltage, and frequency.

   10 sec Diesel generator supply breaker 101-1 or 103-14 closes. Load sequencing begins according to Tables 1, 2, 4, 5, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14) if a LOCA condition appears.

2. Loss-of-Coolant Accident In case of a LOCA signal, the following sequence of events takes place:

   0-10 sec Diesel generators start on LOCA signal, accelerate to rated speed, voltage, and frequency.

   10 sec Diesel generators run on no-load at rated voltage and frequency, awaiting closing of the diesel generator breaker 101-1 or 103-14 in case any LOOP condition arises.

   The Class 1E LOCA loads are sequenced on offsite power in the same way as these are sequenced on the standby diesel generators. Unit 2 uses sequential relaying for load sequencing; it does not use a preprogrammed, electronic or solid-state load sequencer. Load sequential relaying means the staggering of time in starting emergency pumps so as to prevent tripping of diesel generator. These time sequences will allow diesel generator voltage to return. Separate Agastat timers are provided for each sequence load at the switchgear feeding the load. Timers are connected in such a way that failure of one timer will not affect the timing operation of other timers (refer to ESK-5ENS21 and -5ENS22).

3. <u>Random Sequence of Loss-of-Coolant Accident and Loss of Offsite Power</u> A LOCA and LOOP can occur in any of the following random sequences:

   a. Simultaneous LOCA and LOOP.

   b. LOCA and subsequent LOOP.

   c. LOOP and subsequent LOCA.

   Under simultaneous LOCA and LOOP, the sequence of events is similar to that under LOOP (Condition 1); under LOCA and subsequent LOOP, the sequence of events is similar to those under LOCA (Condition 2) followed by tripping of the offsite power supply breakers and shedding of selected loads on emergency buses and then sequencing loads. The first group of loads is sequenced after the residual voltage on the largest motor in this group has decayed to approximately 25 percent of its rated voltage, which takes 1 sec. The sequence of events occurring in case of LOOP and subsequent LOCA is similar to those under LOOP (Condition 1).

   Tables 1, 2, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14) give details of sequencing loads on the standby diesel generators under the conditions of simultaneous LOCA and LOOP, LOOP with delayed LOCA, LOCA with delayed LOOP, and LOOP with unit trip.

   In these tables, the time, T, is measured from the instant the diesel generator attains its rated speed, voltage, and frequency, and is connected to the bus by closing the diesel generator breaker.

   T=0 indicates that these loads are not shed from their buses and are energized as soon as the diesel generator breaker is closed.

   T=1, 6, etc., indicates the time of the equipment start after the closing of the diesel generator breaker (T=0).

   Sequencing of the service water pumps under the first three conditions described above is as follows. (Sequencing for Division I is explained. Division II is similar and is indicated in parentheses.)

   At T=32 sec, service water pump 2SWP*P1A (2SWP*P1B) receives an autostart signal if it was previously in service. The other two Division I (Division II) service water pumps are blocked from manual starting until T=70 sec.

At T=37 sec, service water pump 2SWP*P1C (2SWP*P1D) receives an autostart signal if it was previously in service and none of the other Division I (Division II) service water pumps are running. Pumps 2SWP*P1E and 2SWP*P1A (2SWP*P1F and 2SWP*P1B) are blocked from manual starting until T=70 sec.

At T=42 sec, service water pump 2SWP*P1E (2SWP*P1F) receives an autostart signal if it was previously in service and if none of the other Division I (Division II) service water pumps are running. Pumps 2SWP*P1A and 2SWP*P1C (2SWP*P1B and 2SWP*P1D) are blocked from manual starting until T=70 sec.

For condition IV (LOOP with unit trip, nonaccident loading), the sequencing of the service water pumps is similar (T=32, 37, and 42 sec). There are no residual heat removal (RHR) or low-pressure core spray (LPCS) pumps sequenced to start prior to service water under this condition.

Tables 4, 5, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14) give total starting and running loads under different load blocks totaled from Tables 1, 2, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14), respectively.

Assumptions used in these calculations are as follows:

a. For 600-V motor loads, a conservative value of 1 kVA per hp has been assumed when the efficiency or power factor is not known.

b. For 4-kV motors, brake hp of driven equipment requirements are used to calculate motor kVA.

c. MOVs are assumed to be energized intermittently and all Class 1E MOVs are assumed to operate for the initial 2-min post-accident period. MOVs are assumed to have a starting kVA of 10 times the nameplate hp rating. When the actual starting current/torque is not known, this is conservative. If actual MOV constant load operating torques are not known, load torque is assumed to be 200 percent of nameplate hp rating. The higher opening or closing torque usually required at the beginning or end of the valve operation is assumed to occur over the initial 2-min diesel generator loading sequence and does not appear as a significant additional load to the diesel generator. Ten percent of the MOV running loads are assumed after the initial 2 min of diesel generator loading sequence. These assumptions are very conservative.

d. Transformer magnetizing in-rush current is assumed to be 12 times full load nameplate current with a 0.1-sec duration. Transformer losses for units smaller than 75 kVA are assumed as negligible.

Transformers smaller than 75 kVA are assumed to be loaded to nameplate kVA rating unless the actual load is known.

e. For 600-V loads other than MOVs, a locked rotor current of six times the full load current and a starting power factor of 0.35 are assumed when the actual starting current and starting power factors are not known. These assumptions are conservative.

f. Small power/lighting transformers, battery chargers, heaters, and other direct nonmotor loads are assumed loaded to nameplate values unless the actual load is known.

<u>Automatic Transfer of the Standby Diesel Generators from the Test Mode to the Emergency Mode in Case of a LOCA or LOOP</u> Periodic testing of the Division I and II standby diesel generators does not impair its capability to supply emergency power within required times. During the test mode, the standby diesel generator is either loaded by paralleling this with the offsite power system or is running unloaded. If the diesel generator is running unloaded on test (not connected to the emergency bus), it will go on emergency mode if a LOCA occurs. If a LOCA occurs when the diesel generator is running in parallel with the offsite power during test, the diesel generator breaker will trip and the diesel generator will be running idle on emergency mode. The LOCA loads will be sequenced on offsite power. If a LOOP occurs when the diesel generator is running in parallel with the offsite power during test, the diesel generator will attempt to supply power to the offsite test loads through the closed offsite breaker. If the current exceeds a preset value, a set of three directional overcurrent relays will trip the offsite breaker; the diesel generator will continue to power the emergency bus.

The control power for automatic starting and load sequencing is provided from the emergency 125-V dc system belonging to the respective divisions. The nonsafety-related stub buses 2NNS-SWG014 and 2NNS-SWG015 are only connected manually, in case of a LOOP and in absence of any LOCA within the diesel generator capability. Upon a LOCA signal, these buses are automatically tripped off the emergency buses.

Control and Protection System Each standby diesel generator has a protection system designed to initiate diesel generator trouble alarms and shutdown sequence to prevent damage or destruction of the engine or generator should a malfunction occur during emergency or test mode operation. The control and protection logics are shown on Figure 8.3-6. The protective functions are outlined below. All conditions which shut down the diesel generator during test but are bypassed during emergency operation are alarmed in the main control room. Table 8.3-6a is a list of control room annunciator windows for the diesel generators. This table includes a window description, originating device number, and description of the originating device. This table reflects the separation of disabling and nondisabling alarms to annunciator windows. A disabling condition will not annunciate the same window a nondisabling condition annunciates. The generator phase overcurrent trip is bypassed under emergency conditions. Except for sensors and other equipment that must be directly mounted on the engine or associated piping, the control and monitoring instrumentation is installed on a freestanding, floor-mounted panel located in a separate room from the engine skids, and located on a vibration-free floor area.

1. Each standby diesel generator is rendered incapable of responding to an emergency autostart signal by the following conditions. These conditions are annunciated in the diesel generator control room and in the main control room:

   a. Low fuel oil level in day tank.

   b. Low starting air pressure.

   c. Dc control power failure at engine panel.

   d. Mode selector switch in OFF position.

   e. Dc control power failure at generator panel.

   f. Generator differential protection operated.

   g. Engine overspeed trip.

2. During emergency operation, the standby diesel generator is shut down and the diesel generator breaker tripped under the following conditions:

   a. Engine overspeed.

   b. Generator differential.

   c. Manual stop (main or diesel generator control room).

   d. Voltage-controlled overcurrent.

This is actually a bus protection and not a diesel generator protection. The relay trips the diesel generator breaker; it does not stop the diesel generator. Therefore, no coincident logic is necessary.

3. Each standby diesel generator is provided with the following safety shutdowns under test run condition:

   a. Engine overspeed.

   b. Generator differential.

   c. Manual stop.

   d. Generator directional ground overcurrent.

   e. Generator reverse power.

   f. Generator loss of field and generator relay potential not normal.

   g. Jacket water outlet temperature high.

   h. Lube oil temperature high.

   i. Lube oil pressure low.

   j. Turbocharger lube oil pressure low.

   k. Bearing temperature high.

   l. Turbocharger thrust bearing failure.

   m. Deleted.

4. The following emergency conditions are annunciated locally in the diesel generator control room under all operating conditions:

   a. Generator differential (with shutdown).

   b. Reverse power and field loss (with shutdown).

   c. Generator field ground fault.

   d. Generator overvoltage.

   e. Generator panel - dc control power failure.

   f. Voltage-controlled overcurrent.

   g. Directional ground overcurrent (with shutdown).

h. Blown potential transformer fuse.

i. Mode selector switch in OFF position.

j. Incomplete sequence (starting).

k. Overspeed engine (with shutdown).

l. Deleted.

m. Generator control in maintenance position or inoperable.

n. Generator space heater auxiliary switches or MCC not proper for auto operation.

o. Jacket water pressure low.

5. Indicating instruments which are provided for monitoring the status of system pressure, temperature, level, etc., locally in the diesel generator control room and/or main control room are discussed in Sections 9.5.4 through 9.5.8. In addition, the following indicators are provided for monitoring the status of the generators:

a. Voltmeters.

b. Ammeters.

c. Wattmeters.

d. Varmeters.

e. Field ammeter.

f. Synchroscope.

g. Frequency meters.

h. Engine speed indicator.

i. Watt-hour meter.

j. Generator field voltmeter.

<u>Qualification Testing</u> The Division I and II standby diesel generators are qualified by tests and analysis in accordance with RG 1.9, IEEE-387-1977 and IEEE-323-1974 (see Section 3.11). Sufficient information on testing to qualify the Unit 2 diesel generators was submitted under separate cover in January 1984.

<u>Standby Diesel Generator - Division III (HPCS)</u> The Division III standby diesel generator is a unit supplied by General Electric Company (GE) as part of the NSSS system consisting of a 2-cycle, 20-cylinder, 900-rpm diesel engine having the following ratings:

Continuous rating:	8,760 hr	3,600 bhp	2,600 kW
Short-term ratings:	2,000 hr	3,950 bhp	2,850 kW
	200 hr	4,100 bhp	2,950 kW
	2 hr	4,000 bhp	2,860 kW
	30 min	4,225 bhp	3,050 kW

The continuous rating is subject to 10 percent overload for 2 hr out of 24-hr operation. The 2000-hr, 200-hr and 30-min ratings are not subject to overload.

The associated generator is a synchronous generator with the following ratings:

Output	2,850 kW
Voltage	4,160 V
rpm	900
Power factor	0.8 lag
Frequency	60 Hz
Phase	3 ph

The HPCS division does not use load sequencing. The Division III standby diesel generator is required to start and carry the HPCS pump 2CSH*P1 (3050 hp), which constitutes about 94 percent of the HPCS diesel generator load in the event of a LOCA and LOOP. There are other 600-V auxiliary loads that are fed through MCC 2EHS*MCC201 via auxiliary transformer 2EJS*X2. The total loads to be connected to the HPCS diesel generator are shown in Table 3, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14). The 2000-hr rating of the diesel generator exceeds the maximum required load.

The HPCS diesel generator is capable of starting and accelerating the HPCS pump to rated speed, voltage, and frequency and energizing other connected 600-V loads within 27 sec of the receipt of the starting signal. The HPCS diesel generator cannot maintain the voltage and frequency within 75 and 90 percent, respectively, during initial loading. This does not, however, reduce the reliability of the HPCS system, since 94 percent of the HPCS system load consists of the HPCS pump which is being started; all other loads are fed via the 600-V MCC and auxiliary transformer. Consequently, momentary drops of voltage below 75 percent and frequency below 95 percent would not have any significant effect on HPCS system operation. During recovery from transients during starting its motor load or resulting from a full load rejection, the speed of the HPCS diesel generator will not exceed nominal speed plus 75 percent of the difference between nominal speed and the overspeed trip setpoint which is set in the range of 1035-1050 rpm.

The HPCS diesel generator has the following auxiliary systems to ensure reliable and safe operation:

1. Fuel oil storage and transfer system.

2. Jacket water system.

3. Starting air system.

4. Lubrication system.

5. Combustion air intake and exhaust system.

These systems are described in Sections 9.5.4 through 9.5.8. The auxiliary systems of the HPCS diesel generator are physically separated from and electrically independent of the auxiliary systems of any other standby diesel generator, so that any failure in one standby diesel generator system will not jeopardize the safety function of any other standby diesel generator. A heavy-duty turbocharger drive gear assembly has been installed in the HPCS diesel generator.

Automatic Starting and Loading The HPCS diesel generator starts automatically in case of a LOCA and LOOP supply. The autoconnected loads do not exceed the 2000-hr rating of 2850 kW. The sequence of events following such a condition is as follows:

0-3 sec	Offsite power supply breaker 102-4 and 102-5 trips; HPCS diesel generator starts.
10 sec	HPCS diesel generator supply breaker 102-1 closes; HPCS pump starts; 600-V loads energized.
27 sec	HPCS pump at rated speed; HPCS injection valves fully open.

The control power for automatic starting and loading is provided from the Division III emergency 125-V dc system.

Periodic testing of the HPCS diesel generator is performed from the control room by manual initiation or simulation of LOCA. This testing does not impair the capability of starting the HPCS pump within the required time. The test controls are overridden by the LOCA event.

The local engine control switch is usually in the automatic position to allow operation and periodic testing from the control room. The local engine control switch also provides a maintenance and test position. The maintenance position places the HPCS diesel generator in "out of service." The test position is used only for test after maintenance prior to transferring to automatic operation. The LOCA signal will not start the engine when the engine control switch is in the test position; however, the switch is spring loaded in the test position, returning automatically to the automatic position when released. As such, it is not necessary to provide any annunciation in the main control room for this test switch.

The diesel generator performs its emergency function automatically when it is operating in the test mode. During the test mode, the diesel generator is either loaded by paralleling with the offsite power system or is running unloaded. The emergency start demand signal that reverts the diesel to emergency mode from test during auto mode from the control room is a LOOP signal or a LOCA signal.

If a LOOP occurs, a parallel-loaded diesel generator would attempt to supply power to the offsite test loads through the closed feed breakers. A set of three directional overcurrent relays will trip the offsite feed breakers when the overcurrent exceeds the preset value on the relays. The diesel generator would continue to power the HPCS bus. The diesel generator would keep running with the voltage regulator in the automatic mode and the governor would remain in the droop mode until manually restored to the isochronous mode.

If a LOCA signal is received during HPCS diesel generator periodic testing and the diesel generator is running in parallel with the offsite power, the diesel generator feed breakers will trip. The LOCA signal would override the test start signal during auto mode and the diesel generator would continue running unloaded. The HPCS pump motor automatically would start from the HPCS bus.

Except in the case of a LOCA, diesel generator protective trips are operational. A LOCA signal causes all engine protective trips except engine overspeed and generator differential protection to be bypassed.

If the diesel generator is running unloaded, a LOOP signal would automatically trip the feed breaker and connect the diesel generator to the HPCS bus.

<u>Control and Protection System</u> The logics for control and protection of the Division III standby power system are shown on Figure 7.3-3. Except for sensors and other equipment that must be directly mounted on the engine or associated piping, the control and monitoring instrumentation is installed on a freestanding floor-mounted panel located in a separate room from the engine skid, and located on a vibration-free floor area. The Division III standby diesel generator has a control and protection system designed to initiate diesel generator trouble

alarms and shutdown sequences to prevent damage or destruction of the engine or generator should a malfunction occur during emergency or test mode operation. The protective functions are as follows:

1. The HPCS diesel generator is rendered incapable of responding to an emergency autostart signal in case of a LOCA and LOOP due to the following conditions. These conditions are annunciated in the diesel generator control room and/or in the main control room:

   a. Low fuel oil level in day tank.

   b. Low starting air pressure.

   c. Control power failure.

   d. Engine in maintenance position (alarm in control room only).

   e. Diesel engine trouble/lockout not reset (alarm in main control room only).

   f. Generator trip/lockout not reset (alarm in main control room only).

2. The HPCS diesel generator is shut down and the generator breaker 102-1 tripped under the following conditions during LOCA operation:

   a. Engine overspeed.

   b. Generator differential.

   c. Manual stop (main or diesel generator control room).

   d. Voltage-controlled overcurrent.

      This is actually a bus protection and not a diesel generator protection. The relay trips the diesel generator breakers; it does not stop the diesel generator. Therefore, no coincident logic is necessary.

3. The HPCS diesel generator has the following safety shutdowns under test run condition:

   a. Engine overspeed.

   b. Generator differential lockout.

   c. Manual stop.

d. Low lubrication oil pressure.

e. High jacket water outlet temperature.

f. Generator loss of excitation.

g. Engine overcrank.

h. Generator reverse power.

i. Generator ground.

j. Generator overcurrent.

4. The following emergency conditions of the HPCS diesel generator are annunciated locally in the diesel generator control room under all operating conditions:

a. Generator fails to start/run.

b. Left bank starter inlet pressure low.

c. Loss of control power.

d. Engine overspeed.

e. Engine tripped.

f. High generator stator temperature.

g. High jacket water temperature.

h. Low expansion tank water level.

i. Low cooling water pressure.

j. Low lubrication oil pressure.

k. Right bank starter inlet pressure low.

l. Low turbo lubrication oil pressure.

m. Crankcase pressure high.

n. High lubrication oil temperature.

o. Low lubrication oil temperature.

p. Restricted lubrication oil filter.

q. Fuel oil transfer pumps trouble.

r. Main fuel pump failure.

s. Reserve fuel pump failure.

t. Restricted fuel oil filter.

u. Dc turbo lube pump running.

v. Storage tank level off normal.

w. Day tank level off normal.

5. The following remote annunciation is provided in the main control room:

a. Engine in maintenance position.

b. 125-V dc system trouble.

c. Automatic start not ready.

d. Engine overspeed.

e. Engine running.

f. Engine trip.

g. Engine trouble.

h. Generator trip/lockout.

i. HPCS system ground.

j. HPCS system sustained undervoltage.

k. Diesel generator overcurrent.

l. HPCS control power failure or breaker in lower position.

m. HPCS battery breaker open.

n. Engine bypassed/inoperable.

o. Diesel generator loss of control power.

6. Indicating instruments which are provided for monitoring the status of the system pressure, temperature, and level, etc., in the diesel generator control room and/or main control room are detailed in Sections 9.5.4 through 9.5.8. In addition, the following indicators are provided for monitoring the status of the HPCS generator:

a. Voltmeters.

b. Ammeters.

c. Wattmeters.

d. Varmeters.

e. Tachometers.

f. Synchroscopes.

g. Frequency meters.

All normal diesel generator trip conditions that are bypassed during emergency operation are alarmed in the control room. The following conditions shut down the Division III (HPCS) diesel generator during testing, but are bypassed during emergency (LOCA) operation:

1. Low lubrication oil pressure.

2. High jacket water outlet temperature.

3. Engine overcrank.

4. Generator loss of excitation.

5. Generator reverse power.

Conditions 1, 2, and 3 are individually alarmed at the local diesel generator control panel when any of the respective parameters have exceeded the preset limit. Concurrent with any one of these local alarms, a common control room alarm, Diesel Engine Trouble, is annunciated.

Conditions 4 and 5 are indirectly alarmed in the control room as HPCS System Sustained Undervoltage. Generator reverse power due to loss of diesel engine or due to loss of excitation will cause loss of bus voltage.

Table 8.3-3A provides a comparison of the HPCS diesel engine conditions described in Subparagraphs 1, 2, and 3, under Control and Protection Systems, and corresponding remote annunciations to the main control room that are listed in Subparagraph 5. The emergency conditions listed in Subparagraph 4 are annunciated in the diesel generator control room only.

<u>Qualification Testing</u> The Division III standby diesel generator is qualified by tests and analysis in accordance with RG 1.9 and IEEE-387-1972 (Section 3.11). GE Licensing Topical Report NEDO-10905 (Reference 4), Section 7.0, covers the HPCS diesel generator's compliance to these qualification guidelines.

<u>Surveillance Testing</u> The testing and loading of the diesel generators will follow the accepted good operating practices, and

diesel runs will be made at or near 100-percent load. Provisions are made in operating procedures to prevent failures due to light load operation by following good operating practices, as described by the diesel vendor, including heavy loading of the diesel after any light load operation.

Perform the following at least once per 24 months:

1. Verify that autoconnected loads to each diesel generator do not exceed the 2000-hr rating specified in Section 8.3.1.1.2;

2. Subject the diesel generators to an inspection in accordance with procedures prepared in conjunction with the station’s recommendations for this class of standby service.

Additional periodic surveillance testing will be performed in accordance with Technical Specifications and Nuclear Regulatory Commission (NRC) guidelines, as outlined in conformance to RG 1.108.

<u>Periodic Inspection</u> The diesel generators will be inspected, in accordance with the procedures prepared in conjunction with the station’s recommendations for this class of standby service, once per fuel cycle.

Preventive or corrective maintenance forms provide for the identification of cause of failure. A periodic review of maintenance of equipment is performed to determine failure trends. Increasing or unacceptable failure rates are utilized as one mechanism of determining requirements for additional testing or examinations to determine root cause of problems. Determination of root cause may require modification or redesign of components to improve reliability.

Prior to restoration of any equipment to service, all protective markups are removed and the components placed in the required operable condition. Procedure steps specifically require the restoration of jumpers, blocks, or lifted leads if required by the procedure. Following extensive maintenance activities, a complete system lineup will be performed. These activities are administratively controlled and required double verification for safety-related components. These methods, combined with a visual inspection by Operators prior to starting the diesel or support equipment, provide the assurance that the diesel is ready for testing. Steps are included in surveillance tests of the diesel generator units to ensure that automatic standby service is restored and verified at the conclusion of the test.

<u>Standby Diesel Generator Associated Training</u> Standby diesel generator training, like the overall training program, was developed consistent with INPO accreditation objectives and criteria. This training will be implemented in accordance with

the training system development (TSD) process. Because Operator and Maintenance Technician tasks impact the plant-specific risk assessment (PRA), additional consideration will be given to the content of the initial training and the content and frequency of continuing training.

The TSD process developed by INPO and its members is a systematic approach for establishing and maintaining a performance-based training program.

The process of maintaining an INPO-accredited training program is controlled internally through the use of training procedures.

Training Department personnel who teach diesel generator courses shall be:

1. Qualified Instructors (in accordance with site procedural requirements).

2. Knowledgeable on the specific diesel generator tasks to be trained.

8.3.1.1.3 Reactor Protection System Power Supply

The RPS power supply system provides power to the logic system that operates the RPS in accordance with the requirements of GDC 2, 21, and 23; IEEE-279-1971; and IEEE-379-1972. The RPS power supply consists of: 1) power supply to the RPS trip channels that monitor specific plant parameters that are critical for safe reactor operation and initiate a scram, and 2) power supply to the scram pilot valves solenoids that operate the scram inlet and outlet valves and cause a scram. The RPS power supply system is illustrated on Figure 8.3-7.

Power supply to the RPS trip channels consists of two UPS systems and the associated protective devices, distribution panels, and wiring. The RPS utilizes two separate trip systems identified as trip systems A and B. Each trip system is composed of two trip channels which produce the automatic trip signals. The two trip channels for trip system A are identified as trip channels A-1 and A-2. Similarly, the trip channels for trip system B are identified as trip channels B-1 and B-2. Each trip system receives power from one of the two 10-kVA, 120-V, 1-phase UPS systems. RPS trip system A is fed from UPS 2VBB-UPS3A. This is normally energized from 600-V ac nonsafety-related lighting panel 2LAT-PNL100. In case of loss of the normal supply, UPS 2VBB-UPS3A automatically receives power from its backup dc source provided by 125-V dc nonsafety-related battery 2BYS-BAT1C via 125-V dc nonsafety-related switchgear bus 2BYS-SWG001C. The battery is capable of feeding the UPS for 2 hr in case of loss of all ac sources. The associated battery charger 2BYS-CHGR1C1 is fed from stub bus load center 2NJS-US6. In case of any failure of the inverter, this UPS is fed from its alternate 600-V ac source from nonsafety-related distribution panel 2NJS-PNL500.

RPS trip system B is fed from UPS 2VBB-UPS3B. This is normally energized from 600-V ac nonsafety-related power distribution panel 2NJS-PNL402. In case of loss of this normal supply, with inverter available, UPS 2VBB-UPS3B automatically receives power from its backup dc source, provided by 125-V dc normal battery 2BYS-BAT1B, via 125-V dc nonsafety bus 2BYS-SWG001B. The battery is capable of supplying the UPS for 2 hr after loss of all ac supply. The associated battery charger 2BYS-CHGR1B1 is fed from stub bus load center 2NJS-US6. In case of any failure of the inverter, this UPS is fed from alternate 600-V ac source from normal power distribution panel 2NJS-PNL600. The detail data for the UPS systems are as follows:

Rating	10 kVA, 120 V ac, 1 phase, 60 Hz
Input ac (normal and alternate)	
Voltage	575 ±10%
Frequency	60 Hz + 10%, - 5%
Phase	3
Input dc	125-V nominal varying between 103 and 140 V
Output voltage stability	124 V ±2% for all combinations of input voltages, output loading, and temperature
Output frequency stability	60 Hz ±0.5 Hz
Transient response	Any output voltage deviation, averaged over one-half cycle, will not exceed ± 15% for a 100% load application or removal and will return to within ±2% for all combinations of dc input, ac input, and temperature.
Overload capacity	The UPSs are capable of supplying 125% full rated load for 10 min without failure while maintaining output voltage within ±10% of nominal.

