8.3 ONSITE POWER SYSTEMS

8.3.1 AC POWER SYSTEMS

8.3.1.1 Description

8.3.1.1.1 General

Preferred (offsite) power from the start-up transformers or from the unit auxiliary transformers is distributed to the nonsafety related loads by two 6.9 kV buses (3A1 and 3B1) and by two 4.16 kV buses (3A2 and 3B2). The 6.9 kV buses serve only motors rated 4000 hp and above; the 4.16 kV buses supply motors rated from 300 to 3000 hp, as well as all remaining motors and other loads through 4160-480 V unit substations and motor control centers (MCCs). The Offsite Power System is described in Section 8.2. Power is also distributed from: the two 4.16 kV buses 3A2 and 3B2 to the engineered safety features (ESF) buses 3A3-S and 3B3-S. All safety related loads are supplied from these two buses as described below.

The ESF buses 3A3-S and 3B3-S may also receive power from diesel generators, should preferred power from buses 3A2 or 3B2 be unavailable.

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The Onsite Power System is shown in Figure 8.1-7 and Drawing G287, Sheet 1.

←

a) 4.16 kV Auxiliary System

The two 4.16 kV ESF buses 3A3-S and 3B3-S supply equipment essential for safe shutdown of the plant. These two buses receive power either from the nonsafety related buses 3A2 and 3B2 or from the diesel generators (3A-S and 3B-S). A third 4.16 kV bus, 3AB3-S, can receive power from either bus 3A3-S or 3B3-S, but not from both simultaneously. This bus supplies power to equipment which is standby to equipment on the other buses. Either bus 3A3-S or 3B3-S can supply sufficient power to shut down the plant and to maintain the plant in a safe condition, under normal and design basis accident conditions.

The 4.16 kV ESF buses are of indoor, three-phase, metal-clad construction, with draw out magnetic air circuit-breakers.

The circuit-breakers operate from 125 V dc control power which is supplied by the safety related 125 V dc system of the appropriate division (A or B) as described in Subsection 8.3.2.1.

Each breaker may be electrically operated from the main control room by the operator and may be automatically operated in conjunction with the diesel generator loading on loss of preferred power (see Subsection 8.3.1.1.2.8), when in the "operate" position. In the "test" position, local electrical operation is possible, but the main power circuit will not be completed when the breaker closes.

Breaker status is indicated by red (closed) and green (tripped) indicating lights at the main control room and at the switchgear.

Breaker status lights in the main control room also indicate that the breaker is in the operating position.

Bus and breaker ratings are listed in Table 8.3-2.

→ (DRN E9900733)

Power cables for the 4.16 kV auxiliary system are shielded and rated 5 kV, 90 C with ethylene-propylene rubber or cross-linked polyethylene insulation, a flame resistant jacket and aluminum conductors. The cables are sized to carry the maximum available short circuit current for the time required for the circuit breaker to clear a fault. They are also sized for continuous operation at 125 percent of nameplate full load current. (NOTE: Due to cable tray filled and fire/separation wrap requirements some cables have been derated. Engineering calculations demonstrate the ampacity of these cables are properly sized for the connected loads.)

← (DRN E9900733)

All of the safety-related distribution equipment, including raceway system, is designed to meet the seismic requirements for Class 1E electric equipment as discussed in Section 3.10.

The 4.16 kV ESF switchgear is located within switchgear rooms in the Reactor Auxiliary Building which is a seismic Category I structure and is protected from potential missile hazards. Physical separation is maintained in the location and installation of the ESF switchgear for the redundant systems.

b) 480 Volt Auxiliary System

→ (DRN E9900733)

The 480V auxiliary system receives power from the 4.16 kV system through dry type, three-phase indoor and outdoor transformers. The arrangement of the plant 480V auxiliary system is shown on Figure 8.1-7, while the arrangement of the ESF portions of the 480V auxiliary system are shown on Figure 8.1-7.

← (DRN E9900733)

The 480V ESF auxiliary system consists of three safety-related power centers (plus two non-safety-related power centers), 17 motor control centers (MCCs) (including four non-safety-related MCCs), the safety-related loads and interconnecting cables.

Each of the two safety-related power centers 3A31-S, and 3B31-S, and two non-safety-related power centers, 3A32 and 3B32, consists of a 4160-480V, three-phase, delta-wye, indoor, dry-type transformer, rated as given in Table 8.3-2 and connected to a 4000A bus. The remaining safety-related power center, 3AB31-S, can receive power from either power center 3A31-S or 3B31-S, but not from both simultaneously. Its bus is rated 1600 A.

Feeder circuit breakers are 1600 A frame size as shown in Table 8.3-2. All breakers are of metal-enclosed, drawout construction, arranged for local operation when in the "test" position and for normal operation from the main control room. Control power is furnished at 125V dc from the appropriate division battery.

MCCs consist of metal enclosed groups of motor starters, feeder circuit breakers, and control devices, assembled in a common structure with horizontal and vertical buses. Buses are rated at 22 kA symmetrical withstand capability. Circuit breakers are rated greater than their required interrupting requirements and incoming feeder reactors are used where necessary to reduce the available 50 kA short circuit current to 14 kA or 22 kA at the MCC bus. Two MCCs (3A315-S and 3B315-S) are

➜ (DRN E9900733)

supplied from the 4.16 kV ESF buses (3A3-S and 3B3-S respectively) through 1000 kVA, 4160-480V, delta-wye, three-phase, gas-filled transformers.

← (DRN E9900733)

Feeder circuit breakers in MCCs are manual, thermal-magnetic trip, molded case units in 100 A frame size or larger as required.

Motor starters are combination type, consisting of a three pole magnetic or thermal magnetic with fuses (Subsection 8.3.1.1.4c) trip circuit breaker, a magnetic contactor (or contactors, if for reversing or two-speed service); a three pole thermal overload relay and a 480-120 V control transformer. Control devices are included as necessary.

➜ (DRN E9900733)

Power and control cables for the 480V auxiliary system are rated 600 V 90°C with ethylene-propylene rubber, silicon rubber or crosslinked polyethylene insulation, flame resistant jacketing, and the copper conductors of the cables are sized to carry the maximum available short circuit current for the time required for a circuit breaker or fuse to clear a fault. They are also normally sized for continuous operation at 125 percent of nameplate full load current. (NOTE: Due to cable tray fill and fire/separation wrap requirements some cables have been derated. Engineering calculations demonstrate the ampacity of these cables are properly sized for the connected loads.)

← (DRN E9900733)

All of the 480 V ESF distribution equipment is designed to meet the seismic requirements for Class 1E electric equipment as discussed in Section 3.10.

All power center transformers, power center buses, and MCC buses have adequate capacity to supply the momentary and continuous loads connected to the 480 V buses.

The ESF power centers and MCCs are located within switchgear rooms in the Reactor Auxiliary Building which is a seismic Category I structure and are protected from potential missile hazards. Physical separation or fire walls are provided for redundant components. For example, power center 3A31-S is physically separated from its redundant counterpart, power center 3B31-S; likewise, MCCs are separated from their redundant counterparts by physical separation or fire walls.

c) 120 Volt Uninterruptible (Vital) AC System

A 120V uninterruptible ac system has been provided to supply the Plant Protection System control and instrumentation channels. The 120V uninterruptible ac system consists of rectifier/inverters and power distribution panels. Each inverter is normally supplied through its rectifier from a 480V ESF MCC. Should this supply fail, the inverter is supplied automatically from a 125 V dc ESF battery.

The Plant Protection System (PPS) uses four inverters, two from each division, to supply the four measurement channels.

➜ (DRN E9900733)

The other safety-related control and instrumentation systems are connected to two inverters, one for each Division A and B. A seventh inverter, and eighth inverter with its own battery, are used to supply other important but nonsafety-related loads. The plant monitoring computer is supplied from a ninth inverter, with its own battery.

← (DRN E9900733)

The four PPS ac systems and two ac safety-related control and instrumentation systems are ungrounded while the remaining ac systems have solidly grounded neutrals.

Each system is arranged so that any type of single failure or fault will not prevent proper protective action of the safety related systems.

→(DRN E9900733)

Power and control cables for the 120 V uninterruptible ac systems are rated 600 V 90°C with ethylene-propylene rubber or cross-linked polyethylene insulation, flame-resistant jacket and copper conductors of the cables are sized to carry the maximum available short circuit current for the time required by the circuit breaker or fuse to clear the fault. These cables are normally sized for continuous operation at 125 percent of nameplate full-load current. (NOTE: Due to cable tray fill and fire/separation wrap requirements some cables have been derated. Engineering calculations demonstrate the ampacity of these cables are properly sized for the connected loads.)

d) 208V/120 V AC System

Certain loads for which 480 V three-phase supply is either impractical or undesirable are supplied from 208V/120 V distribution panels. These panels are connected to 480 –208V/120 V three-phase transformers mounted close to the wall-mounted panels or in MCCs. Loads may be supplied at 208 V three-phase, 208 V single phase and 120 V single phase. The transformer secondary wye winding has its neutral grounded.

←(DRN E9900733)

e) Standby Power Supply

The Onsite Power Distribution System can receive power from either the Preferred (offsite) Power System (Section 8.2) or from Standby Power Supply which consists of two diesel generators, one for each division. Each diesel generator is rated at 4400 kw, 0.8 power factor, 4.16 kV and is complete with its accessories and fuel storage and transfer system.

The diesel generator ratings are sufficient to supply reliable power to all safety-related loads in its respective division, as well as to those nonsafety related loads which are indicated in Table 8.3-1.

Each diesel generator is designed for fast starting and load acceptance, with a high degree of availability and reliability.

→(DRN E9900733; EC-774, R301)

The diesel generators have open drip-proof frames, Class F insulation and are wye connected, synchronous type with static, solid state excitation systems, capable of carrying full-rated load continuously without exceeding rated temperature rise above 50°C ambient. Each diesel generator is furnished with automatic field flashing equipment for quick voltage buildup during the start-up sequence. The automatic voltage regulators provide steady-state voltage regulation within 1.0 percent for any load from no load to full load.

←(DRN E9900733; EC-774, R301)

The diesel engine starting system and the fuel oil storage and transfer systems are covered in Subsections 9.5.6 and 9.5.4 respectively.

Cooling water to the diesel generator jacket water heat exchangers is supplied from the Component Cooling Water System (CCWS) as described in Subsection 9.5.5.

The ventilation system provided for each diesel generator room is described in Subsection 9.4.3.3. Each diesel generator has its own Combustion Air Intake and Exhaust System as described in Subsection 9.5.8.

Each diesel generator unit is designed to start automatically upon receipt of a start signal, attain rated speed and rated voltage within 10 seconds, and automatically accept loads in sequence as shown in Table 8.3-1 and later manually applied loads. Each diesel generator is capable of sequentially starting all required motors and accelerating them to full load operation after receiving the start signal.

Diesel generator 3A-S supplies power to 4.16 kV bus 3A3-S and diesel generator 3B-S supplies power to 4.16 kV bus 3B3-S.

→ (DRN E9900733)

The diesel generator controls are designed for automatic as well as manual operation. The manual operation is from one of two locations: a main control room panel (remote) and the diesel generator control panels (local). The choice of the operating location is controlled by "LOCAL-REMOTE" selector switches located at the engine and generator control panels. Placing the selector switches in the local mode permits manual starting of the diesel generator from the local position only. The position of selector switch is indicated in the main control room. Placing the selector switches in the remote mode permits manual starting of the diesel generator from the main control room only. Regardless of the position of the "Local-Remote" selector switches the diesel generator will start automatically on loss of offsite power or on receipt of a Safety Injection Actuation Signal.

← (DRN E9900733)

A diesel generator may be locked out of service for maintenance, by de-energizing the dc control circuits. The loss of dc control circuits is annunciated on Diesel-Generator control panel.

Voltage and speed sensing devices are provided to prevent loading the generator until the diesel engine has accelerated to rated speed and rated voltage is available.

The neutral of each generator is grounded through a transformer-resistor combination which is mounted in a self-ventilated metal enclosure.

→ (DRN E9900733)

Provision has been made for manually or automatically synchronizing the diesel generator with the incoming power source. Each diesel generator has been provided with a preheat system which maintains adequate engine temperature to ensure fast starts. The preheat system includes a jacket coolant heater and a lubricating oil heater. Each heater is energized from a 480 V ESF MCC. Interlocks (based on engine RPM) are provided to de-energize the lube oil and jacket coolant heater after starting of the respective diesel generators.

← (DRN E9900733)

Control circuits for each diesel generator operate from separate Class 1E 125 V dc circuits supplied from the station battery of the same division.

Each diesel generator is capable of starting and carrying the maximum ESF loads required under postulated accident conditions. After the automatic loading sequence is complete, (see Table 8.3-1) each diesel generator will have a reserve capacity which is the difference between the diesel generator rating and the total load shown in Table 8.3-1.

Additional loads may be manually started only one at a time by the operator. Such additional loading is limited to those loads listed in the manual loading sequence of Table 8.3-1 up to the rated capacity of the diesel generators. A wattmeter, a varmeter and an ammeter are provided for continuous indication of diesel generator loading. Administrative control will be exercised to prevent loading the diesel generators over their rated capacities. Single line and logic diagrams for the diesel generators are shown in Figures 8.1-7 and 8.3-1.

→ (DRN E9900733)

All of the standby power supply system components are designed to meet the seismic requirements for Class 1E electric equipment as described in Section 3.10. All Class 1E components are located within seismic Category I structures and are protected from potential missile and fire hazards. Physical separation and isolation have been maintained in the location and installation of equipment for redundant systems. Each diesel generator is housed in a separate concrete room in the Reactor Auxiliary Building at +21 ft. MSL.

← (DRN E9900733)

8.3.1.1.2 Specific Details of Onsite AC Power System

8.3.1.1.2.1 Power Supply Feeders

→ (DRN E9900733)

Power for onsite distribution is normally obtained from the Offsite Power System 4.16 kV buses 3A2 and 3B2. The conductors connecting the onsite distribution buses 3A3-S and 3B3-S to the respective nonsafety related bus 3A2 and 3B2 consist of 3000 A cable bus duct, as detailed in Subsection 8.2.1.4.5.

← (DRN E9900733)

The ties from buses 3A3-S and 3B3-S to the "standby" bus 3AB3-S consist of 1200 A nonsegregated phase bus duct.

→ (DRN E9900733)

The diesel generators are connected to the two buses 3A3-S and 3B3-S through cable feeders, consisting of four 500 MCM aluminum conductors per phase. Outgoing cable feeders serve 4000V motors and 4160-480V transformers supplying 480V power centers, as shown on Figure 8.1-7. From the 480V power centers, feeder cables supply power to motors 100 hp to 250 hp and to MCCs for motors below 100 hp. Feeders also serve 480V power panels and lighting transformers from the MCCs.

← (DRN E9900733)

8.3.1.1.2.2 Busing Arrangements

Figure 8.1-7 shows the busing arrangements for the onsite ac power system. There are no ties between buses of the two divisions. Bus AB3-S is connected to either bus 3A3-S or bus 3B3-S, but never to both, so that the two Divisions, A and B are completely separate electrically. Similarly, 480V bus 3AB31-S is tied to the same division as 4160V bus 3AB3-S at all times.

8.3.1.1.2.3 Loads Supplied from Each Bus

The Power Distribution and Motor Data (see Section 1.8, Drawing LOU 1564 B 289) shows each load in the plant and the bus to which it is connected. The criteria governing the assignment of loads are (1) that redundant loads are assigned to different divisions and (2) that all loads in a given train are supplied from the same division (for example, a motor operated valve in the discharge line of a pump whose motor is supplied by bus 3A3-S would be assigned to a 480V MCC supplied by the same 4.16 kV bus 3A3-S though a 4160-480V Division A power center).

→ (DRN E9900733)

The design criterion governing the assignment of extra redundant loads (the third high pressure safety injection pump, the third component cooling water pump and the third water chiller, and associated valves) is to ensure the availability of one component in each division during extensive maintenance. The third-of-a-kind equipment consisting of the installed spares may be utilized by connecting bus 3AB3-S to the bus 3A3-S or 3B3-S (i.e., to the bus that has a component requiring extensive maintenance). At the same time, bus 3AB31-S will be connected to 3A31-S or 3B31-S corresponding to the 4.16 kV connection. This will ensure that all related "AB" loads are always connected to the same division. The reassignment of extra redundant loads on the 3AB3-S bus requires a 'dead bus' transfer. It is therefore not a normal practice to transfer the 3AB3-S bus when the plant is at power, because the momentary deenergizaton of the 3AB3-S bus could result in the loss of non-safety related essential auxiliaries.

← (DRN E9900733)

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

Normal bus transfers used on start-up or shutdown of the main generator are manual "live bus" transfers (i.e., the incoming source feeder circuit breaker is closed onto the energized bus section), as described in Subsection 8.2.1.6.5.

Emergency bus transfers, used on the loss of main generator, are automatic dead bus transfers (i.e. the normal source feeder circuit breaker is tripped and then the alternative source circuit breaker is closed, resulting in a transfer within a few cycles) as described in Subsection 8.2.1.6.5.

Loss of the normal unit source is indicated by the tripping of the main generator lockout relay (Subsection 8.2.1.6.3) which initiates the bus transfer. If the incoming preferred source is not available, as indicated by a potential transformer and voltage relay on the incoming feeder, transfer will not occur. The resultant loss of voltage at the ESF bus will thereupon trip the breakers at both ends of the tie feeder and will start the diesel generator as described in Subsection 8.3.1.1.2.8.

Switching of the 4.16 kV feeders to the 4160-480V power centers is manual, as is switching of MCCs to the power centers. Most loads are manually switched but safety-related loads (ESFD) (including certain 480V power centers) are automatically switched on occurrence of an event requiring them, as described in Subsection 8.3.1.1.2.8.

Buses 3AB3-S and 3AB31-S are manually switched to the appropriate division bus, as described in Subsection 8.3.1.1.2.2.

→ (DRN E9900733)
Certain MCCs are sectionalized into Class 1E and associated circuit buses. The bus tie breaker is tripped automatically on occurrence of loss of voltage, and administrative control will assure that it may be reclosed manually only after power is restored to both divisions. (Operations procedures provide guidance for restoration with only one division available.)
← (DRN E9900733)
There are no connections, either manual or automatic, between buses of different divisions. There are also no interconnections between the 120V uninterrupted ac (nuclear instrumentation) buses, although the two supply inverters for channels A and C are driven normally by 480V feeders from separate Division A MCCs.

(Emergency dc supply to these two inverters is also by separate feeders from the Division A Battery 3A-S). Similarly, inverters B and D are powered by separate feeders from Division B supplies.

Loss of the ac feeder to any inverter results in automatic assumption of load by the dc feeder because the ac input is rectified and the resultant dc output is "auctioneered" with the dc feeder input. Thus the supply with the higher voltage (normally the ac feeder) supplies the inverter.

8.3.1.1.2.5 Interconnections Between Safety-Related and Non-Safety Related Buses

Apart from the preferred source connections from bus 3A2 and bus 3B2 to bus 3A3-S and bus 3B3-S respectively, the following interconnections between safety-related and non-safety-related buses occur: from bus 3A3-S and 3B3-S to bus 3A32 and 3B32 respectively, at the MCCs where associated circuit buses are connected as described in Subsection 8.3.1.1.2.4, and from bus 3AB31-S to bus 3AB313 and 3AB312.

8.3.1.1.2.6 Redundant Bus Separation

Separation of redundant 4.16 kV and 480 V redundant power centers, the 480 V redundant MCCs and power panels, the 120 V uninterruptible ac buses and inverters and the 125 V dc batteries, chargers and distribution panels has been accomplished through spatial separation or provision of fire resistant barriers. The two redundant diesel generators are housed in separate fire resistant rooms in Reactor Auxiliary Building which is a seismic Category I structure.

8.3.1.1.2.7 Equipment Capacities

Ratings of all safety-related electrical system equipment are shown in Table 8.3-2. The two redundant diesel generators each have adequate capacity to supply all ESF and uninterruptible equipment loads required for safe shutdown of the plant. Table 8.3-1 lists all the ESF loads connected to each of the diesel generators under emergency conditions.

Table 8.3-1 lists both motor nameplate data and loads under expected flow and pressure (brake horsepower) for ESF motors. All safety-related equipment capacities were confirmed by preoperational tests.

8.3.1.1.2.8 Automatic Tripping and Loading of Buses

→ (DRN 99-0733)

The 4160V buses 3A3-S and 3B3-S, have been provided with undervoltage relays to monitor the voltage condition on these buses. See Section 8.3.1.1.2.13.f for a discussion related to shedding of bus loads. The undervoltage detection portion of the undervoltage protection system shown on Figure 8.3-5 illustrates the detection scheme for load group A 4160V ESF bus 3A3-S and 3AB3-S. Figure 8.3-6 shows the detection scheme for load group B, 4160V ESF bus 3B3-S. This protection scheme is designed consistent with the recommendations of IEEE-279-1971.

The undervoltage relays (induction disc relays with inverse time characteristics) 27-1, 27-2, and 27-3/A, B, and AB and undervoltage relays 27-1, 27-2, and 27-3/A1 and B1 (solid state relays with integral timers) are physically located in each 4160 V Class 1E switchgear. The relay contacts are combined in a three out of three logic to generate a loss of voltage signal (LOVS) and in one out of three logic to generate an alarm on loss of instrument potential transformer fuse. The design basis for operation of these relays is shown in Table 8.3-13. A complete loss of offsite power will result in approximately a 2 second delay in LOVS actuation. The diesel generator starts and is available to accept loads within a 10 second interval on SIAS or LOVS. Emergency power is established within the nominal times shown in Table 8.3-1.

If a sustained degraded voltage condition occurs on the onsite power system, the undervoltage relays will trip as shown on the time-voltage curve of Figure 8.3-37. The sequence of events for this condition with the emergency diesel generator in standby and in the test mode are shown in Table 8.3-14.

← (DRN 99-0733)

→ (DRN 99-2345)

If a degraded bus condition occurs when power is supplied by the diesel generator the probable cause is a fault in the excitation system. If the voltage available is insufficient to accelerate the motors during sequencing, a LOVS would occur tripping all the circuit breakers and resetting the sequencing circuit time delay relays. If minimum required reset voltage is re-established as detected by the bus undervoltage relays, 27-1, 27-2, and 27-3/A and B, the sequencer is actuated and re-loads the diesel generator. Sequencing will occur on LOVS reset and SIAS.

← (DRN 99-2345)

If the preferred source is available and Safety Injection Actuation Signal is present, the appropriate ESF loads will be started sequentially on the preferred power source. The diesel generator or generators will attain rated speed and voltage but will not be connected to the ESF bus or buses if the preferred power source continues to be available.

→(DRN 99-0733; 99-0682)

The 480V ESF power station is designed to minimize the effects of an undervoltage condition and is provided with undervoltage alarms. All loads connected to the 480 V ESF MCCs are deenergized when voltage is lost on the corresponding 4160 V ESF buses. Only the ESF and non-ESF loads identified in Table 8.3-1 are automatically re-energized when voltage is restored to these buses. The transformer taps were selected so as to maintain operable voltage for all systems based on the largest motor starting on a fully loaded bus. The initial transformer tap selection was performed by utilizing a computerized load flow program and field verified during plant startup.

← (DRN 99-0733; 99-0682)

→ (DRN 99-0682)
Any non-ESF load (excluding loads identified in Table 8.3-1) connected to the ESF buses can be manually reconnected by the operator, as provided for in subsection 8.3.1.1.2.4.
← (DRN 99-0682)
The undervoltage relays 27-1, 27-2, and 27-3/A, A1, B and B1, are set so as not to trip during the diesel generator loading sequence. Therefore, a lockout to prevent load shedding of the Class 1E 4160V buses, once the diesel-generator is supplying the electric power, is not required. For details refer to Table 8.3-14. This is based upon the inverse voltage time characteristics of the undervoltage relays 27-1, 27-2, and 27-3/A and B, and the capability of the motors to accelerate and operate under the voltage conditions described above. However, as a conservative method, a temporary lockout of the undervoltage relays is provided on the first two load blocks.

A LOVS will not be generated if a short circuit occurs on motor feeders since the resultant bus voltage dip will not be picked up by the undervoltage protection system before the fault is cleared by the motor circuit breaker (within 0.14 seconds) and the voltage returns to normal on the bus.

If a SIAS occurs during the periodic test of the diesel generator, the generator breaker will be tripped automatically. This permits the unit to be cleared from parallel operation with the system and enables the diesel generator to attain the emergency standby mode. In this mode of operation, the diesel governor control changes automatically to the isochronous mode which maintains the engine running at a preset constant synchronous speed corresponding to 60 hertz at the generator terminals.

→(DRN 99-2053)
Simultaneously, the voltage regulator changes to the automatic mode maintaining the generator at a preset constant voltage of 4160 volts. The diesel-generator unit is now ready to accept load in the event of a LOVS. If during periodic test of diesel generator a LOVS takes place both the generator breaker and tie breaker will be tripped automatically and as explained above, the unit controls will change to the standby mode. For details on sequence of events, see FSAR Table 8.3-14. The speed setting in the emergency mode, corresponding to 60 hertz, is performed once, and further adjustments are normally not needed. The voltage setting is determined by the most recent positioning of the automatic voltage regulator motor operated potentiometer which will be approximately 4160 volts.
←(DRN 99-2053)

If the undervoltage is caused by a fault diesel generator excitation system, it is assumed that per the single failure criterion, the redundant diesel generator will function correctly consistent with the recommendations of Regulatory Guide 1.6 and IEEE Standard
279-1971.

The undervoltage and bus loading schemes have been tested and calibrated. This is discussed in Subsections 8.3.1.1.2.12 and 13.

8.3.1.1.2.9 Safety-Related Equipment Identification

Safety-related equipment has been marked, tagged and identified in accordance with its respective division or channel markings. This is discussed under Subsection 8.3.1.3.

8.3.1.1.2.10 Instrumentation and Control Systems with Assigned Power Supply

→ (DRN E9900733)

The Plant Protection System (PPS), including the Reactor Protection Systems (RPS) and core protection calculators and other instrumentation and control systems provided for monitoring and controlling the reactivity, temperature and other vital parameters within the reactor, is supplied with power from the four uninterruptible ac inverters described in Subsection 8.3.1.1.1(c). There are four separate channels in these control systems, each of which operates at 120 V ac ungrounded, from one of the four buses 3MA-S, 3MB-S, 3MC-S and 3MD-S. Buses 3MA-S and 3MC-S receive power from inverters supplied from Division A power and buses 3MB-S and 3MD-S receive power from inverters in Division B. Thus, independence of the four channels from each other extends back to either the 480 V safety-related power center buses 3A31-S and 3B31-S, or the 125 V dc distribution panels 3A-DC-S/3A1-DC-S and 3B-DC-S/3B1-DC-S.

← (DRN E9900733)

The other safety-related control and instrumentation systems receive power from two inverters similar to those of the PPS, and also described in Subsection 8.3.1.1.1(c).

Each inverter is supplied from a safety-related MCC, with automatic transfer to battery supply on ac failure. Since the ac and dc supplies for the two inverters are taken from the same Division (A or B) as the inverter serves, full separation between divisions is assured.

Controlled actuators or final devices, such as motor operated valves, receive power from safety-related MCCS, if ac, and from the 125 V batteries, if dc; larger devices, such as pumps, are powered from 480 V power centers or 4160 V switchgear, and control power is supplied in these cases from the 125 V battery of the appropriate division.

8.3.1.1.2.11 Electric Circuit Protection Systems

Electrical protection has been designed for selective tripping, so that only the affected circuit, close to the point of fault, is isolated. Backup protection, where provided, may require isolation of more than one circuit, should the primary protection fail.

a) Safety-Related 4.16 kV Bus Protection

Each of the ESF buses 3A3-S and 3B3-S is protected against bus faults or uncleared outgoing feeder faults by three inverse time overcurrent relays, one in each phase. Each of these relays will trip the incoming feeder breaker from the preferred power source (Bus 3A2 or 3B2).

The setting of the long time characteristic unit permits starting of the largest motor in the system with the ESF buses carrying the total of the connected nameplate equipment load. The pickup current of the relay has been selected high enough to avoid false relay operation due to setpoint drifting while maintaining bus overload protection. Figure 8.3-8 illustrates the ESF buses 3A3-S and 3B3-S protection criteria.

Each ESF bus incoming breaker will also be tripped if there is loss of voltage on the bus.

Bus 3AB3-S is similarly protected by three inverse time overcurrent relays which will trip the tie breaker from bus 3A3-S or 3B3-S, whichever is closed.

b) Safety Related 4.16 kV Feeder Protection

All outgoing feeders from Buses 3A3-S, 3B3-S and 3AB3-S are protected against feeder short circuit by instantaneous relays in each phase.

→ (DRN E9900733)

Motor feeders are equipped with an inverse time relay in each phase; one relay with long time characteristic unit connected to phase A provides an alarm only when the overload is between 115 and 130 percent (1.0 to 1.15 motor service factor respectively) of the motor full load nameplate current. This condition is annunciated in the control room and is displayed on the plant monitoring computer CRT at the operator's desk. The control room operator will assess the abnormal condition and decide the course of action to be followed. The independent instantaneous unit of this relay trips the motor breaker on overloads from twice the motor locked rotor current approximately up to the maximum short circuit current available.

← (DRN E9900733)

The other two relays have a long time and instantaneous characteristic units connected to phase C and B. The long time unit has been set to trip the motor breaker if the time to accelerate the motor to full speed approaches the safe stall time (motor thermal limit). If motor thermal limit is exceeded, permanent motor damage may occur, resulting in an extended equipment outage. The pickup current of this unit is set to trip the motor breaker at 140 to 160 percent of motor nameplate amps (1.0 to 1.15 motor service factor respectively) approx. which is sufficiently high to avoid false relay operation due to setpoint drift. This setting is not considered critical hence the main function of the unit is to protect the motor insulation against excessive motor locked rotor current time during acceleration.

→ (DRN E9900733)

The independent instantaneous unit of these relays trips the motor breaker on overloads from twice the motor locked rotor current approximately up to the maximum short circuit current available. Figure 8.3-8 illustrates the motor protection design criteria.

← (DRN E9900733)

Feeders to the 4160-480 V power center transformers are equipped with relays having one inverse time overcurrent unit and one instantaneous unit in each phase. These relays will trip the breaker under all overload conditions. The setting of the very inverse long time characteristic unit allows to start the largest motor with the transformer carrying nameplate load. The pickup current of the relay is 130 percent of the transformer rating minimum. This setting is high enough to avoid false relay tripping due to setpoint drifting and to permit coordination with other relays upstream.

→ (DRN E9900733)

Figure 8.3-9 illustrates the station service transformers protection criteria.

← (DRN E9900733)

Each feeder is also equipped with ground fault alarm.

c) Diesel Generator System Protection

A lockout relay is provided for each diesel generator set which is tripped by the following devices:

1) Engine overspeed switch

2) Generator differential relay (87/DG)

3) Generator time overcurrent relay, (voltage controlled) (51V/DG)

4) Loss of generator excitation relay (40/DG)

5) Reverse power flow (anti-motoring) relay (32/DG)

→(DRN 99-2065)

6) Engine protective devices (Refer to Subsection 9.5.5 and 9.5.7)

← (DRN 99-2065)

Operation of the lockout relay will trip the generator breaker and will stop the engine. However, when the generator unit is operating as a result of loss of offsite power or Engineered Safety Features Actuation Signal, only overspeed and differential protection, (1) and (2) above, are permitted to shutdown the unit.

d) Safety Related 480 V System Protection

Feeders to 480 V ESF MCCs have been protected by Air Circuit Breakers, ACBs, each provided with a three phase direct-acting, series trip having short time and long time trip elements. The settings of the long time and short time elements allow starting of the largest motor with the MCC bus carrying full load. The pickup current of the long time element is 10 percent above the MCC bus rating to allow for setpoint drifting. The short time element has a minimum of six hertz time delay which provides coordination with the maximum interrupting time of downstream protective devices such as molded case breakers. In addition, instantaneous and inverse-time overcurrent relays are provided on each phase. The settings of the long time and high dropout units of these relays have been selected to provide the same level of protection as the direct-acting series trip devices. Figure 8.3-10 illustrates the 480V ESF MCC protection criteria.

→ (DRN E9900733)

Feeders to 480 V motors from the 480 V ESF load centers have been provided with a three phase, direct-acting, series trip having long-time and instantaneous elements. The setting of the long time element has been selected to trip the motor breaker if the time to accelerate the motor to full speed approaches the safe stall time (motor thermal limit). The pickup current of this element is set to trip the motor breaker

← (DRN E9900733)

→ (DRN E9900733)

to protect the motor insulation against excessive motor locked rotor current time during acceleration. The instantaneous element trips the breaker on overloads from twice the motor locked current approximately up to the maximum short circuit available. In addition, instantaneous and inverse time overcurrent relays on each phase have been provided. Motor protection is arranged to give alarm on small overloads, with tripping on heavy overload or short circuits. The long time characteristic relay connected to phase A provides an alarm when the overload is between 115 to 130 percent (1.0 to 1.15 motor service factor respectively) of the motor full load nameplate current. This condition is annunciated in the control room and displayed on the plant monitoring computer CRT at the operator's desk. The control room operator will determine the corrective action that should be taken.

← (DRN E9900733)

The other two relays have long time and instantaneous characteristic units connected to phases C and B. The settings of these units have been selected to provide the same level of protection as the long time and instantaneous elements of the three phase, direct-acting, series trip devices. Figure 8.3-9 illustrates the 480 V ESF motor protection design criteria.

Each power center feeder is also provided with ground fault alarm.

→(LBDCR 14-009, R 308)

The 480 V MCC combination motor controllers for motors other than valve operators have been provided with an instantaneous trip circuit breaker (for short-circuit protection) and thermal overload relays for each phase. The three inverse-time overload elements of the starters have been selected to open the controller contactor on 125 percent motor overloads. Its long time characteristic allows accelerating of the motor to full speed. Each phase of the adjustable instantaneous trip element of the molded case circuit breakers has been set on the basis of two times the motor locked rotor current. If motor locked rotor current was unknown, then each phase of the adjustable instantaneous trip element of the molded case circuit breakers has been set on the basis of the motor horsepower rating using a trip setting position as applicable per B289 Sheet 2, Table 1 & 2. For overload element (heaters) selection tables see Power Distribution and Motor Data Dwg LOU-1564 B-289 Sheet 2a. (Section 1.7)

←(LBDCR 14-009, R308)

Figure 8.3-11 shows the 480 V MCC ESF motor protection criteria.

→ (DRN E9900733)

In the case of the valve operators, which have short-time rated motors, the thermal overload relays are adequately sized and/or bypassed to prevent tripping when an Engineered Safety Features Actuation Signal is present. This gives additional time for the motor (if overloaded, but not stalled) to complete the valve closure (or opening). A thermal element in the breaker will ultimately trip after giving the motor sufficient time to accelerate to full speed, but before the penetration cable insulation reaches a dangerous temperature.

← (DRN E9900733)

Feeders supplying loads inside the containment through penetrations are provided with back-up protection as discussed in Subsection 8.3.1.1.4.

→ (DRN E9900733)

e) 208V/120 V AC System Protection

← (DRN E9900733)

Each outgoing feeder is provided with overcurrent and short circuit protection by a thermal magnetic breaker. Single pole breakers are used for 120 V single phase circuits; double pole breakers are used on 208 V single phase circuits and triple pole breakers are used on 208 V three-phase circuits.

→ (DRN E9900733)

Each panel bus is directly connected to the secondary terminals of a three-phase 480 –208V/120 V transformer, the primary of which is protected by a triple pole thermal magnetic breaker. The instantaneous trip element of this breaker will trip only on faults on the feeder cable or within the transformer itself, thus ensuring that faults in the branch circuits will trip only the affected secondary breaker and not the transformer feeder breaker.

The continuous rated currents of the thermal-magnetic breakers have been selected on the basis of the next higher standard size corresponding to 125 percent of the equipment full load current, therefore, a 25 percent margin above the equipment full load current has been allowed for breaker tolerance as well as to avoid false tripping due to breaker characteristic drifting.

← (DRN E9900733)

f) 120 V Uninterruptible AC System Protection

The 120 V output from the inverters is ungrounded, so double pole, inverse time, magnetic breakers are used in the outgoing feeders.

The continuous rated current of the breakers have been selected on the basis of 125 percent of the equipment full load current, minimum, to allow for breaker tolerances and drifting of breaker characteristic.

g) Ground Fault Protection

High resistance grounding is used on the 4.16 kV and 480 V systems so that ground fault currents will be too small (about 10 A) to require tripping of the affected breaker. Ground faults are detected and alarmed by a sensitive relay connected to a current transformer, whose core surrounds all three conductors of the circuit. (This is a so-called "zero-sequence" current transformer).

→ (DRN E9900733)

The 208V/120 V systems are effectively grounded, so that ground faults are seen by the breaker as equivalent to phase-to-phase faults and tripping will occur.

← (DRN E9900733)

The 120 V uninterruptible ac systems are effectively ungrounded. A ground detector is provided on the bus to alarm on occurrence of a ground anywhere on the system; two ground faults on different poles of the system are required for tripping.

8.3.1.1.2.12 Testing of the Power Systems During Operation

→ (DRN E9900733)

Operational or periodic tests, including in-service tests, are performed after installation on the power and control circuits and components, including protective relays, meters and instruments. Protective relays, meters and instruments have provisions for in-service testing and calibration. Power circuit breaker operation and operation of the control circuits and protective devices are tested by racking the circuit breaker into the test position. Testing of each diesel generator is described in Subsection 8.3.1.1.2.13(g).

← (DRN E9900733)

8.3.1.1.2.13 Diesel Generators

a) Automatic Starting Initiating Circuits

Each diesel generator can be started automatically either by a Safety Injection Actuation Signal or by the undervoltage relay on the respective 4160 V ESF Bus.

b) Starting Mechanism and System

Each diesel generator is started by compressed air, which is stored in two separate air tanks. Each tank has sufficient air to start the engine five times. Therefore, each diesel generator can be started 10 times without recharging. The air starting system is described in Subsection 9.5.6.

Admission of air to the starting header on the engine is by solenoid valves, which are energized by a Safety Injection Actuation Signal, and undervoltage signal from the related 4.16 kV Bus, or by local or remote control switch operation. Unless the engine has been deliberately shutdown for maintenance, the automatic starting signals override all manual controls, irrespective of the position of the "local-remote" transfer switches.

c) Tripping Devices

Diesel generator protection is described in Subsection 8.3.1.1.2.11 (c) which gives the conditions under which automatic shutdown of the unit will occur.

Manual tripping may be done by operator action at any time during the test mode and under certain conditions during a Safety Injection Actuation Signal (SIAS) or under- voltage on the 4160 V ESF BUS (LOVS). In the test mode, if the unit is on the local or remote manual control, it may be tripped by the local or remote control selector switch; in addition, the local or remote emergency pushbutton will trip the unit irrespective if it is in local or remote manual control. If, however, the unit has been started by SIAS or LOVS, the unit may be tripped manually only if the emergency diesel generator breaker is open and the tie breaker to offsite power is closed. In all cases, the unit may be secured by manually tripping both trains of dc control power supplied to the unit.

d) Interlocks

Interlocks have been provided in the closing and tripping circuits to prevent closing of a diesel generator breaker under the following conditions:

1) If a lockout relay is tripped, the breaker closing circuit is deenergized, and the trip is energized.

2) If the generator is out of synchronism with the bus, synchronism check relays prevent closure of the incoming breaker.

3) Automatic connection of the ESF loads without voltage on the associated ESF bus is prevented by a contact of the bus voltage sensing relays in the closing circuits of the individual breakers.

e) Permissives

1) To start the diesel generator:

(a) local selector switches in agreement (i.e., both in "local" or both in "remote") and dc control fuses intact.

(b) diesel generator lockout relay in reset position.

2) To trip the emergency diesel generator when the unit is on auto operation:

This is covered in Subsection 8.3.1.1.2.13(c)

3) To close the diesel generator ACB:

(a) Manual - with live bus (test condition)

(1) diesel generator lockout relay in reset position

(2) correct voltage and frequency on the diesel generator

(3) synchronizing switch "on" and sychronizing check relay contact closed or automatic synchronizing equipment in service

(b) Auto Close (after emergency start)

(1) diesel generator lockout relay in reset position

(2) near-rated voltage and frequency on the diesel generator

(3) preferred source breaker open

f) Load Shedding Circuits

All loads connected to the 4.16 kV buses shed upon a loss of preferred sources of power, except:

1) The 480V 3A31-S power center
2) The 480V 3B31-S power center
3) The 4.16 kV 3AB3-S bus

Then, the diesel generator breaker will close within 10 seconds after receipt of an emergency start signal. On Diesel Generator 3A-S, one 480V power center (3A31-S) energizes through its station service transformer concurrently with the diesel generator breaker closing. In addition, one power center (3A32) energizes (if SIAS is not present) through its station service transformer and one 480V MCC (3A315-S) through its station service transformer at 1/2 second intervals. Diesel Generator 3B-S energizes Buses 3AB3-S, 3B31-S, 3B32 and 3B315-S in a similar manner.

→ (DRN 99-0682)

This sequence avoids the sudden imposition of the transformer inrush currents all at once, but still results in all power centers being energized and ready to assume loads within 11 seconds after diesel generator receipt of an emergency start signal. When the diesel generator is the only source of supply, non-essential loads (excluding loads identified in Table 8.3-1), which can be connected to the ESF supply are not re-energized through the automatic load sequencer. Subsequent reconnection of these loads to the diesel source can only be done manually under administrative control.

← (DRN 99-0682)

g) Testing

Each diesel generator is equipped with a means for starting periodically to test for readiness, a means for synchronizing the unit onto the bus without interrupting the service, for loading, and for shutdown after test. Administrative controls ensure that both diesel generator units are not tested simultaneously.

The following periodic tests will be performed on each diesel generator:

1) starting
2) load acceptance
3) design loading
4) load rejection
5) functional

h) Fuel Storage and Transfer System

→ (DRN E9900733)

The Diesel Generator Fuel Oil Storage and Transfer System is described in Subsection 9.5.4.

← (DRN E9900733)

i) Diesel Generator Cooling and Heating System

The Diesel Generator Cooling Water System is described in Subsection 9.5.5.

j) Instrumentation and Control for Onsite Power Supply

Manual control of the diesel generators is described in Subsection 8.3.1.1.1(e).

Automatic operation of the units, as described in Subsection 8.3.1.1.1(e) is initiated by the engineered safety features or by a 4160 V bus undervoltage, and supersedes manual control.

Performance of the engine, generator and auxiliaries is monitored locally and at the main control room. Local devices are provided to monitor the following:

1) Fuel oil pressure and day tank level

2) Lube oil pressure, temperature and sump level

3) Jacket water pressure and temperature

4) Starting air pressure (in each receiver)

→ (DRN E9900733)

5) Manifold pressures and temperatures

← (DRN E9900733)

6) Engine speed and operating time

7) Exhaust gas temperatures at each cylinder head

8) Generator stator temperature

9) Engine crankcase pressure

10) Generator output (current, frequency, voltage, power, reactive power and energy)

11) Air receiver pressure (in each receiver)

→ (DRN E9900733)

12) Turbo oil pressure and temperature

← (DRN E9900733)

13) Lube oil filter differential pressure

14) Standpipe level

Main control room indication is provided for:

1) Generator output (voltage, power, reactive power, current and frequency)

2) Local - RTG control switch position, diesel stopped, cranking and running

3) Day tank level

4) Control voltage (dc)

Local alarms include high or low pressures, temperatures and levels as listed in Subsections 9.5.4, 9.5.5, 9.5.6 and 9.5.7, together with engine and generator trip alarms as listed in Subsection 8.3.1.1.2.11(c). A common alarm is transmitted to the main control room if any alarm condition occurs.

Two separate alarms (windows) per diesel generator in the control room are provided:

→ (DRN E9900733)

1) One alarm (window) annunciates "EDG Unavailable," and

2) One alarm (window) annunciates "EDG Trouble."

← (DRN E9900733)

The specific conditions that render a diesel incapable of responding to an automatic signal, which will be annunciated in the control room as "Diesel Generator Unit Available" are those listed below:

1) Low Low Starting Air Pressure in the Right and Left Air Receivers

2) Extremely Low Fuel Oil Day Tank Level

3) Diesel Generator Differential Protection Actuated

4) Diesel Generator Turning Gear Engaged

5) Diesel Generator Overspeed Protection Actuated

6) Loss of Both DC Control Power Sources

→ (DRN E9900733)

These six inputs, together with others which trip the Diesel Generator when running, are a subset of a broader "EDG Trouble" alarm. When any of the above inputs are present, both "EDG Unavailable" and "EDG Trouble" annunciators will be actuated.

Each of the above items are locally annunciated. Item 1 is annunciated on a local alarm when air pressure in right and left air receiver drops to a low pressure point.

← (DRN E9900733)

For local testing, both local and RTGB mode selector switches must be aligned. However, regardless of the mode selector switches position, the diesel generator will start automatically upon an emergency signal.

In the same group of annunciators discussed above, the "Diesel Generator Breaker Trip/Trouble" annunciates the breaker status: breaker trip, loss of control power, closing spring discharged and breaker not in position (racked-out).

k) Prototype Qualification Program

The KSV-16-T Diesel Generator set (similar to Waterford 3 Diesel Generator set) was fully qualified for standby power supply during the qualification program conducted jointly by Cooper Energy Services/Commonwealth Edison for their Zion station and Nebraska Public Power for their Cooper station. The qualification program and data are presently being used in the qualification of the Susquehanna 1 & 2 Diesel Generator sets and therefore is considered as a prototype qualification program for the Waterford 3 Diesel Generator sets and the Zion Units are as follows:

Parameter	Zion Units	Waterford 3 Units
Model	KSV-16-T	KSV-16-T
Power Rating	4030 KW, continuous	4400 KW, continuous
Supplementary Power Rating	4400 KW, 2 hrs out of 24	4840 KW, 2 hrs out of 24
Voltage	4160 V.	4160 V
WR^2	146,500 lb ft^2	67,900 lb ft^2
Phase Frequency	3 phase, 60 HZ	3 phase, 60 HZ

Note: Although the continuous rating of the Zion generator is lower than the Waterford 3 Unit, its WR^2 is much higher. Hence, the starting duty of the units qualified for Zion is more severe.

l) Basis for Diesel Generator Sizing

→

Table 8.3-1 lists all ESF loads and non-ESF loads which are used in checking the steady state rating of the diesel generator. This table shows the nature of the various loads, the number of each load that can be connected to the ESF bus, rating of each load in hp, starting load in kVA, the loading sequence step time and other details. The continuous rating of each diesel generator is based on the total calculated consumption of all loads, ESF and non-ESF, that will have to be powered by the system under design basis accident or safe shutdown conditions. The calculated load on each motor or heater is based on design calculations under expected flow and pressure conditions, or manufacturers' recommendations.

←

Each diesel generator has the following ratings:

1) 4400 kW - 8760 hours.

2) 4840 kW - two hours in any 24 hour period.

m) Diesel Generator Loading

→

Table 8.3-1 shows the automatic and manual loading sequence of the emergency power supply system. All essential loads are started automatically by their respective safety features actuation signals in a predetermined step-by-step loading sequence. Equipment which may require manual startup will only be started after the initial automatic sequential loading. The duration of time each safety-related load is required to be in operation is given in Table 8.3-1 along with the nominal size of the load, starting inrush load, etc. The diesel generator loading sequences for the three emergency conditions (LOCA, MSLB, LOOP) are also plotted graphically by load versus time, as shown on Figures 8.3-25a, 8.3-25b, 8.3-26a, 8.3-26b, 8.3-27a, 8.3-27b, 8.3-27c and 8.3-27d.

←

→(DRN 06-709, R15)
←(DRN 06-709, R15)

n) Operation of Sequencer Circuit

In the normal state the sequencer circuit is kept continuously energized. Thus, the status of sequencer readiness for operation is continuously monitored. In case of loss of 125V dc power source to the sequencer or failure of any of the sequencer relay, an alarm shall be annunciated in the control room. An alarm is also initiated in the control room each time the sequencer is tested or actuated by SIAS or undervoltage contacts. Any failure in the annunciator circuitry, such as short across the output wires, will be detected the first time the sequencer is tested. Periodic testing is shown in the Technical Specifications.

The operation of sequencer circuit is as follows (see Figure 8.3-36):

1) SIAS is reset, voltage on safety bus is normal.

Sequencer relays, 62S, SO thru S8, S61, SOX thru S5X, S7X and S8X are energized, S6X is deenergized, all contacts to annunciator are closed. In this state sequencer remains continuously ready for action.

2) SIAS is tripped

→(DRN E9900733)

Contact SIAS-1 opens and contact SIAS-2 closes. An interruption of power, for a duration of two seconds to the relays SO thru S8, S61 will be created due to a delayed action of relay 62S. Upon restoration of power, relays SO thru S8, S61 energize. They will start to pick-up relays S0X-S5X, S7X, S8X and S61X and drop out relay S6X in predetermined sequence, thus initiating sequential loading of the diesel.

←(DRN E9900733)

3) Voltage on safety buses is lost.

→(DRN E9900733)

Undervoltage relay contacts 27-1X, 27-2X, 27-3X, 27-11X, 27-12X and 27-13X will open and remain in open position until the voltage on safety buses is restored. The undervoltage relay contacts will reclose thus starting the sequencing action for loading of diesel.

←(DRN E9900733)

4) Sequencer circuit is tested.

The contact TS/TEST is opened momentarily. The sequencer relays will be momentarily de-energized and then will pick-up in their sequential order. Indicating lights on the main control room will indicate the operation of sequencer relays throughout the test, no other action will ensure from this test.

→ (DRN E9900733)

Change of state of the sequencer relays is also monitored by the Plant Monitoring Computer. Timing of the change of state can be determined by reviews of the Sequence of Events Recorder from the PMC.

← (DRN E9900733)

8.3.1.1.3 Design Criteria for Class 1E Equipment

Design criteria are discussed below for certain Class 1E equipment.

a) Motor Size

Motor sizes have been selected based on calculations of load-torque requirements or on the basis of equipment (pump, fan, compressor, etc.) supplier's recommendations.

→ (DRN E9900733)

In most cases motor rated horsepowers are greater than the normal running load and the associated maximum emergency load.

← (DRN E9900733)

b) Minimum Motor Accelerating Voltage

Safety-related motors are designed to start and accelerate their loads within specified time with a Diesel Generator output voltage profile as described in Subsection 8.3.1.2.4c and d.

c) Motor Starting Torque

The motor starting torque is capable of starting and accelerating the connected load to normal speed within specified time to permit its safety function for all expected operating conditions including the minimum design terminal voltage.

d) Motor Insulation

Insulation systems have been selected based on the particular ambient conditions to which the insulation will be exposed. For Class 1E motors located within the containment, the insulation system has been selected to withstand the postulated accident environment. In general all Class 1E motors have Class B, or better, insulation and are suitable for high-humidity operating conditions.

e) Interrupting Capacities of Switchgear, Power Centers, MCC's and Distribution Panels.

The interrupting capacities of the protective equipment have been determined as follows:

In the calculation of medium voltage switchgear interrupting capacities, ANSI C37.010-1972 (IEEE 320-72) has been followed. The power system, diesel generator, and connected motor contributions have been considered in determining the fault current.

Power center, MCCs and distribution panel circuit breakers have a symmetrical rated interrupting capability at least as great as the calculated total available symmetrical current at the point of application. Symmetrical currents have been calculated in accordance with procedures of ANSI C37.12 (IEEE 20-73) for low voltage circuit breakers other than molded case breakers and in accordance with NEMA Standards Publication AB-1-1975 (Rev 2-1977) for molded case circuit breakers.

f) Electric Circuit Protection

Refer to Subsection 8.3.1.1.2.11 for discussion regarding the electric circuit protection.

g) Grounding

→ (DRN E9900733)

The station ground grid has been designed based on IEEE standard formulas which were incorporated into a computer program entitled "Ground System Design." Equipment frames are solidly connected to the station ground rid with conductors of adequate capacity to carry the maximum ground fault current due to line to ground faults for the breaker tripping time. The program has been used successfully in various installations and it has been found acceptable by the respective users. A listing of users is provided in Table 8.3-18.

← (DRN E9900733)

The system has been designed with neutral grounding for detection and alarm of ground faults. The neutral of the diesel generator is grounded through a combination grounding transformer and resistor. This will permit the diesel generator to function continuously under emergency conditions with a single ground fault in the 4.16 kV ESF system.

The 4.16 kV and 6.9 kV delta windings of the unit auxiliary transformers and start-up transformers have been grounded through resistor/transformer combinations. Neutrals of all power center transformers are resistance grounded.

8.3.1.1.4 Electrical Penetrations

All electrical penetrations are of modular design with header plates of stainless steel. The modules have dual pressure seals and a retaining ring arrangement within the header plates. The header plate assemblies are welded to the nozzles through the containment and Shield Building walls. A steel sleeve attached to the Shield Building protects the conductors where they pass through the annulus between the penetrations. Each penetration assembly will be leak-rate tested periodically in accordance with the Technical Specifications.

High voltage penetrations are equipped with bushing type terminations. The low-voltage power control modules are provided with pigtails.