Each UPS is connected to its associated distribution panel through two redundant electric protective assemblies (EPA) connected in series. The EPAs are called electric power monitoring assemblies in the Technical Specifications. The EPAs provide redundant protection to the RPS system and other associated essential circuits against overvoltage, undervoltage, and underfrequency conditions in the nonsafety-related power sources. The EPAs consist of overvoltage, undervoltage, and underfrequency trip components, housed in a Class 1E qualified 18"W x 37"H x 14"D protective enclosure. They operate and provide electrical protection under the following nominal input power conditions:

Power	18.7 kVA
Voltage	120-V ac ±2%
Phase	1 phase
Frequency	60 Hz - 1% slip
Current	156 A

The EPA overvoltage and undervoltage trip levels are adjustable over a range of 80 to 115 percent of the nominal input voltage of 120 V ac and 40 to 70 Hz frequency. The EPA underfrequency trip level is adjustable from 85 to 100 percent of the nominal input of 60 Hz. The EPAs disconnect the RPS power sources whenever the ac voltage or frequency exceeds the predetermined limits of overvoltage, undervoltage, or underfrequency.

Power supply to the solenoid-operated scram pilot valves consists of two high inertia motor generator (MG) sets and the associated protective devices, distribution panels, and wiring. The MG sets are designated 2RPM-MG1A and 2RPM-MG1B. One MG set feeds all of the A solenoid valves for the four groups of scram pilot valves through separate feeders. The other MG set feeds the B solenoid valves through separate feeders. Each MG set consists of an induction motor driving a synchronous generator and has a flywheel to supply sufficient stored energy to maintain the generator output voltage and frequency within specified limits during momentary interruptions of input power. The driving motor is fed from the plant 600-V nonsafety-related MCCs. MG set 2RPM-MG1A is fed from normal MCC 2NHS-MCC008, and MG set 2RPM-MG1B is fed from normal MCC 2NHS-MCC009. The detail data for the induction motor, the synchronous generator, and the flywheel assembly are as follows:

Induction Motor Data

25 hp, 1,785 rpm at full load
575 V, 3 phase, 60 Hz
33.2 amps at full load
NEMA Design A
Class B insulation
Drip-proof enclosure
110-V rated space heaters
Designed for continuous operation
Service factor 1.15

Synchronous Generator Data

18.75 kVA, 120 V, 1 phase, 60 Hz
1,800 rpm, 70°C temperature rise

156 amps full load current
Class B insulation
Drip-proof enclosure
Integral brushless exciter
110-V rated space heater

Flywheel Assembly

Calculated net weight 880 lb
Calculated WK^2 700 lb/ft^2

The steady-state output voltage regulation of the synchronous generator is 2 percent from no load to full load with normal input to the drive motor. With a 50-percent step load change, the voltage variation is limited to ±15 percent momentarily. Recovery to steady-state regulation for both voltage and frequency does not exceed 1 sec. During a 2-sec power interruption, output voltage and frequency remain within 5 percent of the normal operating values. During a power interruption exceeding 2 sec, voltage is maintained within ±5 percent until output frequency has dropped by 15 percent.

MG set 2RPM-MG1A is connected to auxiliary bus 2RPM-PNL1A. An alternate power supply from the plant normal 600-V power distribution system is also connected to this auxiliary bus via a 15-kVA, 600-120/240-V, 1-phase step-down transformer. The alternate source energizes the auxiliary bus when the MG set is taken out of service for maintenance. The auxiliary bus is connected to the MG set main distribution panel 2RPM*PNLA100 through two redundant EPAs connected in series. These EPAs are similar to those used with the UPS systems feeding RPS trip systems and consist of molded-case circuit breakers and overvoltage, undervoltage, and underfrequency devices. MG set 2RPM-MG1B and its auxiliary source are connected to auxiliary bus 2RPM-PNL1B and main distribution bus 2RPM*PNLB100 in the same manner. From each of the main distribution panels, four separate circuits are drawn to four groups of scram solenoids.

There are two dc backup scram valves, A and B, which are fed from the plant emergency 125-V dc power system. Backup scram valve A is fed from Division I emergency dc bus 2BYS*SWG002A(G) via emergency dc panel 2BYS*PNL201A(G). Backup scram valve B is fed from Division II emergency dc bus 2BYS*SWG002B(Y) via emergency dc panel 2BYS*PNL201B.

The UPS systems and MG sets used to supply power to the RPS are classified nonsafety related because the RPS is designed as fail-safe, i.e., the system operates in a safe mode (trips and causes a scram) in case of loss of electric power. The EPAs and the distribution systems downstream from the EPAs' panel boards, associated protective devices, and wiring are classified as safety related and are designed and qualified as Class 1E and Category I to ensure reliability of the tripping function. The EPAs protect the Class 1E RPS and other associated Class 1E systems and components powered by the nonsafety-related RPS power supply sources against the effects of possible sustained abnormal voltage or frequency conditions from the non-Class 1E RPS power sources. Any random undetectable or seismically-induced abnormal voltage or frequency conditions in the outputs of the MG sets or their associated alternate power supplies, or the UPS systems, would trip either one or both of the two EPAs, thereby producing a half scram on that channel and retaining full scram capability on the other channel.

The power distribution systems associated with separate channels of the RPS are segregated into separate divisions. These are color coded and are installed with adequate physical separation between them so that no single failure in the RPS power supply system will jeopardize the safety function of the RPS. The methods of identification and physical separation of the power distribution system associated with different RPS channels are described in Sections 8.3.1.3 and 8.3.1.4.

8.3.1.1.4 Cables and Raceways

Insulated copper conductors are used for all onsite power distribution systems. The insulations used are thermosetting rubber-based elastomer or cross-linked polyethylene, which are heat, moisture, impact, ozone, and nuclear radiation-resistant and are suitable for a nuclear power plant environment. The material of the cable jacket is flame-resistant protective thermosetting, heavy-duty, black chlorosulfonated polyethylene (or hypalon) which is also moisture, heat, weather, oil, ozone, and nuclear radiation resistant and, as such, suitable for nuclear power plant application.

The cables are installed in cable trays, conduits, and duct lines, etc., and derated in accordance with applicable IPCEA publications. The cables and raceways for the emergency onsite power distribution system are routed to meet the physical separation requirements of RG 1.75 and IEEE-384-1974.

All safety-related cables are qualified for their appropriate environmental conditions (Section 3.11).

<u>Description of Cables</u>

The types of cables used in the onsite power distribution system are as follows:

1. <u>Medium Voltage Power Cable - 15 kV</u> Thermosetting rubber-based elastomer insulated stranded copper conductors with ground wire, rated at 15 kV, are used for the 13.8-kV distribution system. The conductor jacket is flame-resistant, protective thermosetting, heavy-duty, black chlorosulfonated polyethylene. The ground wire is jacketed only. The cable is either single conductor or triplexed. All 15-kV cables are

shielded, each conductor having a shield between the insulation and jacket.

2. Medium Voltage Power Cable - 5 kV Thermosetting rubber-based elastomer insulated stranded copper conductors with ground wire, rated at 5 kV, are used for the 4.16-kV onsite distribution system. The conductor jacket is flame-resistant, protective thermosetting, heavy-duty, black chlorosulfonated polyethylene. The ground wire is jacketed only. The 5-kV cables are triplexed and nonshielded, or single conductor and nonshielded.

3. Low Voltage Power Cable - 600 V The 600-V power cables used in the 600-V onsite distribution system have thermosetting rubber-based elastomer insulation, and flame-resistant, protective thermosetting, heavy-duty, black chlorosulfonated polyethylene jacket. The 600-V cables are either single conductor quadruplexed or four conductor, stranded copper, nonshielded.

4. Control Cable - 1,000 V The 1,000-V grade control cables are used for 125-V dc control circuits associated with the 13.8-kV and 4.16-kV switchgear buses, 600-V load centers, switchyard, long runs of other 125-V dc control wiring, and current transformer connections. The cables are multiple conductor, stranded copper, having insulating and jacket material similar to that of the power cables. The minimum size of cable used in this grade is No. 12 AWG.

5. Control Cable - 600 V The 600-V grade control cables are used for wiring 120-V ac motor control circuits, miscellaneous 125-V dc (electronics) circuits, electrohydraulic control (EHC) circuits, and indicating and annunciator circuits. These are single or multiple conductor, stranded copper cables with heat, moisture, impact, ozone, and nuclear radiation resistant thermosetting-type insulation and thermosetting, heavy-duty, black chlorosulfonated polyethylene jacket. The minimum size cable is No. 12 AWG for 120-V ac motor control circuits and 125-V dc (electronic) circuits. The minimum size cable for the EHC circuits and the 125-V dc annunciator circuits is No. 16 AWG.

6. Instrument Cable - 300 V The 300-V grade instrument cables are used for the wiring of analog input and output, instrument transmitters, and resistance temperature detectors. These are single or multiple, pair, triple or quadruple, twisted, stranded copper conductors with heat, moisture, impact, ozone, and nuclear radiation resistant thermosetting-type insulation and thermosetting, heavy-duty, black chlorosulfonated polyethylene jacket. These conductors

are pair-shielded, triple-shielded, quadruple-shielded, or overall-shielded.

7. Thermocouple Extension Cable Thermocouple extension cables are twisted-pair construction, solid copper-constantan, iron-constantan, or chromel-alumel cables with a 90°C flame-resistant thermosetting-type insulation and a chlorosulfonated polyethylene jacket. These cables are either pair-shielded or overall-shielded.

8. Communication System Cables The communication cables are used for the wiring of the plant page party/public address (PP/PA) communication system, and maintenance and calibration communication (M/CC) system. These are 600-V single- or multiple-pair, twisted, stranded copper cables with heat, moisture, impact, ozone, and nuclear radiation resistant thermosetting-type insulation and thermosetting, heavy-duty, black chlorosulfonated polyethylene jacket.

   In addition, some serial bus connections utilize a two-conductor #20 AWG shielded twin-axial data communications cable, with a nominal 100 ohm impedance, 150-V Teflon insulation with Teflon jacket and rated for operation in a 200°C ambient temperature.

9. Special Cable A number of special types of cables are provided to interconnect equipment, such as the NMS, the rod position information system (RPIS), the rod drive control system, and the area and process radiation system. These cables are of the coaxial or twinax type, except for the RPIS cable.

   The coaxial cables consist of tin-coated copper or copper-clad steel conductors and tin-coated copper shields, radiation cross-linked modified polyolefin and polymer LE insulations, and radiation cross-linked, flame-retardant, noncorrosive modified polyolefin jackets. The RPIS cable consists of 11 tin-coated copper conductors and one pair of chromel-alumel, thermocouple conductors. The insulation and jacket material is cross-linked polyethylene.

10. PGCC Cable The cables used in PGCC are 600-V single- or multiple-shielded twisted pair, stranded copper cables insulated and jacketed with tefzel insulation. These are rated for continuous use at 115°C and conform to IPCEA S-61-402[1].

Cable Ampacities and Derating

Cable ampacities and derating factors are based on IPCEA Publications No. P-46-426 and P-54-440[2,3]. The criteria are as follows:

1. All cable ampacities are based on the following ambient conditions:

    a. 65.5°C (150°F) for all cables in the primary containment.

    b. 51.7°C (125°F) for all cables in the standby diesel generator buildings.

    c. 54.4°C (130°F) for all cables in the main steam tunnels.

    d. 40°C (105°F) for all cables other than a, b, and c, and secondary containment including auxiliary bays.

2. Cable ampacities given in NEC or IPCEA Publications are based on 40°C ambient[2,3]. To derate for other ambients, Equation 5-a (Page III) of Reference 2 is used:

$$I' = I\sqrt{\frac{T_C - T_{a'}}{T_C - T_a}}\ amps$$

(8.3-1)

    Where:

    T_c = Conductor temperature, °C

    T_a = Ambient temperature, °C

    I = Cable ampacity at T_a

    T_a' = New ambient temperature, °C

    I' = Cable ampacity at T_a'

    This gives a derating factor of 0.9 for 50°C ambient and 0.7 for a 65.5°C ambient over the 40°C ambient ampacity. When one cable passes through areas with different ambients, the highest ambient is used for derating.

3. Derating for cable tray fill is in accordance with IPCEA Table VII[2]. Since it does not provide any derating factor for quadruplexed cable, the derating

factors for triplexed cable are used for this, which give conservative cable fill. Ampacities for continuous duty cables in "open top 4-in deep" trays are based on 50-percent tray fill and a calculated depth of cables in cable tray of 2.5 in(3).

4. For cables in duct lines, IPCEA tables are further derated by ampacity multipliers to yield more conservative results.

5. For cables in conduit, tables in IPCEA(2) are used. For cables in conduit, other than triplexed cables, IPCEA(2) ampacities are used and derated by 0.82.

   For single-conduit runs, no further derating is necessary; for groups of conduit, multipliers in accordance with Table IX of IPCEA are used(2).

   Ampacities for triplexed cable run in conduit are taken from IPCEA (tables for isolated conduit in air)(2).

6. Cables that are run in a combination of duct, wall sleeves, conduit, and tray, are analyzed for the ampacity limiting factor. If that part of the raceway that is the limiting factor for ampacity is more than 10 ft long, then this governs the cable rating for the entire run.

7. Selection of a cable for any particular load is decided on the basis of three parameters.

   a. Ampacity.

   b. Permissible voltage drop.

   c. Short-circuit capability.

8. Cables for feeding safety-related motors are sized at 180 percent of the motor full load current. Cables for nonsafety-related motors are sized at 125 percent of the full load current to take into account overloads and service factor loading. For ac or dc fire pump motors, the cables are sized to carry 100-percent locked rotor current in accordance with NFPA-20-1976, Paragraph 7-4.2.7, and NEC 1978, Article 230-90, Exception No. 5.

9. Cables for safety-related and nonsafety-related MOVs are sized at 55 percent of the manufacturer's special locked rotor current, and not exceeding 300 percent of the full load current, except for dc safety-related MOVs, where cables are sized at 100 percent locked rotor current.

Raceways

The raceways used to route the cables throughout the plant are generally as follows.

Cable Trays Solid-bottom or ladder-type galvanized steel trays with solid sides are generally used. Trays for power cables have 3- or 4-in inside depth, and trays for control and instrumentation cables have 4-in inside depth. In general, control and instrumentation cable trays are 30 in wide. The width of power cable trays varies according to the cable requirement from 12 to 30 in. The cable trays generally conform to the requirements of NEMA Standards Publication No. VE1, Cable Tray Systems.

Standard trays, splice devices, and fittings are hot-dipped galvanized after fabrication, in accordance with ASTM A386. Steel covers are fabricated of sheet steel pregalvanized in accordance with ASTM A525. Special adjustable fittings are coated with zinc-rich paint.

Nuts, bolts, and washers for steel trays are steel. Coatings, where required, are either hot-dipped galvanized in accordance with ASTM A153, or cadmium electroplated in accordance with ASTM A165 to a minimum 0.2 mil thickness, followed by a dichromate finish.

Cable trays are installed in continuous runs, varying in lengths, in continuous beam or beam overhang configurations. Straight run seismic supports are spaced not more than 8 ft apart (10 ft, nonseismic), and fittings are supported. With this support system design, cable trays and fittings are capable of sustaining an allowable dynamic vertical working load of 165 lb/linear ft. However, the total weight of cable and attachment in trays located in seismic areas is limited to 50 lb/linear ft to provide an additional safety factor. The cable trays and fittings are designed to meet the requirements for the plant safe shutdown earthquake (SSE) and operating basis earthquake (OBE).

Metal Conduit Metal conduits used are zinc-coated rigid steel or electrical metallic tubing. All metal conduit, electrical metallic tubing and fittings bear the label of Underwriters Laboratories Inc. (UL). Steel conduit having zinc coating applied by electrogalvanizing, sherardizing, or metal spraying process has an additional outer acid-resisting coating. All steel conduit supporting members and hardware are protected against corrosion by galvanizing or by suitable corrosion-resisting paint. Where metal conduit is used for short direct burial runs without concrete encasement, it is rigid steel and the buried portion is coated with asphalt after assembly to protect against corrosion.

Nonmetallic Conduit Nonmetallic conduits are polyvinylchloride (PVC), high-density polyethylene, or reinforced fiberglass. All nonmetallic conduits meet the requirements of NEMA Publications TC6 - Underground Ducts; TC2 - Electrical Plastic Tubing (EPT) Conduit (EPC 40 and EPC 80) and Fittings; TC3 - Polyvinylchloride Fittings for Use with Rigid Polyvinylchloride Conduit and Tubing; TC4 - Polyethylene Fittings for Use With Rigid Polyethylene Conduit; and TC9 - Fittings for ABS and PVC Plastic Utility Duct for Underground Installation. Joints in concealed or direct-buried PVC conduit are threaded or of slip-on, solvent welded type.

Cable Tray Fill

The criteria for cable tray loading are given in Table 8.3-7.

8.3.1.1.5 Containment Electrical Penetrations

Modular-type electrical penetrations are used to carry electrical power, instrumentation, and control cables inside the containment. These are designed in accordance with RG 1.63, IEEE-317-1976, and ASME Boiler and Pressure Vessel Code, Section III, Subsection NE Class MC for metal containment components to maintain mechanical and electrical integrity under normal and DBA conditions of the plant. All electrical penetration assemblies are designed to withstand the maximum possible fault current for the time sufficient for operation of the backup protective devices in case the primary protective devices fail to operate. Appropriate actions and surveillance requirements are described in Technical Requirements Manual (TRM) Section 3.8.2.2. The ac circuits inside primary containment that are not provided with primary and backup containment penetration conductor overcurrent protective devices are listed in TRM Section 3.8.2.1. TRM Section 3.8.2.1 requires that these circuits be de-energized in Operational Conditions 1, 2, and 3.

Two typical penetration assemblies are shown on Figure 8.3-8. Each penetration assembly consists of a stainless steel header plate that is bolted to the containment penetration nozzle flange and sealed with viton O-ring aperture seals. The header plate holds the conductor modules which are sealed within the header plate using stainless steel compression fittings, and are sealed at the terminal bushings of the medium voltage penetrations with stainless steel compression fittings. Each conductor module is a stainless steel tube carrying an insulated single conductor or conductor group. The conductor modules are sealed at each end with resilient high-temperature thermoplastic sealants. The conductors inside the modules are continuous from inside containment termination to outside containment termination. There are no internal splices of cables. Inside the containment, the modules terminate on a support plate. All penetrations have continuous pressure-monitoring and leak-detection devices.

There are five different types of penetrations based on their service, as follows:

Type 1

Each Type 1 penetration assembly contains five conductor modules, three with 15-kV insulated cables, one jacketed ground conductor, and one shielding cable. This is used to feed the 13.8-kV reactor recirculation pumps. Type 1 penetrations have hermetically-sealed bushings on the outboard header plate and inboard support plate, and compression-type terminal lugs for field cable connections. Each of the Type 1 penetration assemblies has a dual-element copper-constantan thermocouple to monitor the temperature within the assembly at the hottest spot.

Type 2

Each Type 2 penetration assembly contains multiple conductor modules with 600-V insulated solid copper conductors and a jacketed ground conductor. This is used to feed 600-V power loads inside the containment. In certain cases where 120-V control loads are fed through Type 2 penetrations along with 600-V power feeds, they use separate feedthroughs. Pigtail terminations are provided for connecting field cables at inboard and outboard ends. Heat shrink tubing is used on all pigtail terminations. Inboard and outboard terminations are enclosed in terminal enclosures for all low-voltage penetrations. For shielded conductors, the shield is carried through the penetration as a separate conductor.

Type 3

Type 3 penetrations are similar to Type 2 penetrations, except that Type 3 does not have any ground conductor. Type 3 penetrations are used to feed 120-V power, instrumentation, and control loads inside the containment.

Type 4

Each Type 4 penetration assembly contains multiple conductor modules with 300-V insulated solid copper conductors, except for thermocouple cables. Penetration cables for thermocouples match the external thermocouple leads. In Type 4 penetrations, each module may contain multiple, twisted conductors. Pigtail terminations are used for terminating field cables. The terminations are enclosed in terminal enclosures at both ends. Type 4 penetrations are used for feeding 120-V instrument loads, thermocouples, resistance temperature detectors, etc.

Type 5

Type 5 penetrations contain shielded signal cables and are used to connect nuclear in-core instrumentation cables inside and outside the primary containment. Type 5 penetrations also use pigtail terminations and terminal enclosures.

All power and control feeders passing through electrical penetrations are provided with primary and backup protective devices which are capable of limiting the maximum heat produced by the fault current (I^2t) at the penetration to a value less than the thermal capability of the penetration.

For all instrumentation circuits, the penetrations can carry continuously the maximum short-circuit current available without exceeding their thermal limit. The primary and backup protective devices for safety-related circuits going through the penetrations are Class 1E. The primary and backup protective devices for the nonsafety-related circuits going through the penetrations are non-Class 1E; these are similar to the Class 1E protective devices and are of high quality. The MCCs and distribution panels housing the protective devices for the nonsafety-related circuits going through the penetrations are seismically mounted.

The two 13.8-kV feeders to the reactor recirculation pumps have two redundant circuit breakers in series in the 13.8-kV safety-related switchgear. The 13.8-kV circuit breakers are electrically operated. Their operating time has been assured as 30 cycles for the purpose of calculation. This is very conservative. The actual time is expected to be around 10 cycles. The two breakers receive trip signals from the two separate divisions of the RPS system (see Section 8.3.1.1.3). Figure 8.3-8B Sheet 13 gives the short-circuit decrement curve for the reactor recirculation pump LFMG set for a three-phase asymmetrical short circuit under full load condition. This curve shows that the available short-circuit current from the LFMG set is insufficient to cause loss of the penetration mechanical integrity. Therefore, two overcurrent protective devices are not required in the LFMG feeder circuits to the penetration.

Each 600-V feeder from the MCCs has a backup thermal-magnetic circuit breaker in series with the primary thermal-magnetic breaker. The backup circuit breaker trip setting is the same as the primary circuit breaker. The 600-V circuit breakers are molded-case type with 1-cycle operating time. The calculated worst case I^2t for the different types of penetrations and corresponding penetration I^2t capability are given in the following table. This shows that the thermal capability of the electrical penetrations is not exceeded. Figure 8.3-8A gives a typical simplified one-line diagram indicating the location of the penetrations, the primary and backup breakers, and the data used for calculating the fault currents in the penetrations. For the purpose of calculating worst case I^2t, the fault is assumed to occur at the load side terminals of the penetrations. The feeders used for calculation are the shortest feeders for each cable size.

Cable Voltage	Cable Size	Penet. Thermal	Calculated Worst Case I^2t (t for 600 V=.0166 Sec

Rating	AWG/KCM	Capability (I^2t)	t for 13.8 kV=0.5 Sec)
600V	#10	9.42×10^5	4.61×10^5
600V	#8	2.30×10^6	9.00×10^5
600V	#6	5.72×10^6	1.53×10^6
600V	#4	1.47×10^7	2.24×10^6
600V	#2	2.83×10^7	1.09×10^6
13.8 kV	750 KCM	8.19×10^9	4.27×10^8

Figure 8.3-8B shows samples of penetration capability curves plotted with the primary and backup protection device characteristic curves. The figure also indicates the continuous current rating and maximum short-circuit current that may be available at the penetration of any particular size. The samples include all types and ratings of primary and backup protective devices and all sizes of the penetrations used.

Since the penetration capability curves and the primary and backup protection device characteristic curves are plotted with the maximum available short circuit current at any particular size of the penetration, the samples represent the worst-case conditions.

All electrical penetration assemblies are qualified for 40-yr service in the applicable environment in accordance with RG 1.63, IEEE-317-1976, and IEEE-323-1974.

The details of the qualification procedure, test results, and analysis are given in Section 3.11.

Refer to TRM Section 3.8.2.3 for specific requirements regarding emergency lighting system overcurrent protective devices.

8.3.1.1.6 Safety-Related Motors

All Class 1E motors are designed in accordance with NEMA Publications No. MG1. Motor sizes have been determined by the characteristic of the driven equipment so that the motor develops sufficient torque to start and accelerate the driven equipment to rated speed, under maximum expected flow and pressure, with the minimum specified motor terminal voltage. The minimum starting voltage for all Class 1E and NSSS-supplied motors is 80 percent of the motor nameplate voltage. The actual available starting voltage under degraded voltage conditions for safety-related MOVs is calculated on a case-by-case basis and used in determining if the valve can develop sufficient torque to operate under design conditions. The Division I and II standby diesel generators have been designed to maintain at least 80 percent of nominal bus voltage during load sequencing. The acceleration time is less than the time to sequence each load group by the standby diesel generator. Class 1E motors have either Class B, F, or H insulation. Motors for inside containment service have Class H insulation. All Class 1E motors 1,500 hp and above have winding thermocouples embedded in the stator windings at locations uniformly distributed around the winding where the highest temperatures are expected. All vertical motors and horizontal motors with sleeve bearings have bearing thermocouples for monitoring the bearing temperature.

Class 1E motors are qualified as described in Section 3.11.

8.3.1.1.7 Criteria for Interrupting Capacity of Class 1E Switchgear, Load Centers, Motor Control Centers, and Distribution Panels

The interrupting capacity of the Class 1E switchgear, load centers, MCCs, and distribution panels are determined based on the maximum short-circuit current available at the respective buses. The available fault current is determined by short-circuit studies. All possible sources of fault current contribution have been considered. The interrupting ratings for 13.8-kV and 4.16-kV switchgear buses and 600-V load centers are then selected in accordance with ANSI Standards C37.06-1971 and C37.04-1969. The interrupting rating of the MCCs and the panel boards are selected in accordance with ANSI Standard C19.3-1973 and NEMA Publication PB-1, 1971. The interrupting ratings of the Class 1E switchgear buses, load centers, and MCCs are given in Section 8.3.1.1.2.