Pigtails are terminated on all safety related circuits inside the containment by in-line splices (bolted and crimped) and coaxial cable connectors, only. All safety related pigtails outside the containment are terminated by in-line splices (bolted and crimped), coaxial cable connectors and terminal blocks.

The electrical penetrations are in conformance with IEEE 317-1972.

Penetrations are protected against overcurrent as follows:

a) 6.9 kV Circuits

Each of the four reactor coolant pump motor circuits, which are the only circuits penetrating the containment at this voltage, is provided with differential and overcurrent protection, arranged to trip the feeder breaker. If current still flows in the feeder after a preset time, (i.e., the feeder breaker fails to trip) a transfer trip signal is given to the line breaker feeding the bus.

In order to protect the 6.9 kV circuit containment penetration from a single failure of dc control power which would prevent the primary and backup feeder circuit breaker from clearing an electrical fault in the RCP motor power feeder circuit, an independent source or dc control power is provided for the RCP motor and the 6.9 kV containment penetration circuits as shown on Figure 8.3-7. This illustrates the 125 V dc power sources for the primary and backup feeder breaker control power.

A line-to-line fault is detected by two differential relays and two overcurrent relays; hence failure of three relays does not prevent tripping. A three phase fault involves three of each kind of relay and failure of five relays does not prevent tripping.

Overcurrent in the feeder does not cause the differential relays to operate if it is due to overload on the motor. However, overload on one phase only is impossible, so at least two overcurrent relays are involved for any overload condition. Therefore a single relay failure will not prevent tripping.

A single line-to-ground fault results in only about 10 A of fault current because the 6.9 kV system is high-resistance grounded.

Tripping is therefore not necessary to protect the penetration against this low current.

b) 480 V Circuits from Switchgear

Differential protection is not applied to any 480 V circuits, but otherwise the penetrations are protected by the same type of overcurrent protection as the 6.9 kV penetrations. The backup breaker receiving the transfer signal in this case is the 4.16 kV breaker supplying the station service transformer which supplies the affected 480 V bus.

c) 480 V Circuits from Motor Control Center

Overcurrent protection is provided on these circuits by a thermal overload relay in each phase, responsive to overloads up to locked rotor (stalled) conditions, which trip the contactor. Should the contactor not trip, a thermal magnetic breaker will trip on overloads of this kind.

Fault currents, in excess of locked rotor currents, cause instantaneous tripping of the breaker. Should the breaker fail to trip, backup fuses or breakers are provided which have tripping characteristics chosen to parallel the response curves of the overload relays, and of the thermal and magnetic elements of the breaker. The maximum energy let-through of this protection system is far less than that required for thermal damage to the penetration conductor. The three-fold nature of this protection ensures that no single failure will prevent tripping.

d) 480 V and 208 Y/120 V AC Circuits from Distribution Panels.

These feeders are not provided with thermal overload relays and contactors, so the first stage of protection, as outlined in c) above, is omitted. However, two thermal magnetic breakers in series or thermal magnetic breakers with backup fuses still provide two level of protection, so that no single failure will prevent tripping.

e) 208 V and 120 V AC Motor Space Heater Circuits

These circuits are provided with two molded case circuit breakers in series, either of which will trip for any fault or overload condition.

f) 120 V AC Control Circuits from Control Transformers

These low energy circuits are protected by fuses. No backup protection is provided as the largest control transformer used is 350 VA which will limit the short circuit current at the penetration to a value below the continuous rating of the penetration conductor. Any 120 V ac control circuits derived from distribution panels have backup protection as described in Subsection 8.3.1.1.4.d.

g) 125 V DC Control Circuits

→ (DRN E9900733)

DC circuits are ungrounded and protected by double pole fuses or circuit breakers with backup fuses. In both cases short circuit or overcurrent condition is detected by two devices in series; if one fails, the other provides protection.

← (DRN E9900733)

h) Instrumentation Circuits

These are circuit in which the possible energy release on fault is so low as to be less than the maximum that the penetration can withstand. Therefore, no protection is required.

Table 8.3-20 and Figures 8.3-28 through 8.3-32 provide the electrical penetration capability rating, the maximum expected fault currents, the maximum expected clearing times and the maximum fault conditions in case of primary protection failure.

8.3.1.1.5 Cables and Raceways

All cables are rated to suit the conditions of service to which they are exposed. Ampacities are governed by the maximum continuous load and fault currents, as described in Subsection 8.3.1.1.1.

Environmental conditions under which cables must operate are given in Section 3.11 and the cables have been proved (by type-testing) to meet these conditions.

Raceways are rigid steel conduits, solid bottom cable trays or ladder type cable trays. Power cable fill and ampacity derating are in accordance with NEMA and IPCEA requirements. For Control and Instrumentation trays, no derating is required since negligible heat is generated and calculated fills may equal the side rail depth. In practice this may result in fills exceeding the side rail depth due to limitations of training cables during installation.

All raceways are supported securely and at intervals governed by the span loading plus any point loading which may be imposed.

Where necessary, seismic restraints are provided. (Refer to Subsection 3.10.3).

8.3.1.1.6 Cathodic Protection

→(DRN 99-2053)

Although cathodic protection is a requirement for underground metallic structures, cathodic protection is not provided for the Preferred Power System since the system has no components that are located underground. (See Subsection 8.2.1.6.6 for description).

←(DRN 99-2053)

8.3.1.2 Analysis

Class 1E electric components are designed to ensure that any of the design basis events listed in IEEE Standard 308 does not prevent operation of the minimum number of ESF loads and protective devices required. The onsite power system is designed to meet the requirements of IEEE Standards, General Design Criteria and Regulatory Guides, as listed in Subsection 8.1.4.3.

The General Design Criteria are covered in detail in Section 3.1.

The following design aspects illustrate the extent of conformance with Regulatory Guides and IEEE standards.

8.3.1.2.1 GDC Criterion 17

The two divisions of the onsite power system are completely redundant to and independent of each other and are also independent of the preferred (offsite) power system.

No equipment is ever shared between the two divisions and each division can supply all the power required by the various safety related loads in sufficient time to ensure that reactor design limits are not exceeded.

8.3.1.2.2 GDC Criterion 18

Because of the redundancy of the two onsite power divisions, components of either may be tested while the other remains available to supply power to the redundant ESF loads.

8.3.1.2.3 Regulatory Guide 1.6-1971

a) The electrically powered loads, both ac and dc, have been separated into two redundant divisions such that loss of either division will not prevent the minimum safety functions from being performed.

b) Each ac division has a connection to the preferred (offsite) power source and to a standby (onsite) power source. Each standby power source has no connection to the other redundant load group.

c) Each dc division has a separate battery and battery charging system. No connection has been provided between the battery and charger combination of one group and the combination of the other redundant load group.

d) The two redundant standby sources have no provision for automatic paralleling. Manual paralleling with the preferred power system is possible only through one of the two non-ESF 4.16 kV buses 3A2 and 3B2. However, administrative control will ensure that only one diesel generator is in parallel with the system at any time. If the standby sources are the only sources of power during an emergency, they are always isolated from each other and from the non-safety related 4.16 kV system.

e) No provision exists for automatically connecting one load group to the other or for transferring loads between redundant power sources.

f) The tie breakers that connect buses 3A3-S or 3B3-S to bus 3AB-S are electrically interlocked to prevent the connection of the two buses 3A3-S and 3B3-S to each other. Similar interlocking is provided to prevent the interconnection of 480 V buses 3A31-S and 3B31-S through bus 3AB31-S.

→(DRN E9900733)

The system can be tested from the control room following the sequence of operations described in Subsection 8.1.3 for the transference of system SAB from system SA to SB or vice versa. Breaker position status is given by indicating lights located in the control room. These lights will show that two breakers of the same voltage level are open. The time interval to demonstrate proper breaker alignment and power availability will be in accordance with the applicable Technical Specification.

←(DRN E9900733)

g) Each standby power source consists of a single generator driven by a single prime mover.

→(LBDCR 14-010, R308)

8.3.1.2.4 Regulatory Guide 1.9-1971 and 1.9-2007

←(LBDCR 14-010, R308)

The diesel generators are each rated as shown on Table 8.3-2. The maximum automatically started load on each diesel generator is within the continuous rating of 4400 kw. The total maximum load, including manually started loads, is within the two-hour rating.

→(LBDCR 14-010, R308)

Waterford 3 was originally licensed to Regulatory Guide 1.9 Revision 0. All historic requirements such as the original design criteria, factory production testing, initial type tests, preoperational testing have been completed and approved by the NRC. The historic requirements remain approved to Regulatory Guide 1.9 Revision 0. New or ongoing activities such as surveillance testing, periodic testing, and modifications meet Regulatory Guide 1.9 Revision 4 requirements as described in FSAR Section 1.8.1.9.

←(LBDCR 14-010, R308)

a) Preoperational tests are discussed in Chapter 14.

b) Preoperational tests will verify the capability of each diesel generator set to start and accelerate to rated speed all of the needed ESF and emergency shutdown loads in the required sequence.

→(DRN E9900733)

c) During the period of load application or during the period of load removal, the generated voltage and frequency are maintained above 75 percent and 95 percent, respectively. However, in the remote event that the EDG loading is not sequenced as designed (i.e., all process controlled loads are simultaneously connected at the end of the loading cycle) then the frequency may momentarily dip to 93.3 percent. This issue is discussed in NRC Information Notice 92-53.

→(DRN 99-2053)

d) Diesel generator design requires that during the loading sequence the voltage and frequency are restored to at least 90 and 98 percent respectively within 40 percent of each loading sequence time interval. (Additional discussion can be found in Technical Specification Bases, "Electrical Power Systems".)

←(DRN E9900733; 99-2053)

e) The diesel generator has been designed to withstand without damage speeds up to 125 percent of normal rated speed. Also, the overspeed trip device is set sufficiently high (110 percent of normal rated speed) to ensure that the unit will not trip on rejection of the largest single load.

f) Each diesel generator has adequate capacity to start and accelerate the largest single load out of sequence, with all other loads running.

8.3.1.2.5 Regulatory Guide 1.22-1972

References discussing compliance with this guide are listed in Table 8.1-3.

8.3.1.2.6 Regulatory Guide 1.29-1973

The onsite power supplies, the ESF 4160 V and 480 V switchgear, the 4160-480 V ESF power center transformers, ESF MCCs and the 120 V uninterruptible ac system are all in compliance with RG 1.29-1973. The isolating devices between MCC buses and associated circuits also comply, as discussed in Chapter 7.

8.3.1.2.7 Regulatory Guide 1.30-1972

References discussing compliance with this guide are listed in Table 8.1-3.

8.3.1.2.8 Regulatory Guide 1.32-1972

The design complies with the positions of this guide. It also complies with the positions of Revision, dated March 1976, except for the following:

→(DRN E9900733)

Position (b) has been complied with, except that "transient" loads occurring within the first two periods of the loading cycle (Tables 8.3-4 and 8.3-5) have not been considered. Such loads are only applied to the battery when ac power is unavailable, which means that the battery chargers have no input and therefore no output. (Further discussion of the batteries and their chargers is contained in Subsection 8.3.2.1.2.)

←(DRN E9900733)

8.3.1.2.9 Regulatory Guide 1.40-1973

Compliance with this guide is discussed in the QA Program Manual.

8.3.1.2.10 Regulatory Guide 1.41-1973

That the requirements of Regulatory Guides 1.9 and 1.32 have been met will be proved by Preoperational Testing.

8.3.1.2.11 Regulatory Guides 1.53-1973, 1.62-1973 and 1.73-1974

References discussing compliance with these guides are listed in Table 8.1-3.

8.3.1.2.12 Regulatory Guide 1.63-1973

Compliance with this guide is discussed in Subsection 8.3.1.1.4.

8.3.1.2.13 Regulatory Guide 1.75-1975

The Class 1E portions of the Onsite Electric System comply with the positions of this guide, as follows:

a) Position C1. The non-class 1E 4.16kV, most 480V electrical power circuits and some plant lighting circuits supplied from the class 1E system, have provision for isolation through class 1E circuit breakers located in seismic Category I structures. Isolation is initiated by a LOVS (Loss of Voltage Signal) which trips the individual 4.16kV or 480V power breakers feeding the non-class 1E loads. For loads fed from 480V MCC's, the bus is divided into class 1E and non-class 1E sections and the LOVS isolates the non-class 1E section by tripping the interconnecting tie breaker.

→ (DRN E9900733)

The non-Class 1E inverter, and some low voltage power circuits and lighting circuits, fed from the Class 1E system include double protection by either: two breakers in series; or one breaker and a fuse in series; or two fuses in series. All these designs prevent the non-1E circuits from degrading the Class 1E system. These double protection schemes coordinate with the upstream device protecting the bus. Waterford discontinued using Class 1E powered non-1E valve motor operator limit-switch-compartment heaters and valve motor-housing heaters in early 1988.

← (DRN E9900733)

b) Position C2. Interlocked armored cable is not used as a raceway.

c) Position C3. As far as possible, redundant equipment is located in separate compartments within a seismic Category I structure. Where this is not possible, barriers or physical separation are used as described in Subsection 8.3.1.2.19.

d) Position C4. Cables used in both safety-related and associated circuits are subject to the same requirements such as cable derating, environmental qualifications, flame retardance, splicing restrictions and raceway fill.

→ (DRN E9900733)

e) Position C5. The feeders to the safety-related buses from the Preferred Power System buses are run in cable bus duct, which contains no other cables, and which is separated from all Class 1E circuits.

← (DRN E9900733)

f) Position C6, C7. Non-safety-related computer digital input low voltage circuits (48v dc or less) and annunciator inputs emanating from safety-related equipment form a separate category of "information" circuits which, due to their low power levels, cannot degrade Class 1E systems with their failure. These circuits are called "information" circuits.

Computer digital input low voltage circuits (48v dc or less) and annunciator input signals are considered non-Class 1E information circuits. Information circuits will not be provided with isolation devices as separation from Class 1E circuits. The cables for information circuits run with Class 1E circuits inside the equipment and in the external non-Class 1E Instrumentation Raceway System. It is permissible for these computer and annunciator cables from redundant Class 1E equipment to be connected together onto a common point at the annunciator or computer.

The analysis shown on Tables 8.3-15, 8.3-16 and 8.3-21 demonstrate that for these types of circuits, the maximum fault current is negligible and therefore pose no source of adverse interaction between adjacent cables or terminations. This analysis demonstrates the absence of adverse interaction between non-Class 1E and associated or Class 1E circuits.

g) Position C8. No such reliance is placed on Section 5.1.1.1 of IEEE 384-1974.

h) Position C9. Cables are not spliced in raceways. All cable splices are made in properly designed fittings, boxes, etc, or in controlled areas (eg, the penetration pigtail splices).

i) Position C10. The method of identification of cables and raceways such as that described in this position is not required based on the Waterford 3 PSAR commitments. While LP&L has made every effort to meet the recommendations of Reg. Guide 1.75 wherever practicable. It is not considered practicable or cost effective to comply with this particular position. We believe the methods outlined below provide a satisfactory and practical alternative to achieve the same intent and will facilitate initial verification of separation criteria.

The exposed raceway system consists of cable trays, exposed conduits and boxes. The system we have adopted is based on the following.

<u>Cable Trays</u>

The cable tray systems have been designed in a manner such that no interconnections exist between redundant tray systems. This requirement has been verified during installation, therefore, once a cable is inside the tray the possibility of it improperly entering into a redundant tray is eliminated.

The cable tray number and color code markers have been installed in accordance with the design criteria which enabled the field QA Engineer to visually trace and verify the compliance of the cable tray installation with the Waterford 3 design drawings.

In areas of congestion, additional markers were installed to facilitate easy identification.

Conduits connecting the trays to other equipment are installed from a computer printed slip which duplicates the same data as the conduit list drawing. Each conduit installation is verified by the QA Engineer. Once this has been done it is only necessary to ensure that the correct cable enters the conduit and verification is ensured.

Cable installation is also controlled from a computer printed slip. Cables are inspected for proper entrance into each conduit, box, equipment or drop into another tray of the same system.

Conduits

As in the case of cable trays, conduits have been identified in accordance with the design criteria with numbers, and coded to permit verification of the installation by the QA Engineer.

Note: As shown on Drawing LOU 1564 B288 (Installation Details for Solenoid Operated Valves and Other Miscellaneous Devices), certain conduits running from a terminal box to a device are not numbered. In these cases, cable and conduit installation is verified, and traceability maintained, by using conduit and cable cards requiring identification by Bill of Material/Reel Number data and color coding (For safety-related conduit). The QC Inspector acknowledges observing the pull by signing the card.

Pull Boxes

Boxes are color coded and numbered.

Cables

All single and multiple conductor cables with overall jackets have been purchased with black jackets. During plant construction, color coding per design criteria was performed with adhesive colored markers. The cables are numbered (except as noted above) at each end with an adhesive marker which includes safety class designators. Because of built-in safeguards and several levels of checking for cable routing (both from the design standpoint and the installation standpoint), color coding of cables installed after plant construction in not required.

k) Position C11. Color coding and labeling techniques are such as to be easily memorized and to require no reference to documents, etc. (See Subsection 8.3.1.3).

l) Position C12. Except for lighting and other low power cables supplying circuits within the main control room, no power cables are routed through the cable spreading room.

Redundant cable spreading rooms are not used, but all cables of one division are physically separated from those of the other by distance or barriers as described in Subsection 8.3.1.2.19.

m) Positions C14 and C15. Separate ventilation systems are furnished (see Subsection 9.4.2).

n) Position C16. Refer to Subsection 8.3.1.2.19.

8.3.1.2.14 IEEE Standard 279-1971

The provisions of this standard relate mainly to the Reactor Protective System and are discussed in Chapter 7. The electrical system supplying power to the Reactor Protective System has been designed to ensure that failures in the supply system have no worse consequences than failures in the Reactor Protective System, as follows:

→ (DRN E9900733)

a) Power supply to the protection systems is from four (one for each channel) power supply inverters as described in Subsection 8.3.1.1.1(c). No random single failure in any one inverter will degrade the performance of the other three,. With one measurement channel bypassed for testing, failure of a second channel inverter will still leave two channels functional, thus providing protection without unnecessary tripping (because of the "two out of four" logic).

← (DRN E9900733)

b) Any one of the four power supply units can be isolated for maintenance at the same time as the remaining protective channel equipment is being maintained.

c) Action of the manual transfer of the 120 V bus to the bypass transformer, is annunciated in the main control room.

d) Each power supply unit is so constructed as to facilitate repair by replacement of defective components or modules, to ensure a minimum of downtime.

IEEE Standard 279-1971 has also been used as a guide in the design of all safety related power systems as far as applicable. In particular, the power systems have been designed to meet the single failure criterion; equipment may be tested for functional integrity when the loads it supplies are tested; and all bypasses in safety related circuits (eg, thermal overload relays in valve-operating motor starters) are provided with indication.

8.3.1.2.15 IEEE Standard 308-1971

The Class 1E electric systems comply with the requirements of this standard, as modified by Regulatory Guide 1.32 (see Subsection 8.3.1.2.8) as follows:

a) Principal Design Criteria:

1) Conditions of operation, due to Design Basis Events, both natural and postulated, have been defined in Sections 3.10 and 3.11; Class 1E electric systems design was developed and equipment purchased such that their safety related functions can be performed, in the respective operating environment, under normal and DBE conditions.

2) The quality of the Class 1E electric system output is such that all electrical loads are able to function in their intended manner, without damage or significant performance degradation.

3) Control and indicating devices, required to switch between the preferred and standby power supplies and to control the standby power supply system are provided inside and outside the main control room.

4) All Class 1E electric system components are identified, along with proper channel assignment.

5) Class 1E electric equipment is physically located in seismic Category I structures and separated from its redundant counterpart to prevent the occurrence of common mode failures.

6) Equipment qualification by analysis, tests, successful use under similar conditions, or a justifiable combination of the foregoing, ensures that the performance of safety related functions under normal and DBE conditions was demonstrated. (Refer to Section 3.10).

7) Tables 8.3-6 through 8.3-11 depict the single failure analysis and the failure mode analysis for the Class 1E electric systems.

b) AC Power Systems

1) Alternating current power systems include power supplies, a distribution system and load groups arranged to provide ac electric power to the Class 1E loads. Sufficient physical separation, electrical isolation and redundancy have been provided to prevent the occurrence of common failure modes in the Class 1E systems.

2) The electric loads have been separated into two redundant groups.

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

4) Each of the load groups has access to both a preferred and a standby power supply.

5) The preferred and the standby power supplies do not have a common failure mode between them. This has been ensured by means of administrative controls that will allow only one diesel generator to be tested at any time. Also, protective relaying has been included to isolate the standby sources from the preferred power sources from the preferred power sources in order to preserve the availability of the standby sources.

c) Distribution System

1) All distribution circuitry is capable of starting and sustaining required loads under normal and DBE conditions.

2) Physical isolation between redundant counterparts ensures independence.

3) Local and remote control and indicating components monitor distribution circuits at all times.

4) Auxiliary devices that are required to operate dependent equipment are supplied from a related bus section to prevent loss of electric power in one load group from causing the loss of equipment in another load group.

d) Preferred Power Supply

1) The preferred power supply derives power from two alternative sources.

2) Energy in sufficient quantities is available for normal, standby, and emergency shutdown conditions of the plant.

3) Offsite power is available to start and sustain all required loads.

4) Surveillance of the availability and status of the preferred power supply is maintained to ensure readiness when required.

e) Standby Power Supply:

1) The standby power supply consists of two diesel generators, each connected to one of the ESF 4.16 kV ac buses. Each diesel generator represents a complete, independent source of standby power.

2) The redundant standby power supplies provide energy for the ESF systems when the preferred power supply is not available.

3) Independence of the two standby power systems ensures that a failure of either standby power source will not jeopardize the capability of the remaining standby power source to start and run the required Class 1E loads.

4) Each diesel generator is available for service within the time specified upon loss of the preferred power supply.

5) Status indicators, in the main control room and remotely located, provide monitoring and alarm for the surveillance of all vital functions for each diesel generator with respect to standby and operating modes. (See Section 9.5)

6) Sufficient fuel is provided at the site to sustain the operation of both standby diesel generators continuously for seven days (with loading as shown in Table 8.3-1), or of one unit for 14 days (with loading as shown in Table 8.3-1). Offsite supplies of fuel are available for transportation to the site within seven days.

→ (DRN 99-0682)

7) Automatic and manual controls are provided for the selection and connection of all ESF loads supplied by the standby power sources. Any non-ESF load (excluding loads identified in Table 8.3-1) connected to the ESF buses can be manually reconnected by the operator as provided for in Subsection 8.3.1.1.2.4.

← (DRN 99-0682)

8) Automatic devices disconnect and isolate failed equipment and indication to this effect is provided.

9) Test starting and loading can be accomplished during normal station operation.

For the analysis of the dc system, see Subsection 8.3.2.2.1.

8.3.1.2.16 IEEE Standard 317-1972

Electrical penetrations are designed in accordance with this standard. For description, and for discussion on protection, see Subsection 8.3.1.1.4.

8.3.1.2.17 IEEE Standard 336-1971

Electrical equipment has been so specified as to enable the requirements of this standard to be met.

8.3.1.2.18 IEEE Standard 338-1971

Because of the separation of all safety related electrical equipment into at least two redundant groups, it is possible to test the power equipment while testing the signal and control systems. (Further discussion is in Chapter 7.)

8.3.1.2.19 IEEE Standard 384-1974

The extent to which this standard has been followed is described below. (Refer to Subsection 8.3.1.2.13 for a discussion of the related provisions of Regulatory Guide 1.75-1975.)

a) General Separation Criteria

Equipment and circuits requiring separation have been identified on drawings and in the field in a distinctive manner as described in Subsection 8.3.1.3.

All control and power equipment and cables of systems in each safety related division have been separated from those of the other division and from those of non-safety related systems, except as noted in Subsection 8.3.1.2.13.

Associated circuits have been designed and installed in accordance with Sections 4.5 (1) and 4.5 (2) of the standard. A special group of associated circuits are the low energy "information" circuits (for computer and annunciator service), which are discussed and analyzed in Subsection 8.3.1.2.13 in accordance with Section 4.5 (3) of the standard.

Non-Class 1E circuits have been separated from Class 1E circuits and associated circuits in accordance with Sections 4.6.1 and 4.6.2 of the standard, with the exception of the "information" circuits discussed in Subsection 8.3.1.2.13.

Class 1E equipment is installed in safety class structures and where equipment of both divisions is contained in a single room, separation is provided by incombustible barriers. No high pressure piping, flammable material or rotating machinery is present in the switchgear room containing the 4.16 kV switchgear, 480 V power centers, 125 V dc batteries, chargers and switchboards and certain 480 V MCCs.

b) Specific Separation Criteria - Cables and Raceways

Cables used in the plant are flame retardant and are installed in steel ladder or trough type trays or in steel conduit. Therefore, in areas from which missiles and other hazards are excluded, the minimum separation distances of Sections 5.1.3 and 5.1.4 of the standard are generally maintained. Where one inch minimum separation cannot be maintained between redundant enclosed raceways and between barriers and raceways, a flame retardant material is used to provide as a minimum the equivalence to one inch separation in air.

In those cases where a flame retardant material is not used and damage is limited to failures or faults internal to the circuits, the minimum separation distance is established by analysis of the cable installation in accordance with Paragraph 5.1.1.2 of the standard.

→ (DRN E9001247)

An analysis was performed and which determined that control/low voltage level circuits in one enclosed raceway may be within one inch (including touching) of another enclosed raceway containing control/low voltage level circuits due to insufficient energy in those circuits. Some power circuits do not have the ability to generate sufficient energy to cause damage to an adjacent raceway. This analysis is governed by 480 volts and less and by #8 AWG and smaller cable. Temporary routed cables, not contained in conduit, may be within one inch (including touching) of an enclosed raceway containing safety related cables based on the cable's energy level.

← (DRN E9001247)

The cable spreading room contains no switchgear, piping, high power cables or other sources of high energy. Low power (120 V) cables are installed in rigid steel conduits and cable trays.

A dedicated automatic sprinkler system has been provided for each safety related cable tray in the cable spreading room and the electrical penetration area (EL. +35.00' MSL). In these areas, cable tray covers are not provided since they would defeat the protection afforded by the dedicated suppression system.

Cables are identified as described in Subsection 8.3.1.3 and markers are located as discussed in Subsection 8.3.1.2.13. Raceways are marked and markers are located as described in Subsection 8.3.1.3.

Where cables enter control boards, the provisions of Section 5.1.3 of the standard are met by the use of enclosed raceways. For discussion of separation of circuits inside control boards, refer to paragraph (g) below.