8.3.1.1.8 Electric Circuit Protection

Motor feeders from 13.8-kV and 4.16-kV Class 1E switchgear buses are protected against short circuit by inverse time overcurrent relays with instantaneous elements in two phases. Each motor feeder also has an instantaneous ground overcurrent relay for ground fault protection. The Class 1E load center transformer feeders from Class 1E 4.16-kV switchgear are protected against short circuit and ground fault with time overcurrent relay with instantaneous elements in each of the three phases, and an instantaneous ground overcurrent relay. The time overcurrent relays on the bus incoming line provide protection against bus faults and backup protection to individual feeder circuits from the bus.

The Class 1E 600-V load center (Divisions I and II) buses are protected against bus faults by the incoming bus circuit breakers, which are the direct-acting, series trip type having short-time and long-time trips. The incoming breaker also provides backup protection for the load center feeder circuits. The feeders from load centers to the MCCs on the static loads are protected by circuit breakers with short-time and long-time trips. The motor feeders from the load centers are protected with circuit breakers with long-time and instantaneous trips.

The feeder circuits from the 600-V MCCs have overload and short-circuit protection. The motor circuits have combination starters containing thermal-magnetic breakers with inverse time and instantaneous trip elements and thermal overload relays for short-circuit and overload protection, respectively. Nonmotor circuits are provided with thermal-magnetic breakers with inverse time and instantaneous trip elements for overcurrent and short-circuit protection. No ITE-make, molded-case circuit breakers, type HE-3, manufactured before May 1974 are used.

Safety-related 120-V circuits from 120-V, 120-V/240-V distribution panels are protected by thermal-magnetic breakers or by fuses. The panels are directly connected to the secondary of the 600-V-120/240-V, 1-phase distribution transformers, the primary of which is protected by thermal-magnetic breakers. The instantaneous trip settings of these breakers are set high enough to trip only on faults on the panel bus, on the main feeder cable, or within the transformers, thus ensuring that faults in the branch circuits from the panels trip only the affected secondary breaker and not the transformer feeder breaker.

A list on non-Class 1E lighting fixtures which are powered from Class 1E emergency power systems is provided in TRM Section 3.8.2.3. TRM Section 3.8.2.3 provides operability requirements for these devices.

The 120-V circuits from 120-V Class 1E uninterruptible power distribution panels are protected by thermal-magnetic breakers or by fuses. The ac incoming feeders to each UPS are protected by thermal-magnetic breakers. The 125-V dc incoming feeder is protected by an air circuit breaker. Each Class 1E UPS system is provided with necessary undervoltage and overcurrent protection to maintain its uninterruptible service.

No Westinghouse type BF and BFD relays or DB circuit breakers are used at Unit 2. Cutler-Hammer type M relays, with dc coils (Catalog No. D23MRD, manufactured before July 1976) are excluded in Unit 2 design. Also excluded are GE type STD relays and AK-2 circuit breakers.

All the protective devices are set to isolate the faulted circuit or equipment with minimum disruption of the system function. The criteria is to set the overcurrent trips at 125 percent of the full load current, and the alarms at 120 percent of the full load current (minimum). All protective device trip functions are coordinated, starting from the lowest downstream buses and moving upward for proper sequential tripping, thus providing backup protection with appropriate time delay.

The thermal overload on all safety-related ac MOVs is bypassed by any automatic safety signal or manually by the Operator holding the spring return control switch. Annunciation is provided in the control room for those overload control conditions. An example is shown on drawing nos. ESK-6CSL02 and ESK-6CSL03 in the drawing package.

There are no thermal overloads on dc safety-related MOVs with an active safety function. For dc safety-related MOVs with no active safety function, the thermal overload provides annunciation.

The relay trip setpoint drift problems are minimized by appropriate testing and preventive maintenance.

There are no cases within the Unit 2 design wherein power is disconnected from the control circuit of a valve (MOV, air-operated valve [AOV], solenoid-operated valve [SOV]) in order to satisfy a safety function. There are, however, designs within Unit 2 that require the opening of a contact within a control circuit to de-energize the coil of a SOV (AOV) to perform the valve's intended safety function. An example of this would be an AOV which must close to perform its safety function upon receipt of an initiation signal. This signal would de-energize the SOV which, in turn, would open, venting air from the AOV and causing it to close.

In all cases where the above discussion holds true, it has been verified by a FMEA that should this circuit fail due to a failure of any of the connections, a redundant valve system is available to ensure completion of the intended safety function. This ensures compliance to the single failure criteria.

Refer to Appendix 9B for valves which are de-energized from their power sources during normal plant operation to meet the requirements of Appendix R.

8.3.1.1.9 Grounding of Class 1E Systems

The 13.8-kV and 4.16-kV systems are low-resistance grounded. The 13.8-kV system is grounded through resistors connected to the neutral of the wye-connected secondary winding of the normal Station service transformer and the reserve Station service transformers. The Class 1E 4.16-kV system is grounded through grounding transformer and resistor combination connected to the tertiary winding of the reserve Station service transformers and the auxiliary boiler transformer. The 600-V and lower voltage distribution systems are solidly grounded at the auxiliary Station transformer neutrals. All major electrical equipment is directly connected to the ground grid by ground conductors. All components and hardware are grounded through the ground bus, which is in turn connected to the ground grid. The standby diesel generators are resistance grounded.

8.3.1.1.10 Periodic Testing and Maintenance

The equipment and systems associated with plant emergency onsite ac power system are designed to be testable during normal plant operation or during plant shutdown. The redundancy of the plant emergency onsite ac power system allows periodic testing and maintenance of equipment during normal plant operation. Periodic testing and maintenance are performed in accordance with the normal Station operating procedures to ascertain the status of the safety-related equipment operating during normal plant operation and to demonstrate capability of the equipment which is normally de-energized to perform its function when required. The periodic testing procedures will be in accordance with RG 1.118.

Testing of Offsite/Onsite Power System

Transfer of emergency 4.16-kV buses 2ENS*SWG101, 2ENS*SWG102, and 2ENS*SWG103 from offsite power sources to their respective standby diesel generators will be tested in accordance with the Technical Specifications.

Periodic Testing of Standby Diesel Generators

Preoperational and periodic testing of the standby diesel generators will be performed in accordance with provisions of Section 8.3.1.1.2, RG 1.9, RG 1.108, and IEEE-387-1972. The standby diesel generators have a complete exercise mode for this purpose, including manual starting, manual synchronizing with the offsite power sources, and manual loading. The standby diesel generators are capable of operating in parallel with the offsite power sources.

Protective Systems and Actuating Devices

The protective systems associated with the plant onsite emergency ac power system are designed to permit periodic testing of the relays, actuating devices, and circuits during normal plant operation. Periodic testing of this equipment will be done in accordance with RG 1.22.

8.3.1.2 Analysis

The plant electric power systems have been designed, in accordance with the criteria provided in the general design criteria and the applicable regulatory guides, to ensure power supply to all systems and components required to mitigate the consequences of any DBA and/or safety shutdown of the reactor under all conditions of plant operation. The following analysis demonstrates the extent of compliance with the general design criteria, regulatory guides, and IEEE standards. All safety-related equipment is qualified to serve in its respective environment. (See Section 3.11.) Originally, the FMEA of the plant auxiliary power system was contained in the Unit 2 FMEA document, which is historical. FMEAs for plant systems are now performed and controlled by the design process.

For conformance to general design criteria and regulatory guides, see Sections 3.1 and 1.8.

For conformance to the Station Blackout Rule, 10CFR50.63, see Section 8.3.1.5.

8.3.1.3 Physical Identification of Safety-Related Equipment

Two methods of identification have been used to distinguish between Class 1E and non-Class 1E components and between the three independent divisions of the onsite power systems. These are color coding and alphanumeric coding. Color coding is applied to all safety-related equipment and systems for ready identification. The alphanumeric coding is applied, in addition to color coding, to all safety-related equipment including cables and raceways for specific identification.

8.3.1.3.1 Color Coding

The following color coding is applied to all safety-related components of the onsite power system. Nonsafety-related systems are not color coded and are generally black.

Division	Color Code
Division I	Green
LPCS, RHR-A, ADS-A,	
Service water A, C & E,	
EECW-A, safety related	
HVAC-A, safety related	
Onsite power system - Division I	
Division II	Yellow
RHR-B and C, ADS-B,	
Service water B, D and F,	
EECW-B, safety related	
HVAC-B, safety related	
Onsite power system - Division II	
Division III (HPCS system)	Purple

The following color coding is applied to the redundant channels of the RPS, NMS and primary containment and reactor vessel isolation control systems (PCRVICS).

System	Color
RPS	
Logic power supply	Noncolor
Input channel and logic	
RPS D1	Green
RPS D2	Yellow
RPS D3	Orange
RPS D4	Blue
RPS D1 Channel A1	Green/White
RPS D2 Channel B1	Yellow/White
RPS D3 Channel A2	Orange/White
RPS D4 Channel B2	Blue/White
Output and power supply	
Scram solenoid	

System	Color
Group 1	Orange
Group 2	Yellow
Group 3	Green
Group 4	Blue
NMS	
Input channels	
Channel NA	Green
Channel NB	Yellow
Channel NC	Orange
Channel ND	Blue
Output channels	
Channel IA	Green
Channel IIA	Orange
Channel IB	Yellow
Channel IIB	Blue
Power supply	Noncolor
PCRVICS	
Input channels	
MSLIV D1	Green
MSLIV D2	Yellow
MSLIV D3	Orange
MSLIV D4	Blue
MSLIV D1 Channel 2	Green/White
MSLIV D2 Channel 2	Yellow/White
Output and power supply	
MSLIV (Power)	Noncolor
MSLIV (Logic)	
Div. D1 Channel 1	Green
Div. D1 Channel 2	Green/White
Div. D2 Channel 1	Yellow
Div. D2 Channel 2	Yellow/White
MOV, SOV, Division I	Green
MOV, SOV, Division II	Yellow

Safety-related equipment has permanently affixed identification plates. Safety-related cables outside the control room are color coded through application of paint, colored tape, or colored wraparound split-sleeve markers. Cables in trays are color marked at each end, at intervals not exceeding 15 ft, at both sides of walls, and at partitions on floors separating areas prior to or during pulling of cables. All exposed safety-related raceways are color-marked at intervals not to exceed 15 ft and at both sides of walls and at partition or floor separating areas, prior to installation of cables. Flexible or rigid plastic color markers with pressure-sensitive adhesive backing are used for cable trays and conduits. All markers used are prequalified for the environmental conditions to which they may be exposed.

8.3.1.3.2 Alphanumeric Coding

Each piece of mechanical and electrical equipment that has an electrical cable routed to it, and all scheduled cable and raceway, is identified by an alphanumeric code number in addition to the color coding.

<u>Equipment Alphanumeric Code</u>

The alphanumeric code used to identify any piece of equipment has the following format:

```
2 ENS * SWG 101
|  |  |  |   |
1  2  3  4   5
```

Where:

1 = Unit number

2 = System code, e.g., ENS for 4.16-kV emergency system, EPS for 13.8-kV emergency system, etc.

3 = Divider which indicates whether the equipment is safety related or nonsafety related. Safety-related equipment is identified with asterisk (*) whereas the nonsafety-related equipment is identified with a dash (-).

4 = Equipment code indicating the type of the equipment, e.g., SWG for switchgear, US for unit substation, MCC for motor control center, etc.

5 = Equipment identifier, which identifies the particular equipment as part of the similar equipment in the system.

<u>Cable Alphanumeric Code</u>

The alphanumeric code used to identify any piece of cable has the following format:

```
2 EJS B  Y  L 600
|  |  |  |  |  |
1  2  3  4  5  6
```

Where:

1 = Unit number

2 = System code

3 = Part, a symbol which can be either an alpha or numeric character to designate, for example, a MCC cubicle section or one pump of a group (A,B,C, etc.).

4 = Color, an alpha symbol indicating whether the cable is safety related or nonsafety related.

5 = Service, an alpha character indicating the type of service for which the cable is utilized. The symbols used are as follows:

C Control
J 15-kV cables
H 4.16-kV cables
K 600-V derated power or less
L 600-V power or less
X Instrumentation

6 = Number, three characters assigned to specify each individual cable.

<u>Raceway Alphanumeric Code</u>

The alphanumeric code used to identify any raceway has the following format:

```
2  C  L  999  Y  B  E  2
|  |  |   |   |  |  |  |
1  2  3   4   5  6  7  8
```

Where:

1 = Unit number

2 = Type of raceway. The following symbols are used:

A Armored cable or direct-burial cable

Direct-burial cables are given an alphanumeric raceway code to help engineering, design, and field installation personnel to completely identify the route the cables should follow to connect two points. There are, however, no directly buried Class 1E cables at Unit 2. Armored cables are used only to feed Class 1E bar rack heaters in the intake structure. These cables are routed in embedded conduit and duct banks.

C Conduit
D Duct and concealed conduit over 20 ft
F Floor sleeves and concealed conduit 20 ft or under
T Tray and troughs

U Trenches and blockouts
W Wall sleeves

3 = Service as explained under cable alphanumeric code.

4 = Number, three characters assigned to specify each individual raceway.

5 = Color code

6, 7,8 = When used for conduit, the eighth character (always an alpha character) identifies an individual conduit. The ninth character could be either an alpha character or a numeric character. As an alpha character the ninth character identifies an individual conduit; as a numeric character the ninth character identifies that conduit’s branch. The last character (always a numeric character) identifies that conduit's branch. For sleeve or duct, the eighth and ninth characters individually identify a sleeve or duct in a group.

The eighth through tenth characters are never used for tray identification numbers.

8.3.1.4 Independence of Redundant Systems

The plant Class 1E power systems are divided into three independent divisions. Any two out of the three divisions are capable of bringing the reactor to a safe shutdown in case of a DBA. The independence of the three divisions is ensured through electrical isolation and physical separation. The physical separation criteria are in compliance with the requirements of RG 1.75. The criteria are implemented through the Unit 2 electrical installation specification, physical layout drawings, and field QA procedures.

8.3.1.4.1 Electrical Isolation

The three divisions of the plant onsite power system are electrically independent of each other. This independence is maintained through the loads the divisions feed; each division feeds a separate load group and there is no chance of interconnecting independent divisions through the loads. Each division has its dedicated standby power source that is independent of the standby power source of any other division. There is no provision for paralleling the standby power sources of different divisions or for using the standby power source of one division to feed the loads of any other division. Each division uses its own control power sources for instrumentation and control, and the control power source of each division is independent of the control power of any other division. There is no provision for interconnecting these control power sources or for feeding the control circuits of one division from the control power sources of any other division.

Each division is also isolated from the associated nonsafety-related systems. Whenever a safety-related power or control circuit is connected with any nonsafety-related circuit, appropriate isolation devices as defined in RG 1.75 and IEEE-384 are used. In the case of control and instrument circuits, a combination of two interrupting devices actuated by fault current have been used to isolate non-Class 1E circuits from Class 1E circuits (see Section 1.8, RG 1.75 position for justification). Nonsafety power loads are not fed from safety buses except the stub bus loads (see Tables 1, 2, EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION" (Reference 14)). The stub buses are tripped on LOCA signal.

Certain circuits become "associated" circuits by virtue of being connected to the Class 1E power system and are treated as Class 1E. They are identified and color coded as the Class 1E circuit with which they are associated and are isolated by appropriate isolation devices. They are not routed with any division other than the one with which they are associated.

For UPS 2VBB-UPS1A, the normal ac supply (N) is taken from 2NJS-US3 or -US4; the backup dc supply (B) is taken from 125-V dc switchgear 2BYS-SWG001A. The battery charger connected to this dc switchgear is fed from stub bus 2NJS-US5. The alternate ac source (A) is also taken from 2NJS-US5. For UPS 2VBB-UPS1B, the normal ac supply (N) is taken from 2NJS-US3 or -US4; the backup dc supply (B) is taken from 125-V dc switchgear 2BYS-SWG001C. The battery charger connected to this dc switchgear is fed from stub bus 2NJS-US6.

The alternate ac source (A) also is taken from stub bus 2NJS-US6.

The UPSs are transferred to their backup dc sources (B) only in case of loss of the normal source (N). The UPSs are transferred to their alternate source (A) in case of loss of both normal and backup sources or a fault in the inverter. As such, there is no interconnection of 2NJS-US5 and -US6 through UPSs 2VBB-UPS1A and -UPS1B.

Dc power supply to 4.16-kV normal switchgear 2NNS-SWG016, -SWG017, and -SWG018; 600-V load centers 2NJS-US1 through -US10; and 13.8-kV switchgear 2NPS-SWG004 and -SWG005 is provided from both dc buses 2BYS-SWG001A and -SWG001B. One source serves as the normal source and the other as the standby source. Only one set of fuses is provided to connect either of the dc sources so that no interconnection of the two sources may occur.

For 4.16-kV switchgear 2NNS-SWG011 through -SWG015 and 13.8-kV switchgear 2NPS-SWG001 through -SWG003, one dc bus normally supplies control power to the main and tie breakers. The other dc bus supplies control power to the feeder breakers. In case of loss of one of the dc sources, the associated bus may be energized manually from the other source. There are only two sets of fuses to be used with four physically different fuse holders to avoid any interconnection of the two sources (see Figure 8.3-11).

Power supply to the fire protection panels is provided from both stub buses 2NJS-US5 and -US6. One serves as the normal source and the other serves as the standby; they are interlocked electrically to avoid interconnection of the two sources.

There are at least two overcurrent protection devices for each source to prevent failure of any of the load centers fed from the stub buses for any fault in the panel which may short or ground both sources.

8.3.1.4.2 Physical Separation

Physical Separation of the Class 1E Equipment

The items of equipment associated with each of the three independent divisions of the Class 1E onsite power systems are located in separate areas of seismic Category I structures to physically isolate them from each other. The Class 1E 4.16-kV switchgear buses of the three divisions are located in the Division I, II, and III emergency switchgear rooms in the control building at el 261 ft. The Class 1E 600-V load centers associated with Divisions I and II are located in the emergency switchgear room of the respective division. The Class 1E MCCs associated with Divisions I and II are located in the emergency switchgear rooms of the respective division, in separate rooms in the screenwell building (el 261 ft), and in the reactor auxiliary building auxiliary bays north and south (el 240 ft), respectively. The Division III MCC is located in the Division III emergency switchgear room.

The three standby diesel generators are located in the standby diesel generator building and are separated by Category I walls. Each room has an independent ventilation system. The Class 1E batteries are located in the respective divisional battery rooms in the emergency switchgear room. Each battery room has an independent ventilation system. The Class 1E UPS systems associated with Divisions I and II are located in the respective divisional emergency switchgear rooms. The physical separation of the major safety-related electrical equipment is shown on Figures 1.2-15 and 1.2-17.

Physical Separation of Cables and Raceways

The criteria followed for physical separation of the cables and raceways are as follows:

1. General Plant Areas

a. Safety-related circuits associated with the different divisions are routed in separate cable trays, conduits, ducts, tunnels, penetrations, etc. These are never intermixed.

b. Three-ft horizontal and/or 5-ft vertical separation is generally maintained between cable trays associated with redundant circuits or between safety-related and nonsafety-related circuits regardless of their voltage class except in cable spreading areas. In cable spreading areas, the minimum separation distance between redundant Class 1E cable trays and between safety-related and nonsafety-related circuits is 1-ft horizontal and/or 3-ft vertical.

c. Where 3-ft horizontal and/or 5-ft vertical, or 1-ft horizontal and/or 3-ft vertical separation is not practicable, enclosed steel tray or conduit is used or a barrier is installed. Where enclosed raceways are used, the minimum separation distance between the enclosed raceways of different colors, or between one color and nonsafety is 1 in. The minimum separation distance from 600-V or less nonsafety-related conduit to safety-related open cable trays and cable in free air for any service level is 1 in.

   Where a partition-type barrier is provided, the minimum separation distance between the barrier and the raceways is 1 in.

   The minimum separation between any Class 1E raceway and any lighting cord for drops to the lighting fixtures shall be 1 in.

   Aluminum sheath (ALS) cables used for low-energy 120-V ac system are considered enclosed raceways. These cables have flame-retardant cross-linked polyethylene insulation, chlorosulfonated polyethylene jacket, and polypropylene fillers enclosed in a continuous, impervious aluminum sheath which provides adequate protection. As such, the minimum separation between these cables and Class 1E raceways is 1 in.

d. Where vertical shafts are used between elevations, the same criteria for separation of redundant circuits and redundant and nonsafety-related circuits are followed.

e. Fire stops and seals are provided for cabling at walls, partitions, and floors separating areas.

f. Tray covers are provided on the first 6 ft of all vertical trays penetrating a floor where required for physical protection of the cable and on the top tray under grating in areas where water spray fire protection is not used.

g. Flexible conduit is not used as a barrier in non-NSSS systems. Flexible metallic conduit is used for connection of motors or fixed-equipment enclosures to rigid conduit systems to provide flexible connections for seismic considerations, or where installation of rigid conduit would be difficult due to numerous bends, etc. Where flexible conduit is used, the minimum separation distances maintained are as given in the following paragraph, which have been established by test.

h. Supplemental Physical Separation Criteria Where the minimum separation distances specified in Sections 1.a through 1.g cannot be maintained due to physical arrangements, the minimum separation distances specified below for cables and raceways, 600 V and below, shall be maintained (see RG 1.75 position in Table 1.8-1 for justification).

Cable tray to cable tray	10 in horizontal or 10 in vertical
Cable tray to conduit	1 in
Cable in free air to conduit	1/2 in
Cable in free air to cable in free air	10 in vertical or 10 in horizontal
Cable in free air to cable tray	10 in vertical or 10 in horizontal
Wrapped cable to unwrapped cable	0 in
Conduit to conduit	1/2 in

Where the minimum separation distances specified above cannot be maintained, enclosed raceways will be used or a separation barrier will be installed.

2. Hazardous Areas

a. Fire Hazard Areas Routing of divisional cables through any area where there is a potential for accumulation of large quantities of oil or other combustible material is avoided. Where such routing is unavoidable, cables belonging to only one division are allowed in any such area, and the cables are protected by conduits or tray covers or solid tray bottoms designed to prevent the combustible materials from reaching the cables. Separation requirements in such areas are in accordance with RG 1.120.

b. Mechanical and Flood Damage Areas In areas where large rotating equipment is operated or in areas containing high-pressure piping, divisional cables are separated by physical barriers or by additional distance over that specified in Criterion 1, so that a missile or flood cannot damage more than one division. In areas containing an operating crane, divisional cables are separated by a physical barrier or by adequate distance so that the largest dropped load cannot damage more than one division.

3. Panels, Relay and Instrument Racks, and Control Boards

a. Instrumentation and control circuits associated with different divisions are terminated in separate panels, relay and instrument racks, control boards, or in panels having vertical separation barriers. In case it becomes necessary to terminate different divisional circuits in one control panel section, separate terminal boards with terminations separated by at least 6 in are used for terminating the different divisional circuits. Nonsafety-related circuits, terminated in a safety-related panel, are also separated in the same way as two different divisional circuits in the same panel. If a 6-in separation cannot be maintained, a fire-resistant barrier is provided between the terminals or an analysis is made to establish that a fire in one divisional circuit inside the panel will not disable both divisions.

Flexible conduit is used in NSSS panels as a barrier to achieve required separation. It is primarily used in areas where the minimum spatial separation distance of 6 in is not maintained due to circuit configuration. Further discussion is provided in Appendix 8A.

The scram solenoid and MSIV circuits are run in separate conduits. Cables from other circuits are not run in these conduits. Within the PGCC the conduit is flexible and is routed within nondivisional PGCC ducts. There is no mixing of divisions. Interconnection wiring between RPS subpanels is run in conduits to maintain separation from other wiring.

When redundant control switches are located in the same panel, Class 1E wiring of redundant divisions is separated by a 6-in minimum air space. In cases where this spacing is impractical, a barrier as defined by IEEE-384 (such as conduits and/or device enclosures) is used. The adequacy of lesser separations is shown by analysis based on the results of past tests concerning the flame-retardant characteristics of the insulating materials used for common devices and isolators.

Wiring for information outputs from Class 1E or associated signal sources, such as those to annunciators or data loggers, are treated as Class 1E associated and retain divisional classification up to and including the isolation device input. The isolation device output is classified as nondivisional.

Internal wiring within panels, racks, and control boards is color coded for divisional separation except vendor-supplied panels.

Non-Class 1E instrumentation and control circuits not classified as Class 1E associated are treated as nondivisional and are separated from all divisional and associated divisional wiring.

Isolation devices are used at all interfaces between Class 1E divisions and between divisional and nondivisional circuits such as where displays, alarms, and computer circuits connect to Class 1E circuits.

b. <u>Supplemental Physical Separation Criteria</u> Where the minimum physical separation distance specified in Item 3.a cannot be maintained due to physical arrangements, the minimum separation distance between control/instrument cables of one color and noncolor inside control/instrument cabinets shall be 1 in (see RG 1.75 position in Table 1.8-1 and in Appendix 7B). Where the minimum separation distance of 1 in cannot be maintained, a separation barrier will be used.

4. <u>Electrical Penetrations</u>

a. Each penetration assembly carries only one divisional cable; no cables feeding non-Class 1E loads are run in penetrations carrying cables serving Class 1E loads.

b. Each penetration carries cables of one voltage class only, i.e., low-voltage instrument, control and power (below 1,000 V) cables, medium-voltage (13.8-kV) power cables, etc.

c. Division I cables are routed through penetrations on the two north quadrants of the primary containment at el 240 ft; Division II cables are routed through penetrations on the two south quadrants of the primary containment at el 240 ft. Division III cables are routed through one penetration on the 180- to 270-deg quadrant of the primary containment at el 261 ft. This results in a physical separation of more than 3-ft horizontal/5-ft vertical between circuits of different safety-related divisions. Non-Class 1E circuit penetrations are separated from Class 1E circuit penetrations by 3-ft horizontal/5-ft vertical or more.

d. RPIS penetrations are divided into four groups and each group is located in one quadrant of the primary containment.

e. Penetrations carrying the four redundant NMS and RPS cables are located in four different quadrants of the reactor building.

f. NMS and RPS cables are run in separate penetrations. RPS or NMS penetrations are not shared with any other safety-related or nonsafety-related cables.

g. With the exception of the low-signal RPIS penetrations, located on el 240 ft, all penetrations carrying cables of non-Class 1E loads are located on el 261 ft and the suppression pool area below the el 240 ft of the reactor building.

5. <u>Control Building</u> Unit 2 does not have a conventional cable spreading room as it uses the PGCC design for the control room and the relay room. Generally, the safety-related cables belonging to different safety-related divisions are routed into the control room through two vertical cable chases. The Division I cable chase is located on the west side, and the Division II cable chase is located on the east side. Division III cables are routed in the east vertical chase, but these are run in conduit to meet the separation requirements. Fire stops are provided at each flow in the vertical chase.

There is no high-energy equipment or piping in the areas where the vertical cable chases are located. The only power cables routed in the vertical cable chase areas are the low-voltage power supply feeders for the control room panels. These power cables are routed in their own conduits.

6. Reactor Building To accomplish the separation requirements, the reactor building is subdivided into four quadrants: northeast, northwest, southeast, and southwest. A cable tray system is provided in each quadrant to provide access from each floor to the vertical risers and to the tunnels between the control building and the reactor building. The two north quadrants carry predominantly Division I cables; two south quadrants carry predominantly Division II cables. The electrical penetration assemblies carrying Division I and II cables inside the containment are located in the same quadrants. Division III cables are run in trays or conduits maintaining physical separation requirements. Division III electrical penetration assemblies are located in the southwest quadrant at a different elevation from Division I and II penetrations as stated in Item 4 above.

7. Electrical Tunnels Four tunnels are provided to carry cables between the reactor building and control building. One tunnel runs from the northeast quadrant of the reactor building, along the north and west sides of the reactor building, and enters the north side of the control building. This tunnel carries Division I (green) cables and all green cables associated with the RPS, NMS, and PCRVICS. The second tunnel runs from the northwest quadrant of the reactor building along the west side of the reactor building directly under the Division I tunnel and enters the north side of the control building. This tunnel carries all blue cables associated with the RPS, NMS, and PCRVICS. The third tunnel runs from the southwest quadrant of the reactor building and enters the north side of the control building. This tunnel carries all orange cables associated with the RPS, NMS, and PCRVICS. The fourth tunnel runs from the southeast quadrant of the reactor building and enters the east side of the control building. This tunnel carries Division II (yellow) cables and all yellow cables associated with the RPS, NMS, and PCRVICS. The nonsafety (black) cables are run in the second and third tunnels. Black cables are appropriately separated from the Class 1E cables in these tunnels which are run in their own enclosed raceways.

8. Separation of RPS, NMS and PCRVICS Circuits All wiring for the RPS, NMS and PCRVICS is segregated into four

separate divisions as detailed in Section 8.3.1.3.1. All cables associated with RPS, NMS and PCRVICS are routed in enclosed raceways except the undervessel neutron monitoring cables. Cables of different divisions are routed in separate enclosed raceways. Within the same division, all fail-safe wiring is again separated from nonfail-safe wiring by routing those in separate enclosed raceways. Separation between different divisions (different colors) of RPS, NMS and PCRVICS are the same as that between raceways of different safety systems. For MSIV solenoids and limit switches which receive power from two different channels, the channel separation is maintained up to the junction box adjacent to the solenoids/limit switches.

8.3.1.5 Conformance with 10CFR50.63, Station Blackout Rule

Station blackout (SBO) is defined in 10CFR50.2. The SBO Rule requires that each light-water-cooled nuclear power plant be able to withstand and recover from a SBO of a specified duration. RG 1.155 describes a method acceptable to the NRC staff for meeting the requirements of 10CFR50.63.

NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," also provides guidance that is in large part identical to the RG 1.155 guidance and is acceptable to the NRC staff for meeting these requirements. Table 1 of RG 1.155 provides a cross-reference between the regulatory guide and NUMARC 87-00, and notes where the regulatory guide takes precedence.

Unit 2 is evaluated against the requirements of the SBO Rule using guidance from NUMARC 87-00, and the supplemental guidance provided by NUMARC 87-00, Supplemental Questions/Answers, December 27, 1989, and NUMARC 87-00, Major Assumptions, December 27, 1989, except where RG 1.155 takes precedence. The results of this evaluation submitted to the NRC are documented in References 5, 6, 8, 10 and 12 (Section 8.3.4) and are summarized below. NRC evaluations and acceptance of the Unit 2 response to the SBO Rule are documented in References 7, 9 and 11 (Section 8.3.4). The effects of extended power uprate (EPU) conditions on SBO evaluations are documented in Reference 13.

8.3.1.5.1 Station Blackout Duration

A SBO duration of 4 hr is based on the following plant factors:

1. The ac power design characteristic group is "P2" based on:

   a. Expected frequency of grid-related LOOP events does not exceed once per 20 yr.

b. Estimated frequency of LOOP due to extremely severe weather (ESW) places the plant in ESW Group 1.

c. Estimated frequency of LOOP due to severe weather (SW) places the plant in SW Group 3.

d. The offsite power configuration is in the I 1/2 Group.

e. Plant-specific prehurricane shutdown requirements and procedures are not required for Unit 2, nor are such procedures credited in the determination of the ac power design characteristic group.

2. The emergency ac power configuration group is "C" based on:

   a. There are two emergency ac power supplies not credited as alternate ac power sources.

   b. One emergency ac power supply is necessary to operate safe shutdown equipment following a LOOP.

3. The target emergency diesel generator (EDG) reliability is 0.975. A target EDG reliability of 0.975 is selected based on having a nuclear unit average EDG reliability for the last 20 demands greater than 0.90. An analysis showing the EDG reliability statistics for the last 20, 50, and 100 demands to support this target reliability is also performed.

8.3.1.5.2 Station Blackout Coping Capability

The following plant systems are reviewed to assure that the systems have the availability, adequacy, and capability to achieve and maintain a safe plant shutdown and to recover from a SBO for the 4-hr coping duration.

1. Condensate Inventory for Decay Heat Removal

   The minimum condensate storage tank (CST) level of 135,000 gal provides sufficient inventory to cool the core for the 4-hr coping duration. A water inventory of 125,000 gal of water required for decay heat removal for the 4-hr coping duration is calculated, including water usage due to plant depressurization and a leakage rate of 61 gpm (Reference 13). The CST inventory is verified daily, and CST low and low-low levels are alarmed in the control room.

2. Class 1E Battery Capacity

A battery capacity calculation performed pursuant to NUMARC 87-00, Section 7.2.2, and IEEE-485-1978, verifies that the Class 1E batteries have sufficient capacity to meet SBO loads for 4 hr. Non-Class 1E batteries are also assessed. Nonessential loads must be shed from non-Class 1E batteries to cope with SBO duration of 4 hr. The shedding of the nonessential loads from batteries is identified in plant special operating procedures.

3. Compressed Air/Gas

Compressed air-/gas-operated valves relied upon to cope with a SBO for a 4-hr period are the main steam safety relief valves (SRV). These SRVs can be manually operated by the control room Operator using available relief or automatic depressurization system (ADS) mode of operation. The compressed gas available in the accumulator is determined to be adequate for the anticipated required SRVs opening function during the SBO coping duration. Therefore, no independent backup power source is required.

4. Effects of Loss of Ventilation

Based on the equipment used to respond to the SBO event, the key areas in which the loss of ventilation cooling causes a concern for equipment operability are identified as:

a. Control Room

b. Switchgear Room

c. Drywell

d. RCIC Room

Heatup calculations are performed for the above four areas.

The control room temperature calculation is based upon: 1) opening of the door between the control room and control building, 2) opening all control room panel access doors, 3) opening all relay room doors, and 4) opening all relay room panel access doors, to increase cooling by natural convection. Completion of these actions within 30 min of the onset of a SBO event maintains control room temperature below the maximum limit of 120°F during a SBO event as endorsed by NUMARC 87-00.

The drywell and the RCIC room are the key dominant areas of concern (DAC). The operability of SBO response equipment in the DAC is assessed using Appendix F to NUMARC 87-00 and no hardware modifications are needed for equipment operability in the DAC.

5. Containment Isolation

The containment isolation valves (CIV) evaluation in the SBO study determines which valves are normally open or closed and fail as-is upon loss of ac power, and cannot be excluded by the criteria listed in RG 1.155. The resulting list of CIVs is further reduced by applying additional exclusion criteria which provide adequate isolation (i.e., water seals, dc closure capability, valves interlocked closed and valves in series with an excludable valve). The remaining CIVs of SBO concern are:

a. 2DER*MOV120

b. 2DFR*MOV120

c. 2DFR*MOV139

d. 2WCS*MOV112

The above four valves of SBO concern must be closed if "Containment isolation is required and core damage is imminent." A plant special operating procedure lists the CIVs of SBO concern and ensures confirmation of valve closure by position indication (local, mechanical, remote, process information, etc.).

6. Reactor Coolant Inventory

The ability to maintain adequate reactor coolant inventory required for core cooling is evaluated for the SBO duration. An analysis performed for the required inventory makeup includes water usage due to plant depressurization, and assumes a maximum leak rate of 61 gpm for 4 hr (based on 18 gpm per recirculation pump (2 pumps) and the maximum allowable (25 gpm) Technical Specification leak rate) (Reference 13). Based on RCIC system operation and on the reactor pressure vessel (RPV) makeup needs determined by RPV pressure and level indication, the usage of CST water supply estimated and compared with the CST capacity. The minimum capacity based on calculation for Unit 2 is 135,000 gal which is available to the RCIC system. Therefore, the expected rates of inventory loss under SBO conditions are adequately made up by the RCIC system and no core uncovery occurs during the SBO period.

To ensure that appropriate reactor coolant makeup water is provided under SBO conditions, procedures specify operation of the RCIC system in the manual flow control mode to maintain RPV level. This prevents the RCIC system from tripping on high RPV level and improves reliability of operation by avoiding repeated starts.

8.3.1.5.3 Procedure and Training

Plant procedures, SBO response guidelines and ac power restoration procedures implement an appropriate response to a SBO event, and incorporate changes necessary to meet NUMARC 87-00 Section 4 guidelines.

Personnel training to ensure an effective response to a SBO event is incorporated into the training program.

8.3.1.5.4 Quality Assurance

The nondivisional batteries 2BYS-BAT1A, 2BYS-BAT1B and 2BYS-BAT1C are assigned a "Q" classification and are covered under the Quality Related Program for Nine Mile Point Nuclear Station Operations, which is consistent with the guidance of RG 1.155 Appendix A. The remaining SBO equipment, except for the CST, is safety related and is covered by existing quality assurance requirements in 10CFR50 Appendix B.

8.3.1.5.5 EDG Reliability Program

The EDG Reliability Program developed for Unit 2 conforms to the guidance of RG 1.155 Position C.1.2. The program includes a 0.975 EDG target reliability based on EDG reliability data for the last 20, 50 and 100 demands.

8.3.2 Dc Power System

8.3.2.1 Description

8.3.2.1.1 General

The plant dc power system includes equipment and systems required to supply dc power to all protection and control systems and other dc loads, under normal and emergency conditions of plant operation. The dc power system consists of the batteries, battery chargers, dc switchgear, various distribution panels, dc cables, and dc loads. The dc power system is divided into two distinct categories. The components of the dc system and the loads that are required to safely shut down the reactor in case of a DBA are designated nuclear safety related or Class 1E; the others are nonsafety related or non-Class 1E.

The nuclear safety-related dc power system is designed to meet the requirements of the general design criteria and the applicable regulatory guides. The system has adequate capacity, independence, redundancy, and testability to ensure dc power supply to all safety-related protection, control, and other loads under all conditions of plant operation. The safety-related dc system is divided into three independent divisions corresponding to the three divisions of the onsite ac power system.

Each division has its own dedicated battery and battery chargers which are physically independent of and electrically isolated from the battery and the battery chargers of any other division. The independence of the three divisions of the dc system is maintained throughout the distribution system and the dc loads. The emergency batteries, battery chargers, dc switchgear, and panel boards are qualified for operating in their respective environmental conditions (temperature, pressure, humidity, and radiation) for the qualified service life, in accordance with the applicable regulatory guides. All emergency dc system equipment are Category I and are located in Category I structures. The Class 1E battery room ventilation is described in Section 9.4. The plant dc power system is illustrated on Figures 8.3-10 and 8.3-11.

8.3.2.1.2 Safety-Related Dc Systems

Identification

The three divisions of the emergency dc power system are designated Divisions I, II, and III, corresponding to the three divisions of the onsite emergency ac power system with which they are associated. The three divisions are identified by the same color coding as the color coding of the emergency onsite ac power system, i.e.:

Division I	Green
Division II	Yellow
Division III	Purple

The equipment and loads associated with each division are identified with the color coding of that division. The method of identification is described in Section 8.3.1.3.

Safety-Related Dc System Loads

The emergency dc loads fed by the battery and battery chargers of the three independent divisions are listed below. Divisions I and II feed the redundant emergency dc loads associated with Divisions I and II, respectively, of the emergency onsite ac system while Division III feeds the emergency dc loads associated with Division III (HPCS system) of the emergency onsite ac power system.

1. Division I (Green)

a. Protection and control for 4.16-kV switchgear 2ENS*SWG101.

b. Protection and control for 600-V load center 2EJS*US1 via 125-V dc switchgear 2BYS*SWG002A.

c. UPS 2VBA*UPS2A/2VBA*UPS2C.

d. Reactor core isolation cooling (RCIC) system loads via 125-V dc MCC 2DMS*MCCA1.

e. Division I standby diesel generator control panels via 125-V dc panel 2BYS*PNL204A.

f. Division I standby diesel generator field flashing.

g. Division I miscellaneous 125-V dc loads via 125-V dc panel 2BYS*PNL201A.

2. <u>Division II (Yellow)</u>

a. Protection and control for 4.16-kV switchgear 2ENS*SWG103.

b. Protection and control for 600-V load center 2EJS*US3 via 125-V dc switchgear 2BYS*SWG002B.

c. UPS 2VBA*UPS2B/2VBA*UPS2D.

d. Division II standby diesel generator control panels via 125-V dc panel 2BYS*PNL204B.

e. Division II standby diesel generator field flashing.

f. Division II miscellaneous 125-V dc loads through 125-V dc panel 2BYS*PNL201B.

3. <u>Division III (Purple)</u>

a. Protection and control for 4.16-kV switchgear 2ENS*SWG102.

b. Division III standby diesel generator control panels via 125-V dc panel 2CES*IPNL414.

c. HPCS system solenoid valves.

d. HPCS relay panel.

e. Indicator lamps control room panel (HPCS).

f. Division III standby diesel generator standby fuel pump.

g. Division III standby diesel generator field flashing.

h. Turbocharger lube oil pump.

i. Lube oil circulating pump.

j. Division III transient analysis recorder.

Safety-Related Dc System Design Criteria

The safety-related dc system is designed to the following criteria:

1. The emergency 125-V dc system consists of three physically separate and electrically independent dc power divisions corresponding to the three divisions of the onsite ac power system. Each division feeds a separate emergency dc load group through a separate distribution system.

2. Each division of the emergency dc system has its own battery, primary and backup battery chargers, dc switchgear and distribution panels, which are all Class 1E and Category I.

3. Division I and II emergency batteries are sized in accordance with RG 1.32, IEEE-308-1974, and IEEE-485-1978. Division III emergency battery is sized in accordance with RG 1.32 and IEEE-308-1974. Each battery is capable of performing its duty cycle (Tables 8.3-8 through 8.3-10) following the loss of chargers after the battery had been floated between 130 and 135 V dc, is fully charged at 65°F, and with capacity deteriorated to 80 percent. Adequate design margin is included in sizing the battery to support future load growth and less than optimum operating conditions. Should both battery chargers for any particular battery be out of service at any point in the dc load cycle, the battery is capable of starting and operating its associated loads for 2 hr according to a precalculated load profile without the battery terminal voltage falling below minimum acceptable level: 105 V dc for Division I, II and III. For Division I and II dc loads, the operating voltage range is 101 V to 140 V. The actual available starting voltage under degraded voltage conditions for safety-related MOVs is calculated on a case-by-case basis and is used in determining if the valve can develop sufficient torque to operate under design conditions. All the loads with their magnitudes and durations are given in Tables

8.3-8 through 8.3-10. The normal operating voltage range of the Division III dc loads listed in Table 8.3-10 is 101 to 137.5 V. The Division III 125 V dc battery terminal voltage is normally maintained by a battery float voltage of 135 V. The Division III battery is floated at 2.25 V/cell, (135 V dc) to minimize the periodic equalization of the batteries. Whenever equalization is required, the vendor recommends equalizing at 2.28-2.29 V/cell (137.5 V dc). However, during equalization state (137.5 V dc) and lightly loaded conditions, the voltage drop in the circuit brings the voltage at the load terminals within the operating range. The maximum equalizing voltage will not jeopardize dc loads under all conditions. The battery is designed to supply power for 2 hr. Following this 2-hr period, if the battery terminal voltage drops below 105 V, then the dc control devices not already energized may fail to energize. At this point, the Division III dc system is not operable, and the Division III diesel generator may not be capable of responding to LOCA demand. At this point, the Technical Specifications limitations will be used, depending on availability of Division I and II diesel generators. The Division III dc bus is backed by two redundant chargers powered from two separate power sources. Probability is remote that both of these sources will fail simultaneously. This ensures the design adequacy of the 125 V dc power source.

4. Each emergency dc bus has a primary and a backup battery charger. Each emergency battery charger is capable of supplying the largest combined demands of the steady-state loads on the battery while recharging the battery from the design minimum charge state to the fully charged state within 24 hr.

5. All components of the emergency 125-V dc system are designed as Class 1E and Category I. The components of the three divisions are located in separate rooms in a Category I structure.

6. The emergency battery rooms are provided with exhaust ducts which discharge to the atmosphere limiting the hydrogen accumulation to less than 2 percent by volume, and maintain the battery room temperature between 65° and 104°F. Each battery room has smoke detection equipment located in 3-hr rated fire areas.

7. The installation design for the emergency batteries provides adequate space for inspection, maintenance, replacement, and testing of the batteries.

8. The emergency dc system is ungrounded.

Safety-Related Dc System Description

Emergency Batteries Division I and II emergency batteries 2BYS*BAT2A and 2BYS*BAT2B are calcium grid type lead-acid batteries having an amp-hr rating of 2,550 on an 8-hr basis at 77°F. The average float voltage is 2.22 V/cell; the average equalizing voltage is 2.33 V/cell. One minute rating of Division I and II batteries is 2,350 amps at 1.75 V per cell.

Division III emergency battery 2BYS*BAT2C consists of calcium grid lead-acid cells having an amp-hr rating of 100 on an 8-hr basis. The average float voltage is 2.22 V/cell. The average equalizing voltage range is 2.28-2.29 V/cell. One minute rating of Division III battery is 148 amps at 1.75 V per cell.

The battery cell containers are made of translucent plastic material. The cells are sealed type with covers fixed in place with permanent leakproof joints. High and low electrolyte level markers are provided on all four sides of the plastic containers. Cell covers have flash vent arrestor and sample tube openings. All Class 1E batteries are mounted on two-step Category I steel racks with restraining members arranged to prevent motion of the cells relative to each other or to the rack. The battery racks are grounded. The emergency batteries 2BYS*BAT2A, 2BYS*BAT2B, and 2BYS*BAT2C are located in three separate battery rooms in the control building on el 261 ft. The emergency batteries are qualified for their service environment in accordance with IEEE-323-1974. They are seismically qualified in accordance with IEEE-344-1975. The qualification procedures, test results, and analysis are detailed in Sections 3.10 and 3.11. Domestic water is available within the battery rooms for eye wash. The Division I and II batteries and the battery racks have been procured as one package and seismically qualified together so that there are no chances of any incompatibility between the battery and the battery rack which may cause cracking of the battery case. The Division III batteries and battery racks are also procured as one package and seismically qualified together so that there are no chances of any incompatibility between the battery and the battery rack which may cause cracking of the battery case.

Emergency Battery Chargers Each Class 1E battery has two 100-percent capacity battery chargers. The battery chargers associated with Division I emergency battery 2BYS*BAT2A are designated 2BYS*CHGR2A1 and 2BYS*CHGR2A2. The battery chargers associated with Division II battery 2BYS*BAT2B are designated 2BYS*CHGR2B1 and 2BYS*CHGR2B2, and those associated with Division III battery 2BYS*BAT2C are designated 2BYS*CHGR2C1 and 2BYS*CHGR2C2.

The Division I and II emergency battery chargers are constant potential type rated for 300 amp continuous capacity with 575-V, 3-phase nominal ac input and 125-V dc nominal output. The Division III emergency battery chargers are constant potential chargers rated for 50 amp continuous capacity with 575-V, 3-phase nominal ac input and 125-V dc nominal output. Each charger is capable of automatically regulating the output voltage within ±1 percent of the rated value at any load between 0 and 100 percent, with ±10 percent variation in the ac input voltage. Each charger is capable of maintaining the connected battery in a fully charged condition by supplying float charge at 133 to 135 V, or an equalizing charge at 139.8 V for Divisions I and II, and 137.5 V for Division III while supplying the steady-state dc loads. Each charger can also recharge the battery from the designed minimum charge condition after an emergency discharge to full charge in 24 hr while supplying the steady-state dc loads.

Each emergency battery charger is fed from a 600-V emergency power source belonging to the same division. Division I battery chargers 2BYS*CHGR2A1 and 2BYS*CHGR2A2 are fed from Division I 600-V emergency lighting panel 2LAC*PNL100A, and 600-V emergency distribution panel 2EJS*PNL100A, respectively. Division II battery chargers 2BYS*CHGR2B1 and 2BYS*CHGR2B2 are fed from Division II 600-V emergency lighting panel 2LAC*PNL300B and 600-V emergency distribution panel 2EJS*PNL300B, respectively. Division III battery chargers 2BYS*CHGR2C1 and 2BYS*CHGR2C2 are fed from Division III emergency MCC 2EHS*MCC201.

Each emergency battery charger has an input circuit breaker for protection against internal charger faults and for use as a manual disconnecting device. Each charger has an output circuit breaker for protection of the battery against the charger internal faults as well as for manual disconnection. Each charger has an ammeter and a voltmeter in the output circuit to indicate the output current and voltage. Each Division I and II charger has an overvoltage alarm circuit that alarms and trips when the charger dc output voltage exceeds a manually preset value. Each Division III charger has an overvoltage shutdown circuit that disconnects the charger ac input when it exceeds a manually preset value. The chargers are current limiting; the current limit can be set between 110 and 125 percent of the rated output current.

The emergency battery chargers of the three divisions are floor mounted in the three emergency switchgear rooms in the control building at el 261 ft. The battery chargers are qualified for their service environments (temperature, pressure, humidity, and radiation) in accordance with IEEE-323-1974. They are seismically qualified in accordance with IEEE-344-1975. The qualification procedures, test results, and analysis are detailed in Sections 3.10 and 3.11.

<u>Emergency 125-V Dc Switchgear</u> Each emergency battery is connected to an emergency 125-V dc switchgear or distribution panel through a circuit breaker. Two emergency battery chargers associated with each emergency battery for Division I and II are also connected to the same switchgear through their appropriate circuit breakers. This is accomplished by using a breaker alternately between the battery charger switchgear cubicles or by

installing a breaker in each of the battery charger switchgear cubicles. In the event there are breakers installed in both of the battery charger switchgear cubicles, one of the breakers shall be placed in the "Disconnect" position and locked-out while the other breaker is closed. This precludes more than one battery charger being connected to the Division I and II switchgear bus at any time. The Division I emergency battery and battery chargers are connected to emergency 125-V dc switchgear 2BYS*SWG002A. The Division II emergency battery and battery chargers are connected to emergency switchgear 2BYS*SWG002B. The Division III emergency battery and battery chargers are connected to emergency 125-V dc panel 2CES*IPNL414.

Division I and II emergency 125-V dc switchgear are metal enclosed, low-voltage type. The switchgear buses are arranged in a two-wire ungrounded configuration. The bus continuous rating is 2,000 amp. The main and feeder breakers are manually-operated air circuit breakers with either long time and short time, or long time and instantaneous overcurrent protective devices. The main breaker for the battery is rated for the maximum 1-min demand on the battery. All the circuit breakers are rated for 25-kA minimum interrupting capability. Each switchgear has ground detection and bus undervoltage alarms. There are two undervoltage relays in each switchgear. One relay energizes an alarm in the control room when the bus voltage drops below 125 V dc. The other relay annunciates if the bus voltage drops below 110 V dc. Each emergency switchgear also has local ammeters for indicating the battery and the charger currents and a voltmeter to indicate bus voltage. The currents and voltage also are indicated in the main control room for monitoring. The Division I and II emergency switchgear are located in the Division I and II emergency switchgear rooms in the control building at el 261 ft.

The Division III emergency 125-V dc panel is designated as 2CES*IPNL414. The bus is rated for 100 amp which is based on the maximum 1-min demand on the battery. The main and feeder breakers are molded-case circuit breakers with overcurrent protective devices. The main breaker for the battery is rated for the maximum 1-min demand on the battery. The circuit breakers are rated for 10-kA interrupting capability. The panel has ground detection and bus undervoltage alarm. Loss of power to the battery chargers and the bus undervoltage conditions is annunciated in the control room when the bus voltage falls below 125 V dc. The bus voltage and the battery current are indicated in the control room for monitoring. The Division III emergency 125-V dc panel is located in the Division III diesel generator control room in the EDG building at el 261 ft.