In plant areas, wherever a possible missile hazard may be present, barriers are used to protect the electrical systems as described in Section 3.5.

c) Specific Separation Criteria - Stand by Power Supply

The redundant diesel generator units are installed in separate rooms in the seismic Category I Reactor Auxiliary Building at Elevation +21 ft. and have independent ventilation systems. Local controls and auxiliaries for each unit are located in the same room as the unit they serve. Remote controls for both units are located in the main control room at Elevation +46 of the Reactor Auxiliary Building.

d) Specific Separation Criteria - dc System

The Class 1E batteries are installed in separate compartments in the seismic Category I Reactor Auxiliary Building and have independent ventilation systems. The chargers are installed in the same structure but outside the battery rooms, which provide complete physical separation between the chargers of each battery.

e) Specific Separation Criteria - Distribution System

All electrical supply equipment is physically separated in accordance with Section 4 of the standard, as described under a) above.

f) Specific Separation Criteria - Penetrations

The containment electrical penetrations are located in two groups, one for each division, in a missile - protected area. Separation between the two groups is maintained in accordance with Section 4 of the standard. The non-Class 1E penetrations are treated the same as Class 1E penetrations.

g) Specific Separation Criteria - Control Boards

With the exceptions of the two diesel-generator local control boards (paragraph (c) above), all safety related control boards are located in the main control room. The main control room is free from high pressure steam or water piping and from major rotating machinery, and control boards are not exposed to pipe whip, jet impingement or missiles.

→ (DRN E9900733)

Redundant Class 1E equipment is mounted on separate panels wherever possible. Where separate panels are not feasible, instrumentation and other equipment is grouped so that the minimum distance between items of different safety divisions or measurement channels is six in., where this clearance is not possible, a steel barrier is used.

← (DRN E9900733)

→ (DRN E9900733)

Wiring of each safety division or measurement channel is bundled and identified (see Table 8.3-12); where wiring of one division or channel must traverse an area dedicated to another division or channel, steel conduit or solid tray with cover is used.

← (DRN E9900733)

As described in Subsection 8.3.1.2.13f, it is permissible that non-Class 1E information circuits, because of their low energy level, need not be physically separated from Class 1E circuits once the cables exit the conduit or tray for entry into the control panels. The criteria applied to information circuits also applies to other non-Class 1E low level circuits. These circuits may therefore be harnessed together with Class 1E circuits and may share the same terminal board as Class 1E cables. Some examples of control boards (CP's) having this arrangement are CP-10 and CP-22 and the process instrumentation cabinets discussed below.

Within the process instrumentation cabinet (process analog panels (PAC) CP-25 through 28, CP-41 through 45, 48 and 49; LCP-61 and LCP-62) low energy non-Class 1E wiring connected to the plant monitoring computer multiplexors and to annunciator logic cabinet CP-19 are harnessed together with Class 1E wiring. Each PAC cabinet is dedicated to one channel (division) only and the non-Class 1E external cables are segregated from Class 1E external cables where they exit at the bottom of the panel. Figure 8.3-34 depicts the cabling arrangement and routing criteria within these panels. Externally, the non-Class 1E cables are routed in non-Class 1E raceways and do not become associated with redundant channels (divisions).

The low energy non-Class 1E cables connected to the annunciator logic cabinet CP-19 are information circuits identified with a suffix XMA, XMB, XMC, XMD, XA, XB and XAB. The analysis for these circuits is shown in Tables 8.3-15 and 8.3-16. The low energy non-Class 1E cables connected to the plant monitoring computer multiplexor are non-Class 1E circuits identified with a suffix NA, NB or NAB. They carry non-Class 1E analog signals which are separated from the Class 1E circuits by an isolator. The analysis for these circuits is shown in Table 8.3-17. (Refer to event 2.2 for separate powered transmitter and Figure 8.3-21.) Figure 8.3-25 is an example of internal wiring in cabinet CP-41 showing the plant monitoring computer signal isolator.

All materials used in control boards are flame retardant.

h) Specific Separation Criteria - Instrumentation Cabinets

The provisions of paragraph (g) above apply also to instrumentation cabinets.

i) Specific Separation Criteria - Sensors and Sensor-To-Process Connections

The sensors are located and connected to the tap points in accordance with the provisions of Section 5.8 of the standard.

j) Specific Separation Criteria - Actuated Equipment

The locations of all actuated equipment has been reviewed to ensure that the provisions of Section 5.9 of the standard are met.

k) Isolation Panel

The Isolation Panel is used to isolate control circuit whenever an interface between two different channels is required.

The panel is subdivided in several compartments, each compartment being dedicated one channel. The isolation between channels is accomplished by using rotary type isolation relays. The shaft of the isolation relay penetrates the separation barrier between two compartments in the isolation panel.

The coil of these relays are separated from the contacts by a steel barrier covered with a fire retardant material.

The coil of the isolation relay is located in one compartment while the contacts of the same relay are operated by the relay shaft in the other compartment, thus realizing the necessary physical separation between coil and contacts of same relay.

l) Specific Separation Criteria - Heat tracing redundant or single heater cable is installed below the horizontal centerline of the pipe, except when it is being spiraled in accordance with isometric drawings or when an obstruction prevents it.

The control sensor is installed at a minimum of 90° from the heater cable. In case of redundant systems where this separation cannot be maintained for physical reasons, the sensor of one system is installed as close as possible to the heater cable of the other system, without coming in contact.

A minimum of one inch separation is maintained between redundant safety-related heat trace cables wherever physically possible. When the size of the pipe precludes a separation of one inch, a maximum possible separation will be maintained so that in no case do the cables come in contact.

→(LBDCR 14-010, R308)

8.3.1.2.20 IEEE Standard 387-1972 and 387-1995

The diesel generator units are designed, constructed and installed in accordance with IEEE 387-1972. They are provided with surveillance systems to indicate occurrence of abnormal, pretrip or trip conditions. Periodic tests will be performed on the power and control circuits and components including protective relays, meters, and instruments to demonstrate that the emergency power supply equipment and other components that are not exercised during normal operation of the station are operable. The operational tests will be performed at scheduled intervals to test the ability to start the system and run under load for a period of time long enough to establish that the system can meet its performance specifications in accordance with IEEE 387-1995.

←(LBDCR 14-010, R308)

In addition, the components and piping systems for the diesel generator auxiliaries (fuel oil, cooling water, lubricating air starting, and intake and combustion systems) are designed to Safety Class 3 and seismic Category I requirements, as discussed in FSAR Subsections 9.5.4 through 9.5.8.

→(LBDCR 14-010, R308)

All historic requirements such as the original design criteria, factory production testing, initial type tests, preoperational testing have been completed and approved by the NRC. The historic requirements remain approved to IEEE Standard 387-1972. New or ongoing activities such as surveillance testing, periodic testing, and modifications meet IEEE Standard 387-1995 recommendations with the following exceptions and clarifications.

IEEE standard 387-1995 lists that seismic qualifications are in accordance with IEEE Standard 344-1987. Waterford complies with IEEE Standard 344-1971.

←(LBDCR 14-010, R308)

→(LBDCR 14-010, R308)

IEEE Standard 387-1995 lists that documentation satisfies IEEE Standard 323-1983. Waterford 3 complies with IEEE Standard 323-1971.

IEEE Standard 387-1995 Table 4 lists the minimum set of test parameters to be recorded during testing. The table lists six lube oil pressure parameters. Waterford 3 diesel instrument design only captures four of these parameters.

←(LBDCR 14-010, R308)

8.3.1.2.21 Equipment Operating in a Hostile Environment

All electrical equipment which is required to operate in a hostile environment is listed in Section 3.11, together with a full discussion as to how such equipment was qualified for the environmental conditions listed.

8.3.1.3 Physical Identification of Safety Related Equipment

→ (DRN E9900733)

All Class 1E equipment, such as 4.16 kV switchgear, 480 V power centers, 480 V MCCs, 125 V dc batteries, chargers and switchboards, diesel-generator units, inverters, dc and ac distribution panels and control panels, has been identified with permanent and indelible labels. These labels contain the name, identifying number and safety related division. They are color-coded (as described in Table 8.3-12) to indicate the divisions to which the equipment belongs.

←(DRN E9900733)

In addition, a separate label as described in Table 8.3-12 identifies them as "CLASS 1E."

Cable is identified by labels applied at each end of the cable; these labels contain the cable number and division.

Raceways are identified by labels applied at identification points as discussed below; these labels contain the raceway number in black letters on a white background. In addition, safety related raceway labels are color coded as described in Table 8.3-12.

Pull boxes in conduit runs are identified by labels on the cover and inside the box, bearing the box number and color code as for raceways.

Raceways are marked at the points required by IEEE 384-1974. However, where feasible a 50 ft. maximum distance between markers is used, rather than the 15 ft. mentioned in the standard, as this distance has been demonstrated during actual field installation to be reasonable for long raceway runs.

8.3.1.4 Independence of Redundant Systems

The redundant systems are designed to be physically independent of each other so that failure of any part or the whole of one train, channel or division will not prevent safe shutdown of the plant.

→ (DRN E9900733)

The Class 1E electric systems are designed to ensure that the design basis events listed in IEEE 308-1971 will not prevent operation of the minimum amount of ESF equipment required to safely shutdown the reactor and to maintain a safe shutdown condition.

← (DRN E9900733)

The Class 1E power system is designed to meet the requirements of IEEE 279-1971, IEEE 308-1971, 10CFR50, including Appendices A and B, and Regulatory Guide 1.6. ESF loads are separated into two completely redundant load groups. Each load group has adequate capacity to start and operate a sufficient number of ESF loads to safely shutdown the plant, without exceeding fuel design limits or reactor coolant pressure boundary limits, during normal operation or design basis event. As required by IEEE 308 and 10CFR50 (General Design Criterion 17) each redundant ESF load can be powered by both onsite and offsite power supplies. Two diesel generators, one on each ESF bus, will furnish the required emergency

ESF power supply requirements. Consistent with Regulatory Guide 1.6, no provision exists for automatically transferring loads between the redundant power sources. Further, the redundant load groups cannot be automatically connected to each other, nor can the two emergency power sources be paralleled automatically. Separation and independence have been maintained between all redundant systems, including the raceways, so that any component failure in ESF channel will not disable the other ESF channel.

8.3.2 DC POWER SYSTEM

8.3.2.1 Description

Drawing G287, Sheet 1 shows the 125 V dc system. The dc system is designed to provide a source of reliable continuous power for Plant Protection System control and instrumentation and other loads for start-up, operation, and shutdown under normal and emergency conditions.

The Class IE dc System consists of three 60 cell 125 V nominal batteries, each with its own battery chargers, dc load center and distribution panels. Any nonsafety loads that can be connected to the safety buses have been included in the dc power supply sizing criteria.

The 3 banks of batteries designated 3A-S, 3B-S and 3AB-S and their associated load centers and distribution panels have been arranged to feed the safety related redundant dc loads and the nonsafety-related loads associated with divisions A, B, and AB.

8.3.2.1.1 Batteries

→(EC-7960, R302)

Each of the safety related batteries, designated as 3A-S, 3B-S and 3AB-S, are assembled in heat and shock resisting, flame retardant, self-extinguishing polycarbonate jars. Each battery consist of 60 cells and is rated 2320 Ah for an eight-hour rate or 1116 Ah for one-hour rate of discharge to 1.75 V per cell, 1.215 specific gravity at 25°C. 3A-S and 3AB-S are rated for 1116 Ah and 3B-S is rated for 1167 Ah for a one-hour rate of discharge to 1.75 V per cell, 1.215 specific gravity at 25°C.

←(EC-7960, R302)

The 125 V dc loads, for a Design Basis Accident (DBA), supplied from each battery 3A-S, 3B-S and 3AB-S are shown in Tables 8.3-3, 8.3-4 and 8.3-5, respectively.

The four hour load profiles for coping with the loss of all ac power, Station Blackout (SBO), for the batteries 3A-S, 3B-S and 3AB-S are shown in Figures 8.3-2A, 8.3-3A and 8.3-4A, respectively. (For reference only)

The 3A-S and 3B-S batteries are each mounted on two two-tier battery racks and the 3AB-S battery is mounted on two two-step battery racks. All battery racks are made of structural steel members bolted to the floor and meet seismic Category I requirements stated in Section 3.10. Each battery is sized to provide the maximum simultaneous combination of steady state loads and peak loads for the periods as shown on the emergency duty cycle (Figures 8.3-2, 8.3-3 and 8.3-4).

→(DRN E9900733;EC-5000082399, R301)

The DBA load cycle for battery 3A-S shown in figure 8.3-2 is based on a minimum final voltage of not less than 1.85V per cell and a minimum specific gravity from start of discharge of 1.205. Battery voltage will not fall below 111.0 volts (1.85V per cell x 60 cells) during any peak or continuous load condition. The one minute rating of the battery at the minimum specific gravity is 1182 amps (73.9 Amps/positive plate X 16 plates) which exceeds the one minute peak current as specified in Figure 8.3-2.

←(DRN E9900733; EC-5000082399, R301)

→(EC-5000082399, R301; EC-7960, R302)
The DBA load cycle for battery 3B-S shown in figure 8.3-3 is based on a minimum final voltage of not less than 1.82V per cell and a minimum specific gravity from start of discharge of 1.205. Battery voltage will not fall below 109.2 volts (1.82V per cell X 60 cells) during any peak or continuous load condition. The one minute rating of the battery at the minimum specific gravity is 1487.2 amps (92.95 Amps/positive plate X 16 plates) which exceeds the one minute peak current as specified in Figure 8.3-3.
←(EC-7960, R302)

The DBA load cycle for battery 3AB-S shown in figure 8.3-4 is based on a minimum final voltage of not less than 1.81V per cell and a minimum specific gravity from start of discharge of 1.205. Battery voltage will not fall below 108.6 volts (1.81V per cell X 60 cells) during any peak or continuous load condition. The one minute rating of the battery at the minimum specific gravity is 1502 amps (93.9 Amps/positive plate X 16 plates) which exceeds the one minute peak current as specified in Figure 8.3-4.
←(EC-5000082399, R301)

Note: The one minute rating of each battery is dependent on minimum acceptable cell voltage.

8.3.2.1.2 Battery Chargers

Four battery chargers, 3A1-S, 3A2-S, 3B1-S and 3B2-S are provided, two for each battery 3A-S and 3B-S. Each is rated 150 A continuous capacity. Two other chargers, 3AB1-S and 3AB2-S, are provided for battery 3AB-S. These chargers are rated 200 A continuous capacity.

All chargers are solid state, regulated units, with limited output of 115 percent of rated continuous current. Each is capable of maintaining the connected battery in a fully charged (float) condition while supplying the normal continuous load on the dc bus and can also supply an equalizing charge under the same conditions see Table 8.3-2 for values. Each charger can recharge a fully discharged battery and at the same time supply the normal steady state dc bus load.

Each charger is supplied from a 480 V, three phase, 60 Hz MCC and can maintain its adjusted output voltage within 0.5 percent for any load from zero to full rated current, with input variations of 10 percent in voltage and five percent in frequency.

To assure equipment protection in the dc system from damaging overvoltages from the battery chargers that may occur due to a faulty regulation or operator error, each battery charger is equipped with built-in overvoltage shutdown protection circuitry to sense output overvoltages (setpoint adjustable) and shutdown the battery charger after a (adjustable) time delay. The charger alarms at 142V and the shutdown circuitry is set at 144V. Local indication is provided in each battery charger which actuates a charger malfunction alarm. For the main control room alarm to actuate for an AB charger “No Charge” alarm both AB chargers need to be in a “No Charge” condition.

Undervoltage relays, both ac and dc, and a dc voltmeter and ammeter are provided for each charger. Input and output circuit breakers are also provided.

8.3.2.1.3 DC Load Center

a) DC Load Centers 3A-DC-S, 3B-DC-S, 3AB-DC-S

→

Each battery is connected via a two pole non-automatic breaker to an insulated bus in a metal enclosed load center that has provisions for connecting a portable battery load test device. Each of the two related chargers is connected to the bus through a circuit breaker. Molded case circuit breakers are used for all outgoing feeder circuits in load centers 3A-DC-S and 3B-DC-S; load center 3AB-DC-S employs fused circuit breakers for feeders.

←

The dc buses are insulated for 600 V and braced for 50 kA short circuit current.

Each load center is provided with a ground detector relay, as the dc systems operate ungrounded. A ground detector voltmeter (used to indicate grounds), a bus voltmeter and an undervoltage relay are also provided in each load center. Each battery is connected to the bus through a shunt at the disconnect switch. A battery ammeter is provided for measuring discharge current.

b) DC Load Centers 3A1-DC-S, 3B1-DC-S

These load centers are extensions of 3A-DC-S and 3B-DC-S respectively and are paralleled directly off of the battery main leads at the incoming terminals to load centers 3A-DC-S and 3B-DC-S. Molded case circuit breakers are used for all outgoing feeder circuits except for those feeding equipment located inside the containment which used fused disconnect switches.

The dc buses are insulated for 600 V and braced for 20 kA short circuit current.

Ground and undervoltage conditions on these buses will be detected by the relays and devices in load centers 3A-DC-S and 3B-DC-S respectively.

8.3.2.1.4 System Operation

Because the dc system operates ungrounded, at least two grounds are necessary to trip a feeder circuit breaker. Ground fault annunciation provides an opportunity to correct a fault condition before a second fault occurs.

One undervoltage relay is provided on buses 3A-DC-S, 3B-DC-S and 3AB-DC-S to initiate an alarm if voltage drops below a preset value. A charger failure relay, provided on each charger, detects and annunciates failures in ac power input and dc power output.

The battery disconnect switch (non-automatic circuit breaker) is normally closed. This breaker is opened only for battery load testing purposes and its position is annunciated in the control room.

Cables and raceways for the dc power supply systems are described in Subsection 8.3.1.1.5.

Cables for the dc power and control systems are rated 600 V, 90°C with ethylene-propylene rubber insulation, flame-resistant jacket, and copper conductors sized to carry the maximum available short circuit current for the time required by the primary circuit breaker to clear the fault. They are also normally sized for continuous operation at not less than 125 percent of nameplate full-load currents.

8.3.2.1.5 Equipment Separation and Redundancy

The 125 V dc System is designed to meet the seismic Category I requirements stated in Section 3.10. The two redundant batteries and their related accessories are located in separate rooms in the Reactor Auxiliary Building which is a seismic Category I structure, and they are protected from potential missile hazards. The third battery has been installed in a third room in the same building. The safety-related dc loads have been grouped into two redundant load groups such that the loss of either group will not prevent the minimum safety function from being performed.

Complete separation and independence are maintained between components and circuits of the two 125 V ESF dc systems, including the raceways. For the raceway separation criteria, see Subsections 8.3.1.2.5 and 8.3.1.2.6. Because of the physical and electrical separation provided for the batteries, chargers, distribution equipment and wiring for the 125 V dc ESF systems, a single failure at any point in either system will not disable both systems. The single failure analysis for the 125 V dc systems is given in Table 8.3.10.

8.3.2.1.6 Ventilation

The three battery sets (A, B, AB) are in three separate ventilated rooms. Their respective chargers and distribution panels are also in three separate rooms. The ventilating fan for each battery room is powered from a redundant ESF motor control center.

8.3.2.1.7 Identification of Safety-Related Loads and Their Duration

→

Tables 8.3-3, 8.3-4 and 8.3-5 identify the safety-related dc loads and the length of time they would be operable in the event of loss of offsite power and a design basis accident.

←

8.3.2.1.8 Inspection, Servicing, Testing, Installation and Qualification

→

The station batteries and their associated equipment are easily accessible for inspection, servicing and testing. Service and testing will be performed on a routine basis in accordance with the manufacturer's recommendations and the Technical Specifications. The foregoing discussion on the dc system leads to the Technical Specifications. Typical inspection includes visual inspection for leaks, corrosion, or other deterioration, and checking all batteries for voltage, specific gravity, level of electrolyte, and temperature. Rated discharge acceptance tests (service tests and performance tests) are made to verify that the battery capacity meets the required design capacity.

←

The 125 V dc system components were purchased and installed under a strict quality assurance program described in the QA Program Manual.

→

The equipment has been qualified by tests and/or analysis.

←

The qualification of the 125 V dc system equipment meets the requirements of IEEE 323-1971.

→

A battery capacity test is performed at the factory to meet Section 5.1 of IEEE 450-1980.

←

A performance discharge test, as listed in Table 2 of IEEE-308-1971 will be performed according to Sections 5.2 and 6.4 of IEEE-450-1980 with the exception that the required frequency will be as stated in the Technical Specifications.

A battery service test, to meet the requirements of Section 5.3 of IEEE-450-1980 and Section 6.2 of IEEE-308-1971 is performed upon initial installation according to Sections 5 and 6 of IEEE-450-1980. In case of any significant dc system design changes, the battery service test will be repeated to satisfy the requirements of Section 5.3 of IEEE-450-1980.

8.3.2.2 Analysis

The 125 V dc electric system is Class 1E and is designed to meet the requirements of IEEE-279-1971, IEEE-308-1971, General Design Criteria 17 and 18, and Regulatory Guides 1.6 and 1.32. The system also meets the requirements for the Design Basis Accidents described and evaluated in Chapter 15.

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

The following analysis of the Class 1E dc system demonstrates compliance with General Design Criteria 17 and 18, Regulatory Guides 1.6 and 1.32, and IEEE-308-1971.

8.3.2.2.1.1 GDC Criterion 17

The two systems which supply the 125 V dc power to redundant Class 1E load groups from the two separate 125 V dc buses are electrically independent and physically separated from each other. Each of the two systems has adequate capacity to supply the 125 V dc power for the safety-related loads required for safe shutdown of the plant.

8.3.2.2.1.2 GDC Criterion 18

As described in Subsection 8.3.2.1.8, the Class 1E dc system is designed to permit appropriate periodic inspection and testing.

8.3.2.2.1.3 Regulatory Guide 1.6-1971

As described in Subsection 8.3.1.2, the Class 1E dc system is designed with sufficient independence to perform its safety functions assuming a single failure.

8.3.2.2.1.4 Regulatory Guide 1.32-1972

The battery chargers have been sized to furnish electric energy for the largest combined demands of the various steady state loads while restoring the battery from the minimum charged state to the fully charged state, irrespective of the status of the plant during which these demands occur.

Because of the current limiting (and hence self-protection) design, the chargers cannot supply the momentary inrush currents of valve operators and other motors. This is the function of the battery itself, which is designed for the purpose. Since these loads occur predominantly in the first minutes after loss of ac power before the diesel generator is able to supply load, it follows that these loads must be supplied by the battery alone.

8.3.2.2.1.5 IEEE-308-1971

For the analysis per Principal Design Criteria of IEEE-308-1971, see Subsection 8.3.1.2. The following presents an analysis per supplementary Design Criteria as applicable to the Class 1E dc system.

The Class 1E dc system provides dc electric power to the Class 1E dc loads and for control and switching of the Class 1E systems. Physical separation, electrical isolation, and redundancy have been provided to prevent the occurrence of common mode failures. The design of the Class 1E dc system includes the following features:

a) The dc system is separated into two main redundant systems.

b) The safety actions by each group of loads are independent of the safety actions provided by its redundant counterpart.

c) Each redundant dc system includes power supplies that consist of one battery and two battery chargers.

d) Redundant batteries cannot be interconnected.

e) The batteries are arranged to prevent a common mode failure.

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

Each battery supply is continuously available during normal operation, and following a loss of power from the ac system, to start and operate all required loads. If both of the associated redundant battery chargers are without ac power or are disabled, the batteries will supply sufficient power for the times indicated in Tables 8.3-3, 8.3-4 and 8.3-5 and on Figures 8.3-2, 8.3-3 and 8.3-4.

Instrumentation is provided to monitor the status of the battery supply as follows:

a) dc bus undervoltage alarm (main control room);

b) battery current indication (switchgear rooms);

c) dc voltage indication (switchgear room and main control room);

→
d) dc ground alarm (main control room); and
←

e) battery main breaker open alarm (main control room).

The batteries are maintained in a fully charged condition and have sufficient stored energy to operate all necessary circuit breakers and to provide an adequate amount of energy for all required emergency loads.

The battery chargers of one redundant system are independent of the battery chargers for the other redundant system. Instrumentation has been provided to monitor the status of each battery charger as follows:

a) output voltage at charger;

b) output current at charger;

c) breaker position indication at charger; and

d) charger malfunction alarm in main control room, including input ac and dc undervoltage.

Each battery charger has an input ac and output dc circuit breaker for isolation of the charger. Each battery charger power supply has been designed to prevent the ac supply from becoming a load on the battery due to a power feedback as the result of the loss of ac power to the chargers.

Equipment of the Class 1E dc system is protected and isolated by fuses or circuit breakers in case of short circuit or overload conditions. Indications have been provided to identify equipment that is made unavailable per the following:

	Event	Available Indication
a)	Battery charger ac input breaker trip	Charger malfunction alarm
b)	Battery charger dc output breaker trip	Charger malfunction alarm
c)	Distribution circuit breaker trip	Individual equipment alarm

Periodically the battery charger ac supply breakers will be opened to verify the load-carrying ability of the battery.

Dependable power supplies have been provided for the Plant Protection System. Two independent dc and four independent ac power supplies have been provided for control and instrumentation of these systems. The independent dc supplies are provided by distribution circuits from each of two redundant dc distribution panels. Independent ac supplies are provided by the four inverters and associated 120 V ac buses. Refer to Subsection 8.3.1.1 for further description of these 120 V uninterruptible ac power supplies.

Since each inverter is normally powered from an ac supply with dc backup, the failure of a battery or battery charger will not in any way effect the operation of the required ac loads from the inverter, unless there is a simultaneous failure of the ac feeder.

8.3.2.2.1.6 IEEE Standard 450-1980

Operational Procedures for normal maintenance, testing and replacement comply with IEEE Standard 450-1980. Acceptance tests were made in accordance with the Standard. The batteries will be tested, serviced, and inspected at regular intervals, as outlined in the Technical Specifications to ensure that batteries and associated equipment are maintained in a satisfactory condition.
→
Batteries 3A-S, 3B-S and 3AB-S will be replaced when their capacity, as determined in Subsection 6.5 of the Standard, drops to 80 percent of rated capacity. Records are maintained in accordance with the recommendations in the Standard.
←
8.3.3 FIRE PROTECTION FOR CABLE SYSTEMS

This subject is covered in Subsection 9.5.1.