The Division I and II emergency 125-V dc systems utilize other emergency distribution panels connected to the dc switchgear for miscellaneous dc circuits. These panels are in NEMA 12 enclosures suitable for indoor application. These panels have fusible switches for branch circuit protection.

Safety-Related Dc System Instrumentation and Control

Remote indications and alarms are provided for all three divisions in the main control room for monitoring the status of the emergency dc system as follows:

1. Indications:

    a. Ammeter for the battery current.

    b. A common ammeter for the primary and backup charger output currents.

    c. Voltmeters for the dc bus voltages.

2. Alarms:

    a. Division I dc system trouble alarm, actuated by the Division I dc bus undervoltage/overvoltage bus ground, battery breaker open, and battery charger undervoltage.

    b. Division II dc system trouble alarm, actuated by the Division II dc bus undervoltage/overvoltage, bus ground, battery breaker open, and battery charger undervoltage.

    c. Division III dc system trouble alarm, actuated by the Division III dc bus undervoltage/overvoltage, bus ground, and battery breaker open. If the battery terminal voltage inadvertently drops to 125 V, control room alarm "Division 3 emergency dc bus 125 V dc system trouble" will be annunciated with no time delay. The same alarm also will be reannunciated at 110 V dc if the battery terminal voltage drops further. This will alert the Operator to take necessary action to restore the bus voltage. If the bus voltage is not restored, the battery will continue to supply all connected dc loads assuming that the battery chargers are not available.

    d. One ground detection control switch with one test push button for each battery for ground detection.

    Local indications are provided for each battery current and dc bus voltage on the associated dc switchgear (Divisions I and II) or distribution panel (Division III).

Safety-Related Dc System Testing and Maintenance

The emergency dc system has been designed to permit periodic inspection and testing of the system. Each battery cell has high and low electrolyte level markers on all four sides. The emergency battery rooms have adequate space to permit battery inspection, maintenance, removal, and testing. Each emergency battery is connectable to a battery test load for battery capacity testing.

The regular inspection and maintenance of the emergency batteries is performed in accordance with RG 1.129 (IEEE-450-1980). Surveillances are performed at intervals as specified in the Technical Specifications and Surveillance Frequency Control Program. Exception to the torque requirement during regular inspection applies when periodic inspection indicates that cell-to-cell and terminal connection resistance readings do not exceed the prescribed parameters. Preoperational and periodic testing of the batteries are performed in accordance with RG 1.32 (IEEE-308-1974), 1.128 (IEEE-484-1975 or IEEE-484-1987), and 1.129 (IEEE-450-1980) to ensure continued integrity and reliability of the emergency dc system. Surveillances are performed at intervals as specified in the Technical Specifications and Surveillance Frequency Control Program. For the battery service test, provisions have been made in each Class 1E dc switchgear (Division I and II), or dc panel (Division III) to connect the test load to the battery for battery capacity testing (See Figure 8.3-10). For each of Division I and Division II, a breaker cubicle has been provided for this purpose. There is only one breaker to be used with these two cubicles. This breaker is usually stored in the cubicle on Division I bus. For Division III, the battery breaker and the test load breaker are manually operated with position indication. These breakers are administratively controlled such that the test load is not connected during normal operation. The test load is a portable resistor bank. It is temporarily connected to the "test load" connections on the particular switchgear to be tested. It is moved from one switchgear to another for testing. The load bank is stored disconnected from the switchgear when testing is complete. The Division I, Division II, and Division III service test is performed as part of the preoperational test after installation and will be repeated as part of the preoperational test or prior to startup if there is any significant change in the dc system design. A battery performance discharge test and a service test are performed in accordance with the schedule outlined in Technical Specifications. The battery service test load profiles are described in Tables 8.3-8, 8.3-9 and 8.3-10.

All components of the emergency dc system are designed as Class 1E and Category I for their service environments (temperature, radiation, and humidity). The qualification procedures, test results, and analysis are given in Sections 3.10 and 3.11.

Originally, the FMEA for the dc power system was contained in the Unit 2 FMEA document, which is historical. FMEAs for plant systems are now performed and controlled by the design process.

8.3.2.1.3 Nonsafety-Related Dc Power System

Identification

The dc power system equipment and components required for normal operation of the plant, but not required for safe shutdown of the reactor in case of a DBA, are classified as nonsafety related, normal, or non-Class 1E. These items of equipment and components are identified by black color or no-color coding, as are components of the nonsafety-related onsite ac power system. The nonsafety-related dc power system consists of the normal 125-V dc system and the normal ±24-V dc system. The normal 125-V dc system feeds all nonsafety-related dc instrumentation, control, and other dc loads, and consists of three 125-V batteries with associated battery chargers, dc switchgear, and distribution panels. The ±24-V dc system feeds all NMS loads, and consists of two 24-V batteries with associated battery chargers and distribution panels.

Nonsafety-Related Dc System Load

The loads connected to different nonsafety-related batteries and battery chargers are as follows:

1. 125-V normal battery 2BYS-BAT1A:

    a. Control power for all nonsafety-related 13.8-V and 4.16-kV switchgear, 600-V load centers, and associated relay and instrumentation control circuits.

    b. Fire protection system loads.

    c. Emergency bearing oil pump.

    d. Plant normal UPS systems 2VBB-UPS1A and 2VBB-UPS1C.

    e. Control power for generator field breaker.

    f. Control power for 115-kV circuit switchers.

    g. Control power for reserve Station service transformer 2RTX-XSR1A.

    h. Control power for normal Station service transformer 2STX-XNS1.

    i. Standby diesel generator fuel pump.

2. 125-V normal battery 2BYS-BAT1B:

a. Control power for all nonsafety-related 13.8-kV and 4.16-kV switchgear, 600-V load centers, and associated relay and instrumentation control circuits.

b. Fire protection system loads.

c. Emergency seal oil pump.

d. Plant normal UPS systems 2VBB-UPSID and 2VBB-UPS3B.

e. Control power for main transformers 2MTX-XM1A, 2MTX-XM1B, 2MTX-XM1C, and 2MTX-XM1D sudden pressure relay panels.

f. Control power for generator field breaker.

g. Control power for 115-kV circuit switchers.

h. Control power for reserve Station service transformer 2RTX-XSR1B.

i. Standby diesel generator fuel pump.

j. Energy management system remote terminal unit (EMS RTU).

3. 125-V normal battery 2BYS-BAT1C: plant computer UPS 2VBB-UPS1G, normal system UPS 2VBB-UPS1B and RPS UPS 2VBB-UPS3A.

4. 24-V normal batteries 2BWS-BAT3A and 2BWS-BAT3C: NMS.

5. 24-V normal batteries 2BWS-BAT3B and 2BWS-BAT3D: NMS.

The battery load profiles are given in Tables 8.3-11 through 8.3-15.

Nonsafety-Related 125-V Dc Power System Description

The nonsafety-related 125-V dc power system consists of three subsystems each consisting of its own battery, battery charger, and dc switchgear or distribution panel as follows:

125-V Dc Battery	Battery Charger	Dc Switchgear
2BYS-BAT1A	2BYS-CHGR1A1	2BYS-SWG001A
2BYS-BAT1B	2BYS-CHGR1B1	2BYS-SWG001B
2BYS-BAT1C	2BYS-CHGR1C1	2BYS-SWG001C

Each battery is sized in accordance with IEEE-485-1978 and capable of performing its duty cycle following the loss of charger after the battery had been floated between 130 and 135 V dc, while fully charged at 55°F (batteries 2BYS-BAT1A, 2BYS-BAT1B, and 2BYS-BAT1C) and with capacity deteriorated to 80 percent. Adequate design margin is included for various contingencies and future load growth. Each battery can start and operate all required loads for 2 hr according to the battery load profile without battery terminal voltage falling below 105 V dc should the battery charger be out of service at any point in the dc load cycle. The batteries are lead-acid with 5,100 amp-hr capacity. Each battery is connectable to a test load for battery load testing.

Each normal 125-V dc battery has a normal battery charger having a nominal output of 125-V dc with a nominal input of 575 V, 3 phase ac. Each battery charger can supply the continuous load on the battery excluding the UPS loads while recharging the battery from the design minimum charge state to the fully-charged state in 24 hr. The chargers are constant potential current-limiting type rated for 500 amps. Each charger is fed from one of the 600-V stub bus load centers that are connectable to the standby diesel generators in case of a LOOP without any DBA condition.

Each normal 125-V dc battery and its associated battery charger is connected to a dc switchgear via manually-operated air circuit breakers. The switchgear bus is arranged in a two-wire ungrounded configuration. The battery breaker and the bus are rated for the maximum 1-min demand on the battery. The feeder circuit breakers are manually-operated air circuit breakers with long time, short time or long time instantaneous overcurrent protective devices. Each dc switchgear is equipped with local battery ammeters and a bus voltmeter. Two undervoltage relays are provided in each dc switchgear. One relay actuates an alarm in the control room when the bus voltage drops below 125 V dc. The other relay actuates an alarm when the bus voltage drops below 110 V dc. Each switchgear also has provided a ground fault relay that actuates an alarm in the control room.

<u>Nonsafety-Related ±24-V Dc Power System</u>

The ±24-V dc power system provides two redundant dc power sources for the NMS. The ±24-V dc system is illustrated on Figure 8.3-10. Each of the redundant systems consists of a three-wire bus, two 24-V dc batteries, and two 24-V dc battery chargers. One of the batteries is connected between the positive and the common ground wire; the other battery is connected between the negative and the common ground wire. Each charger is connected to the same buses as its associated battery.

The 24-V dc batteries 2BWS-BAT3A, 3B, 3C, and 3D are lead-acid batteries. The battery discharge rating is 100-amp/hr on an 8-hr basis. The batteries are sized in accordance with IEEE-485-1978. Each battery is capable of performing its duty cycle following the loss of charger after the battery had been floated between 26 and 27 V dc, while fully charged at 60°F, and with capacity deteriorated to 80 percent. Adequate design margin is provided for various contingencies and future load growth. Each battery can start and operate all required loads for 4 hr according to the battery load profile without battery terminal voltage falling below 21 V dc should the charger be out of service at any point of the dc load cycle.

Each 24-V dc battery has a normal battery charger with a nominal output of 24-V dc and a nominal input of 120/240-V 1-phase ac. The chargers are rated for 25 amps. The chargers are current limiting and protected against feedback. Each charger is capable of carrying the maximum continuous steady-state loads on the battery while recharging the battery from the design minimum charge state to the fully charged state in 24 hr. Each charger is fed from a 600-V stub bus distribution panel through a 600-120/240-V distribution transformer.

The ±24-V dc distribution panel boards are in NEMA 12 enclosure. The batteries and the battery chargers are connected to the panel through fusible disconnect switches. The feeder circuits are also protected by fusible disconnect switches.

The normal battery, battery chargers, dc switchgear, and distribution panels are located in the normal switchgear room in the control building. The battery rooms have sufficient ventilation to limit hydrogen accumulation to less than 2 percent by volume and to maintain battery room temperatures between 60° and 104°F. The battery rooms have smoke detectors. They have adequate illumination and space to facilitate inspection, maintenance, testing, and replacement.

<u>Nonsafety-Related Dc System Instrumentation and Control</u>

Remote indications and alarms are provided in the control rooms for monitoring the status of each of the normal dc systems as follows:

1. Indications:

    a. Battery charging/discharging current.

    b. Battery charger supply current.

    c. Dc bus voltage.

2. Alarms:

    a. Station batteries 2BYS-BAT1A, -1B, and -1C 125-V dc system trouble alarm. This is actuated by bus undervoltage/overvoltage bus ground, battery breaker open, and battery charger undervoltage.

    b. Normal ±24-V dc distribution panel 2BWS-PNL300A undervoltage.

c. Normal ±24-V dc distribution panel 2BWS-PNL300B undervoltage.

8.3.2.2 Analysis

The plant emergency dc power system is designed in accordance with the general design criteria and the applicable regulatory guides to meet the requirements of capacity, independence, redundancy, and testability. The method of conformance is described in the following paragraphs.

General Design Criterion 17

The plant emergency dc power system is divided into three divisions, each division feeding a separate safety-related load group. Each division has adequate capacity and capability to supply its connected dc loads under normal conditions of plant operation, and to perform its required duty cycle in case of a LOCA or any other DBA and LOOP. Each division is physically separate from and electrically independent of any other division. The components of each division are located in separate rooms in a Category I structure. The cables and raceways associated with each division are physically separated from the cables and raceways of the other divisions in accordance with the criteria outlined in Section 8.3.1.4. Thus, any failure in one division of the plant dc power system will not jeopardize the safety function of any other division.

General Design Criterion 18

The emergency dc power system is designed to permit appropriate periodic inspection and testing to ensure continued integrity and reliability of the system. Each emergency battery includes a pilot cell with a thermometer and a hydrometer to measure the electrolyte temperature and specific gravity. Each emergency battery is connectable to a battery test load for periodic battery capacity testing. The periodic testing schedule is described in Section 8.3.2.1.2.

Regulatory Guide 1.6

The plant emergency dc loads are divided into three separate load groups described in Section 8.3.2.1.2. The Division I load group includes all emergency dc loads associated with Division I of the onsite ac power system. The Division II load group includes all emergency dc loads associated with Division II of the onsite ac power system. The Division III load group includes all emergency dc loads associated with Division III of the onsite ac power system. Since any two out of the three divisions of the onsite ac power system are capable of bringing the plant to a safe shutdown in case of a DBA, loss of any one group of the emergency dc loads will not jeopardize the capability of the onsite power system to safely shut down the reactor in case of a DBA.

Each of the three emergency dc load groups is energized by the emergency battery and the battery chargers of the respective divisions. The emergency battery and the battery chargers of each division are physically separated from and electrically independent of the battery and battery chargers of any other division. The emergency battery and battery chargers of one division are not permitted to be interconnected with the battery and battery chargers or the emergency dc load groups of any other division under any conditions of plant operation.

Regulatory Guide 1.32 and IEEE-308-1974

The emergency dc power system is designed to meet the requirements of adequate capacity, physical separation, and electrical isolation throughout the dc power sources, distribution system, and the connected loads. Each emergency battery is capable of starting and operating its required loads for the specified duration. Each battery is maintained in a fully-charged condition and is immediately available to its loads during both normal operations and following the loss of power from the ac system. Each emergency battery is connectable to a battery capacity test load for periodic battery capacity testing. Each emergency battery has two 100-percent chargers, each capable of supplying the largest combined demands of the various continuous steady-state dc loads while recharging the battery from the design minimum charge to the fully-charged state in 24 hr. Each emergency battery charger has disconnecting devices in the input ac circuit and the output dc circuit. Each charger is current limiting and has feedback protective devices. Adequate local and remote instrumentation is provided to monitor the status of the dc power supply (Section 8.3.2.1.2).

Preoperational and periodic testing of the emergency dc system is performed in accordance with the requirements of RG 1.32 and 1.129. The battery testing schedule is described in Section 8.3.2.1.2.

Unit 2 consists of one unit only and the emergency dc systems are not shared with any other unit.

Regulatory Guide 1.47

The Division I and II emergency 125-V dc systems are each provided with control room "bypassed/inoperable" indication if the system is bypassed manually or if each of the emergency battery and battery charger breakers are in the open position. The Division III HPCS emergency 125-V dc system battery and battery charger breaker open position is annunciated in the control room in a common "trouble" window. Loss of Division III 125-V dc will cause a HPCS 4-kV emergency bus system level "inoperable/bypassed" annunciation in the control room. Each HPCS 4-kV breaker has an individual Class 1E "inoperable" status light in the control room.

Regulatory Guide 1.75 and IEEE-384-1977

The plant emergency dc distribution system is designed to comply with the physical separation and electrical isolation requirements specified in RG 1.75 and IEEE-384-1977. The method of conformance is described in Section 8.3.1.2. The criteria used for electrical isolation and physical separation are described in Section 8.3.1.4.

Regulatory Guide 1.81

Unit 2 does not share its electric power system with any other nuclear power unit and hence, this regulatory guide does not apply.

Regulatory Guide 1.106

This regulatory guide does not require valves to have thermal overload protection devices. For the dc MOVs with an active safety function, there are no thermal overload protection devices. During periodic testing, the valve's motor operator performance will be monitored and possible overload conditions investigated.

There are some safety-related dc MOVs that have overload heaters but do not have an active safety function. For these valves, the overload heaters will remain in the circuit to provide annunciation.

Regulatory Guide 1.118 and IEEE-338-1977

The emergency dc power system is designed to permit periodic testing of the components and the system. The periodic testing program is addressed in Technical Specifications.

Regulatory Guide 1.128 and IEEE-484-1975 or IEEE-484-1987

The emergency batteries are installed in accordance with the requirements of this regulatory guide and IEEE standard. The three emergency batteries are located in three emergency battery rooms in the control building (el 261 ft) which is a Category I structure. The emergency battery rooms are spacious enough to permit periodic inspection, testing and maintenance, and replacement. Each battery is adequately illuminated and independently ventilated to limit the hydrogen accumulation to less than 4 percent by volume at any location within the battery area. The batteries are mounted on two-step Category I racks with insulated restraining members arranged to prevent motion of the cells relative to each other or to the rack. Each emergency battery room has ventilation air flow sensors with alarms and smoke detectors with alarms.

Regulatory Guide 1.129 and IEEE-450-1980

The emergency batteries are designed to permit inspection, testing, and maintenance in accordance with RG 1.129 (The battery testing schedule is described in Section 8.3.2.1.2).

8.3.2.3 Physical Identification of Safety-Related Dc System Equipment

The safety-related dc system equipment is identified by color coding and alphanumeric coding in the same manner as the safety-related onsite ac system equipment is identified (Section 8.3.1.3).

8.3.2.4 Independence of Redundant Systems

The three divisions of the emergency dc power system are completely independent of each other. The independence is maintained throughout the battery and battery chargers, the distribution system, and the loads as described in Section 8.3.1.4.

8.3.2.5 Station Blackout Capability

The capability of the Class 1E and non-Class 1E batteries to supply SBO loads is addressed in Section 8.3.1.5.

8.3.3 Fire Protection for Cable System

The measures employed for the prevention of and protection against fire in electrical cables are described in Section 9.5.1. Cable derating and cable tray fill, and fire barriers and separation between redundant trays, are described in Section 8.3.1.

8.3.4 References

1. Insulated Power Cable Engineers Association. Thermoplastic-Insulated Wire and Cables for the Transmission and Distribution of Electrical Energy. Publication No. S-61-402.

2. Insulated Power Cable Engineers Association. Power Cable Assemblies - Copper Conductors. Publication No. P-46-426, 1962.

3. Insulated Power Cable Engineers Association. Ampacities, Cables in Open-Top Cable Trays. Publication No. P-54-440, 1976.

4. NEDO-10905, High Pressure Core Spray System Power Supply Unit, May 1973, Class 1.

5. Letter No. NMP2L 1194 from C. D. Terry (NMPC) to NRC, dated April 13, 1989.

6. Letter No. NMP2L 1230 from C. D. Terry (NMPC) to NRC, dated April 3, 1990.

7. Letter from D. S. Brinkman (NRC) to B. R. Sylvia (NMPC), Station Blackout Rule Safety Evaluation - Nine Mile Point Nuclear Station Unit No. 2 (TAC No. 68571), dated May 29, 1991.

8. Letter No. NMP2L 1308 from C. D. Terry (NMPC) to NRC, dated July 1, 1991.

9. Letter from J. E. Menning (NRC) to B. R. Sylvia (NMPC), Station Blackout Rule Supplementation Safety Evaluation - Nine Mile Point Nuclear Station Unit No. 2 (TAC No. 68571), dated November 21, 1991.

10. Letter No. NMP2L 1331 from C. D. Terry (NMPC) to NRC, dated January 2, 1992.

11. Letter from R. A. Laura (NRC) to B. R. Sylvia (NMPC), Station Blackout Rule Supplemental Safety Evaluation Response Closure - Nine Mile Point Nuclear Station Unit 2 (TAC No. M68571), dated February 7, 1992.

12. Letter No. NMP2L 1365 from C. D. Terry (NMPC) to NRC, dated January 4, 1993.

13. GE Hitachi Nuclear Energy, "Safety Analysis Report for Nine Mile Point Nuclear Station Unit 2 Constant Pressure Power Uprate," NEDC-33351P, Revision 0, May 2009.

14. EC-032, NMP Unit 2 "DIESEL GENERATOR LOADING CALCULATION"

TABLE 8.3-1

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TABLE 8.3-2

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TABLE 8.3-3

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TABLE 8.3-3A

HPCS DIESEL GENERATOR CONDITIONS AND CORRESPONDING MAIN CONTROL ROOM ANNUNCIATIONS

HPCS Diesel Generator Condition	Main Control Room Remote Annunciation
Low fuel oil level in day tank	Engine trouble
Low starting air pressure	Engine trouble
Control power failure	Diesel generator inoperable
Engine in maintenance position	Diesel engine in maintenance position
Diesel engine trip/lockout not	Diesel engine trip/trouble reset
Generator trip/lockout not a. Loss of excitation[1] b. Generator reverse power[1]	Generator trip/lockout reset
Engine overspeed	Engine overspeed
Generator differential	Generator trip/lockout
Manual out-of-service (main breakers or diesel generator inoperable) (control room)	Engine bypassed/inoperable
Low lubrication oil pressure[1]	Engine trouble
High jacket water outlet temperature[1]	Engine trouble
Engine overcrank[1]	Engine trouble
Generator Ground	EDG 2 system ground
Generator Overcurrent	EDG 2 overcurrent

[1] During emergency (LOCA) operation, these conditions are bypassed and do not shut down the HPCS diesel generator.

TABLE 8.3-4
LIST OF CLASS 1E SAFETY-RELATED LOADS BY POWER SOURCE

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2HVC*UC108A	Unit cooler CB standby switchgear room A	G	10 hp	575	3	10.80	64.3	2EJS*PNL102A
DELETED								
DELETED								
2VBS*PNLA103	Control room RPS and NS4 distribution panel	G	200 A	120	1	100.0	-	2VBS*PNLA100
2VBS*PNLA104	RPS and N54 distribution panel	O	200 A	120	1	100.0	-	2VBS*PNLA100
2VBS*PNLA105	MSIV distribution panel	G	200 A	120	1	100.0	-	2VBS*PNLA100
2VBS*PNLA106	MSIV distribution panel	Y/W	200 A	120	1	100.00	-	2VBS*PNLA100
2VBS*PNLA110	Control room RPS distribution panel	B/W	200 A	120	1	100.00	-	2VBS*PNLA100
2VBS*PNLB103	Control room RPS distribution panel	Y	200 A	120	1	100.0	-	2VBS*PNLB100
2VBS*PNLB104	RPS and NS4 distribution panel	B	200 A	120	1	100.0	-	2VBS*PNLB100
2VBS*PNLB105	MSIV distribution panel	G/W	200 A	120	1	200.0	-	2VBS*PNLB100
2VBS*PNLB106	MSIV distribution panel	Y	200 A	120	1	200.0	-	2VBS*PNLB100
2VBS*PNLB110	Control room RPS distribution panel	O/W	200 A	120	1	100.0	-	2VBS*PNLB100
2EGS*EG1	DG Div. I	G	5,500 kVA	4,160	3	763.3	-	Diesel generator
2EGS*EG2	DG Div. III	P	3,250 kVA	4,160	3	451	-	Diesel generator
2EGS*EG3	DG Div. II	Y	5,500 kVA	4,160	3	763.3	-	Diesel generator
2BYS*SWG002A	125-V dc switchgear	G	2,000 A	125	0	229*	-	2BYS*BAT2A
2BYS*SWG002B	125-V dc switchgear	Y	2,000 A	125	0	182*	-	2BYS*BAT2B
2BYS*BAT2A	125-V 1E standby battery Div. I	G	2,500 AH	125	0	330	-	2BYS*CHGR2A1

* Average load between 1 min to 119 min.