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

									LOAD WITH LOSS OF OFFSITE POWER					
ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
		SIGNAL TO START DIESEL						0sec						
		***** LOAD BLOCK 1a *****												
		GENERATOR BREAKER CLOSES						10s						
		(ITEMS NOT TRIPPED):												
A1a-01	4KV-ESWGR-3A	SWGR 3A3		3.00	0.74	kA		10s-cont	5.00	6.01	5.00	6.01	5.00	6.01
A1a-02	4KV-ESWGR-3AB	SWGR 3AB3(A)		1.20		kA		10s-cont						
A1a-03a	SSD-EMT-31A	S.S. XFMR 31A INRUSH	(i)	2.50		MVA	50000.00	10s-cont	5.36		5.36		5.36	
A1a-03b	SSD-EMT-31A	S.S. XFMR 31A LOSSES		2.50	1.92	MVA		10s-cont	14.74	134.06	14.74	134.06	14.74	134.06
A1a-04	SSD-ESWGR-31A	SWGR 3A31		4.00	2.31	kA		10s-cont						
A1a-05	SSD-ESWGR-31AB	SWGR 3AB31(A)		1.60	0.36	kA		10s-cont						
A1a-06a	SSD-EMCC-311A	MCC 3A311		1.00	0.35	kA		10s-cont	0.19	0.33	0.19	0.33	0.19	0.33
A1a-06b		MCC 3A311 REACTOR		0.02		OHM		10s-cont	0.35	6.58	0.35	6.58	0.35	6.58
A1a-07a	SSD-EMCC-312A	MCC 3A312		600.00	233.29	A		10s-cont	0.13	0.12	0.13	0.12	0.13	0.12
A1a-07b		MCC 3A312 REACTOR		0.02		OHM		10s-cont	0.16	2.94	0.16	2.94	0.16	2.94
A1a-08a	SSD-EMCC-313A	MCC 3A313		600.00	363.98	A		10s-cont	0.59	0.56	0.59	0.56	0.59	0.56
A1a-08b		MCC 3A313 REACTOR		0.02		OHM		10s-cont	0.39	7.15	0.39	7.15	0.39	7.15
A1a-09	SSD-EMCC-314A	MCC 3A314		600.00	115.03	A		10s-cont	0.41	0.70	0.41	0.70	0.41	0.70
A1a-10a	SSD-EMCC-317A	MCC 3A317		600.00	259.45	A		10s-cont	0.08	0.08	0.08	0.08	0.08	0.08
A1a-10b		MCC 3A317 REACTOR		0.01		OHM		10s-cont	0.20	2.02	0.20	2.02	0.20	2.02
A1a-11a	SSD-EMCC-311AB	MCC 3AB311(A)		600.00	225.06	A		10s-cont	0.18	0.17	0.18	0.17	0.18	0.17
A1a-11b		MCC 3AB311(A) REACTOR		0.03		OHM		10s-cont	0.46	3.80	0.46	3.80	0.46	3.80
A1a-12	EGA-EMTR-312A-4F	EDG A - AIR COMPR NO. 1		15.00	9.30	HP	94.02	10s-17hr	7.58	6.51	7.58	6.51	7.58	6.51
A1a-13	EGA-EMTR-312A-5F	EDG A - AIR COMPR NO. 2		15.00	9.30	HP	94.02	10s-17hr	7.57	6.51	7.57	6.51	7.57	6.51
A1a-14	EGF-EMTR-312A-3F	EDG A - FUEL OIL XFER PUMP		7.50	5.80	HP	50.59	10s-17hr	5.13	3.72	5.13	3.72	5.13	3.72
A1a-15a	LTN-EPNL-311	EMERG LTG PNL: LP-311-PA		30.00		KVA		10s-cont						
A1a-15b	LTN-EMT-311A-12ML	LP-311-PA XFMR & FEEDER		30.00		KVA		10s-cont	0.19		0.19		0.19	
A1a-16a	LTN-EPNL-340	EMERG LTG PNL: LP-340-PA		30.00	13.00	KVA	13.00	10s-cont	13.00		13.00		13.00	
A1a-16b	LTN-EMT-311A-4DR	LP-340-PA XFMR & FEEDER		30.00	13.00	KVA	13.00	10s-cont	0.33	0.19	0.33	0.19	0.33	0.19
A1a-17a	LTN-EPNL-318	EMERG LTG PNL: LP-318-PA		37.50	22.00	KVA	22.00	10s-cont	22.00		22.00		22.00	
A1a-17b	LTN-EMT-311A-3DR	LP-318-PA XFMR & FEEDER		37.50	22.00	KVA	22.00	10s-cont	0.60	0.46	0.60	0.46	0.60	0.46
A1a-18a	LTN-EPNL-324	EMERG LTG PNL: LP-324-PA		30.00	21.50	KVA	21.50	10s-cont	21.50		21.50		21.50	

|← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 16-014 R309)

Table 8.3-1 (Sheet 2 of 24)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

									LOAD WITH LOSS OF OFFSITE POWER					
ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
A1a-18b	LTN-EMT-311A-4BR	LP-324-PA XFMR & FEEDER		30.00	21.00	KVA	21.00	10s-cont	0.53	0.49	0.53	0.49	0.53	0.49
A1a-19a	LTN-EPNL-12PA	EMERG LTG PNL: LP-312-PA		37.50	25.00	KVA	25.00	10s-cont	25.00		25.00		25.00	
A1a-19b	LTN-EMT-311A-3BR	LP-312-PA XFMR & FEEDER		37.50	25.00	KVA	25.00	10s-cont	0.68	0.59	0.68	0.59	0.68	0.59
A1a-20a	LTN-EPNL-350	EMERG LTG PNL: LP-350-PA		45.00	22.00	KVA	22.00	10s-cont	22.00		22.00		22.00	
A1a-20b	LTN-EMT-314A-1LR	LP-350-PA XFMR & FEEDER		45.00	22.00	KVA	22.00	10s-cont	0.64	0.25	0.64	0.25	0.64	0.25
A1a-21a	LTN-EPNL-3003	Chem Lab LP-3003/PDP-3055-NAB	(j,u)	7.50	7.50	KVA	7.50	10s-cont	7.50		7.50		7.50	
A1a-21b	LTN-EMT-311AB-6FR	LP-3003/PDP-3055-NAB XF & FDR	(j,u)	7.50	7.50	KVA	7.50	10s-cont	1.38	1.32	1.38	1.32	1.38	1.32
A1a-22a	LVD-EPDP-004A	PWR DISTR PNL: PDP-3004-SA		45.00	6.00	KVA	6.00	10s-cont	5.04	3.26	5.04	3.26	5.04	3.26
A1a-22b	LVD-EMT-312A-5BL	PDP-3004-SA XFMR & FEEDER		45.00	6.00	KVA	6.00	10s-cont	0.30	0.02	0.30	0.02	0.30	0.02
A1a-23a	LVD-EPDP-60A	PWR DISTR PNL: PDP-360-SA		45.00	25.50	KVA	25.50	10s-cont	24.88	5.68	24.88	5.68	24.88	5.68
A1a-23b	LVD-EMT-312A-5BR	PDP-360-SA XFMR & FEEDER		45.00	25.50	KVA	25.50	10s-cont	0.49	0.40	0.49	0.40	0.49	0.40
A1a-24	SSD-EPDP-007	PWR DISTR PNL: PDP-3007-NAB	(j)	66.50	66.50	KVA	66.50	10s-cont	60.09	29.08	60.09	29.08	60.09	29.08
A1a-25a	LVD-EPDP-62AB	PWR DISTR PNL: PDP-362-SAB	(j)	30.00	8.60	KVA	8.60	10s-cont	8.15	2.74	8.15	2.74	8.15	2.74
A1a-25b	LVD-EMT-311AB-4BR	PDP-362-SAB XFMR & FEEDER	(j)	30.00	8.60	KVA	8.60	10s-cont	0.25	0.09	0.25	0.09	0.25	0.09
		MOTOR OPERATED VALVES:												
A1a-26	SI-EMTR-311A-6F	LPSI FLOW CONTROL		2.60	2.60	HP	30.28	10s-1min	2.62	2.62	2.62	2.62		
A1a-27	SI-EMTR-311A-6C	LPSI FLOW CONTROL		2.60	2.60	HP	30.28	10s-1min	2.62	2.62	2.62	2.62		
A1a-28	BAM-EMTR-311A-7C	REACTOR MAKEUP BYPASS		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
A1a-29	SI-EMTR-311A-6J	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
A1a-30	SI-EMTR-311A-6M	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
A1a-31	SI-EMTR-311A-7J	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
A1a-32	SI-EMTR-311A-7M	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
A1a-33	MS-EMTR-313A-6J	STM LINE 1 UPSTRM NORM DRAIN		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
A1a-34	MS-EMTR-313A-6M	STM LINE 1 UPSTRM EMERG DRAIN		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
A1a-35	HVR-EMTR-313A-6C	CVAS A TRAIN OUTLET	(o)	0.66	0.66	HP	12.75	10s-17s	0.67	0.67	0.67	0.67		
A1a-36	HVR-EMTR-313A-6F	CVAS A TRAIN INLET	(o)	1.00	1.00	HP	12.75	10s-17s	1.01	1.01	1.01	1.01		
A1a-37	SBV-EMTR-311A-9C	SBVS A TRAIN OUTLET	(o)	0.66	0.66	HP	9.80	10s-17s	0.67	0.67	0.67	0.67		
A1a-38	SBV-EMTR-311A-9F	SBVS A TRAIN INLET	(o)	0.67	0.67	HP	9.80	10s-17s	0.68	0.68	0.68	0.68		
A1a-39	SBV-EMTR-311A-9M	SBVS A RECIRC	(o)	0.67	0.67	HP	9.80	10s-17s	0.68	0.68	0.68	0.68		
A1a-40	SBV-EMTR-311A-9J	SBVS A EXHAUST	(o)	0.67	0.67	HP	9.80	10s-17s	0.68	0.68	0.68	0.68		
A1a-41	ID-EUPS-014AB	SUPS 3014-AB 37.5KVA/30KW		30.00	30.00	KW	46.53	10s-cont	37.15	28.21	37.15	28.21	37.15	28.21
A1a-42	BAM-EMTR-313A-3D	BORIC ACID PUMP A	(q)	25.00	16.40	HP	129.07	10s-8hr	13.33	6.41	13.33	6.41	13.33	6.41
a1a-43	ACC-EMTR-311A-10M	ACCW PMP LINE DISCH ISOL VLV	(p)	1.33	1.33	HP	12.75	10-27s	1.34	1.34	1.34	1.34	1.34	1.34

|← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 16-014 R309)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER: LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
A1a-44a	SSD-EMCC-313AB	MCC 3AB313(A)		600.00	138.59	A		10s-cont	0.37	0.34	0.37	0.34	0.37	0.34
A1a-44b		MCC 3AB313(A)REACTOR		0.03		OHM		10s-cont	0.17	1.44	0.17	1.44	0.17	1.44
		LOAD BLOCK 1a TOTAL:							330.00	278.13	330.00	278.13	315.45	263.58
		***** LOAD BLOCK 1b *****												
		Relay S0X, set at 0.5sec:												
A1b-01	SSD-EMT-32A	STA SERVICE XFMR 3A32 INRUSH	(i)	2.50		MVA	50000.00	10.5s-cont					4.95	
		LOAD BLOCK 1b TOTAL:							0.00	0.00	0.00	0.00	4.95	0.00
		***** LOAD BLOCK 1c *****												
		Relay S1X, set at 1.0sec:												
A1c-01	SSD-EMT-315A	STA SERVICE XFMR 3A315 INRUSH	(i)	1.00		MVA	20000.00	11s-cont	2.37		2.37		2.37	
A1c-02a	LTN-EPNL-333	LIGHTING PANEL LP-333-PA		15.00	15.00	KVA	15.00	11s-cont	15.00		15.00		15.00	
A1c-02b	LTN-EMT-315A-14B	LP-333-PA XFMR & FEEDER		15.00	15.00	KVA	15.00	11s-cont	0.43	0.27	0.43	0.27	0.43	0.27
A1c-03a	SSD-EMT-315A	STA SERVICE XFMR 3A315 LOSSES		1.00	0.81	MVA		11s-cont	8.07	46.60	8.07	46.60	8.07	46.60
A1c-03b	SSD-EMCC-315A	MCC 3A315		1.00	0.98	kA		11s-cont	0.76	1.28	0.76	1.28	0.76	1.28
		LOAD BLOCK 1c TOTAL:							26.62	48.15	26.62	48.15	26.62	48.15
		***** LOAD BLOCK 1d *****												
		Relay S2X, set at 1.5 secs:												
A1d-01	SI-EMTR-3A-4A	HPSI PUMP A	(s)	600.00	530.00	HP	3394.82	11.5s-Cont	418.87	208.11				
A1d-01	SI-EMTR-3A-4A	HPSI PUMP A	(c,s)	600.00	530.00	HP	3394.82	11.5s-4days			418.87	208.11		
a1d-01z	SI-EMTR-3AB-3A	HPSI PUMP AB		600.00	530.00	HP	3394.82	11.5s-4day						
	SI-EMTR-3AB-3A	HPSI PUMP AB		600.00	530.00	HP	3394.82	11.5s-Cont						
A1d-02	HVR-EMTR-313A-4K	SAFEGUARD PMP RM AH-2(3A-SA)		5.00	3.20	HP	36.65	11.5s-cont	2.90	3.56	2.90	3.56		
A1d-03	HVR-EMTR-313A-5K	SAFEGUARD PMP RM AH-2(3C-SA)		5.00	3.20	HP	36.65	11.5s-cont	2.90	3.56	2.90	3.56		
A1d-04	CS-EMTR-3A-6	CONTAINMENT SPRAY PUMP A	(r,s)	300.00	277.00	HP	1759.76	11.5s-Cont	224.43	89.69				
A1d-04	CS-EMTR-3A-6	CONTAINMENT SPRAY PUMP A	(r,s)	300.00	277.00	HP	1759.76	11.5s-4day			224.43	89.69		
		LOAD BLOCK 1d TOTAL:							649.11	304.92	649.11	304.92	0.00	0.00
		***** LOAD BLOCK 2a(individual												

|← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 16-014 R309)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING	SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER					
								LOCA		MSLB		SHUTDOWN	
								KW	KVAR	KW	KVAR	KW	KVAR
		relays set at 5 secs): *****											
A2a-01	DC-EBC-1AB	BATTERY CHARGER 3AB1-S		45.00	3.99 KVA	3.99	15s-cont	2.68	2.95	2.68	2.95	2.68	2.95
A2a-02	DC-EBC-2AB	BATTERY CHARGER 3AB2-S		45.00	3.99 KVA	3.99	15s-cont	2.68	2.95	2.68	2.95	2.68	2.95
A2a-03	ID-EUPS-2572-AB	SUPS 3AB 30KVA NORMAL SUPPLY		30.00	30.00 KVA	50.00	15s-cont	40.15	29.97	40.15	29.97	40.15	29.97
		LOAD BLOCK 2a TOTAL:						45.51	35.88	45.51	35.88	45.51	35.88
		***** LOAD BLOCK 2b *****											
		Relays S3X/S3X2, set at 7secs:											
A2b-01	CC-EMTR-3A-2	CCW PUMP A		300.00	300.00 HP	1669.70	17s-cont	241.70	143.44	241.70	143.44	241.70	143.44
A2b-02	HVR-EMTR-313A-4M	CCW PMP UNIT AH-10 (3A-SA)		3.00	1.70 HP	25.50	17s-cont	1.68	2.93	1.68	2.93	1.68	2.93
	CC-EMTR-3AB-4	CCW PUMP AB		300.00	300.00 HP	1669.70	17s-cont						
	HVR-EMTR-311AB-5B	CCW PMP AB UNIT AH-20(3A-SAB)		3.00	1.70 HP	25.50	17s-cont						
A2b-03	EFW-EMTR-3A-10A	EFW PUMP A	(I)	400.00	380.00 HP	2411.01	17s-4hr	306.10	187.09	306.10	187.09	306.10	187.09
A2b-04	HVR-EMTR-311A-14B	EFW PUMP RM UNIT AH-17(3A-SA)	(I)	3.00	1.34 HP	25.50	17s-4hr	1.28	1.59	1.28	1.59	1.28	1.59
A2b-05a	HT-EPNL001-A	CVCS HEAT TRACING		45.00	9.00 KVA	9.00	17s-cont	9.00		9.00		9.00	
A2b-05b		CVCS HEAT TRACE A XFMR & FDR		45.00	9.00 KVA	9.00	17s-cont	0.35	0.05	0.35	0.05	0.35	0.05
A2b-06	DC-EBC-1A	BATTERY CHARGER 3A1-S		34.00	3.73 KVA	3.73	17s-cont	2.48	2.79	2.48	2.79	2.48	2.79
A2b-07	DC-EBC-2A	BATTERY CHARGER 3A2-S		34.00	3.73 KVA	3.73	17s-cont	2.48	2.79	2.48	2.79	2.48	2.79
A2b-08	ID-EUPS-MA	SUPS 3MA-S 20KVA NORMAL SUPPLY		20.00	20.00 KVA	36.23	17s-cont	26.75	24.54	26.75	24.54	26.75	24.54
	ID-EUPS-MA	SUPS 3MA-S BYPASS XFMR		25.00	20.00 KVA		17s-cont						
A2b-09	ID-EUPS-A1	SUPS 3A1-S 20KVA NORMAL SUPPLY		20.00	20.00 KVA	36.23	17s-cont	26.78	24.55	26.78	24.55	26.78	24.55
	ID-EUPS-MC	SUPS 3MC-S BYPASS XFMR		25.00	20.00 KVA		17s-cont						
A2b-10	ID-EUPS-A	SUPS 3A-S 20KVA NORMAL SUPPLY		20.00	6.10 KVA	11.45	17s-cont	10.35	4.92	10.35	4.92	10.35	4.92
	ID-EUPS-A	SUPS 3A-S BYPASS XFMR		30.00	17.30 KVA	17.30	17s-cont	2.44	17.13	2.44	17.13	2.44	17.13
A2b-11	CCS-EMTR-317A-2M	CONT FN CLR AH-1(3A-S) LOW SP		62.50	29.00 HP	462.11	17s-cont	24.82	53.25	24.82	53.25		
A2b-11	CCS-EMTR-317A-2M	CONT FN CLR AH-1(3A-S) HI SP		125.00	110.00 HP	964.06	17s-cont					90.92	51.91
A2b-12	CCS-EMTR-317A-3M	CONT FN CLR AH-1(3C-S) HI SP		125.00	110.00 HP	964.06	17s-cont					90.96	51.95
A2b-12	CCS-EMTR-317A-3M	CONT FN CLR AH-1(3C-S) LOW SP		62.50	29.00 HP	462.11	17s-cont	24.84	53.27	24.84	53.27		
A2b-13	HVR-EMTR-311A-5F	AUX BLDG CVAS EXH FN E-23		15.00	10.00 HP	92.42	17s-cont	8.65	6.34	8.65	6.34		
A2b-13a	HVR-EMTR-313A-6C	CVAS A TRAIN OUTLET VALVE	(o)	0.66	0.66 HP	3.98	17s-1min	0.67	0.67	0.67	0.67		
A2b-13b	HVR-EMTR-313A-6F	CVAS A TRAIN INLET VALVE	(o)	1.00	1.00 HP	3.98	17s-1min	1.01	1.01	1.01	1.01		
A2b-14	HVR-EEHC-313A-3BR	AUX BLDG CVAS HEAT COIL EHC-48		20.00	20.00 KW	20.00	17s-cont	20.00		20.00			

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 16-014 R309)

Table 8.3-1 (Sheet 5 of 24)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

								LOAD WITH LOSS OF OFFSITE POWER					
ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING	SKVA	TIME	LOCA		MSLB		SHUTDOWN	
								KW	KVAR	KW	KVAR	KW	KVAR
A2b-15	SBV-EMTR-31A-5B1	SHIELD BLDG VENT FN E-17		100.00	70.00 HP	577.64	17s-cont	58.06	36.45	58.06	36.45		
A2b-15a	SBV-EMTR-311A-9C	SBVS A TRAIN OUTLET VALVE	(o)	0.66	0.66 HP	4.02	17s-1min	0.67	0.67	0.67	0.67		
A2b-15b	SBV-EMTR-311A-9F	SBVS A TRAIN INLET VALVE	(o)	0.67	0.67 HP	4.02	17s-1min	0.68	0.68	0.68	0.68		
A2b-15c	SBV-EMTR-311A-9M	SBVS A RECIRC VALVE	(o)	0.67	0.67 HP	9.48	17s-1min	0.68	0.68	0.68	0.68		
A2b-15d	SBV-EMTR-311A-9J	SBVS A EXHAUST VALVE	(o)	0.67	0.67 HP	2.51	17s-1min	0.68	0.68	0.68	0.68		
A2b-16	SBV-EEHC-313A-5BL	SBVS HEAT COIL EHC-51(3A-SA)		60.00	60.00 KW	60.00	17s-cont	60.00		60.00			
		LOAD BLOCK 2b TOTAL:						832.12	565.50	832.12	565.50	813.26	515.68
		***** LOAD BLOCK 3 *****											
		Relay S4X, set at 17secs:											
A3-01	SI-EMTR-3A-5	LPSI PUMP A	(b,c)	500.00	435.00 HP	2840.56	27s-75min	350.03	179.27	350.03	179.27		
A3-02	ACC-EMTR-3A-3	AUX CCW PUMP A		300.00	295.00 HP	1669.70	27s-Cont					237.70	141.50
A3-02	ACC-EMTR-3A-3	AUX CCW PUMP A		300.00	250.00 HP	1669.70	27s-Cont	201.29	126.23	201.29	126.23		
A3-03	HVR-EMTR-312A-3M	DSL RM A EXH FN E-28 (3A-SA)		60.00	51.00 HP	346.58	27s-cont	42.59	34.00	42.59	34.00	42.59	34.00
A3-04	CVC-EMTR-31A-5C-1	CHARGING PUMP A		100.00	78.00 HP	577.64	27s-10hr	64.79	43.48	64.79	43.48		
A3-04	CVC-EMTR-31A-5C-1	CHARGING PUMP A		100.00	78.00 HP	577.64	27s-cont					64.79	43.48
A3-06	HVR-EMTR-311A-14K	CHARGING PUMP RM UNIT AH-18		3.00	1.30 HP	25.50	27s-10hr	1.24	1.55	1.24	1.55		
A3-06	HVR-EMTR-311A-14K	CHARGING PUMP RM UNIT AH-18		3.00	1.30 HP	25.50	27s-cont					1.24	1.55
	CVC-EMTR-31AB-4C-1	CHARGING PUMP AB		100.00	78.00 HP	577.64	27s-cont						
	HVR-EMTR-311AB-5H	CHARGING PUMP RM UNIT AH-22		3.00	1.28 HP	25.50	27s-cont						
A3-07	ACC-EMTR-311A-10M	ACCW PMP LINE DISCH ISOL VLV	(p)	1.33	1.33 HP	12.75	27-1min	1.34	1.34	1.34	1.34	1.34	1.34
		LOAD BLOCK 3- TOTAL:						661.27	385.87	661.27	385.87	347.66	221.86
		***** LOAD BLOCK 4 *****											
		Relay S5X, set at 29secs:											
A4-01	SVS-EMTR-313A-5H	RAB SWGR & BATTERY RM AH-25		50.00	37.40 HP	288.42	39s-cont	30.51	18.87	30.51	18.87	30.51	18.87
A4-02	SVS-EEHC-313A-4BL	RAB SWGR & BATTERY RM EHC-36		60.00	60.00 KW	60.00	39s-cont	60.00		60.00		60.00	
A4-03	HVR-EMTR-313A-4D	SHTDWN HEAT EXCHANGER AH-3	(e)	3.00	1.67 HP	25.50	39s-cont	1.65	2.92	1.65	2.92	1.65	2.92
A4-04	HVR-EMTR-313A-2M	MAIN HVAC EQPT RM SUP AH-13	(e)	30.00	24.70 HP	173.29	39s-cont	20.77	15.09	20.77	15.09		
A4-05	HVR-EMTR-311A-3H	MAIN HVAC EQPT RM EXH FN E-41		15.00	9.10 HP	92.42	39s-cont	7.87	6.16	7.87	6.16		
A4-06	HVC-EMTR-311A-4H	CONTR RM AC SUP FN AH-12	(e)	75.00	42.00 HP	431.83	39s-cont	34.29	28.84	34.29	28.84	34.29	28.84
A4-07	HVC-EEHC-313A-5BR	CNTRL RM MN HEAT COIL EHC-34	(e)	30.00	30.00 KW	30.00	39s-cont	30.00		30.00		30.00	

|← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

Table 8.3-1 (Sheet 6 of 24)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

									LOAD WITH LOSS OF OFFSITE POWER					
ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
A4-08	HVC-EMTR-313A-4F	CNTRL RM EQPT RM AH-26		3.00	1.17	HP	25.50	39s-cont	1.12	1.39	1.12	1.39	1.12	1.39
A4-09	HVC-EMTR-311A-5B	CONTR RM EM FILT S-8 (3A-SA)	(e)	15.00	12.00	HP	92.42	39s-cont	10.37	6.79	10.37	6.79		
A4-10	HVC-EEHC-313A-4BR	CNTRL RM BOOST HT COIL EHC-49		10.00	10.00	KW	10.00	39s-cont	10.00		10.00			
A4-11	HVR-EMTR-313A-5D	CCW HEAT EXCHANGER A AH-24	(e)	3.00	1.34	HP	25.50	39s-cont	1.35	2.58	1.35	2.58	1.35	2.58
A4-12	SVS-EMTR-311A-2F	BATT ROOM EXH FAN E-29 (3A-SA)		0.75	0.11	HP	9.96	39s-cont	0.13	0.27	0.13	0.27	0.13	0.27
A4-13	SVS-EMTR-311A-3F	BATT ROOM EXH FAN E-30 (3A-SA)		0.75	0.11	HP	9.96	39s-cont	0.13	0.27	0.13	0.27	0.13	0.27
A4-14	SVS-EMTR-311A-13K	BATT ROOM EXH FAN E-31 (3A-SA)		0.75	0.11	HP	9.96	39s-cont	0.13	0.27	0.13	0.27	0.13	0.27
A4-15	SVS-EMTR-311A-2H	COMP BATTERY RM E-46 (3A-SA)		0.75	0.40	HP	9.96	39s-cont	0.45	0.91	0.45	0.91	0.45	0.91
A4-16	SVS-EMTR-311A-14H	BATTERY RM EXH FN E-52(3A-SA)		0.75	0.13	HP	7.97	39s-cont	0.16	0.31	0.16	0.31	0.16	0.31
A4-17	SVS-EMTR-311A-13B	SWGR AREA AH-30 (3A-SA)		15.00	10.90	HP	92.42	39s-cont	9.39	6.43	9.39	6.43	9.39	6.43
		LOAD BLOCK 4- TOTAL:							218.30	91.08	218.30	91.08	169.30	63.04
		***** LOAD BLOCK 5a *****												
		Relay S6X, set at 41secs:												
A5a-01	CC-EMTR-315A-1F	DRY COOLING TOWER FAN1-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.36	15.83	31.36	15.83	31.36	15.83
A5a-02	CC-EMTR-315A-1M	DRY COOLING TOWER FAN2-SA	(k)	40.00	38.40	HP	224.68	51s-cont	31.29	18.05	31.29	18.05	31.29	18.05
A5a-03	CC-EMTR-315A-2F	DRY COOLING TOWER FAN3-SA	(k)	40.00	38.40	HP	226.28	51s-cont	31.26	18.05	31.26	18.05	31.26	18.05
A5a-04	CC-EMTR-315A-2M	DRY COOLING TOWER FAN4-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.37	15.84	31.37	15.84	31.37	15.84
A5a-05	CC-EMTR-315A-3F	DRY COOLING TOWER FAN5-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.35	15.83	31.35	15.83	31.35	15.83
A5a-06	CC-EMTR-315A-3M	DRY COOLING TOWER FAN6-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.32	15.83	31.32	15.83	31.32	15.83
A5a-07	CC-EMTR-315A-4F	DRY COOLING TOWER FAN7-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.42	15.85	31.42	15.85	31.42	15.85
A5a-08	CC-EMTR-315A-4M	DRY COOLING TOWER FAN8-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.39	15.84	31.39	15.84	31.39	15.84
A5a-09	CC-EMTR-315A-5F	DRY COOLING TOWER FAN9-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.37	15.84	31.37	15.84	31.37	15.84
A5a-10	CC-EMTR-315A-5M	DRY COOLING TOWER FAN10-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.47	15.85	31.47	15.85	31.47	15.85
A5a-11	CC-EMTR-315A-7F	DRY COOLING TOWER FAN11-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.43	15.85	31.43	15.85	31.43	15.85
A5a-12	CC-EMTR-315A-7M	DRY COOLING TOWER FAN12-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.41	15.84	31.41	15.84	31.41	15.84
A5a-13	CC-EMTR-315A-8F	DRY COOLING TOWER FAN13-SA	(k)	40.00	38.40	HP	215.12	51s-cont	32.17	19.35	32.17	19.35	32.17	19.35
A5a-14	CC-EMTR-315A-8M	DRY COOLING TOWER FAN14-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.49	15.86	31.49	15.86	31.49	15.86
A5a-15	CC-EMTR-315A-9F	DRY COOLING TOWER FAN15-SA	(k)	40.00	37.00	HP	231.06	51s-cont	31.46	15.85	31.46	15.85	31.46	15.85
A5a-16	ACC-EMTR-315A-10H	WET COOLING TOWER FAN1-SA	(k)	30.00	28.80	HP	173.29	51s-Cont	24.08	14.06	24.08	14.06	24.08	14.06
A5a-17	ACC-EMTR-315A-10M	WET COOLING TOWER FAN2-SA	(k)	30.00	28.80	HP	173.29	51s-Cont	24.08	14.06	24.08	14.06	24.08	14.06
A5a-18	ACC-EMTR-315A-11H	WET COOLING TOWER FAN3-SA	(k)	30.00	28.80	HP	173.29	51s-Cont	24.08	14.06	24.08	14.06	24.08	14.06
A5a-19	ACC-EMTR-315A-11M	WET COOLING TOWER FAN4-SA	(k)	30.00	28.80	HP	188.35	51s-Cont	24.56	29.91	24.56	29.91	24.56	29.91

|← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
A5a-20	ACC-EMTR-315A-12H	WET COOLING TOWER FAN5-SA	(k)	30.00	28.80	HP	173.29	51s-4day	24.14	14.07	24.14	14.07		
A5a-20	ACC-EMTR-315A-12H	WET COOLING TOWER FAN5-SA	(k)	30.00	28.80	HP	173.29	51s-cont					24.14	14.07
A5a-21	ACC-EMTR-315A-12M	WET COOLING TOWER FAN6-SA	(k)	30.00	28.80	HP	173.29	51s-4day	24.14	14.07	24.14	14.07		
A5a-21	ACC-EMTR-315A-12M	WET COOLING TOWER FAN6-SA	(k)	30.00	28.80	HP	173.29	51s-cont					24.14	14.07
A5a-22	ACC-EMTR-315A-13H	WET COOLING TOWER FAN7-SA	(k)	30.00	28.80	HP	173.29	51s-cont					24.14	14.07
A5a-22	ACC-EMTR-315A-13H	WET COOLING TOWER FAN7-SA	(k)	30.00	28.80	HP	173.29	51s-4day	24.14	14.07	24.14	14.07		
A5a-23	ACC-EMTR-315A-13M	WET COOLING TOWER FAN8-SA	(k)	30.00	28.80	HP	173.29	51s-4day	24.14	14.07	24.14	14.07		
A5a-23	ACC-EMTR-315A-13M	WET COOLING TOWER FAN8-SA	(k)	30.00	28.80	HP	173.29	51s-cont					24.14	14.07
A5a-24a	LVD-EPDP-81AS	PWR DISTR PNL: PDP-381-SA		30.00	2.50	KVA	2.50	51s-cont	2.50	0.00	2.50	0.00	2.50	0.00
A5a-24b	LVD-EMT-315A-14M	PDP-381-SA XFMR & FEEDER		30.00	2.50	KVA	2.50	51s-cont	0.19	0.01	0.19	0.01	0.19	0.01
		LOAD BLOCK 5a TOTAL:							667.56	373.93	667.56	373.93	667.56	373.93
		***** LOAD BLOCK 5b *****												
		Relay S61X, set at 110secs:												
A5b-01	ID-EUPS-2572	COMPUTER POWER SUPPLY		200.00	75.00	KVA	75.00	120s-cont	73.48	15.39	73.48	15.39	73.48	15.39
	ID-EMT-2572	COMPUTER POWER SUPPLY STBY		225.00	65.00	KVA		120s-cont						
		LOAD BLOCK 5b TOTAL:							73.48	15.39	73.48	15.39	73.48	15.39
		***** LOAD BLOCK 6a *****												
		Relay S7X, set at 168secs:												
A6a-01	CHW-EMTR-311A-5M	AUX BLDG WTR CHLR PMP P-1		40.00	25.40	HP	203.97	178s-cont	20.56	17.56	20.56	17.56	20.56	17.56
	CHW-EMTR-311AB-2M	AUX BLDG WTR CHLR PMP P-1		40.00	25.40	HP	231.06	178s-cont						
		LOAD BLOCK 6a TOTAL:							20.56	17.56	20.56	17.56	20.56	17.56
		***** LOAD BLOCK 6b *****												
		Chiller Control Panel - Timer												
		23sec after S7X signal												
A6b-02	RFR-EMTR-311A-2M	AUX BLDG WTR CHLR OIL PMP		1.50	0.62	HP	15.93	201s-cont	0.70	0.87	0.70	0.87	0.70	0.87
	RFR-EMTR-311AB-3K	AUX BLDG WTR CHLR OIL PMP		1.50	0.62	HP	15.93	201s-cont						
		LOAD BLOCK 6b TOTAL:							0.70	0.87	0.70	0.87	0.70	0.87
		***** LOAD BLOCK 6c *****												

|← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER					
									LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
		Relay S8X, set at 200secs:												
A6c-01	CMU-EMTR-311A-4M	CCW MAKE-UP PUMP A		40.00	32.00	HP	231.06	210s-14hr	26.87	22.80	26.87	22.80	26.87	22.80
A6c-03	BAM-EMTR-312A-2D	BORIC ACID PUMP B	(q)	25.00	16.40	HP	129.07	210s-8hr	13.35	6.41	13.35	6.41	13.35	6.41
	LOAD BLOCK 6c TOTAL:								40.22	29.21	40.22	29.21	40.22	29.21
		***** LOAD BLOCK 6d *****												
		Chiller Control Panel - Timer												
		51sec after S7X signal												
A6d-01a	RFR-EMTR-3A-9A	AUX BLDG WTR CHLR COMPR WC-1		416.00	416.00	KW	3400.02	229s-cont	419.92	260.32	419.92	260.32		
A6d-01b	RFR-EMTR-3A-9A	AUX BLDG WTR CHLR COMPR WC-1		379.00	379.00	KW	3400.02	229s-cont					382.54	237.14
	RFR-EMTR-3AB-5A	AUX BLDG WTR CHLR COMPR WC-1		416.00	416.00	KW	3400.02	229s-cont						
	LOAD BLOCK 6d TOTAL:								419.92	260.32	419.92	260.32	382.54	237.14
		**** AUTOMATIC LOAD BLOCK ****												
A-AUTO	SI-EMTR-311A-7F	SIS SUMP OUT TO RECIRC HDR A	(m,n)	0.70	0.70	HP	9.48	30m-30m25s	0.71	0.71	0.71	0.71		
	AUTOMATIC LOAD BLOCK TOTAL:								0.71	0.71	0.71	0.71	0.00	0.00
		***** MANUAL LOADING: *****												
AM-01	CDC-EMTR-31A-8B	CEDM COOLING FAN E-16 (3A)		250.00	237.00	HP	1454.06	30min-cont					187.76	118.17
AM-02	CDC-EMTR-31A-9B	CEDM COOLING FAN E-16 (3C)		250.00	237.00	HP	1454.06							
AM-03	RC-EHTR-72A	PDP-372A(PRESS BU HTRS BNK 1)	(f)	150.00	150.00	KW	150.00							
AM-04	RC-EHTR-70A	PDP-370A(PRESS BU HTRS BNK 2)	(f)	200.00	200.00	KW	200.00							
AM-05	RC-EHTR-71A	PDP-371A(PRESS BU HTRS BNK 3)	(f)	200.00	200.00	KW	200.00							
AM-06	RC-EHTR-69A	PDP-369A(PRESS HTRS PRO BNK1)		150.00	150.00	KW	150.00	30min-4hr					150.00	
AM-07	SSD-EMT-32A	STA SERVICE XFMR 3A32 LOSSES		2.50	0.15	MVA		30min-4hr					0.09	0.96
AM-08	IA-EMTR-31A-9A	INSTRUMENT AIR COMP A		150.00	130.00	HP	811.24	30min-cont	106.01	83.28	106.01	83.28	106.01	83.28
AM-09	LOG-EMTR-313AB-2M	BEARING OIL PUMP (BOP)		75.00	68.50	HP	431.83	30-90min	56.46	38.51	56.46	38.51	56.46	38.51
AM-11	ANP-EMTR-312A-10H	ANPS FAN E-19 (3A)		3.00	2.30	HP	25.50	30min					2.36	2.07
AM-12	HVC-EMTR-311A-5D	CNTRL RM AC EXH FN E-34(3A-SA)		0.75	0.46	HP	9.96	30min					0.47	0.63
AM-13	HRA-EMTR-311A-2B	H2 ANALYZER SAMPLE PUMP A		2.50	2.50	HP	19.92	30min-cont	2.34	2.02	2.34	2.02		
AM-14	HVR-EMTR-311A-5F	AUX BLDG CVAS EXH FN E-23		15.00	10.00	HP	92.42	30min					8.65	6.34
AM-15	TUR-EMTR-313AB-4M	TURNING GEAR		50.00	31.20	HP	288.42	30min					25.51	18.02

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EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER					
									LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
AM-16a	SI-EMTR-3A-5	LPSI PUMP A	(s)	500.00	435.00	HP	2840.56	4d-cont			350.03	179.27		
AM-16b	SI-EMTR-3A-5	LPSI PUMP A	(l)	500.00	435.00	HP	2840.56	4hr-cont					350.03	179.27
am-17	HRA-EHTR-313A-3M	HYDROGEN RECOMBINER A	(g)	75.00	75.00	KW								
AM-18	SP-EMTR-314A-4F	COOL TWR AREA DRN SUMP PUMP 1A		10.00	10.00	HP	64.54	30min-10h30	8.84	6.49	8.84	6.49	8.84	6.49
AM-19	SP-EMTR-314A-5F	COOL TWR AREA DRN SUMP PUMP 2A		10.00	10.00	HP	64.54	30min-10h30	8.93	6.49	8.93	6.49	8.93	6.49
AM-20	LOG-EMTR-313AB-4D	BOL PUMP AC MTR ON OIL RESER		15.00	11.30	HP	92.42	30min					9.81	6.52
AM-21	SI-EMTR-313A-7F	RC LOOP 1 HOT LEG ISOL	(t)	0.66	0.66	HP	4.02	2hr-2hr50s	0.67	0.67				
AM-22	FS-EMTR-314A-5M	FUEL POOL PUMP A		60.00	49.20	HP	331.45	6hr-cont	41.05	26.46	41.05	26.46	41.05	26.46

|← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

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ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING	SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
		LOAD SUMMARY:											
		0-10s :Generator Starts											
		10-10.5s:Load Block 1a						330.00	278.13	330.00	278.13	315.45	263.58
		10.5-11s:Load Block 1b						330.00	278.13	330.00	278.13	320.40	263.58
		11-11.5s:Load Block 1c						356.62	326.29	356.62	326.29	347.02	311.73
		11.5-15s:Load Block 1d						1005.73	631.21	1005.73	631.21	347.02	311.73
		15-17s :Load Block 2a						1051.24	667.09	1051.24	667.09	392.54	347.62
		17-27s :Load Block 2b						1879.00	1228.22	1879.00	1228.22	1205.80	863.30
		27-39s :Load Block 3						2538.93	1612.75	2538.93	1612.75	1552.11	1083.82
		39-51s :Load Block 4						2757.23	1703.83	2757.23	1703.83	1721.41	1146.87
		51-60s :Load Block 5a						3424.80	2077.76	3424.80	2077.76	2388.97	1520.80
		60-120s :MOVs Deenergize						3408.91	2061.87	3408.91	2061.87	2387.63	1519.46
		120-178s:Load Block 5b						3482.39	2077.26	3482.39	2077.26	2461.12	1534.85
		178-201s:Load Block 6a						3502.95	2094.82	3502.95	2094.82	2481.67	1552.41
		201-210s:Load Block 6b						3503.65	2095.69	3503.65	2095.69	2482.37	1553.28
		210-229s:Load Block 6c						3543.87	2124.89	3543.87	2124.89	2522.59	1582.48
		229s-30m:Load Block 6d						3963.79	2385.21	3963.79	2385.21	2905.13	1819.62
		30m-30m25s:Auto Load Bloc						4147.08	2522.70	4147.08	2522.70	3470.02	2107.10
		30m25s-75m:Manual Loading						4146.37	2522.00	4146.37	2522.00	3470.02	2107.10
		75-90m :LPSI Deenergizes						3796.34	2342.72	3796.34	2342.72	3470.02	2107.10
		90m-2h:Turb Aux Deenergize						3739.88	2304.21	3739.88	2304.21	3413.56	2068.59
		2h-2h50s: Manual MOV						3740.55	2304.88	3739.88	2304.21	3413.56	2068.59
		2h50s-4h:MOV Deenergize						3739.88	2304.21	3739.88	2304.21	3413.56	2068.59
		4-6h :EFW Deenergize						3432.50	2115.53	3432.50	2115.53	3306.11	2058.21
		6-8h : SFP Pump Start						3473.55	2141.99	3473.55	2141.99	3347.17	2084.68
		8-10h : BA Pumps Deenergize						3446.87	2129.18	3446.87	2129.18	3320.49	2071.86
		10-14h : Chrg Deenergize						3363.07	2071.17	3363.07	2071.17	3302.72	2058.88
		14-17h : CCW Makeup						3336.20	2048.37	3336.20	2048.37	3275.85	2036.08
		17-4d : de EDG Xfer pump						3315.92	2031.63	3315.92	2031.63	3255.57	2019.35
		4d-4d18h :WCT fans 5-8 de						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		4d18h-4d20						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		4d20h-4d21h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		4d21h-5d						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		5d-5d8h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

EMERGENCY DIESEL GENERATOR A LOADING SEQUENCE (STEADY STATE)

→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING	SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER					
								LOCA		MSLB		SHUTDOWN	
								KW	KVAR	KW	KVAR	KW	KVAR
		5d8h-5d9h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		5d9h-5d21h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		5d21h-5d22h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		5d22h-5d23h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		5d23h-6d						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d-6d12h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d12h-6d14h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d14h-6d15h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d15h-6d18h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d18h-6d19h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d19h-6d21h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d21h-6d22h						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35
		6d22h-7d						3219.38	1975.36	2926.11	1856.84	3255.57	2019.35

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-009, R309; LBDCR 16-014 R309)

Table 8.3-1 (Sheet 12 of 24)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
		SIGNAL TO START DIESEL						0sec						
		***** LOAD BLOCK 1a *****												
		GENERATOR BREAKER CLOSES						10s						
		(ITEMS NOT TRIPPED):												
B1a-01	4KV-ESWGR-3B	SWGR 3B3		3.00	0.73	kA		10s-cont	3.23	3.89	3.23	3.89	3.23	3.89
B1a-02	4KV-ESWGR-3AB	SWGR 3AB3(B)		1.20		kA		10s-cont						
B1a-03a	SSD-EMT-31B	S.S. XFMR 31B INRUSH	(i)	2.50		MVA	50000.00	10s-cont	5.16		5.16		5.16	
B1a-03b	SSD-EMT-31B	S.S. XFMR 31B LOSSES		2.50	1.90	MVA		10s-cont	14.75	134.39	14.75	134.39	14.75	134.39
B1a-04	SSD-ESWGR-31B	SWGR 3B31		4.00	2.29	kA		10s-cont						
B1a-05	SSD-ESWGR-31AB	SWGR 3AB31(B)		1.60	0.44	kA		10s-cont						
B1a-06a	SSD-EMCC-311B	MCC 3B311		1.00	0.35	kA		10s-cont	0.25	0.43	0.25	0.43	0.25	0.43
B1a-06b		MCC 3B311 REACTOR		0.02		OHM		10s-cont	0.37	6.80	0.37	6.80	0.37	6.80
B1a-07a	SSD-EMCC-312B	MCC 3B312		600.00	139.76	A		10s-cont	0.07	0.07	0.07	0.07	0.07	0.07
B1a-07b		MCC 3B312 REACTOR		0.02		OHM		10s-cont	0.06	1.05	0.06	1.05	0.06	1.05
B1a-08a	SSD-EMCC-313B	MCC 3B313		600.00	345.38	A		10s-cont	0.19	0.18	0.19	0.18	0.19	0.18
B1a-08b		MCC 3B313 REACTOR		0.02		OHM		10s-cont	0.35	6.44	0.35	6.44	0.35	6.44
B1a-09	SSD-EMCC-314B	MCC 3B314		600.00	112.62	A		10s-cont	0.40	0.67	0.40	0.67	0.40	0.67
B1a-10a	SSD-EMCC-317B	MCC 3B317		600.00	259.45	A		10s-cont	0.11	0.10	0.11	0.10	0.11	0.10
B1a-10b		MCC 3B317 REACTOR		0.01		OHM		10s-cont	0.20	2.02	0.20	2.02	0.20	2.02
B1a-11a	SSD-EMCC-311AB	MCC 3AB311(B)		600.00	225.06	A		10s-cont	0.18	0.17	0.18	0.17	0.18	0.17
B1a-11b		MCC 3AB311(B) REACTOR		0.03		OHM		10s-cont	0.46	3.80	0.46	3.80	0.46	3.80
B1a-12	EGA-EMTR-312B-4F	EDG B - AIR COMPR NO. 1		15.00	9.30	HP	94.02	10s-17h	7.54	6.51	7.54	6.51	7.54	6.51
B1a-13	EGA-EMTR-312B-5F	EDG B - AIR COMPR NO. 2		15.00	9.30	HP	94.02	10s-17h	7.54	6.51	7.54	6.51	7.54	6.51
B1a-14	EGF-EMTR-312B-3F	EDG B - FUEL OIL XFER PUMP		7.50	5.80	HP	50.59	10s-17h	5.09	3.72	5.09	3.72	5.09	3.72
B1a-15a	LTN-EPNL-310	EMERG LTG PNL: LP-310-PB		30.00		KVA		10s-cont						
B1a-15b	LTN-EMT-311B-7ML	LP-310-PB XFMR & FEEDER		30.00		KVA		10s-cont	0.19		0.19		0.19	
B1a-16a	LTN-EPNL-341	EMERG LTG PNL: LP-341-PB		30.00	13.00	KVA	13.00	10s-cont	13.00		13.00		13.00	
B1a-16b	LTN-EMT-311B-4DR	LP-341-PB XFMR & FEEDER		30.00	13.00	KVA	13.00	10s-cont	0.35	0.20	0.35	0.20	0.35	0.20
B1a-17a	LTN-EPNL-319	EMERG LTG PNL: LP-319-PB		37.50	26.75	KVA	26.75	10s-cont	26.75		26.75		26.75	
B1a-17b	LTN-EMT-311B-3DR	LP-319-PB XFMR & FEEDER		37.50	26.75	KVA	26.75	10s-cont	0.74	0.67	0.74	0.67	0.74	0.67
B1a-18a	LTN-EPNL-325	EMERG LTG PNL: LP-325-PB		30.00	20.00	KVA	20.00	10s-cont	20.00		20.00		20.00	

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

Table 8.3-1 (Sheet 13 of 24)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER: LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
B1a-18b	LTN-EMT-311B-4BR	LP-325-PB XFMR & FEEDER		30.00	18.70	KVA	18.70	10s-cont	0.48	0.40	0.48	0.40	0.48	0.40
B1a-19a	LTN-EPNL-13PB	EMERG LTG PNL: LP-313-PB		37.50	24.00	KVA	24.00	10s-cont	24.00		24.00		24.00	
B1a-19b	LTN-EMT-311B-3BR	LP-313-PB XFMR & FEEDER		37.50	24.00	KVA	24.00	10s-cont	0.60	0.52	0.60	0.52	0.60	0.52
B1a-20a	LTN-EPNL-351	EMERG LTG PNL: LP-351-PB		45.00	20.00	KVA	20.00	10s-cont	20.00		20.00		20.00	
B1a-20b	LTN-EMT-314B-1MR	LP-351-PB XFMR & FEEDER		45.00	20.00	KVA	20.00	10s-cont	0.58	0.21	0.58	0.21	0.58	0.21
B1a-21a	LTN-EPNL-3003	Chem Lab LP-3003/PDP-3055-NAB	(j,u)	7.50	7.50	KVA	7.50	10s-cont	7.50		7.50		7.50	
B1a-21b	LTN-EMT-311AB-6FR	LP-3003/PDP-3055-NAB XF & FDR	(j,u)	7.50	7.50	KVA	7.50	10s-cont	1.38	1.32	1.38	1.32	1.38	1.32
B1a-22a	LVD-EPDP-005B	PWR DISTR PNL: PDP-3005-SB		45.00	6.40	KVA	6.40	10s-cont	5.52	3.23	5.52	3.23	5.52	3.23
B1a-22b	LVD-EMT-312B-5BL	PDP-3005-SB XFMR & FEEDER		45.00	6.40	KVA	6.40	10s-cont	0.30	0.03	0.30	0.03	0.30	0.03
B1a-23a	LVD-EPDP-61B	PWR DISTR PNL: PDP-361-SB		45.00	23.00	KVA	23.00	10s-cont	22.41	5.21	22.41	5.21	22.41	5.21
B1a-23b	LVD-EMT-312B-5BR	PDP-361-SB XFMR & FEEDER		45.00	22.00	KVA	22.00	10s-cont	0.43	0.29	0.43	0.29	0.43	0.29
B1a-24	SSD-EPDP-007	PWR DISTR PNL: PDP-3007-NAB	(j)	66.50	66.50	KVA	66.50	10s-cont	60.09	29.08	60.09	29.08	60.09	29.08
B1a-25a	LVD-EPDP-62AB	PWR DISTR PNL: PDP-362-SAB	(j)	30.00	8.60	KVA	8.60	10s-cont	8.14	2.79	8.14	2.79	8.14	2.79
B1a-25b	LVD-EMT-311AB-4BR	PDP-362-SAB XFMR & FEEDER	(j)	30.00	8.60	KVA	8.60	10s-cont	0.25	0.09	0.25	0.09	0.25	0.09
		MOTOR OPERATED VALVES:												
B1a-26	SI-EMTR-311B-6F	LPSI FLOW CONTROL		2.60	2.60	HP	30.28	10s-1min	2.62	2.62	2.62	2.62		
B1a-27	SI-EMTR-311B-6C	LPSI FLOW CONTROL		2.60	2.60	HP	30.28	10s-1min	2.62	2.62	2.62	2.62		
B1a-28	BAM-EMTR-311B-7C	BORIC ACID GRAVITY FEED		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-29	BAM-EMTR-312B-2J	BORIC ACID GRAVITY FEED		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-30	SI-EMTR-311B-6J	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-31	SI-EMTR-311B-6M	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-32	SI-EMTR-311B-7J	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-33	SI-EMTR-311B-12M	HPSI FLOW CONTROL		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-34	MS-EMTR-313B-6J	STM LINE 2 UPSTRM NORM DRAIN		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-35	MS-EMTR-313B-6M	STM LINE 2 UPSTRM EMERG DRAIN		0.70	0.70	HP	9.48	10s-1min	0.71	0.71	0.71	0.71		
B1a-36	HVR-EMTR-313B-6C	CVAS B TRAIN OUTLET	(o)	0.66	0.66	HP	12.75	10s-17s	0.67	0.67	0.67	0.67		
B1a-37	HVR-EMTR-313B-6F	CVAS B TRAIN INLET	(o)	1.00	1.00	HP	12.75	10s-17s	1.01	1.01	1.01	1.01		
B1a-38	SBV-EMTR-311B-9C	SBVS B TRAIN OUTLET	(o)	0.67	0.67	HP	9.80	10s-17s	0.68	0.68	0.68	0.68		
B1a-39	SBV-EMTR-311B-9F	SBVS B TRAIN INLET	(o)	0.67	0.67	HP	9.80	10s-17s	0.68	0.68	0.68	0.68		
B1a-40	SBV-EMTR-311B-9M	SBVS B RECIRC	(o)	0.67	0.67	HP	9.80	10s-17s	0.68	0.68	0.68	0.68		
B1a-41	SBV-EMTR-311B-9J	SBVS B EXHAUST	(o)	0.67	0.67	HP	9.80	10s-17s	0.68	0.68	0.68	0.68		
B1a-42	CVC-EMTR-311B-10M	VOLUME CONTROL TANK DISCH		1.00	1.00	HP	12.75	10s-1min	1.01	1.01	1.01	1.01		
B1a-43	ID-EUPS-014AB	SUPS 3014-AB 37.5KVA/30KW		30.00	30.00	KW	46.53	10s-cont	37.15	28.21	37.15	28.21	37.15	28.21

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

									LOAD WITH LOSS OF OFFSITE POWER					
ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
B1a-44	ACC-EMTR-311B-12J	ACCW PMP LINE DISCH ISOL VLV	(p)	1.33	1.33	HP	12.75	10-27s	1.34	1.34	1.34	1.34	1.34	1.34
B1a-45a	SSD-EMCC-313AB	MCC 3AB313(B)		600.00	138.59	A		10s-cont	0.37	0.34	0.37	0.34	0.37	0.34
B1a-45b		MCC 3AB313(B)REACTOR		0.03		OHM		10s-cont	0.17	1.44	0.17	1.44	0.17	1.44
		LOAD BLOCK 1a TOTAL:							313.96	268.40	313.96	268.40	297.69	252.13
		***** LOAD BLOCK 1b *****												
		Relay S0X, set at 0.5sec:												
B1b-01	SSD-EMT-32B	STA SERVICE XFMR 3B32 INRUSH	(i)	2.50		MVA	50000.00	10.5s-cont					4.85	
		LOAD BLOCK 1b TOTAL:							0.00	0.00	0.00	0.00	4.85	0.00
		***** LOAD BLOCK 1c *****												
		Relay S1X, set at 1.0sec:												
B1c-01	SSD-EMT-315B	STA SERVICE XFMR 3B315 INRUSH	(i)	1.00		MVA	20000.00	11s-cont	2.36		2.36		2.36	
B1c-02a	LTN-EPNL-334	LIGHTING PANEL LP-334-PB		15.00	13.00	KVA	13.00	11s-cont	13.00		13.00		13.00	
B1c-02b	LTN-EMT-315B-14B	LP-334-PB XFMR & FEEDER		15.00	13.00	KVA	13.00	11s-cont	0.34	0.20	0.34	0.20	0.34	0.20
B1c-03a	SSD-EMT-315A	STA SERVICE XFMR 3B315 LOSSES		1.00	0.81	MVA		11s-cont	7.67	46.04	7.67	46.04	7.67	46.04
B1c-03b	SSD-EMCC-315B	MCC 3B315		1.00	0.97	kA		11s-cont	0.75	1.27	0.75	1.27	0.75	1.27
		LOAD BLOCK 1c TOTAL:							24.12	47.51	24.12	47.51	24.12	47.51
		***** LOAD BLOCK 1d *****												
		Relay S2X, set at 1.5 secs:												
B1d-01	SI-EMTR-3B-3A	HPSI PUMP B	(s)	600.00	530.00	HP	3394.82	11.5s-Cont	418.86	208.09				
B1d-01	SI-EMTR-3B-3A	HPSI PUMP B	(c,s)	600.00	530.00	HP	3394.82	11.5s-4day			418.86	208.09		
b1d-01z	SI-EMTR-3AB-3A	HPSI PUMP AB		600.00	530.00	HP	3394.82	11.5s-4day						
	SI-EMTR-3AB-3A	HPSI PUMP AB		600.00	530.00	HP	3394.82	11.5s-Cont						
B1d-02	HVR-EMTR-313B-4K	SAFEGUARD PMP RM AH-2(3B-SB)		5.00	3.10	HP	36.65	11.5s-cont	2.83	3.54	2.83	3.54		
B1d-03	HVR-EMTR-313B-5K	SAFEGUARD PMP RM AH-2(3D-SB)		5.00	3.10	HP	36.65	11.5s-cont	2.83	3.54	2.83	3.54		
	HVR-EMTR-311AB-5F	SAFEGUARD PMP RM AB AH-21		3.00	1.60	HP	25.50	11.5s-cont						
B1d-04	CS-EMTR-3B-5	CONTAINMENT SPRAY PUMP B	(r,s)	300.00	277.00	HP	1759.76	11.5s-4day			224.43	89.69		
B1d-04	CS-EMTR-3B-5	CONTAINMENT SPRAY PUMP B	(r,s)	300.00	277.00	HP	1759.76	11.5s-Cont	224.43	89.69				

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING	SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
		LOAD BLOCK 1d TOTAL:						648.94	304.87	648.94	304.87	0.00	0.00
		***** LOAD BLOCK 2a(individual relays set at 5 secs): *****											
B2a-01	DC-EBC-1AB	BATTERY CHARGER 3AB1-S		45.00	3.99 KVA	3.99	15s-cont	2.68	2.95	2.68	2.95	2.68	2.95
B2a-02	DC-EBC-2AB	BATTERY CHARGER 3AB2-S		45.00	3.99 KVA	3.99	15s-cont	2.68	2.95	2.68	2.95	2.68	2.95
B2a-03	ID-EUPS-2572-AB	SUPS 3AB 30KVA NORMAL SUPPLY		30.00	30.00 KVA	50.00	15s-cont	40.15	29.97	40.15	29.97	40.15	29.97
		LOAD BLOCK 2a TOTAL:						45.51	35.88	45.51	35.88	45.51	35.88
		***** LOAD BLOCK 2b ***** Relays S3X/S3X2, set at 7secs:											
B2b-01	CC-EMTR-3B-8	CCW PUMP B		300.00	300.00 HP	1669.70	17s-cont	241.61	143.37	241.61	143.37	241.61	143.37
B2b-02	HVR-EMTR-313B-4M	CCW PMP UNIT AH-10 (3B-SB)		3.00	1.70 HP	25.50	17s-cont	1.67	2.93	1.67	2.93	1.67	2.93
	CC-EMTR-3AB-4	CCW PUMP AB		300.00	300.00 HP	1669.70	17s-cont						
	HVR-EMTR-311AB-5D	CCW PMP AB UNIT AH-20(3B-SAB)		3.00	1.70 HP	25.50	17s-cont						
B2b-03	EFW-EMTR-3B-2A	EFW PUMP B	(I)	400.00	380.00 HP	2411.01	17s-4hr	306.10	187.09	306.10	187.09	306.10	187.09
B2b-04	HVR-EMTR-311B-14B	EFW PUMP RM UNIT AH-17(3B-SB)	(I)	3.00	1.34 HP	25.50	17s-4hr	1.28	1.59	1.28	1.59	1.28	1.59
B2b-05a	HT-EPNL001-B	CVCS HEAT TRACING		45.00	7.00 KVA	7.00	17s-cont	7.00		7.00		7.00	
B2b-05b		CVCS HEAT TRACE B XFMR & FDR		45.00	7.00 KVA	7.00	17s-cont	0.33	0.03	0.33	0.03	0.33	0.03
B2b-06	DC-EBC-1B	BATTERY CHARGER 3B1-S		34.00	3.73 KVA	3.73	17s-cont	2.48	2.79	2.48	2.79	2.48	2.79
B2b-07	DC-EBC-2B	BATTERY CHARGER 3B2-S		34.00	3.73 KVA	3.73	17s-cont	2.48	2.79	2.48	2.79	2.48	2.79
B2b-08	ID-EUPS-MB	SUPS 3MB-S 20KVA NORMAL SUPPLY		20.00	20.00 KVA	36.23	17s-cont	26.72	24.54	26.72	24.54	26.72	24.54
	ID-EUPS-MB	SUPS 3MB-S BYPASS XFMR		25.00	20.00 KVA		17s-cont						
B2b-09	ID-EUPS-B1	SUPS 3B1-S 20KVA NORMAL SUPPLY		20.00	20.00 KVA	36.23	17s-cont	26.78	24.55	26.78	24.55	26.78	24.55
	ID-EUPS-MD	SUPS 3MD-S BYPASS XFMR		25.00	20.00 KVA		17s-cont						
B2b-10	ID-EUPS-B	SUPS 3B-S 20KVA NORMAL SUPPLY		20.00	5.50 KVA	10.32	17s-cont	9.33	4.44	9.33	4.44	9.33	4.44
	ID-EUPS-B	SUPS 3B-S BYPASS XFMR		30.00	17.30 KVA	17.30	17s-cont	2.45	17.13	2.45	17.13	2.45	17.13
B2b-11	CCS-EMTR-317B-3M	CONT FN CLR AH-1(3B-S) LOW SP		62.50	29.00 HP	462.11	17s-cont	24.78	53.21	24.78	53.21		
B2b-11	CCS-EMTR-317B-3M	CONT FN CLR AH-1(3B-S) HI SP		125.00	110.00 HP	964.06	-					90.79	51.78
B2b-12	CCS-EMTR-317B-2M	CONT FN CLR AH-1(3D-S) LOW SP		62.50	29.00 HP	462.11	17s-cont	24.75	53.18	24.75	53.18		
B2b-12	CCS-EMTR-317B-2M	CONT FN CLR AH-1(3D-S) HI SP		125.00	110.00 HP	964.06	-					90.69	51.69
B2b-13	HVR-EMTR-311B-5F	AUX BLDG CVAS EXH FN E-23		15.00	10.00 HP	92.42	17s-cont	8.63	6.34	8.63	6.34		

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

Table 8.3-1 (Sheet 16 of 24)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

									LOAD WITH LOSS OF OFFSITE POWER					
ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
B2b-13a	HVR-EMTR-313B-6C	CVAS B TRAIN OUTLET VALVE	(o)	0.66	0.66	HP	12.75	17s-1min	0.67	0.67	0.67	0.67		
B2b-13b	HVR-EMTR-313B-6F	CVAS B TRAIN INLET VALVE	(o)	1.00	1.00	HP	12.75	17s-1min	1.01	1.01	1.01	1.01		
B2b-14	HVR-EMTR-313B-3BR	AUX BLDG CVAS HEAT COIL EHC-48		20.00	20.00	KW	20.00	17s-cont	20.00		20.00			
B2b-15	SBV-EMTR-31B-5B1	SHIELD BLDG VENT FN E-17		100.00	70.00	HP	577.64	17s-cont	57.65	36.28	57.65	36.28		
B2b-15a	SBV-EMTR-311B-9C	SBVS B TRAIN OUTLET VALVE	(o)	0.67	0.67	HP	4.02	17s-1min	0.68	0.68	0.68	0.68		
B2b-15b	SBV-EMTR-311B-9F	SBVS B TRAIN INLET VALVE	(o)	0.67	0.67	HP	4.02	17s-1min	0.68	0.68	0.68	0.68		
B2b-15c	SBV-EMTR-311B-9M	SBVS B RECIRC VALVE	(o)	0.67	0.67	HP	9.48	17s-1min	0.68	0.68	0.68	0.68		
B2b-15d	SBV-EMTR-311B-9J	SBVS B EXHAUST VALVE	(o)	0.67	0.67	HP	2.51	17s-1min	0.68	0.68	0.68	0.68		
B2b-16	SBV-EHTR-313B-5BL	SBVS HEAT COIL EHC-51(3B-SB)		60.00	60.00	KW	60.00	17s-cont	60.00		60.00			
		LOAD BLOCK 2b TOTAL:							828.41	564.64	828.41	564.64	809.70	514.72
		***** LOAD BLOCK 3 *****												
		Relay S4X, set at 17secs:												
B3-01	SI-EMTR-3B-4	LPSI PUMP B	(b,c)	500.00	435.00	HP	3041.48	27s-75min	349.27	159.06	349.27	159.06		
B3-02	ACC-EMTR-3B-6	AUX CCW PUMP B		300.00	295.00	HP	1669.70	27s-Cont					237.60	141.42
B3-02	ACC-EMTR-3B-6	AUX CCW PUMP B		300.00	250.00	HP	1669.70	27s-Cont	201.22	126.17	201.22	126.17		
B3-03	HVR-EMTR-31B-6B1	DSL RM B EXH FN E-28 (3B-SB)		100.00	74.00	HP	577.64	27s-cont	61.16	53.66	61.16	53.66	61.16	53.66
B3-04	CVC-EMTR-31B-6C1	CHARGING PUMP B		100.00	78.00	HP	577.64	27s-10hrs	64.72	43.45	64.72	43.45		
B3-04	CVC-EMTR-31B-6C1	CHARGING PUMP B		100.00	78.00	HP	577.64	27s-cont					64.72	43.45
B3-05	HVR-EMTR-311B-14K	CHARGING PUMP RM UNIT AH-18		3.00	1.30	HP	25.50	27s-10hr	1.24	1.55	1.24	1.55		
B3-05	HVR-EMTR-311B-14K	CHARGING PUMP RM UNIT AH-18		3.00	1.30	HP	25.50	27s-cont					1.24	1.55
	CVC-EMTR-31AB-4C-1	CHARGING PUMP AB		100.00	78.00	HP	577.64	27s-cont						
	HVR-EMTR-311AB-5K	CHARGING PUMP RM UNIT AH-22		3.00	1.28	HP	25.50	27s-cont						
B3-06	ACC-EMTR-311B-12J	ACCW PMP LINE DISCH ISOL VLV	(p)	1.33	1.33	HP	12.75	27s-1min	1.34	1.34	1.34	1.34	1.34	1.34
		LOAD BLOCK 3- TOTAL:							678.94	385.23	678.94	385.23	366.06	241.42
		***** LOAD BLOCK 4 *****												
		Relay S5X, set at 29secs:												
B4-01	SVS-EMTR-313B-5H	RAB SWGR & BATTERY RM AH-25		50.00	37.40	HP	288.42	39s-cont	30.60	18.90	30.60	18.90	30.60	18.90
B4-02	SVS-EEHC-313B-4BL	RAB SWGR & BATTERY RM EHC-36		60.00	60.00	KW	60.00	39s-cont	60.00		60.00		60.00	
B4-03	HVR-EMTR-313B-4D	SHTDWN HEAT EXCHANGER AH-3	(e)	3.00	1.70	HP	25.50	39s-cont	1.68	2.93	1.68	2.93	1.68	2.93
B4-04	HVR-EMTR-313B-2M	MAIN HVAC EQPT RM SUP AH-13	(e)	30.00	24.70	HP	173.29	39s-cont	20.72	15.07	20.72	15.07		

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER: LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
B4-05	HVR-EMTR-311B-3H	MAIN HVAC EQPT RM EXH FN E-41		15.00	9.10	HP	92.42	39s-cont	7.85	6.16	7.85	6.16		
B4-06	HVC-EMTR-311B-4H	CONTR RM AC SUP FN AH-12	(e)	75.00	42.00	HP	431.83	39s-cont	34.19	28.74	34.19	28.74	34.19	28.74
B4-07	HVC-EEHC-313B-5BR	CNTRL RM MN HEAT COIL EHC-34	(e)	30.00	30.00	KW	30.00	39s-cont	30.00		30.00		30.00	
B4-08	HVC-EMTR-313B-4F	CNTRL RM EQPT RM AH-26		3.00	1.17	HP	25.50	39s-cont	1.12	1.39	1.12	1.39	1.12	1.39
B4-09	HVC-EMTR-311B-5B	CONTR RM EM FILT S-8 (3B-SB)	(e)	15.00	12.00	HP	92.42	39s-cont	10.35	6.78	10.35	6.78		
B4-10	HVC-EEHC-313B-4BR	CNTRL RM BOOST HT COIL EHC-49		10.00	10.00	KW	10.00	39s-cont	10.00		10.00			
B4-11	HVR-EMTR-313B-5D	CCW HEAT EXCHANGER B AH-24	(e)	3.00	1.34	HP	25.50	39s-cont	1.34	2.58	1.34	2.58	1.34	2.58
B4-12	SVS-EMTR-311B-2F	BATT ROOM EXH FAN E-29 (3B-SB)		0.75	0.11	HP	9.96	39s-cont	0.13	0.27	0.13	0.27	0.13	0.27
B4-13	SVS-EMTR-311B-3F	BATT ROOM EXH FAN E-30 (3B-SB)		0.75	0.11	HP	9.96	39s-cont	0.13	0.27	0.13	0.27	0.13	0.27
B4-14	SVS-EMTR-311B-13K	BATT ROOM EXH FAN E-31 (3B-SB)		0.75	0.11	HP	9.96	39s-cont	0.13	0.27	0.13	0.27	0.13	0.27
B4-15	SVS-EMTR-311B-2H	COMP BATTERY RM E-46 (3B-SB)		0.75	0.40	HP	9.96	39s-cont	0.45	0.91	0.45	0.91	0.45	0.91
B4-16	SVS-EMTR-311B-14H	BATTERY RM EXH FN E-52(3B-SB)		0.75	0.13	HP	7.97	39s-cont	0.16	0.31	0.16	0.31	0.16	0.31
B4-17	SVS-EMTR-311B-13B	SWGR AREA AH-30 (3B-SB)		15.00	10.90	HP	92.42	39s-cont	9.38	6.43	9.38	6.43	9.38	6.43
	LOAD BLOCK 4- TOTAL:								218.22	91.00	218.22	91.00	169.30	62.99
		***** LOAD BLOCK 5a *****												
		Relay S6X, set at 41secs:												
B5a-01	CC-EMTR-315B-1F	DRY COOLING TOWER FAN1-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.36	15.83	31.36	15.83	31.36	15.83
B5a-02	CC-EMTR-315B-1M	DRY COOLING TOWER FAN2-SB	(k)	40.00	38.40	HP	231.85	51s-cont	31.29	18.05	31.29	18.05	31.29	18.05
B5a-03	CC-EMTR-315B-2F	DRY COOLING TOWER FAN3-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.30	15.82	31.30	15.82	31.30	15.82
B5a-04	CC-EMTR-315B-2M	DRY COOLING TOWER FAN4-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.37	15.84	31.37	15.84	31.37	15.84
B5a-05	CC-EMTR-315B-3F	DRY COOLING TOWER FAN5-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.35	15.83	31.35	15.83	31.35	15.83
B5a-06	CC-EMTR-315B-3M	DRY COOLING TOWER FAN6-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.32	15.83	31.32	15.83	31.32	15.83
B5a-07	CC-EMTR-315B-4F	DRY COOLING TOWER FAN7-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.42	15.85	31.42	15.85	31.42	15.85
B5a-08	CC-EMTR-315B-4M	DRY COOLING TOWER FAN8-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.39	15.84	31.39	15.84	31.39	15.84
B5a-09	CC-EMTR-315B-5F	DRY COOLING TOWER FAN9-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.37	15.84	31.37	15.84	31.37	15.84
B5a-10	CC-EMTR-315B-5M	DRY COOLING TOWER FAN10-SB	(k)	40.00	38.40	HP	234.24	51s-cont	31.43	18.08	31.43	18.08	31.43	18.08
B5a-11	CC-EMTR-315B-7F	DRY COOLING TOWER FAN11-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.44	15.85	31.44	15.85	31.44	15.85
B5a-12	CC-EMTR-315B-7M	DRY COOLING TOWER FAN12-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.41	15.84	31.41	15.84	31.41	15.84
B5a-13	CC-EMTR-315B-8F	DRY COOLING TOWER FAN13-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.51	15.86	31.51	15.86	31.51	15.86
B5a-14	CC-EMTR-315B-8M	DRY COOLING TOWER FAN14-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.49	15.86	31.49	15.86	31.49	15.86
B5a-15	CC-EMTR-315B-9F	DRY COOLING TOWER FAN15-SB	(k)	40.00	37.00	HP	231.06	51s-cont	31.46	15.85	31.46	15.85	31.46	15.85
B5a-16	ACC-EMTR-315B-10H	WET COOLING TOWER FAN1-SB	(k)	30.00	28.80	HP	173.29	51s-Cont	24.14	14.07	24.14	14.07	24.14	14.07

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
B5a-17	ACC-EMTR-315B-10M	WET COOLING TOWER FAN2-SB	(k)	30.00	28.80	HP	173.29	51s-Cont	24.14	14.07	24.14	14.07	24.14	14.07
B5a-18	ACC-EMTR-315B-11H	WET COOLING TOWER FAN3-SB	(k)	30.00	28.80	HP	173.29	51s-Cont	24.14	14.07	24.14	14.07	24.14	14.07
B5a-19	ACC-EMTR-315B-11M	WET COOLING TOWER FAN4-SB	(k)	30.00	28.80	HP	173.29	51s-Cont	24.14	14.07	24.14	14.07	24.14	14.07
B5a-20	ACC-EMTR-315B-12H	WET COOLING TOWER FAN5-SB	(k)	30.00	28.80	HP	173.29	51s-4day	24.16	14.07	24.16	14.07		
B5a-20	ACC-EMTR-315B-12H	WET COOLING TOWER FAN5-SB	(k)	30.00	28.80	HP	173.29	51s-cont					24.16	14.07
B5a-21	ACC-EMTR-315B-12M	WET COOLING TOWER FAN6-SB	(k)	30.00	28.80	HP	173.29	51s-4day	24.28	14.08	24.28	14.08		
B5a-21	ACC-EMTR-315B-12M	WET COOLING TOWER FAN6-SB	(k)	30.00	28.80	HP	173.29	51s-cont					24.28	14.08
B5a-22	ACC-EMTR-315B-13H	WET COOLING TOWER FAN7-SB	(k)	30.00	28.80	HP	188.35	51s-cont					24.95	29.94
B5a-22	ACC-EMTR-315B-13H	WET COOLING TOWER FAN7-SB	(k)	30.00	28.80	HP	188.35	51s-4day	24.95	29.94	24.95	29.94		
B5a-23	ACC-EMTR-315B-13M	WET COOLING TOWER FAN8-SB	(k)	30.00	28.80	HP	173.29	51s-4day	24.16	14.07	24.16	14.07		
B5a-23	ACC-EMTR-315B-13M	WET COOLING TOWER FAN8-SB	(k)	30.00	28.80	HP	173.29	51s-cont					24.16	14.07
B5a-24a	LVD-EPDP-82BS	PWR DISTR PNL: PDP-382-SB		30.00	2.50	KVA	2.50	51s-cont	2.50	0.00	2.50	0.00	2.50	0.00
B5a-24b	LVD-EMT-315B-14M	PDP-382-SB XFMR & FEEDER		30.00	2.50	KVA	2.50	51s-cont	0.19	0.01	0.19	0.01	0.19	0.01
		LOAD BLOCK 5a TOTAL:							667.70	370.51	667.70	370.51	667.70	370.51
		***** LOAD BLOCK 5b *****												
		Relay 62-1, set at 110secs:												
B5b-01a	ID-EMT-2572	COMPUTER POWER SUPPLY STBY		225.00	65.00	KVA	65.00	120s-cont	63.71	13.33	63.71	13.33	63.71	13.33
B5b-01b		COMPUTER PWR SUPP XFMR & FDR		225.00	65.00	KVA	65.00	120s-cont	2.41	1.91	2.41	1.91	2.41	1.91
		LOAD BLOCK 5b TOTAL:							66.12	15.24	66.12	15.24	66.12	15.24
		***** LOAD BLOCK 6a *****												
		Relay S7X, set at 168secs:												
B6a-01	CHW-EMTR-311B-5M	AUX BLDG WTR CHLR PMP P-1		40.00	25.40	HP	231.06	178s-cont	21.54	21.22	21.54	21.22	21.54	21.22
	CHW-EMTR-311AB-2M	AUX BLDG WTR CHLR PMP P-1		40.00	25.40	HP	231.06	178s-cont						
		LOAD BLOCK 6a TOTAL:							21.54	21.22	21.54	21.22	21.54	21.22
		***** LOAD BLOCK 6b *****												
		Chiller Contol Panel - Timer 23sec after S7X signal												
B6b-02	RFR-EMTR-311B-2M	AUX BLDG WTR CHLR OIL PMP		1.50	0.62	HP	15.93	201s-cont	0.70	0.87	0.70	0.87	0.70	0.87

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER: LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
	RFR-EMTR-311AB-3K	AUX BLDG WTR CHLR OIL PMP		1.50	0.62	HP	15.93	201s-cont						
		LOAD BLOCK 6b TOTAL:							0.70	0.87	0.70	0.87	0.70	0.87
		***** LOAD BLOCK 6c *****												
		Relay S8X, set at 200secs:												
B6c-01	CMU-EMTR-311B-4M	CCW MAKE-UP PUMP B		40.00	32.00	HP	231.06	210s-14hr	26.94	22.83	26.94	22.83	26.94	22.83
		LOAD BLOCK 6c TOTAL:							26.94	22.83	26.94	22.83	26.94	22.83
		Chiller Control Panel - Timer												
		51sec after S7X signal												
B6d-01a	RFR-EMTR-3B-14A	AUX BLDG WTR CHLR COMPR WC-1		416.00	416.00	KW	3400.02	229s-cont	419.86	260.26	419.86	260.26		
B6d-01b	RFR-EMTR-3B-14A	AUX BLDG WTR CHLR COMPR WC-1		379.00	379.00	KW	3400.02	229s-cont					382.49	237.09
	RFR-EMTR-3AB-5A	AUX BLDG WTR CHLR COMPR WC-1		416.00	416.00	KW	3400.02	229s-cont						
		LOAD BLOCK 6d TOTAL:							419.86	260.26	419.86	260.26	382.49	237.09
		**** AUTOMATIC LOAD BLOCK ****												
B-AUTO	SI-EMTR-311B-10J	SIS SUMP OUT TO RECIRC HDR B	(m,n)	0.70	0.70	HP	9.48	30m-30m25s	0.71	0.71	0.71	0.71		
		AUTOMATIC LOAD BLOCK TOTAL:							0.71	0.71	0.71	0.71	0.00	0.00
		***** MANUAL LOADING: *****												
BM-01	CDC-EMTR-31B-8B	CEDM COOLING FAN E-16 (3B)		250.00	237.00	HP	1454.06	30min-cont					187.08	117.01
BM-02	CDC-EMTR-31B-9B	CEDM COOLING FAN E-16 (3D)		250.00	237.00	HP	1454.06							
BM-03	RC-EHTR-74B	PDP-374B(PRESS BU HTRS BNK 5)	(f)	150.00	150.00	KW	150.00							
BM-04	RC-EHTR-75B	PDP-375B(PRESS BU HTRS BNK 6)	(f)	150.00	150.00	KW	150.00							
BM-05	RC-EHTR-76B	PDP-376B(PRESS BU HTRS BNK4)	(f)	100.00	100.00	KW	100.00							
BM-06	RC-EHTR-73B	PDP-373B(PRESS HTRS PRO BNK 2)		150.00	150.00	KW	150.00	30min - 4hrs					150.00	
BM-07	SSD-EMT-32B	STA SERVICE XFMR 3B32 LOSSES		2.50	0.15	MVA		30min-4hr					0.09	0.95
BM-08	IA-EMTR-31B-9A	INSTRUMENT AIR COMP B		150.00	130.00	HP	864.47	30min-cont	106.35	79.48	106.35	79.48	106.35	79.48
BM-09	LOG-EMTR-313AB-2M	BEARING OIL PUMP (BOP)		75.00	68.50	HP	431.83	30-90min	56.46	38.48	56.46	38.48	56.46	38.48
BM-11	ANP-EMTR-312B-10F	ANPS FAN E-19 (3B)		3.00	2.30	HP	25.50	30min					2.36	2.07
BM-12	HVC-EMTR-311B-5D	CNTRL RM AC EXH FN E-34(3B-SB)		0.75	0.46	HP	9.96	30min					0.47	0.63