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2BYS*SWG002A	125-V dc switchgear	G	2,000 A	125	0	330	-	2BYS*CHGR2A1
2BYS*SWG002A	125-V dc switchgear	G	2,000 A	125	0	330	-	2BYS*CHGR2A2
2BYS*BAT2B	125-V 1E standby battery Div. II	Y	2,500 AH	125	0	330	-	2BYS*CHGR2B1
2BYS*SWG002B	125-V dc switchgear	Y	2,000 A	125	0	330	-	2BYS*CHGR2B1
2BYS*SWG002B	125-V dc switchgear	Y	2,000 A	125	0	330	-	2BYS*CHGR2B2
2BYS*BAT2C	125-V 1E standby battery Div. III	P	60 AH	125	0	55	-	2BYS*CHGR2C1
2BYS*PNL204A	125-V dc distribution panel	G	225 A	125	0	225	-	2BYS*SWG002A
2BYS*PNL204B	125-V dc distribution panel	Y	225 A	125	0	225	-	2BYS*SWG002B
2BYS*PNL201A	125-V dc distribution panel	G	400 A	125	0	200	-	2BYS*SWG002A
2BYS*PNL202A	125-V dc distribution panel	G	225 A	125	0	200	-	2BYS*SWG002A
2DMS*MCCA1	125-V dc MCC reactor building el 240'	G	600 A	125	0	600	-	2BYS*SWG002A
2BYS*PNL201B	125-V dc distribution panel	Y	400 A	125	0	400	-	2BYS*SWG002B
2BYS*PNL202B	125-V dc distribution panel	Y	225 A	125	0	200	-	2BYS*SWG002B
2DMS*MCCB1	125-V dc MCC reactor building el 240'	Y	600 A	125	0	600	-	2BYS*SWG002B
2ICS*FV108	RCIC pump to condensate storage	G	0.36 hp	125	0	4.2	20.8	2DMS*MCCA1
2ICS*MOV116	Lube oil cooling water supply	G	0.36 hp	125	0	4.0	21.00	2DMS*MCCA1
2ICS*MOV120	RCIC steam supply	G	1.8 hp	125	0	14.5	82	2DMS*MCCA1
2ICS*MOV122	RCIC turbine exhaust	G	1.8 hp	125	0	14.50	82	2DMS*MCCA1
2ICS*MOV124	RCIC pump to condensate storage	G	0.72 hp	125	0	8.00	39	2DMS*MCCA1
2ICS*MOV126	RCIC pump to reactor	G	4.3 hp	125	0	34.0	174	2DMS*MCCA1
2ICS*MOV129	Condensate storage to RCIC pump	G	0.72 hp	125	0	8.00	39	2DMS*MCCA1
2ICS*MOV136	Suppression pool into RCIC pump	G	0.72 hp	125	0	8.00	39	2DMS*MCCA1

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2ICS*MOV143	RCIC pump minimum flow to suppression pool	G	0.36 hp	125	0	4.0	21.70	2DMS*MCCA1
2ICS*MOV150	RCIC trip throttle valve	G	0.33 hp	125	0	4.0	21.70	2DMS*MCCA1
2ICS*MOV164	Vacuum breaker valve outboard	G	0.14 hp	125	0	1.6	15.9	2DMS*MCCA1
2ICS*MOV148	Vacuum breaker valve inboard	Y	0.14 hp	125	0	1.6	15.9	2DMS*MCCB1
2HVY*UC2A	Service water pump pressure indicator transmitter unit cooler	G	40 hp	575	3	40.0	324	2EHS*MCC101
2HVY*UC2C	Service water pump pressure indicator transmitter unit cooler	G	40 hp	575	3	40.0	324	2EHS*MCC101
2SWP*MOV1A	Service water backwash line	G	0.13 hp	575	3	.36	2.5	2EHS*MCC101
2SWP*MOV1C	Service water backwash line	G	0.13 hp	575	3	.36	2.5	2EHS*MCC101
2SWP*MOV1E	Service water strainer backwash	G	0.13 hp	575	3	.36	2.5	2EHS*MCC101
2SWP*MOV3A	Service water to turbine plant	G	4 hp	575	3	5.60	48.0	2EHS*MCC101
2SWP*MOV30A	Motor-operated gate valve	G	1 hp	575	3	2.24	12.8	2EHS*MCC101
2SWP*MOV50A	Service water pump discharge header valve	G	9.90 hp	575	3	15.60	104.00	2EHS*MCC101
2SWP*MOV74A	Service water pump discharge block valve	G	2.6 hp	575	3	4.7	30.0	2EHS*MCC101
2SWP*MOV74C	Service water pump discharge block valve	G	2.6 hp	575	3	4.7	30.0	2EHS*MCC101
2SWP*MOV74E	Service water pump discharge block valve	G	2.6 hp	575	3	4.7	30.0	2EHS*MCC101
2SWP*MOV77A	Motor-operated gate valve	G	0.70 hp	575	3	1.9	10	2EHS*MCC101
2SWP*SSR1A	Bar rack heater	G	3.15 kW	332	1	10.5	-	2EHS*MCC101
2SWP*SSR2A	Bar rack heater	G	3.15 kW	332	1	10.5	-	2EHS*MCC101
2SWP*SSR3A	Bar rack heater	G	3.15 kW	332	1	10.5	-	2EHS*MCC101

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2SWP*SSR4A	Bar rack heater	G	3.15 kW	332	1	10.5	-	2EHS*MCC101
2SWP*SSR5A	Bar rack heater	G	3.15 kW	332	1	10.5	-	2EHS*MCC101
2SWP*SSR6A	Bar rack heater	G	3.15 kW	332	1	10.5	-	2EHS*MCC101
2SWP*STR4A	Strainer service water	G	1.5 hp	575	3	1.6	13.9	2EHS*MCC101
2SWP*STR4C	Strainer service water	G	1.5 hp	575	3	1.6	13.9	2EHS*MCC101
2SWP*STR4E	Strainer service water	G	1.5 hp	575	3	1.6	13.9	2EHS*MCC101
2EJS*PNL101A	Switchgear room A emergency 600-V panel	G	400 A	600	3	150	-	2EHS*MCC102A
2EJS*PNL103A	AB-N emergency 600-V panel	G	400 A	600	3	150	-	2EHS*MCC102A
2EJS*PNL104A	AB-N emergency 600-V panel	G	400 A	600	3	150	-	2EHS*MCC102A
2FWS*MOV21A	Feedwater to reactor	G	26.4 hp	575	3	29.9	297.0	2EHS*MCC102A
2FWS*MOV21B	Feedwater to reactor	G	26.4 hp	575	3	29.9	297.0	2EHS*MCC102C
2GTS*FN1A	SGTS filter train discharge fan	G	40 hp	575	3	38.5	285.0	2EHS*MCC102A
2GTS*MOV1A	Reactor building ventilation mix plenum to grates	G	0.33 hp	575	3	1.68	5.0	2EHS*MCC102A
2GTS*MOV4B	Decay heat cool to train B	G	1.0 hp	575	3	2.2	12.5	2EHS*MCC302B
2HCS*MOV1A	Wetwell hydrogen recombiner isolation valve	G	0.7 hp	575	3	1.9	10.0	2EHS*MCC102A
2HCS*MOV2A	Wetwell hydrogen recombiner isolation valve	G	0.33 hp	575	3	0.64	4.64	2EHS*MCC102A
2HCS*MOV3A	Wetwell hydrogen recombiner isolation valve	G	0.7 hp	575	3	1.9	10.0	2EHS*MCC102A
2CMS*P2A	H_2/O_2 analyzer pump	G	1.0 hp	575	3	1.70	-	2EHS*MCC102A

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[1]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2HCS*MOV4A	Wetwell hydrogen recombiner isolation valve	G	0.33 hp	575	3	0.64	4.64	2EHS*MCC102A
2HCS*MOV5A	Wetwell hydrogen recombiner isolation valve	G	0.33 hp	575	3	0.64	4.64	2EHS*MCC102A
2HCS*MOV6A	Wetwell hydrogen recombiner isolation valve	G	0.33 hp	575	3	0.64	4.64	2EHS*MCC102A
2MSS*MOV112	Main steam to condenser	G	1.6 hp	575	3	3.2	20.0	2EHS*MCC102A
2MSS*MOV119	Vent valve	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC102A
2MSS*MOV208	Main steam valve	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC102A
2SWP*MOV17A	Service water to RBCLCW	G	1.6 hp	575	3	3.2	20.0	2EHS*MCC102A
2SWP*MOV18A	RBCLCW to service water	G	1.6 hp	575	3	3.2	20.0	2EHS*MCC102A
2SWP*MOV19A	Service water to RBCLCW heat exchanger	G	1.0 hp	575	3	2.2	12.5	2EHS*MCC102A
2SWP*MOV21A	RBCLCW to SFC cooling pool	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC102A
2SWP*MOV33A	RHR heat exchanger A to discharge tunnel	G	0.83 hp	575	3	3.5	10.3	2EHS*MCC102A
2SWP*MOV90A	Service water to RHS heat exchanger	G	0.83 hp	575	3	3.5	10.3	2EHS*MCC102A
2CSL*FV114	LPCS test	G	0.33 hp	575	3	0.66	4.14	2EHS*MCC102C
2CSL*MOV104	LPCS pump to reactor	G	7.80 hp	575	3	9.12	75.00	2EHS*MCC102C
2CSL*MOV107	LPCS minimum flow to RHR	G	1.9 hp	575	3	2.8	21.0	2EHS*MCC102C
2CSL*MOV112	Suppression pool to LPCS pump	G	0.70 hp	575	3	1.8	11.25	2EHS*MCC102C
2CSL*P2	LPCS system pressure pump	G	10 hp	575	3	10.3	56.2	2EHS*MCC102C
2DER*MOV120	Containment isolation valve	G	0.66 hp	575	3	0.86	4.5	2EHS*MCC102C
2DER*MOV131	Reactor building equipment drains TK1 vent	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC102C

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2DFR*MOV120	Reactor building floor drain discharge isolation valve	G	1.4 hp	575	3	1.75	8.0	2EHS*MCC102C
2DFR*MOV139	Reactor plant floor drain vent isolation valve	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC102C
2ICS*MOV121	Turbine steam supply isolation outboard	G	7.8 hp	575	3	9.10	76.3	2EHS*MCC102C
2ICS*P2	RCIC system pressure pump A	G	10 hp	575	3	10.30	56.2	2EHS*MCC102C
2SLS*MOV1A	Standby liquid control	G	0.33 hp	575	3	0.7	4.8	2EHS*MCC102C
2SLS*MOV5A	SLCS outboard isolation valve	G	0.70 hp	575	3	1.90	10.6	2EHS*MCC102A
2SLS*P1A	Standby liquid pump A	G	42.3 hp	575	3	40.7	253	2EHS*MCC102C
2WCS*MOV112	RWCU system outboard steam isolation valve	G	7.8 hp	575	3	9.1	76.3	2EHS*MCC102C
2WCS*MOV200	RWCU return isolation valve	G	1.6 hp	575	3	3.20	20.0	2EHS*MCC102A
2CCP*MOV124	Domestic water cooler to RBCLCW outboard I	G	1 hp	575	3	2.2	12.5	2EHS*MCC103A
2CCP*MOV14A	RBCLCW to SFC heat exchanger A	G	1.6 hp	575	3	3.20	20.0	2EHS*MCC103A
2CCP*MOV18A	SFC heat exchanger A to RBCLCW	G	1.6 hp	575	3	3.20	20.00	2EHS*MCC103A
2CCP*MOV265	Isolation valve containment	G	1 hp	575	3	2.2	12.5	2EHS*MCC103A
2CCP*MOV15A	RBCLCW to RCS pump A outboard I	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC103A
2CCP*MOV15B	RBCLCW to RCS pump B outboard I	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC103A
2CCP*MOV17A	To RBCLCW RCS pump A outboard I	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC103A
2CCP*MOV17B	To RBCLCW RCS pump A outboard I	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC103A
2EGA*M1A	DG 1 air comp 1A motor	G	15 hp	575	3	15.80	84.0	2EHS*MCC103A
2EGA*M2A	DG 1 air comp 2A motor	G	15 hp	575	3	15.80	84.0	2EHS*MCC103A
2EGF*P1A	DG 1 fuel oil transfer pump A	G	1.5 hp	575	3	1.82	9.04	2EHS*MCC103A

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2EGF*P1C	DG 1 fuel oil transfer pump C	G	1.5 hp	575	3	1.76	9.04	2EHS*MCC103A
2EGO*P1A	Lube oil circulation pump	G	15 hp	575	3	14.9	83.5	2EHS*MCC103A
2EGS*P1A	Jacket water circulation pump	G	5 hp	575	3	5.6	34.2	2EHS*MCC103A
2EGT*CH2	Lube oil heater	G	12 kW	575	3	12	-	2EHS*MCC103A
2EGT*CH4	Jacket water heater	G	18 kW	575	3	18	-	2EHS*MCC103A
2HVC*ACU1A	Control room A/C unit 1A	G	40 hp	575	3	39.5	219.0	2EHS*MCC103A
2HVC*ACU2A	Relay room A/C unit 2A	G	40 hp	575	3	39.5	219.0	2EHS*MCC103A
2HVC*ACU3A	Remote shutdown on room A/C unit	G	2 hp	575	3	2.48	16.30	2EHS*MCC103A
2HVC*FN11A	Makeup air switchgear floor	G	7.5 hp	575	3	8.2	48.0	2EHS*MCC103A
2HVC*FN2A	Control room A/C booster fan A	G	10 hp	575	3	10.5	65	2EHS*MCC103A
2HVC*FN4A	Battery room A exchange fan	G	3 hp	575	3	3.7	23.4	2EHS*MCC103A
2HVC*MOV1A	Control room A/C special filter bypass	G	0.25 hp	575	3	0.4	4.5	2EHS*MCC103A
2HVR*CHL1A	Auxiliary oil pump	G	0.75 hp	575	3	0.9	4.83	2EHS*MCC103A
2HVK*P1A	Control building chilled water circulating pump A	G	15 hp	575	3	14.8	94.8	2EHS*MCC103A
DELETED								
2SWP*MOV66A	Service water to standby DG coolers E3A	G	1 hp	575	3	2.2	12.8	2EHS*MCC103A
2SWP*MOV67A	Service water to control DG relay room coil	G	0.66 hp	575	3	0.86	4.5	2EHS*MCC103A
2SWP*MOV599	Service water to discharge tunnel isolation	G	1.6 hp	575	3	3.2	20.0	2EHS*MCC103A
2SWP*MOV93A	Service water to discharge tunnel isolation	G	1 hp	575	3	2.20	12.50	2EHS*MCC103A
2SWP*MOV95A	Service water to standby DG coolers	G	1 hp	575	3	2.2	12.5	2EHS*MCC103A

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[1]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2SWP*P2A	Control building chiller service water pump A	G	10 hp	575	3	10.5	64.00	2EHS*MCC103A
2HVP*FN1A	DG 1 exhaust fan 1A	G	30 hp	575	3	32.0	232.0	2EHS*MCC103C
2HVP*FN1C	DG 1 exhaust fan 1C	G	30 hp	575	3	32.0	232.0	2EHS*MCC103C
2RHS*FV38A	Test line A to suppression pool	G	0.33 hp	575	3	0.66	3.8	2EHS*MCC103C
2RHS*MOV1A	Suppression pool to RHR pump A	G	1.6 hp	575	3	6.0	38.0	2EHS*MCC103C
2RHS*MOV104	Heat spray in outboard isolation	G	0.7 hp	575	3	1.8	9.0	2EHS*MCC103C
2RHS*MOV113	Cooling supply outboard isolation	G	19.2 hp	575	3	20.5	156	2EHS*MCC103C
2RHS*MOV12A	Heat exchanger A to reactor	G	0.7 hp	575	3	1.9	10.0	2EHS*MCC103C
2RHS*MOV142	Heat exchanger B to liquid radwaste system	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC103C
2RHS*MOV15A	Containment spray A	G	5.2 hp	575	3	8.5	48	2EHS*MCC103C
2RHS*MOV2A	Reactor to RHR pump A	G	0.83 hp	575	3	3.5	10.3	2EHS*MCC103C
2RHS*MOV24A	LPCI inlet A	G	6.6 hp	575	3	8.0	74.2	2EHS*MCC103C
2RHS*MOV25A	Containment spray A	G	5.2 hp	575	3	8.5	48	2EHS*MCC103C
2RHS*MOV26A	Heat exchanger A vent to suppression pool	G	0.13 hp	575	3	0.83	2.5	2EHS*MCC103C
2RHS*MOV27A	Heat exchanger A vent to suppression pool	G	0.13 hp	575	3	0.83	2.5	2EHS*MCC103C
2RHS*MOV30A	RHR return to suppression pool	G	1.6 hp	575	3	3.20	20.00	2EHS*MCC103C

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2RHS*MOV33A	Suppression pool spray header A	G	0.33 hp	575	3	0.64	4.5	2EHS*MCC103C
2RHS*MOV4A	RHR minimum flow to suppression pool	G	1.9 hp	575	3	2.8	21.00	2EHS*MCC103C
2RHS*MOV40A	Shutdown cooling return A	G	10.3 hp	575	3	12.0	91.4	2EHS*MCC103C
2RHS*MOV67A	RHR shutdown bypass	G	0.33 hp	575	3	0.64	4.50	2EHS*MCC103C
2RHS*MOV8A	Heat exchanger A bypass	G	1.6 hp	575	3	3.2	20.0	2EHS*MCC103C
2RHS*MOV9A	RHR pump A to heat exchanger A	G	0.7 hp	575	3	1.9	10.0	2EHS*MCC103C
2BYS*CHGR2C1	125-V battery charger standby Div. III	P	50 A dc	575	3	13.00	-	2EHS*MCC201
2BYS*CHGR2C2	125-V battery charger	P	50 A dc	575	3	13.00	-	2EHS*MCC201
2CSH*MOV101	Condensate storage to HPCS pump	P	0.7 hp	575	3	1.9	10	2EHS*MCC201
2CSH*MOV105	Flow bypass to suppression pool	P	3.3 hp	575	3	4.2	29.0	2EHS*MCC201
2CSH*MOV107	HPCS pump to reactor	P	19.2 hp	575	3	20.5	156	2EHS*MCC201
2CSH*MOV110	Test bypass to condensate storage	P	13.1 hp	575	3	18.4	131	2EHS*MCC201
2CSH*MOV111	Test bypass to suppression pool	P	9.9 hp	575	3	15.6	104.0	2EHS*MCC201
2CSH*MOV112	Test bypass to condensate storage	P	13.1 hp	575	3	18.4	131	2EHS*MCC201
2CSH*MOV118	Suppression pool to HPCS	P	3.3 hp	575	3	4.2	29.0	2EHS*MCC201
2CSH*P2	Standby water leg pump E22-C003	P	10 hp	575	3	10.3	51	2EHS*MCC201
2EGF*P2A	DG 2 fuel oil transfer pump A	P	1.5 hp	575	3	1.82	9.04	2EHS*MCC201
2EGF*P2B	DG 2 fuel oil transfer pump B	P	1.5 hp	575	3	1.82	9.04	2EHS*MCC201
2EGO*P1	HPCS DG 2 circulating oil pump	P	1 hp	575	3	1.6	-	2EHS*MCC201
2EGT*CH1	HPCS DG 2 immersion heater	P	15 kW	575	3	15.0	-	2EHS*MCC201
DELETED								

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2HVC*UC102	HPCS switchgear room unit cooler	P	5 hp	575	3	5.6	32.9	2EHS*MCC201
2HVP*FN2A	DG 2 exhaust fan 2A	P	30 hp	575	3	32.0	232.0	2EHS*MCC201
2HVP*FN2B	DG 2 exhaust fan 2B	P	30 hp	575	3	32.0	232.0	2EHS*MCC201
2HVP*UC2	DG 2 unit cooler HPCS DG room	P	5 hp	575	3	5.44	-	2EHS*MCC201
2HVR*UC403A	Reactor building HPCS separator cooler el 196'	P	2 motors 15 hp total	575	3	16.00	129.20	2EHS*MCC201
2HVR*UC403B	Reactor building separator cooler el 196'	P	2 motors 15 hp total	575	3	16.00	129.20	2EHS*MCC201
2IAC*XLE03	LTG transformer 600-208Y/120-V	P	30 kVA	600	3	30.0	-	2EHS*MCC201
2SCV*XD200P	Distribution transformer 600-120-V	P	25 kVA	600	1	432.40	-	2EHS*MCC2C1
2SWP*MOV15A	Service water to HPCS unit cooler	P	0.33 hp	575	3	0.64	4.50	2EHS*MCC201
2SWP*MOV15B	Service water to HPCS unit cooler	P	0.33 hp	575	3	0.64	4.50	2EHS*MCC201
2SWP*MOV94A	Service water to standby D/G coolers E3B	P	1 hp	575	3	2.2	12.5	2EHS*MCC201
2SWP*MOV94B	Service water to standby DG coolers E3B	P	1 hp	575	3	2.2	12.5	2EHS*MCC201
2HVY*UC2B	Service water pump PIT unit cooler	Y	40 hp	575	3	40.0	324.00	2EHS*MCC301
2HVY*UC2D	Service water pump PIT unit cooler	Y	40 hp	575	3	40.0	324.00	2EHS*MCC301
2SWP*MOV1B	Service water backwash line	Y	0.13 hp	575	3	0.36	2.5	2EHS*MCC301
2SWP*MOV1D	Service water backwash line	Y	0.13 hp	575	3	0.36	2.5	2EHS*MCC301
2SWP*MOV1F	Service water strainer backwash	Y	0.13 hp	575	3	0.36	2.5	2EHS*MCC301
2SWP*MOV3B	Service water to turbine plant	Y	4 hp	575	3	5.6	48.0	2EHS*MCC301
2SWP*MOV30B	Motor-operated gate valve	Y	1 hp	575	3	2.24	12.8	2EHS*MCC301

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2SWP*MOV50B	Service water pump discharge header	Y	9.9 hp	575	3	15.60	104.00	2EHS*MCC301
2SWP*MOV74B	Service water discharge block valve	Y	2.6 hp	575	3	4.7	30.0	2EHS*MCC301
2SWP*MOV74D	Service water pump discharge block valve	Y	2.6 hp	575	3	4.7	30.0	2EHS*MCC301
2SWP*MOV74F	Service water pump discharge block valve	Y	2.6 hp	575	3	4.7	30.0	2EHS*MCC301
2SWP*MOV77B	Motor-operated gate valve	Y	0.7 hp	575	3	1.9	10.0	2EHS*MCC301
2SWP*SSR1B	Bar rack heater	Y	3.15 kW	332	1	10.5	-	2EHS*MCC301
2SWP*SSR2B	Bar rack heater	Y	3.15 kW	332	1	10.5	-	2EHS*MCC301
2SWP*SSR3B	Bar rack heater	Y	3.15 kW	332	1	10.5	-	2EHS*MCC301
2SWP*SSR4B	Bar rack heater	Y	3.15 kW	332	1	10.5	-	2EHS*MCC301
2SWP*SSR5B	Bar rack heater	Y	3.15 kW	332	1	10.5	-	2EHS*MCC301
2SWP*SSR6B	Bar rack heater	Y	3.15 kW	332	1	10.5	-	2EHS*MCC301
2SWP*STR4B	Strainer service water	Y	1.5 hp	575	3	1.6	13.9	2EHS*MCC301
2SWP*STR4D	Strainer service water	Y	1.5 hp	575	3	1.6	13.9	2EHS*MCC301
2SWP*STR4F	Strainer service water	Y	1.5 hp	575	3	1.6	13.9	2EHS*MCC301
2EJS*PNL302B	AB-S emergency 600-V panel	Y	400 A	600	3	150	-	2EHS*MCC302B
2EJS*PNL303B	AB-S emergency 600-V panel	Y	400 A	600	3	150	-	2EHS*MCC302B
2EJS*PNL304B	AB-S emergency 600-V panel	Y	400 A	600	3	150	-	2EHS*MCC302B
2GTS*FN1B	GTS filter train discharge fan	Y	40 hp	575	3	39.20	232.00	2EHS*MCC302B
2GTS*MOV1B	HVP mix plenum to GTS	Y	0.33 hp	575	3	1.68	5.0	2EHS*MCC302B
2CMS*P2B	H_2/O_2 analyzer pump	Y	1 hp	575	3	1.70	-	2EHS*MCC302B

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[(1)]	Division[(2)]	Rating	Volts	Phase	Amps Full Load[(3)]	Amps Locked Rotor[(3)]	Power Source Identity No.
2GTS*MOV4A	Decay heat cooler to train A	Y	1.0 hp	575	3	2.2	12.8	2EHS*MCC102A
2HCS*MOV1B	Wetwell hydrogen recombiner isolation valve	Y	0.7 hp	575	3	1.9	10.0	2EHS*MCC302B
2HCS*MOV2B	Wetwell hydrogen recombiner isolation valve	Y	0.33 hp	575	3	0.64	4.64	2EHS*MCC302B
2HCS*MOV3B	Wetwell hydrogen recombiner isolation valve	Y	0.7 hp	575	3	1.9	10.0	2EHS*MCC302B
2HCS*MOV4B	Drywell hydrogen recombiner isolation valve	Y	0.33 hp	575	3	0.64	4.64	2EHS*MCC302B
2HCS*MOV5B	Drywell hydrogen recombiner isolation valve	Y	0.33 hp	575	3	0.64	4.64	2EHS*MCC302B
2HCS*MOV6B	Drywell hydrogen recombiner isolation valve	Y	0.33 hp	575	3	0.64	4.64	2EHS*MCC302B
2SWP*MOV17B	Service water to RBCLCW	Y	1.6 hp	575	3	3.2	20.00	2EHS*MCC302B
2SWP*MOV18B	RBCLCW to service water	Y	1.6 hp	575	3	3.2	20.0	2EHS*MCC302B
2SWP*MOV19B	Service water to RBCLCW heat exchanger	Y	1.0 hp	575	3	2.2	12.5	2EHS*MCC302B
2SLS*MOV5B	SLCS inboard isolation valve	Y	0.70 hp	575	3	1.90	10.00	2EHS*MCC302B
2SWP*MOV21B	RBCLCW to SFC cooling pool	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC302B
2SWP*MOV33B	RHR heat exchanger B to discharge tunnel	Y	0.83 hp	575	3	3.5	10.3	2EHS*MCC302B
2SWP*MOV90B	RHR heat exchanger inlet	Y	0.83 hp	575	3	3.5	10.3	2EHS*MCC302B
2DER*MOV119	Containment isolation valve	Y	0.66 hp	575	3	0.86	4.5	2EHS*MCC302D
2DER*MOV130	Der TK1 vent	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC302D
2DFR*MOV121	Drywell floor drain discharge isolation valve	Y	1.4 hp	575	3	1.7	8.0	2EHS*MCC302D

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[(1)]	Division[(2)]	Rating	Volts	Phase	Amps Full Load[(3)]	Amps Locked Rotor[(3)]	Power Source Identity No.
2DFR*MOV140	Drywell floor drain discharge isolation valve	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC302D
2ICS*MOV128	MOV steam supply line	Y	7.80 hp	575	3	9.12	75.4	2EHS*MCC302D
2ICS*MOV170	Bypass of MOV128	Y	0.13 hp	575	3	0.36	2.5	2EHS*MCC302D
2MSS*MOV111	Main steam to condensate inboard isolation	Y	1.6 hp	575	3	3.2	20.0	2EHS*MCC302D
2MSS*MOV118	Vent valve	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC302D
2SLS*MOV1B	Standby liquid control	Y	0.33 hp	575	3	0.7	4.00	2EHS*MCC302D
2SLS*P1B	Standby liquid pump B	Y	42.3 hp	575	3	40.7	253.0	2EHS*MCC302D
2WCS*MOV102	RWCU inboard isolation valve	Y	7.8 hp	575	3	9.1	76.3	2EHS*MCC302D
2HVK*CHL1B	Auxiliary oil pump	Y	0.75 hp	575	3	0.9	4.83	2EHS*MCC303B
2CCP*MOV122	Drywell cooler to RBCLCW inboard I	Y	1 hp	575	3	2.2	12.5	2EHS*MCC303B
2CCP*MOV14B	RBCLCW to SFC heat exchanger B	Y	1.6 hp	575	3	3.20	20.00	2EHS*MCC303B
2CCP*MOV18B	SFC heat exchanger to RBCLCW	Y	1.6 hp	575	3	3.20	20.00	2EHS*MCC303B
2CCP*MOV16A	RBCLCW from RCS pump A	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC303B
2CCP*MOV16B	RBCLCW from RCS pump B	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC303B
2CCP*MOV273	RBCLCW to drywell cooler inboard isolation	Y	1.0 hp	575	3	2.2	12.5	2EHS*MCC303B
2CCP*MOV94A	Cooling water to P1A	Y	0.33 hp	575	3	0.64	4.50	2EHS*MCC303B
2CCP*MOV94B	Cooling water to P1B	Y	0.33 hp	575	3	0.64	4.50	2EHS*MCC303B
2EGF*P1B	DG 3 fuel oil transformer pump B	Y	1.5 hp	575	3	1.73	9.04	2EHS*MCC303B
2EGF*P1D	DG 3 fuel oil transformer pump D	Y	1.5 hp	575	3	1.73	9.04	2EHS*MCC303B
2EGO*P1B	Lube oil circulation pump	Y	15 hp	575	3	14.9	83.5	2EHS*MCC303B
2EGS*P1B	Jacket water circulation pump	Y	5 hp	575	3	5.6	34.2	2EHS*MCC303B

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2EGT*CH3	Lube oil heater	Y	12 kW	575	3	12	-	2EHS*MCC303B
2EGT*CH5	Jacket water heater	Y	18 kW	575	3	18	-	2EHS*MCC303B
2HVC*ACU1B	Control room A/C unit 1B	Y	40 hp	575	3	39.5	219.0	2EHS*MCC303B
2HVC*ACU2B	Relay room A/C unit 2B	Y	40 hp	575	3	39.5	219.0	2EHS*MCC303B
2HVC*ACU3B	Remote shutdown on room A/C unit	Y	2 hp	575	3	2.48	16.3	2EHS*MCC303B
2HVC*FN11B	Makeup air switchgear floor	Y	7.5 hp	575	3	8.2	48.0	2EHS*MCC303B
2HVC*FN2B	Control room A/C booster fan B	Y	10 hp	575	3	10.5	65.6	2EHS*MCC303B
2HVC*FN4B	Battery room B exchange fan	Y	3 hp	575	3	3.7	23.4	2EHS*MCC303B
2HVC*MOV1B	Control room A/C special filter bypass	Y	0.25 hp	575	3	4.5	28.1	2EHS*MCC303B
2EGA*M1B	DG 3 air comp 1B motor	Y	15 hp	575	3	15.8	84.00	2EHS*MCC303B
2EGA*M2B	DG 3 air comp 2B motor	Y	15 hp	575	3	15.8	84.00	2EHS*MCC303B
2HVK*P1B	Control building chilled water circulating pump B	Y	15 hp	575	3	14.8	94.8	2EHS*MCC303B
DELETED								
2SWP*MOV66B	Service water to standby DG coolers E3B	Y	1 hp	575	3	2.2	12.5	2EHS*MCC303B
2SWP*MOV67B	Service water to cont ground relay room coil	Y	0.66 hp	575	3	0.86	4.5	2EHS*MCC303B
2SWP*MOV93B	Service water to discharge tunnel isolation	Y	1.0 hp	575	3	2.2	12.5	2EHS*MCC303B
2SWP*MOV95B	Service water to standby DG coolers	Y	1 hp	575	3	2.2	12.5	2EHS*MCC303B
2SWP*P2B	Catch basin chiller service water pump B	Y	10 hp	575	3	10.5	63.2	2EHS*MCC303B
2HVP*FN1B	DG 3 exhaust fan 1B	Y	30 hp	575	3	32.0	232.0	2EHS*MCC303D
2HVP*FN1D	DG 3 exhaust fan 1D	Y	30 hp	575	3	32.0	232.0	2EHS*MCC303D
2RHS*FV38B	Test line B to suppression pool	Y	0.33 hp	575	3	0.66	3.8	2EHS*MCC303D

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2RHS*FV38C	RHR pump C to suppression pool	Y	0.33 hp	575	3	0.66	3.8	2EHS*MCC303D
2RHS*MOV1B	Suppression pool to RHR pump B	Y	4.0 hp	575	3	6.0	38.0	2EHS*MCC303D
2RHS*MOV1C	Suppression pool to RHR pump C	Y	1.6 hp	575	3	3.2	20.0	2EHS*MCC303D
2RHS*MOV112	Shutdown cooling supply inboard isolation	Y	19.2 hp	575	3	20.5	155	2EHS*MCC303D
2RHS*MOV115	Service water bypass to reactor	Y	1.6 hp	575	3	3.2	20.0	2EHS*MCC303D
2RHS*MOV116	Service water bypass to reactor	Y	1.6 hp	575	3	3.2	20.0	2EHS*MCC303D
2RHS*MOV12B	Heat exchanger B to reactor	Y	0.7 hp	575	3	1.9	10.0	2EHS*MCC303D
2RHS*MOV149	Heat exchanger B to liquid radwaste system	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC303D
2RHS*MOV15B	Containment spray B	Y	5.2 hp	575	3	8.5	48	2EHS*MCC303D
2RHS*MOV2B	Reactor to RHR pump B	Y	0.83 hp	575	3	3.5	10.3	2EHS*MCC303D
2RHS*MOV24B	LPCI inlet B	Y	6.6 hp	575	3	8.0	74.2	2EHS*MCC303D
2RHS*MOV24C	LPCI inlet C	Y	6.6 hp	575	3	8.0	74.2	EHS*MCC303D
2RHS*MOV25B	Containment spray B	Y	5.2 hp	575	3	8.5	48	2EHS*MCC303D
2RHS*MOV26B	Heat exchanger B vent to suppression pool	Y	0.13 hp	575	3	0.4	2.5	2EHS*MCC303D
2RHS*MOV27B	Heat exchanger B vent to suppression pool	Y	0.13 hp	575	3	0.83	2.5	2EHS*MCC303D
2RHS*MOV30B	RHR return to suppression pool	Y	1.60 hp	575	3	3.20	20.00	2EHS*MCC303D

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2RHS*MOV33B	Suppression pool spray header B	Y	0.33 hp	575	3	0.64	4.5	2EHS*MCC303D
2RHS*MOV4B	RHR minimum flow to suppression pool	Y	1.9 hp	575	3	2.8	21.0	2EHS*MCC303D
2RHS*MOV4C	RHR minimum flow to suppression pool	Y	1.9 hp	575	3	2.8	21.0	2EHS*MCC303D
2RHS*MOV40B	Shutdown cooling return B	Y	10.3 hp	575	3	12.0	91.4	2EHS*MCC303D
2RHS*MOV67B	RHR shutdown bypass	Y	0.33 hp	575	3	0.64	4.50	2RHS*MCC303D
2RHS*MOV8B	Heat exchanger B bypass	Y	1.6 hp	575	3	3.2	20.00	2EHS*MCC303D
2RHS*MOV9B	RHR pump B to heat exchanger B	Y	0.7 hp	575	3	1.9	10.0	2EHS*MCC303D
2RHS*P2	RHR system pressure pump	Y	10 hp	575	3	10.3	51	2EHS*MCC303D
2EJA*PNL100A	Reactor building 120-V heater panel	G	150 A	208	3	83.0	-	2EJA*XD100A
2EJA*PNL101A	Control building 120/240-V heater panel	G	150 A	240	1	104.0	-	2EJA*XD101A
2EJA*PNL300B	Reactor building 120-V heater panel	Y	150 A	208	3	83.0	-	2EJA*XD300B
2EJA*PNL301B	Control building 120/240-V heater panel	Y	150 A	240	1	104.0	-	2EJA*XD301B
2BYS*CHGR2A2	125-V battery charger	G	300 A dc	575	3	76	-	2EJS*PNL100A
2EJA*XD100A	Distribution transformer 600V-208Y/120-V	G	30 kVA	600	3	30.0	-	2EJS*PNL100A
2EJA*XD101A	Distribution transformer 600V-120/240-V	G	25 kVA	600	1	43.40	-	2EJS*PNL100A
2EJS*PNL102A	Switchgear room A emergency 600-V panel	G	400 A	600	3	100	-	2EJS*PNL100A
2HVC*CH11A	Control building equipment room 306 heater	G	60 kW	575	3	60.30	-	2EJS*PNL100A
2HVC*CH12A	Control building equipment room 288	G	40 kW	575	3	40.20	-	2EJS*PNL100A

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2SCV*XD101A	Distribution transformer 600-V-120/240-V	G	25 kVA	600	1	43.40	-	2EJS*PNL100A
2VBA*UPS2A	Div. 1A control UPS	G	25 kVA	575	3	76.00	-	2EJS*PNL100A
2VBA*UPS2C	Div. 1A control UPS	G	25 kVA	575	3	50.9	-	2EJS*PNL100A
2HVR*UC401A	Reactor building space cooler el 175'	G	2 hp	575	3	2.5	16.0	2EJS*PNL101A
2HVR*UC401D	Reactor building space cooler el 175'	G	2 hp	575	3	2.5	16.0	2EJS*PNL101A
2HVR*UC402A	Reactor building space cooler el 175'	G	10 hp	575	3	11.20	78.40	2EJS*PNL101A
2HVR*UC402B	Reactor building space cooler el 175'	G	10 hp	575	3	11.20	78.40	2EJS*PNL101A
2HVR*UC404A	Reactor building space cooler el 196'	G	3 hp	575	3	3.60	36.00	2EJS*PNL101A
2HVR*UC404B	Reactor building space cooler el 196'	G	3 hp	575	3	3.60	25	2EJS*PNL101A
2HVR*UC414A	Reactor building space cooler el 175'	G	3 hp	575	3	3.36	25.00	2EJS*PNL104A
2HVC*XD2A	Spec filter train electric heater	G	15 kVA	575	3	15	-	2EJS*PNL102A
2HVC*UC101A	Standby switchgear room A unit cooler	G	7.5 hp	575	3	8.5	45.7	2EJS*PNL102A
2HVC*UC103A	Chloride room unit cooler	G	1 hp	575	3	1.24	10.5	2EJS*PNL102A
2HVC*UC104	Control building cable tunnel unit cooler	G	15 hp	575	3	15.0	84	2EJS*PNL102A
2HVC*UC106	Cable area base unit cooler	G	15 hp	575	3	15.0	84	2EJS*PNL102A
2HVP*UC1A	DG 1 unit cooler standby DG room	G	5 hp	575	3	5.44	39.20	2EJS*PNL102A
2HVR*UC405	Reactor building space cooler el 198'	G	3 hp	575	3	3.72	23.1	2EJS*PNL103A
2HVR*UC407A	Reactor building space cooler el 215'	G	1.5 hp	575	3	1.85	12.4	2EJS*PNL103A
2HVR*UC407B	Reactor building space cooler el 215'	G	1.5 hp	575	3	1.85	12.4	2EJS*PNL103A
2HVR*UC407C	Reactor building space cooler el 215'	G	1.5 hp	575	3	1.85	12.6	2EJS*PNL103A
2HVR*UC415A	SGT space cooler el 261'	G	2 hp	575	3	2.2	16.80	2EJS*PNL103A
2HVC*CAB18A	Cont/relay rooms intake radn	G	1.5 hp	575	3	1.8	10.50	2EJS*PNL102A

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2HVC*CAB18C	Cont/relay rooms intake radn	G	1.5 hp	575	3	1.8	10.50	2EJS*PNL102A
2GTS*XD1A	Filter train A heater	G	20 kW	575	3	20.0	-	2EJS*PNL104A
2HVR*UC408A	Reactor building space cooler el 240'	G	5 hp	575	3	5.68	36.70	2EJS*PNL104A
2HVR*UC408B	Reactor building space cooler el 240'	G	5 hp	575	3	5.68	36.70	2EJS*PNL104A
2HVR*UC410A	Reactor building space cooler el 240'	G	1.5 hp	575	3	1.85	12.40	2EJS*PNL104A
2HVR*UC411A	Reactor building space cooler el 261'	G	3 hp	575	3	3.36	25	2EJS*PNL104A
2HVR*UC412A	Reactor building space cooler el 261'	G	3 hp	575	3	3.0	25	2EJS*PNL101A
2BYS*CHGR2B2	125-V battery charger	Y	300 A dc	575	3	76	-	2EJS*PNL300B
2EJA*XD300B	Distribution transformer 600-V-208Y/120-V	Y	30 kVA	600	3	30	-	2EJS*PNL300B
2EJA*XD301B	Distribution transformer 600-V-120/240-V	Y	25 kVA	600	1	43.40	-	2EJS*PNL300B
2EJS*PNL301B	Switchgear room B emergency 600-V panel	Y	400 A	600	3	100	-	2EJS*PNL300B
2HVC*CH11B	Control building equipment room 306 heater	Y	60 kW	575	3	60.30	-	2EJS*PNL300B
2HVR*CAB14A	Reactor building above refuel floor radn	G	1.5 hp	575	3	1.8	10.00	2EJS*PNL104A
2HVR*CAB32A	Reactor building below refuel floor radn	G	1.5 hp	575	3	1.8	10.00	2EJS*PNL104A
2SWP*CAB146B	Service water effluent radiation monitor	Y	1.5 kW	575	3	1.84	-	2EJS*PNL301B
2HVC*PNLCH12B	Control building equipment room	Y	40 kW	575	3	40.20	-	2EJS*PNL300B
2SCV*XD301B	Distribution transformer 600-V-120/240-V	Y	25 kVA	600	1	43.40	-	2EJS*PNL300B
2VBA*UPS2B	Div. IIA control UPS	Y	25 kVA	575	3	76.00	-	2EJS*PNL300B
2VBA*UPS2D	Div. IIA control UPS	Y	25 kVA	575	3	50.9	-	2EJS*PNL300B
2HVC*XD2B	Transformer 600V-480V	Y	15 kVA	575	3	15	-	2EJS*PNL301B
2HVC*UC101B	Standby switchgear room B unit cooler	Y	7.5 hp	575	3	8.5	45.7	2EJS*PNL301B

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2HVC*UC103B	Chloride room unit cooler	Y	1 hp	575	3	1.24	10.5	2EJS*PNL301B
2HVC*UC105	Control building cable tunnel unit cooler	Y	5 hp	575	3	5.4	35	2EJS*PNL301B
2HVC*UC107	Cable area base unit cooler	Y	15 hp	575	3	15.0	84	2EJS*PNL301B
2HVC*UC108B	Control building standby switchgear room B	Y	10 hp	575	3	10.80	64.3	2EJS*PNL301B
2HVP*UC1B	DG 3 unit cooler standby DG room	Y	5 hp	575	3	5.44	39.20	2EJS*PNL301B
2HVR*UC401B	Reactor building space cooler el 175'	Y	2 hp	575	3	2.5	17.10	2EJS*PNL302B
2HVR*UC401C	Reactor building space cooler el 175'	Y	2 hp	575	3	2.5	16	2EJS*PNL302B
2HVR*UC401E	Reactor building space cooler el 175'	Y	2 hp	575	3	2.5	16	2EJS*PNL302B
2HVC*CAB18B	Cont/relay rooms intake radn	Y	1.5 hp	575	3	1.8	10.5	2EJS*PNL301B
2HVC*CAB18D	Cont/relay rooms intake radn	Y	1.5 hp	575	3	1.8	10.5	2EJS*PNL301B
2HVR*UC401F	Reactor building space cooler el 175'	Y	2 hp	575	3	2.5	16	2EJS*PNL302B
2HVR*UC404C	Reactor building space cooler el 196'	Y	3 hp	575	3	3.36	25	2EJS*PNL302B
2HVR*UC404D	Reactor building space cooler el 196'	Y	3 hp	575	3	3.36	25	2EJS*PNL302B
2HVR*UC414B	Reactor building space cooler el 175'	Y	3 hp	575	3	3.36	25.00	2EJS*PNL304B
2HVR*UC406	Reactor building space cooler el 198'	Y	2 hp	575	3	2.4	15.7	2EJS*PNL303B
2HVR*UC407D	Reactor building space cooler el 215'	Y	1.5 hp	575	3	1.85	12.6	2EJS*PNL303B
2HVR*UC407E	Reactor building space cooler el 215'	Y	1.5 hp	575	3	1.85	12.6	2EJS*PNL303B
2HVR*UC415B	SGT space cooler el 261'	Y	2 hp	575	3	2.2	16.80	2EJS*PNL303B
2GTS*XD1B	Filter train B heater	Y	20 kW	575	3	20.0	-	2EJS*PNL304B
2HVR*UC409A	Reactor building space cooler el 240'	Y	5 hp	575	3	5.68	34.20	2EJS*PNL304B
2HVR*UC409B	Reactor building space cooler el 240'	Y	5 hp	575	3	5.68	34.2	2EJS*PNL304B

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2HTS*XD004	Heat tracing transformer	Y	25 kVA	575	1	43.40	-	2EJS*PNL302B
2HTS*XD003	Heat tracing transformer	Y	25 kVA	575	1	43.40	-	2EJS*PNL302B
2HVR*UC410B	Reactor building space cooler el 240'	Y	1.5 hp	575	3	1.85	12.40	2EJS*PNL304B
2HVR*UC410C	Reactor building space cooler el 240'	Y	1.5 hp	575	3	1.85	12.60	2EJS*PNL304B
2HVR*UC411B	Reactor building space cooler el 261'	Y	3 hp	575	3	3.36	25	2EJS*PNL304B
2HVR*UC411C	Reactor building space cooler el 261'	Y	3 hp	575	3	3.36	25	2EJS*PNL304B
2HVR*UC412B	Reactor building space cooler el 261'	Y	3 hp	575	3	3.36	25	2EJS*PNL302B
2EHS*MCC101	600-V MCC screenwell el 261'	G	600 A	600	3	600	-	2EJS*US1
2EHS*MCC102	600-V MCC reactor building el 240'	G	600 A	600	3	600	-	2EJS*US1
2EHS*MCC103	600-V MCC control building el 240'	G	600 A	600	3	600	-	2EJS*US1
2EJS*PNL100A	Switchgear room A emergency 600-V panel	G	600 A	600	3	600	-	2EJS*US1
2HCS*PNL22A	Hydrogen recombiner power cabinet	G	120 kW	575	3	120	-	2EJS*US1
2HVK*CHL1A	Control building chiller 1A	G	160 kW	575	3	183	725	2EJS*US1
2HVR*UC413A	Reactor building unit cooler A	G	150 hp	575	3	140	782.40	2EJS*US1
2LAC*PNL100A	Control room A emergency lighting panel	G	400 A	600	3	400	-	2EJS*US1
2EHS*MCC301	600-V MCC screenwell el 261'	Y	600 A	600	3	600	-	2EJS*US3
2EHS*MCC302	600-V MCC reactor building el 240'	Y	600 A	600	3	600	-	2EJS*US3
2EHS*MCC303	600-V MCC control building el 261'	Y	600 A	600	3	600	-	2EJS*US3
2EJS*PNL300B	Switchgear room B emergency 600-V panel	Y	600 A	600	3	600	-	2EJS*US3
2HCS*PNL22B	Hydrogen recombiner power cabinet	Y	120 kW	575	3	120	-	2EJS*US3
2HVK*CHL1B	Control building chiller 1B	Y	160 kW	575	3	183	725.00	2EJS*US3
2HVK*UC413B	Reactor building unit cooler B	Y	150 hp	575	3	140	782.4	2EJS*US3

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2LAC*PNL300B	Control room B emergency lighting panel	Y	400 A	600	3	400	-	2EJS*US3
2EHS*MCC201	600-V MCC HPCS switchgear room	P	600 A	600	3	600	-	2EJS*X2
2CSL*P1	LPCS pump	G	1,500 hp	4,000	3	187.0	1,216	2ENS*SWG101
2EJS*US1	600-V US emergency switchgear room A	G	1,600 A	600	3	962	-	2ENS*SWG101
2RHS*P1A	RHR pump A	G	1,000 hp	4,000	3	126	820	2ENS*SWG101
2SFC*P1A	SFC water circulating pump A	G	450 hp	4,000	3	56	329	2ENS*SWG101
2SWP*P1A	Service water pump A	G	600 hp	4,000	3	77.2	447	2ENS*SWG101
2SWP*P1C	Service water pump C	G	600 hp	4,000	3	76	447	2ENS*SWG101
2SWP*P1E	Service water pump P1E	G	600 hp	4,000	3	76	447	2ENS*SWG101
2CSH*P1	HPCS pump	P	3,050 hp	4,000	3	378	2,457	2ENS*SWG102
2EJS*X2	4160/600-V HPCS transformer	P	225 kVA	4,160	3	31.0	-	2ENS*SWG102
2EJS*US3	600-V emergency switchgear room B	Y	1,600 A	600	3	962	-	2ENS*SWG103
2RHS*P1B	RHR pump B	Y	1,000 hp	4,000	3	126	820	2ENS*SWG103
2RHS*P1C	RHR pump C	Y	1,000 hp	4,000	3	126	820	2ENS*SWG103
2SFC*P1B	SFC water circulating pump B	Y	450 hp	4,000	3	56	329	2ENS*SWG103
2SWP*P1B	Service water pump B	Y	600 hp	4,000	3	76	447	2ENS*SWG103
2SWP*P1D	Service water pump D	Y	600 hp	4,000	3	76	447	2ENS*SWG103
2SWP*P1F	Service water pump P1F	Y	600 hp	4,000	3	76	447	2ENS*SWG103
2EPS*SWG002	Emergency switchgear	Y	1,200 A	13.8 kV	3	1200	-	2EPS*SWG001

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2EPS*SWG004	Emergency switchgear	Y	1,200 A	13.8 kV	3	1200	-	2EPS*SWG003
2BYS*CHGR2A1	125-V battery charger Div. I	G	300 A dc	575	3	76	-	2LAC*PNL100A
2LAC*XLE01	Lighting transformer 600-208Y/120-V	G	30 kVA	600	3	30.0	-	2LAC*PNL100A
2LAC*XLE04	Lighting transformer 600-208Y/120-V	G	30 kVA	600	3	30.0	-	2LAC*PNL100A
2LAC*XLE06	Lighting transformer 600-208Y/120-V	G	30 kVA	600	3	30	-	2LAC*PNL100A
2SCM*XD101A	Distribution transformer 600-120/240-V	G	25 kVA	600	1	43.40	-	2LAC*PNL100A
2SCM*XD102A	Distribution transformer 600-120/240-V	G	25 kVA	600	1	43.40	-	2LAC*PNL100A
2SCM*XD103A	Distribution transformer 600-120/240-V	G	25 kVA	600	1	43.40	-	2LAC*PNL100A
2VBA*UPS2A	Div. IA control UPS	G	25 kVA	575	1	68.00	-	2LAC*PNL100A
2BYS*CHGR2B1	125-V battery charger standby Div. II	Y	300 A dc	575	3	76	-	2LAC*PNL300B
2LAC*XLE02	Lighting transformer 600-208Y/120-V	Y	30 kVA	600	3	30.0	-	2LAC*PNL300B
2LAC*XLE05	Lighting transformer 600-208Y/120-V	Y	30 kVA	600	3	30.0	-	2LAC*PNL300B
2LAC*XLE07	Lighting transformer 600-208Y/120-V	Y	30 kVA	600	3	30	-	2LAC*PNL300B
2SCM*XD301B	Distribution transformer 600-V-120/240-V	Y	25 kVA	600	1	43.40	-	2LAC*PNL300B
2SCM*XD104A	Distribution transformer	G	25 kVA	600	1	43.40	-	2LAC*PNL100A
2SCM*XD105A	Distribution transformer	G	25 kVA	600	1	43.40	-	2LAC*PNL100A
2SCM*XD302B	120-V distribution panel	Y	25 kVA	600	1	43.40	-	2LAC*PNL300B
2SCM*XD303B	120-V distribution panel	Y	25 kVA	600	1	43.40	-	2LAC*PNL300B
2VBA*UPS2B	Div. IIA control UPS	Y	25 kVA	575	1	68.00	-	2LAC*PNL300B
2LAC*PNLE01	Lighting panel	G	100 A	208	3	100 A	-	2LAC*XLE01

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2LAC*PNLE02	Lighting panel	Y	100 A	208	3	100 A	-	2LAC*XLE02
2LAC*PNLE04	Lighting panel	G	100 A	208	3	100 A	-	2LAC*XLE04
2LAC*PNLE05	Lighting panel	Y	100 A	208	3	100 A	-	2LAC*XLE05
2LAC*PNLE06	Lighting panel	G	100 A	208	3	100 A	-	2LAC*XLE06
2LAC*PNLE07	Lighting panel	Y	100 A	208	3	100 A	-	2LAC*XLE07
2LAC*PNLE03	Lighting panel	P	100 A	208	3	100 A	-	2LAC*XLE03
2SCM*XD304B	120-V distribution transformer	Y	25 kVA	600	1	43.40	-	2LAC*PNL300B
2SCM*XD305B	120-V distribution transformer	Y	25 kVA	600	1	43.40	-	2LAC*PNL300B
2RCS*MOV10A	Recirculation pump A suction valve	N	4 hp	575	3	5.6	47.80	2NHS-MCC011
2RCS*MOV18A	Recirculation pump A discharge valve	N	2.6 hp	575	3	4.7	30	2NHS-MCC011
2WCS*MOV101	RCS to water cleanup	N	0.70 hp	575	3	1.80	9.00	2NHS-MCC011
2WCS*MOV103	RCS to water cleanup	N	1.6 hp	575	3	3.2	16	2NHS-MCC011
2WCS*MOV104	RCS to water cleanup	N	0.7 hp	575	3	1.9	10.0	2NHS-MCC011
2WCS*MOV105	RCS to water cleanup	N	0.7 hp	575	3	1.8	9.0	2NHS-MCC011
2DER*MOV128	RPV drain isol. valve	N	0.33 hp	575	3	0.64	4.5	2NHS-MCC012
2DER*MOV129	RPV drain isol. valve	N	0.33 hp	575	3	0.64	4.5	2NHS-MCC012
2MSS*MOV108	Vent valve	N	0.33 hp	575	3	0.64	4.5	2NHS-MCC012
2MSS*MOV189	Main steam valve	N	0.33 hp	575	3	0.64	4.5	2NHS-MCC012
2MSS*MOV207	Main steam valve	N	hp	575	3	3.2	20.0	2NHS-MCC012
2RCS*MOV10B	Recirculation pump B suction valve	N	2.6 hp	575	3	4.7	30	2NHS-MCC012
2RCS*MOV18B	Recirculation pump B discharge valve	N	4 hp	575	3	6.0	38.0	2NHS-MCC012
2MHR*CRN1	Reactor building polar crane motor el 387'	N	-	575	3	117	-	2NJS-US2

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2ENS*SWG102	4160-V HPCS switchgear 102	P	1,200 A	4,160	3	1200	-	2NNS-SWG16/17
2ENS*SWG101	4160-V emergency switchgear 101	G	1,200 A	4,160	3	1200	-	2NNS-SWG16/18
2ENS*SWG103	4160-V emergency switchgear 102	Y	1,200 A	4,160	3	1200	-	2NNS-SWG17/18
2EPS*SWG001	Emergency switchgear	G	1,200 A	13.8 kV	3	1200	-	2NPS-SWG001
2EPS*SWG003	Emergency switchgear	G	1,200 A	13.8 kV	3	1200	-	2NPS-SWG003
2SCV*PNL101A	GTS misc. 120/240-V panel	G	150 A	240	1	104	-	2SCV*XD101A
2SCV*PNL200P	HPCS switchgear room 120-V misc. panel	P	225 A	240	1	104	-	2SCV*XD200P
2SCV*PNL301B	GTS misc. 120/240-V panel	Y	150 A	240	1	104	-	2SCV*XD301B
2VBS*PNL101A	120-V UPS distribution panel	G	200 A	120	1	104	-	2VBA*UPS2A/2C
2VBS*PNL102A	120-V UPS distribution panel	G	200 A	120	1	104	-	2VBA*UPS2A/2C
2VBS*PNL301B	120-V UPS distribution panel	Y	200 A	120	1	104	-	2VBA*UPS2B/2D
2VBS*PNL302B	120-V UPS distribution panel	Y	200 A	120	1	104	-	2VBA*UPS2B/2D
2HTS*XD001	Heat tracing transformer	G	25 kVA	575	1	43.40	-	2EJS*PNL103A
2HTS*XD002	Heat tracing transformer	G	25 kVA	575	1	43.40	-	2EJS*PNL103A
2SWP*CAB146A	Service water effluent radiation monitor	G	1.5 hp	575	3	1.84	-	2EJS*PNL102A
2GTS*PNL5A	Reactor building in/out diff press	G	1.5 hp	575	1	3.0	-	2EJS*PNL103A
2CMS*CAB10A	Containment atmosphere leakage radn	G	1.5 hp	575	3	1.8	10.0	2EJS*PNL104A
2SWP*CAB23A	RHR service water A radiation monitor	G	1.5 kW	575	3	1.84	10.0	2EJS*PNL104A
2CMS*CAB10B	Containment atmosphere leakage radn	Y	1.5 hp	575	3	1.8	10.0	2EJS*PNL303B
2HVR*CAB14B	Reactor building above refuel floor radn	Y	1.5 hp	575	3	1.8	10.0	2EJS*PNL303B
2HVR*CAB32B	Reactor building below refuel floor radn	Y	1.5 hp	575	3	1.8	10.0	2EJS*PNL303B

TABLE 8.3-4 (Cont'd.)

Equipment Identity No.	Description[1]	Division[2]	Rating	Volts	Phase	Amps Full Load[3]	Amps Locked Rotor[3]	Power Source Identity No.
2GTS*PNL5B	Reactor building in/out diff press	Y	1.5 hp	575	3	3.0	-	2EJS*PNL303B
2SWP*CAB23B	RHR service water B radiation monitor	Y	1.5 kW	575	3	1.84	10.0	2EJS*PNL303B

(1) KEY TO DESCRIPTION:

A/C = Air conditioning
CWS = Circulating water system
DG = Diesel generator
GTS = Gas treatment system
HPCS = High-pressure core spray
HVR = Reactor building ventilation
LPCS = Low-pressure core spray
MCC = Motor control center
MSIV = Main steam isolation valve
PIT = Pressure indicator transmitter
RBCLCW = Reactor building closed loop cooling water
RCIC = Reactor core isolation cooling
RHR = Residual heat removal
RPS = Reactor protection system
RWCU = Reactor water cleanup
SFC = Spent fuel cooling and cleanup
SFP = Spent fuel pool
SGTS = Standby gas treatment system
SWT = Service water traveling screens, wash and disposal
TBCLCW = Turbine building closed loop cooling water
UPS = Uninterruptible power supply

(2) KEY TO DIVISION:

G = Green (Division I - ECCS, HVAC, SWP, etc. D1-RPS, NMS, NSSSS Ch-1, D1-MSLIV)
Y = Yellow (Division II - ECCS, HVAC, SWP,etc. D2-RPS, NMS, NSSSS Ch-1, D2-MSLIV)
P = Purple (Division III - ECCS (HPCS))
O = Orange (D3-RPS, NMS, NSSS)
B = Blue (D4-RPS, NMS, NSSSS)
G/W = Green/White (Ch-2, D1-MSLIV, Ch-A1, D1-RPS trip)
Y/W = Yellow/White (Ch-2, D2-MSLIV, Ch-B1, D2-RPS trip)
N = Noncolor (Nonsafety systems)
B/W = Blue/White (Ch-B2, D4-RPS trip)
O/W = Orange/White (Ch-A2, D3-RPS trip)

(3) Columns "Amps Full Load" and "Amps Locked Rotor" for motors reflect original equipment rating. All replacement components are one-to-one replacements in regards to form, fit and function. Replacement equipment nameplate data for the columns mentioned above may vary slightly as the manufacturer incorporates latest design innovations without compromising form, fit and function of the equipment.

TABLE 8.3-5

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TABLE 8.3-6

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TABLE 8.3-6a

ANNUNCIATOR WINDOWS FOR THE DIESEL GENERATORS DISPLAYED IN CONTROL ROOM

Alarm Window	Window Description	Alarm Input Signal	
852102	Emerg. DG. 1 Fuel Sys Inop	74-2EGFA04	Fuel Sys Inop
852101	Emerg. DG. 1 Start Sys Inop	74-2EGAA05	Air Start Sys Inop
852110	Emerg. DG. 1 Fuel Sys Trouble	2EGF-FIS13A & 62X-2EGFA05	F.O. Xfr Pump P1A/P1C Lo Flow
		2EGF*LS8A	Day Tk Lvl H
		2EGF*LS12A	Stor Tk Lvl H/L
		2EGF-PDIS20A	F.O. STR1A Diff Press H
		2EGF-PDIS20C	F.O. STR1C Diff Press H
		49X-2EGFA01	Pmp Motor Overload
		49X-2EGFA02	Pmp Motor Overload
852109	Emerg. DG. 1 Start Sys Trouble	2EGA*PS22A	TK1A Press H
		2EGA*PS21A	TK2A Press H
		49X-2EGAA01	CPRSR Motor Overload
		49X-2EGAA02	CPRSR Motor Overload
		30-7038	RCVR No. 1 Air Press Lo
		30-7039	RCVR No. 2 Air Press Lo
		30-7099	CPRSRS Trbl
852141	Emerg. DG. 1 Maint Mode	30-7130	Key Lock OFF Posn Maint Mode
852118	Emerg. DG. 1 Svce Wtr Inlet Press Lo	2SWP*PSLX66A	Inlet Press Lo
852133	Emerg. DG. 1 Overvoltage	30-7042	Gen. Overvoltage
852111	Emerg. DG. 1 Elec Sys Trbl/Trip	30-7047	DC Control Power Fail
		30-7049	Control Main. Posn./Inop
		30-7027	Gl Sequence Incomplete
		30-7023	Blown Pt Fuse
		30-7018	Voltage Controlled OC
852125	Emerg. DG. 1 Overspeed Trip	30-7124	Engine Overspeed
852119	Emerg. DG. 1 Control Pwr Failure	74-2EGPX01	Diff. Ckt Power Failure
		74-2EGPX02	Prot. Ckt Power Failure
852134	Emerg. DG. 1 Shutdown Mech. Failure	30-7128	Deleted
		30-7015	Turb Thrust Brg Fail
		30-7011	Engine Lube Oil Press Lo
		30-7012	Turb Lube Oil Press Lo
		30-7013	Rod Brg Temp Hi
		30-7016	Jkt Wtr Temp Hi
852142	Emerg. DG. 1 Mechanical Failure	30-7031	Crankcase Level Lo
		30-7044	Jkt Wtr Lvl Off Norm
		30-7045	Day Tk Lvl Off Norm
		30-7034	Jkt Wtr Press Lo
		30-7036	Fuel Oil Press Lo

TABLE 8.3-6a (Cont'd.)

Alarm Window	Window Description	Alarm Input Signal	
852142 (Cont'd.)		30-7037	Filters Diff Press Hi
		30-7029	Engine Lo Press
		30-7035	Circ Pmp Lo Press
		30-7040	Stg Air Press Lo
		30-7043	Crankcase Press Hi
		30-7030	Lube Oil Temp Off Norm
		30-7033	Jkt Wtr Temp Off Norm
		30-7170	Jkt Wtr LP Circ Pmp Press Lo
		30-7028	Lube Oil Temp High
852103	Emerg. DG. 1 System Inop	74X-2ENSA27	Ens Div I Sys Inop
852112	Emerg. DG. 1 Bkr 101-1 Auto Trip/FTC	52&52A-2EGPX07	Bkr 101-1 Auto Trip/FTC
852117	Emerg. DG. 1 Running	52CP-2EGSA14	Running
852120	Emerg. DG. 1 Bkr 101-N1 Auto Trip	52&1A-2EGPX06	Bkr 101-N1 Auto Trip
852126	Emerg. DG. 1 Serv Wtr Flow Low	2SWP*FSLX76A	Service Wtr Flow Lo
852127	Emerg. DG. 1 Prot Lo Relay Trip	94-2EGPX06	BU Gnd OC
		30-7172	Diff Relay Trip
		30-7174	Reverse Pwr Trip
852135	Emerg. DG. 1 Field Gnd Fault	30-7120	Field Gnd Fault
852136	Emerg. DG. 1 LOCA BYP Sw On	43LB-2ENSX04	LOCA Byp Sw On
852144	Emerg. DG. 1 LOCA Test Sw On	1LT-2ENSX04	LOCA Test Sw On

NOTES:

a. Window descriptions and alarm inputs for Diesel Generator 1 are shown above. Window descriptions and alarm inputs for diesel generators are similar.

b. Diesel Generator 2, Div. 3, low fuel oil level in day tank will indicate Diesel Generator 2 system inoperable.

Low starting air pressure condition will indicate Div. 3 Diesel Generator 2 start system trouble.

Diesel engine conditions annunciated as an "Engine Trouble Alarm" in the control room normally occur only while the engine is in running mode. During engine standby mode, "low fuel oil level in day tank" or "low starting air pressure" conditions will initiate "Engine Trouble Alarm" in the control room to alert the Operator of an abnormal situation. The operator is required to take necessary action to ensure that proper fuel supply or adequate air supply to the diesel engine is available.

The fuel oil day tank is backed by a 7-day storage tank. The diesel generator starting air supply system has two redundant trains; either train can start the diesel engine. Therefore, even if one tank is at low pressure, adequate starting capability is still available through the redundant air supply train.

TABLE 8.3-7

CABLE SERVICE LEVELS AND TRAY FILL REQUIREMENTS

Tray ID	Voltage (V)	Conductors		Tray Depth (in)	Maximum Tray Fill	Inside Radius (in)	Remarks
		Size	Service				
J	4,161 and above	All	Power	3	1 Layer	36	Maintained spacing[1] Conductors produce heat from I^2R losses
H	601 to 4,160	All	Power	3	1 Layer	36	Maintained spacing[1] Conductors produce heat from I^2R losses
L	600 ac and 125 dc	No. 6 AWG copper and larger	Power	3	1 Layer	24	Maintained spacing[1] Conductors produce heat from I^2R losses
K[2]	600 ac and 125 dc	No. 2 AWG copper and smaller[3]	Misc. Services	4	50%[4]	24	No conductor I^2R loss heating (Type 1) or Sized in accordance with IPCEA Publication No. P-54-440 (Type 2)
C	120-240 ac 125 dc	As required	Control and alarm	4	50%[4]	24	600- or 1,000-V insulation
X	Low level	As required	Instrument communication, etc.	4	50%[4]	24	Generally shielded cables

NOTE: All trays will be 12, 18, 24 or 30 in wide.

(1) For maintained spacing of 0.25 to 1.0 cable diameter on both sides of each cable in a tray, use IPCEA Publication No. P-46-426 derating Table VII, Line 1. (Cable schedule programs calculate fill on 0.50 diameter spacing). For maintained spacing of greater than 1 cable diameter on both sides of each cable in a tray, no derating is required.
(2) K tray cables may be composed of any one or both of the two types. Only Type 2 cable needs to have derating factor applied.
(3) No. 3/0 AWG copper and smaller may be run in K tray for MOVs only.
(4) Or, as approved by the engineers, giving due consideration to derating and tray support loading.

TABLE 8.3-8

DIVISION I 125-V DC BATTERY 2BYS*BAT2A
LOAD PROFILE

Description of Load	0-1 Minute (amp)	1-119 Minutes (amp)	119-120 Minutes (amp)
4.16-kV switchgear and 600-V load centers	53.28[(1)]	-	-
Diesel generator field flashing (2BYS*PNL204A)	60[(1)]	-	-
Motor-operated valves (RCIC)	397.5	-	-
Miscellaneous control load	0.84	0.84	0.84
DC Panels			
2BYS*PNL201A	44.53	44.53	44.53
2BYS*PNL202A	9.00	9.00	9.00
2BYS*PNL204A	28.00	28.00	28.00
UPS system 2VBA*UPS2A	131.38	131.38-157.39	157.39
UPS system 2VBA*UPS2C	41.33	41.33-49.51	49.51
Random load	-	-	136[(2)]
Motor-operated valves (RCIC)	-	-	232.6
Total	766	256-290	658

(1) The motor-operated valve starting and field flashing currents (413.4 + 60 = 473.4 amps) occur approximately 1 sec after the beginning of the load cycle and do not last for the full first minute. The tripping amps for the 4.16-kV and 600-V breakers (49.92 + 3.36 = 53.28 amps)

TABLE 8.3-8 (Cont'd.)

occur during the first second of the load cycle. For calculating the first-minute load on the battery, motor starting currents are assumed to occur for the entire first minute and breaker tripping currents are omitted. This gives a more severe load profile and therefore is justified.

(2) It is assumed that the two 4.16-kV circuit breakers close simultaneously and randomly; this is considered a random load and is applied at the worst section of the load profile, which is the last minute in this case.

TABLE 8.3-9

DIVISION II 125-V DC BATTERY 2BYS*BAT2B
LOAD PROFILE

Description of Load	0-1 Minute (amp)	1-119 Minutes (amp)	119-120 Minutes (amp)
4.16-kV switchgear and 600-V load centers	53.28	-	-
Diesel generator field flashing (2BYS*PNL204B)	60	-	-
Miscellaneous control load	0.84	0.84	0.84
DC Panels			
2BYS*PNL201B	13.75	13.75	13.75
2BYS*PNL202B	8.40	8.40	8.40
2BYS*PNL204B	28.00	28.00	28.00
UPS system 2VBA*UPS2B	121.66	121.66-145.75	145.75
UPS System 2VBA*UPS2D	41.33	41.33-49.51	49.51
Random load	-	-	136(1)
Motor-operated valve 2ICS*MOV148	-	-	15.9
Total	328	214-247	399

(1) It is assumed that the two 4.16-kV circuit breakers close simultaneously and randomly; this is considered a random load and is applied at the worst section of the load profile, which is the last minute in this case.

TABLE 8.3-10

DIVISION III 125-V DC BATTERY 2BYS*BAT2C
LOAD PROFILE

A. Normal Load

Description of Load	0-1 Minute (amp)	1-120 Minutes (amp)
Lube oil circulating pump*	6.9	-
and control circuit	0.2	-
4.16-kV switchgear (one breaker closing)	14.0	-
4.16-kV switchgears control relays/indications	2.1	2.1
Relays and indicator lamps in diesel generator panels	0.21	0.21
Solenoid valves (diesel air start)	2.0	-
control relays, lights, solenoid governor	1.88	1.88
Diesel generator fuel pump	6.3	6.3
control relays	0.21	0.21
Turbocharger lube oil pump*	7.4	-
Diesel generator field flashing	2.0	-
Relays and indicator lamps in main control room panels (2CEC*PNL625)	1.0	1.0
Division III transient analysis recorder system local panel (2CES*PNL520), power supplies, valve position indicator	1.75	1.75

TABLE 8.3-10 (Cont'd.)

Description of Load	0-1 Minute (amp)	1-120 Minutes (amp)
Division III inop aux relays and optical isolator	2.06	2.06
Total	48.01**	15.6

* These pumps run only during loss of ac power at E22-S002 (HPCS motor control center) when the ac pump motors are not running.

** Based on the discrete sequence loading on this battery for the 0-1 min interval, the maximum load at any instant is 98.01 amps.

TABLE 8.3-11

NORMAL 125-V DC BATTERY 2BYS-BAT1A
LOAD PROFILE

Description of Load	0-1 Minute (amp)	1-45 Minutes (amp)	45-119 Minutes (amp)	119-120 Minutes (amp)
Circuit breaker trip	298.74	-	-	-
Indicating lights for switchyard and normal 13.8-kV, 4.16-kV, and dc switchgear	13.87	13.87	13.87	13.87
Misc. control and instrumentation loads	64	64	64	64
Essential lighting & communication (2VBB-UPS1C)	492	492-529	529-590	590
Normal UPS system (2VBB-UPS1A)	327	327-352	352-392	392
Bearing lube oil pump	691	207-222	-	-
Standby diesel generator fuel pump	30[1]	7.5-8.1	8.1-9.1	9.1
Random loads (1 min)	-	-	-	114
Total	1917	1112-1189	967-1069	1183

[1] 30-amp locked rotor used for first minute load only.

TABLE 8.3-12

NORMAL 125-V DC BATTERY 2BYS-BAT1B
LOAD PROFILE

Description of Load	0-1 Minute (amp)	1-119 Minutes (amp)	119-120 Minutes (amp)
Circuit breaker trip	294.64	-	-
Indicating lights for switchyard and normal 13.8-kV, 4.16-kV, and dc switchgear	18.54	18.54	18.54
Misc. control and instrumentation loads	63.55	63.55	63.55
Essential lighting (2VBB-UPS1D)	492	492-590	590
Normal UPS system (2VBB-UPS3B)	47.5	47.5-56.9	56.9
Emergency seal oil pump	375	142-173	173
Turbine gland seal compressor	145	58-74	74
Standby diesel generator fuel pump	30[1]	7.5-9.1	9.1
Energy management system remote terminal unit (EMS RTU)	5	5	5
Random loads (1 min)	-	-	179
Total	1472	835-991	1170

[1] 30-amp locked rotor used for first minute only.

TABLE 8.3-13

NORMAL 125-V DC BATTERY 2BYS-BAT1C
LOAD PROFILE

Description of Load	0-1 Minute (amp)	1-119 Minutes (amp)	119-120 Minutes (amp)
Plant computer UPS system (2VBB-UPS1G) normal system UPS 2VBB-UPS1B and RPS UPS 2VBB-UPS3A	638	638-766	766
Total	638	638-766	766

TABLE 8.3-14

NORMAL 24-V BATTERY 2BWS-BAT3A AND 3C
LOAD PROFILE

Description of Load	0-240 Minutes (amp)
Neutron monitoring	10.0-11.43
Total	10.0-11.43

TABLE 8.3-15

NORMAL 24-V BATTERY 2BWS-BAT3B AND 3D
LOAD PROFILE

Description of Load	0-240 Minutes (amp)
Neutron monitoring	10.0-11.43
Total	10.0-11.43

APPENDIX 8A

FLEXIBLE CONDUIT AND FIRE RETARDANT TAPE AS SEPARATION BARRIERS

APPENDIX 8A

FLEXIBLE CONDUIT AND FIRE-RETARDANT TAPE AS SEPARATION BARRIERS

8A.1 INTRODUCTION

Flexible steel conduit as a separation barrier

The testing has demonstrated that the electrical short circuit in a #10 AWG, tefzel insulated wire circuit, supported by a continuous source of dc current ranging from 0 to 140 amps, within a flexible steel conduit, cannot cause electrical fire of sufficient magnitude and induce thermal energy migration through a flexible steel conduit barrier. The wiring which generates heat to the separation barrier melts apart and becomes an open circuit before significant thermal damage can occur to the separation barrier.

The test report was submitted under a separate cover(1).

Fire-retardant tape as a separation barrier

Tests were conducted on "siltemp" tape samples using "siltemp" as an electrical separation barrier. The tests demonstrated that the tape is capable of preventing propagation of damage between the circuits under maximum short circuit and neighboring rated current circuits. Thus, the "siltemp" tape provides adequate thermal and electrical insulation to preclude propagation of damage between two redundant circuits.

The test report was submitted under a separate cover(2).

8A.2 CONCERN (QUESTION F430.23e)

a. Identify any non-Class 1E circuits running in proximity of divisional circuits with power generation control complex (PGCC).

b. Concerning the test reports for flexible conduit and for "siltemp" tape, the staff wants to see the PGCC site configuration to compare with the test documents to verify that test documents are applicable to Unit 2.

c. Is flex conduit used in floor sections? The test analysis assumes a fault within a cable and not a short to the conduit itself. If flex conduit is used within floor sections, a 1-in air space surrounding the conduit would be acceptable to the staff, or verify that a short to the conduit will not affect the surroundings.

d. In the flex conduit test reports, there appears to be a discrepancy in thermocouple placement as described in Section C, page 2, and Section 6, page 13. Which set of thermocouples is correct or were there two sets of thermocouples? Also address the discrepancy in temperature rises between Section C, page 3, and Section 6, page 12.

8A.3 RESOLUTION

a. PGCC ducts are divisionalized for separation; Class 1E circuits through these ducts are run into their respective divisions. Nondivisional wiring is routed through non-Class 1E ducts. Any non-Class 1E wiring which must be run in close proximity to Class 1E wiring is placed in conduit (rigid or flexible) or separated from Class 1E wiring by a barrier. Thus, there is no mixing of non-Class 1E circuits with divisional circuits within PGCC and PGCC floor ducts.

b. <u>Flexible Conduit</u>

The actual installation of flexible conduit within PGCC ducts or panels is the same as or no worse than the flexible conduit test configuration. Wherever practical, a 1-in air gap has been maintained between conduits of different divisions and between conduit and other cables. The test configuration did not take credit for conduit-to-conduit or conduit-to-cable separation.

<u>"Siltemp" Tape</u>

Limited application of "siltemp" tape as a barrier within PGCC panels is used to prevent propagation of damage between circuits under maximum short conditions. "Siltemp" tape is not used where flexible conduit is required for a grounding path in fail-safe circuits and in scram signal cables.

The actual installation of the "siltemp" tape in the PGCC site configuration is as follows:

The cable or wire bundles are wrapped with "siltemp" tape using a minimum overlap of 1/2 in. The start and end of wrap area (2 1/2 in) is finished with a minimum of two layers secured by a stainless steel strap. All wrapped sections of the cables are continuously wrapped with Scotch 3M No. 69 tape applied counter to the wrapping direction of the tape. Ty-raps are used to secure the tape at 12-in intervals. Ty-raps also may be used to anchor the bundle to a supporting structure.

The laboratory test configuration for the "siltemp" tape is described in Test Report No. 56719 in Section 4.0, Summary, and under Test Data sheets, page 23.

The PGCC uses the same "siltemp" tape and similar application procedures as the test configuration. The PGCC site configuration is not more severe than the test configuration.

c. Flex conduit is used in PGCC floor sections to achieve separation. The test configuration reflected the worst-case application with respect to the damage potential occurring from an electrical fire within the flexible conduit housing the wiring. All PGCC conduits are grounded at a maximum of 30-ft intervals along the entire length of the conduit. Thus, the test configuration is more severe than a short to the grounded conduit.

d. The flexible conduit test report contains eight sections designated as A, B, C, D, E, F, G, and H. Section C was a trial run conducted to ensure that all equipment was functioning properly and to identify the worst-case configuration. The final, successful test is included in Section A.

8A.4 REFERENCES

1. General Electric Engineering Test Report, DRF No. A00-794-6, Tab A; "Electrical Fire Separation Capability of Flexible Conduit Encased Electrical Cables and Partitioned

Module Enclosures," dated April 16, 1980; submitted by NMPC to the NRC on September 20, 1984.

2. Wyle Laboratories Test Report No. 56719, "Electrical Wire and Cable Isolation Barrier Material Test for the Susquehanna Steam Electric Station Units 1 and 2 for Bechtel Power Corporation," dated November 20, 1980; submitted by NMPC to the NRC on September 20, 1984.