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

|→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING		SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER					
									LOCA		MSLB		SHUTDOWN	
									KW	KVAR	KW	KVAR	KW	KVAR
BM-13	HRA-EMTR-311B-2B	H2 ANALYZER SAMPLE PUMP B		2.50	2.50	HP	17.53	30min-cont	2.33	2.02	2.33	2.02		
BM-14	HVR-EMTR-311B-5F	AUX BLDG CVAS EXH FN E-23		15.00	10.00	HP	92.42	30min					8.63	6.34
BM-15	TUR-EMTR-313AB-4M	TURNING GEAR		50.00	31.20	HP	288.42	30min					25.51	18.02
BM-16a	SI-EMTR-3B-4	LPSI PUMP B	(s)	500.00	435.00	HP	3041.48	4d-cont			349.27	159.06		
BM-16b	SI-EMTR-3B-4	LPSI PUMP B	(l)	500.00	435.00	HP	3041.48	4hr-cont					349.27	159.06
BM-17	HRA-EHTR-313B-3M	HYDROGEN RECOMBINER B	(g)	75.00	75.00	KW								
BM-18	SP-EMPTR-314B-4F	COOL TWR AREA DRN SUMP PUMP 1B		10.00	10.00	HP	64.54	30min-10h30	8.85	6.49	8.85	6.49	8.85	6.49
BM-19	SP-EMTR-314B-5F	COOL TWR AREA DRN SUMP PUMP 2B		10.00	10.00	HP	64.54	30min-10h30	8.92	6.49	8.92	6.49	8.92	6.49
BM-20	LOG-EMTR-313AB-4D	BOL PUMP AC MTR ON OIL RESER		15.00	11.30	HP	92.42	30min					9.71	6.50
BM-21	SI-EMTR-313B-7J	RC LOOP 2 HOT LEG ISOL	(t)	0.66	0.66	HP	9.48	2hr-2hr50s	0.67	0.67				
BM-22	FS-EMTR-314B-5M	FUEL POOL PUMP B		60.00	49.20	HP	331.45	6hr-cont	41.05	26.46	41.05	26.46	41.05	26.46

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING	SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER LOCA KW	LOCA KVAR	MSLB KW	MSLB KVAR	SHUTDOWN KW	SHUTDOWN KVAR
		LOAD SUMMARY:											
		0-10s :Generator Starts											
		10-10.5s:Load Block 1a						313.96	268.40	313.96	268.40	297.69	252.13
		10.5-11s:Load Block 1b						313.96	268.40	313.96	268.40	302.54	252.13
		11-11.5s:Load Block 1c						338.08	315.92	338.08	315.92	326.66	299.64
		11.5-15s:Load Block 1d						987.02	620.79	987.02	620.79	326.66	299.64
		15-17s :Load Block 2a						1032.53	656.67	1032.53	656.67	372.17	335.52
		17-27s :Load Block 2b						1856.57	1216.94	1856.57	1216.94	1181.87	850.25
		27-39s :Load Block 3						2534.17	1600.83	2534.17	1600.83	1546.58	1090.32
		39-51s :Load Block 4						2752.39	1691.83	2752.39	1691.83	1715.88	1153.31
		51-60s :Load Block 5a						3420.10	2062.34	3420.10	2062.34	2383.59	1523.82
		60-120s :MOVs Deenergize						3402.49	2044.73	3402.49	2044.73	2382.25	1522.48
		120-178s:Load Block 5b						3468.61	2059.97	3468.61	2059.97	2448.37	1537.72
		178-201s:Load Block 6a						3490.15	2081.19	3490.15	2081.19	2469.91	1558.95
		201-210s:Load Block 6b						3490.85	2082.06	3490.85	2082.06	2470.61	1559.81
		210-229s:Load Block 6c						3517.79	2104.88	3517.79	2104.88	2497.56	1582.64
		229s-30m:Load Block 6d						3937.65	2365.15	3937.65	2365.15	2880.04	1819.73
		30m-30m25s:Auto Load Block						4121.26	2498.81	4121.26	2498.81	3444.46	2102.19
		30m25s-75m:Manual Loading						4120.56	2498.10	4120.56	2498.10	3444.46	2102.19
		75-90m :LPSI Deenergizes						3771.29	2339.04	3771.29	2339.04	3444.46	2102.19
		90m-2h:Turb Aux Deenergize						3714.84	2300.56	3714.84	2300.56	3388.01	2063.71
		2h-2h50s: Manual MOV						3715.50	2301.23	3714.84	2300.56	3388.01	2063.71
		2h50s-4h:MOV Deenergize						3714.84	2300.56	3714.84	2300.56	3388.01	2063.71
		4-6h :EFW Deenergize						3407.45	2111.88	3407.45	2111.88	3279.80	2033.14
		6-8h : SFP Pump Start						3448.51	2138.34	3448.51	2138.34	3320.86	2059.60
		8-10h : BA Pumps Deenergize						3448.51	2138.34	3448.51	2138.34	3320.86	2059.60
		10-14h : Chrg Deenergize						3364.78	2080.36	3364.78	2080.36	3303.09	2046.62
		14-17h : CCW Makeup						3337.83	2057.53	3337.83	2057.53	3276.14	2023.79
		17-4d : de EDG Xfer pump						3317.66	2040.80	3317.66	2040.80	3255.97	2007.06
		4d-4d18h :WCT fans 5-8 de						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		4d18h-4d20						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		4d20h-4d21h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		4d21h-5d						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		5d-5d8h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR B LOADING SEQUENCE (STEADY STATE)

→ (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014 R309; LBDCR 16-017, R309)

ITEM	UNID NO	EQUIPMENT	NOTES	RATED	RUNNING	SKVA	TIME	LOAD WITH LOSS OF OFFSITE POWER					
								LOCA		MSLB		SHUTDOWN	
								KW	KVAR	KW	KVAR	KW	KVAR
		5d8h-5d9h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		5d9h-5d21h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		5d21h-5d22h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		5d22h-5d23h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		5d23h-6d						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d-6d12h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d12h-6d14h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d14h-6d15h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d15h-6d18h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d18h-6d19h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d19h-6d21h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d21h-6d22h						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06
		6d22h-7d						3220.10	1968.64	2926.08	1829.92	3255.97	2007.06

← (DRN 99-1255, R11; 99-682, R11; 01-1322, R11-B; 04-673, R13-A; 04-1551, R14; 05-838, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305; LBDCR 15-008, R309; LBDCR 16-014, R309; LBDCR 16-017, R309)

EMERGENCY DIESEL GENERATOR LOADING SEQUENCE

→(DRN E9900733; 99-1255, R11; 00-1674; 01-1322, R11-B; 01-1362, R12; 04-673, R13-A)

NOTES:

(a) Continuous is taken as 24 hours or more.

(b) 75 minutes is the approximate maximum time to RAS with one Emergency Diesel Generator in operation. (Ref. 2.114)

(c) RCS pressure will increase above the shutoff head at the SIS pumps shortly after MSLB. These loads may be secured by the operator after low pressure signal has cleared.

(d) Fans are automatically placed in low speed under accident conditions. Normally three fans are required for shutdown, therefore, if two Emergency Diesel Generators are running one has a load of approximately 180 kW; the other approximately 90 kW.

(e) Thermostatically controlled load, comes on as required at or after the sequencer timer start signal is given.

→(DRN 04-1551, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305, LBDCR 15-004, R309, LBDCR 16-017, R309)

(f) Three Backup Heater sets are available, after sequencer initiation, on each Emergency Diesel Generator. Only one bank is anticipated to be required as substitution for one proportional bank if necessary. Backup banks #1, #5 and #6 are rated at 150 KW. Backup Bank #4 is rated at 100 KW

← (DRN 04-1551, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305, LBDCR 15-004, R309, LBDCR 16-017, R309)

(g) Applied manually as required 24 hours post-accident.

(h) Emergency Diesel Generator is rated 4400 kW continuous with a supplementary rating of 4840 kW for two hours out of any 24 hours. Under condition of a MSLB with loss of offsite power automatic loads may need to be secured by the operator before the total manual load may be applied in order to maintain the Emergency Diesel Generator within these loading limits.

(i) The Emergency Diesel Generator breaker is closed when the generator voltage reaches 78 percent of nominal and the frequency reaches 95 percent of nominal. The first station service transformer breaker does not trip, it is energized when the Emergency Diesel Generator breaker closes. The second and third station service transformers are energized at 0.5 second intervals (see Subsection 8.3.1.1.2.13.f).

(j) The load, on the "AB" bus, is only on either Emergency Diesel Generator 3A-S or Emergency Diesel Generator 3B-S.

(k) These loads are blocked from operation until load block 5a in the automatic loading sequence. Since the requirement of these loads is thermostatically controlled, these loads will come on, as required after 409 seconds. Loading sequences assume that all fans come on simultaneously in load block 5a.

(l) The operator may de-energize the emergency feedwater pump and energize the LPSI pump when shutdown cooling entry conditions are met.

←(DRN E9900733; 99-1255, R11; 00-1674; 01-1322, R11-B; 01-1362, R12; 04-673, R13-A)

Table 8.3-1 (Sheet 24 of 24) Revision 309 (06/16)

EMERGENCY DIESEL GENERATOR LOADING SEQUENCE

←(DRN E9900733; 99-1255, R11; 00-1674; 01-1322, R11-B; 01-1362, R12; 04-673, R13-A)

NOTES: (Continued)

→ (EC-5000082353, R301; EC-26817, R305)

(m) The initiation of an RAS results in a peak load of 4147.08 kW and 4121.26 kW (for EDG 3A-S and 3B-S respectively) for 25 seconds. The 25 seconds allows motor operated valves SI-602A (EDG 3A-S) and SI-602B(EDG 3B-S) to transfer the Safety Injection header from the RWSP to the Safety Injection sump. Upon completion of the transfer (i.e. valves are fully open) the load will reduce to 4146.37 kW and 4120.56 kW (for EDG 3A-S and 3B-S respectively). RAS can occur anytime after 20 minutes into a LOCA. Therefore, valves SI-602A and SI-602B are assumed to operate during the peak Emergency Diesel Generator load (at 30 minutes).

← (EC-5000082353, R301; EC-26817, R305)
→(DRN 04-1551, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305, LBDCR 15-004, R309, LBDCR 16-014, R309)

(n) If an RAS were initiated, a peak load of 4147.08 kW and 4121.26 kW (for EDG 3A-S and 3B-S respectively) would result for 25 seconds. The 25 seconds allows motor operated valves SI-602A (EDG 3A-S) and SI-602B (EDG 3B-S) to transfer the Safety Injection header from the RWSP to the Safety Injection sump. Upon completion of the transfer (i.e. valves are fully open) the load will reduce to 4146.37 kW and 4120.56 kW (for EDG 3A-S and 3B-S respectively). An RAS can not occur within the first 10 minutes of a MSLB (i.e. peak EDG load). Therefore valves SI-602A and SI-602B are assumed to operate during the next largest Emergency Diesel Generator load (at 30 minutes).

← (DRN 04-1551, R14; 05-980, R14; EC-5000082353, R301; EC-26817, R305, LBDCR 15-004, R309, LBDCR 16-014, R309)

(o) CVAS inlet and outlet valves and SBVS inlet, outlet, recirculation and exhaust valves are energized in load block 1a (when the EDG breaker closes), these valves then stop and restart in load block 2b.

(p) ACCW pump line discharge isolation Motor Operated Valves (MOVs) ACC-110A (ACC-EMTR-311A-10M) and ACC-110B (ACC-EMTR-311B-12J) are energized in load block 1a (when the EDG breaker closes); these valves then stop and restart in load block 3. These MOVs are opened or closed based upon whether the ACCW pumps are running or not running, respectively. The worse case condition (i.e. most fuel used) is if a LOOP occurred with the MOVs open. The MOV would close when the MCC is re-energized since the ACCW pump is tripped. It would re-open when the ACCW pump starts.

(q) Both Boric Acid pumps have contacts to start in load block 6c, but if the pump start/stop switch is in the start position it will start immediately (load block 1a). Therefore, it is assumed one Boric Acid pump will start in load block 1a (switch in start) and one will start in load block 6c (switch in auto).

(r) The containment spray pump is controlled by containment pressure, it will start as required at or after the sequencer timer start signal is given.

(s) The LPSI pump is energized after four days to replace the HPSI and Containment Spray pumps which are shut down.

(t) Reactor coolant loop 1 & 2 hot leg injection isolation valves have the potential to be loaded manually between two and four hours after an accident when the diesel generator loads are sequenced on.

(u) Chemistry procedure CE-001-25 will control the combined load from PDP-3055 and LP-3003 to 7.5 KW (each transformer is rated at 7.5 KVA).

| (DRN E9900682; 99-1255, R11; 01-1322, R11-B; 04-673, R13-A)

TABLE 8.3-2 (Sheet 1 of 4) Revision 11 (05/01)

RATINGS OF CLASS 1E
ELECTRICAL DISTRIBUTION EQUIPMENT

a) DIESEL GENERATOR

		3A-S & 3B-S
Starting time to rated speed and voltage	sec	10
Output, continuous	kW	4400
Power Factor, Lagging		0.80
Frequency	Hz	60
Voltage	kV	4.16
Overload Capacity (2 hours in any 24 hours)	%	10.0
Largest motor to be started	hp	600
Cooling Water:		
→ (DRN E9900733)		
Max. temperature	F	115°F
Inlet Air Temperatures:		
Maximum	F	100°F
← (DRN E9900733)		
Minimum	F	0

b) 4160 V SWITCHGEAR

		3A3-S,3B3-S	3AB3-S
Rated Maximum Voltage	kV	4.76	4.76
Nominal Interrupting Capacity	MVA	350	350
Rated Voltage Range Factor (K)		1.19	1.19
Rated Bus Continuous Current (rms)	A	3000	1200
Rated Short Circuit Current (rms sym) (at Maximum Voltage)	kA	41	41
Closing and Latching Capability (rms asym.)	kA	78	78
Control Voltage, dc	V	125	125

c) 480 V LOAD CENTERS AND TRANSFORMERS

Transformers			3A31-S & 3B31-S	3A315-S & 3B315-S
→ (DRN 98-1388)				
Output	kVA		2500/3333	1000
Type			AA/FA	Sealed, gas filled
Temperature rise	C		150	150
H V Winding:				
rated voltage	kV		4.16	4.16
connection	-		delta	delta
BIL rating,	kV		45	60
L V Winding:				
rated voltage	V		480	480
connection	-		wye	wye
BIL rating,	kV		10	30
Taps no load full capacity:				
above rated voltage		No-%	Two - 2-1/2	Two - 2-1/2
below rated voltage		No-%	Two – 2-1/2	Two – 2-1/2
← (DRN 98-1388)				

c) <u>480 V LOAD CENTERS AND TRANSFORMERS</u> (Cont'd)

Impedance	%	(on 2500 kVA) 3A31 9.12 3B31 9.32	(on 1000kVA) 3A315 7.08 3B315 7.11

Circuit Breakers:

Voltage Rating	V	600
Control Voltage, dc	V	125

Frame Size	Iterrupting Rating RMS Sym., Current @ 480V	
	Trip (A)	Trip (A)
1600	50,000	50,000
		-

d) <u>480 V MOTOR CONTROL CENTERS</u>

Circuit Breakers

→

Voltage Rating	V	600
Frame Size	-	100, 150 & 225
Interrupting Rating, rms symmetrical @ 480 V	kA	14 65 22

←

Magnetic Motor Controller

Voltage Rating	V	600
Control Circuit Voltage, ac	V	120
Control Transformer		Single Phase
Voltage ratio	V/V	480/120
Output rating	VA	100 minimum

→

Buses		
Short circuit current, rms symmetrical	kA	22 and 42
Main, current capacity	A	600 and 1000 @ 50 C rise
Vertical, current capacity	A	300 and 600 @ 50 C rise

←

Reactors		
Continuous current	A	800 & 600
Reactance	ohm	0.025, 0.01 & 0.018

e) BATTERY CHARGERS		3A1-S,3A2-S 3B1-S,3B2-S	3AB1-S,3AB2-S
Input (ac, 3 phase)			
Voltage	V	480	480
Frequency	Hz	60	60
Output (dc)			
Voltage range	V	120-145	120-145
Float Voltage (range/setting)	V	132.0-135.0/134.5	132.0-135.0/134.5
Equalize Voltage (setting)	V	**	**
→(DRN 06-709, R15)			
Continuous battery load	A	<35	<40
←(DRN 06-709, R15)			
Voltage regulation	%	0.5	0.5
Output Current	A	150	200

→(EC-7960, R302)

f) BATTERIES		3A-S & 3AB-S
←(EC-7960, R302)		
Capacity (@ 77°F to 1.75 V/cell	AH	1952 @ 4h
Cells per battery		60
Short circuit current kA		16.95

→(EC-7960, R302)

BATTERY		3B-S
Capacity (@ 77°F to 1.75 V/cell	AH	2000 @ 4h
Cells per battery		60
Short circuit current kA		21.834

←(EC-7960, R302)

→(DRN 06-709, R15)

		VOLTS PER CELL	BATTERY VOLTAGE 3A-S, 3B-S and 3AB-S
←(DRN 06-709, R15)			
Equalize Voltage	V	2.33/2.38	**
Float Voltage nominal/maximum	V	2.20/2.25	132.0/135.0
Final Discharge	V	1.75	105.0

** The manufacturers nominal equalize voltage range is 2.33 to 2.38 VPC. This equates to 139.8 to 142.8 volts dc for 60 cells. These values exceed the maximum allowable dc bus voltage of 137.5 VDC. In order to equalize 60 cells in a string, the cells must be disconnected from the dc system.

g) 125 DC LOAD CENTERS		3A-DC-S, 3A1-DC-S 3B-DC-S, 3B1-DC-S	3AB-DC-S
Circuit Breakers			
Voltage Rating	V	250	250
Frame Size	A	400 & 150	800, 400 & 100
Poles	-	3*	2
Minimum Interrupting Rating @ 250 V dc	kA	22	30
*Only two poles are used			
Buses			
→(DRN 06-709, R15)			
Short Circuit Current	kA	20	50
←(DRN 06-709, R15)			
Continuous Rating	A	400 20 3A1, 3B1	1200

TABLE 8.3-2 (Sheet 4 of 4) Revision 309 (06/16)

Fusible disconnects*		
Voltage Rating	V	250
Poles	-	2
→(DRN 06-709, R15)		
Fuse Rating	A	10
←(DRN 06-709, R15)		
Fuse Interrupting Rating	kA	100

* 3A1-DC-S & 3B1-DC-S only

→(DRN 06-709, R15, LBDCR 15-008, R309, LBDCR 15-009, R309)

h) UNINTERRUPTIBLE POWER SUPPLIES		SUPPS-3MB-S, SUPS-3MC-S	SUPS-3A-S, 3B-S, 3B1-S, 3A1-S
←(DRN 06-709, R15, LBDCR 15-008, R309, LBDCR 15-009, R309)			
Output Rating			
→(DRN 00-184)			
Output (@ Load Power Factor)	kVA	20	20
Load Power Factor	-	0.8	0.7
←(DRN 00-184)			
Output Voltage	V	120	120
Output Frequency	Hz	60	60
Output Circuit		1 ph 2 wire ungrounded	1 ph 2 wire ungrounded
→(DRN 00-184)			
Input Rating:			
→(DRN 06-709, R15)			
Normal (ac, 3 phase); Bypass (ac, 1 phase)			
←(DRN 06-709, R15)			
Voltage	V	480	480
Frequency	Hz	60	60
Available Fault Current, rms symmetrical	kA	14	14
Emergency Input: (dc)			
Normal Voltage	V	125	125
Low Voltage	V	105	100
High Voltage	V	140	140
Available Fault Current	kA	<10	<10
Frequency Regulation:			
Commercial Power Available	%	± 1.3	± 1.3
Free Running	%	± 0.5	± 0.5
Voltage Regulation (Steady State)	%	+5, -2	± 2.0
Voltage Recovery, no load to full load, to within 1.0% of rated. (2.0% for 3A-S and 3B-S)	ms	48	50
Total Harmonic Distortion, rms	%	5	5
→(DRN 06-709, R15)			
Efficiency @ rated load power			
←(DRN 06-709, R15)			
factor and normal input source	%	75	75
←(DRN 00-184)			

TABLE 8.3-3 Revision 309 (06/16)

BATTERY 3A-S LOADING

(SAFETY-RELATED DIVISION A LOADS)

→(DRN E9900733)

ITEM	DESCRIPTION	CIRCUIT (Panel-Circuit)
1	DC Lights	A-5
2	EDG Control Power	A-11, 12/A1-1,2,13
3	EDG Fuel Oil Booster Pump	A-13
4	EDG Field Flash	A-15
5	6.9 KV Breaker Control	A1-20
6	4.16 KV Breaker Control	A-17
7	0.48 KV Breaker Control	A-18/A1-23
8	Reactor Trip Switchgear Control	A-21, 32
9	MCC Bus Tie Breaker's Control	A-20, 25, 27
10	Misc. Valve Control	A-23-24/A1-3-10
11	Sequencer Control	A-28
→(DRN 00-184)		
12	SUPS 3A-S [20 KVA]	A-35
←(DRN 00-184) →(LBDCR 15-009, R309)		
13	SUPS 3A1-S [20 KVA]	A1-21
←(LBDCR 15-009, R309)		
14	SUPS 3MC-S [20 KVA]	A-38

←(DRN E9900733)

General: For a detailed explanation of the loads listed reference the approved battery calculation.

→(DRN E9900733)

←(DRN E9900733)

TABLE 8.3-4 Revision 309 (06/16)

BATTERY 3B-S LOADING

(SAFETY-RELATED DIVISION B LOADS)

→(DRN E9900733)

ITEM	DESCRIPTION	CIRCUIT (Panel-Circuit)
1	DC Lights	B-5
2	EDG Control Power	B-11, 12/B1-1, 2, 13
3	EDG Fuel Oil Booster Pump	B-13
4	EDG Field Flash	B-15
5	6.9 KV Breaker Control	B1-20
6	4.16 KV Breaker Control	B-17
7	0.48 KV Breaker Control	B-18/B1-23
8	Reactor Trip Switchgear Control	B-21, 32
9	MCC Bus Tie Breaker's Control	B-20, 25, 27
10	Misc. Valve Control	B-23-24/B1-3-10
11	Sequencer Control	B-28
12	SUPS 3B-S [20 KVA]	B-35
13	SUPS 3MB-S [20 KVA]	B1-22
→(LBDCR 15-008, R309)		
14	SUPS 3B1-S [20 KVA]	B-37
→(LBDCR 15-008, R309)		

→(DRN E9900733)

General: For a detailed explanation of the loads listed reference the approved battery calculation.

←DRN E9900733)

←(DRN E9900733)

TABLE 8.3-5 Revision 11 (05/01)

BATTERY 3AB-S LOADING

(SAFETY RELATED DIVISION AB LOADING)

MOTORS

→ (DRN E9900733)

1 Emergency Feed Water Pump Turbine Steam Shut-Off Valve VA-2MS-V611A
2 Emergency Feed Water Pump Turbine Steam Shut-Off Valve VA-2MS-V612B

PANELS

1 Fire Protection Distribution Panel PDP 346AB
2 Fire Protection Distribution Panel PDP 3461AB
3 Fire Protection Distribution Panel PDP 3FDAB

SUPS(1)

1 Non Safety Related Uninterruptible AC Power Supply SUPS 3 AB (30 KVA)

MISC

1 Relays
2 4.16 KV Switchgear 3 AB3-S
3 480 V Switchgear 3AB31-S
4 Emergency Feed Water Pump Turbine governor Valve

General: For a detailed explanation of the loads listed referenced the approved battery calculation.

Notes: (1) SUPS loading is determined by field readings.

← (DRN E9900733)

TABLE 8.3-6 (Sheet 1 of 2) Revision 11 (05/01)

4.16 KV ENGINEERED SAFETY FEATURES SYSTEM SINGLE FAILURE ANALYSIS

FAILURE	CAUSE	CONSEQUENCES AND COMMENTS
1. 4.16 kV power to bus 3A3-S or 3B3-S (assuming coincident loss of preferred power.	a. Failure of the associated DG (diesel generator) to start.	a. Failure of the DG to start will result in the loss of one complete ESF actuation division. The redundant DG will start and supply the redundant ESF loads. The reliability of the DG to start has been enhanced considerably by the following design features: Starting Signal: Engineered Safety Features Actuation Signalor undervoltage relays on 4.16 kV bus. Starting System: Two air starting systems for each DG.
→ (DRN E9900733)	b. Failure of the DG to develop voltage.	b. The consequences will be identical to Item a.
	c. Failure of DG ACB to autoclose.	c. Consequences will be identical to Item a.
← (DRN E9900733)	d. Bus fault on Bus 3A3-S or 3B3-S.	d. A bus fault will prevent loading of the bus. The redundant bus will provide the power to the redundant ESF loads.
	e. Loss of associated dc control power source.	e. DC control power to the two redundant 4.16 kV ESF systems is supplied from two redundant batteries. Loss of control power to any one system will not prevent the redundant system from performing the safety function.
	f. Failure of a feeder breaker to the trip on feeder fault.	f. A fault on a feeder cable, if not cleared by the feeder breaker, will lead to tripping of the bus. Under this condition, the redundant 4.16 kV bus will supply the redundant ESF loads. The ESF System is designed to operate without isolating any component on a single ground fault. As multiphase faults are relatively few in number, reliability of complete safety functions is greatly increased.

TABLE 8.3-6 (Sheet 2 of 2)

FAILURE	CAUSE	CONSEQUENCES AND COMMENTS
2. 4.16 kV load (power center, motor, etc)	a. Failure of power center feeder. ACB to close.	Any of the events a, b or c will result in loss of the affected actuated component. The redundant load on the redundant bus will perform the safety function.
	b. Stalled motor	
	c. Feeder cable fault	

TABLE 8.3-7

480 V ENGINEERED SAFETY FEATURES SYSTEM SINGLE FAILURE ANALYSIS

FAILURE	CAUSE	CONSEQUENCES AND COMMENTS
1. 480 V power to bus 3A31-S or 3B31-S	a. Failure of associated power center transformer	Any of the five events a, b, c, d or e will cause the loss of 480 V ESF loads one channel. The redundant 480 V load center bus will supply the redundant ESF loads.
	b. 4.16 kV cable fault	
	c. Power center bus fault	
	d. Failure of any load breaker to clear a fault	
	e. Loss of dc control power source	e. The redundant 480 V ESF load centers are supplied from redundant batteries. A single failure will not result in the loss of control power to both redundant systems.
2. 480 V MCC feeders	a. Feeder cable fault	Any of the events a, b, or c will result in the loss of 480 V power to the ESF loads connected to the affected MCC. The redundant loads connected to the redundant MCC will perform the safety function.
	b. MCC bus fault	
	c. Failure of any MCC load feeder breaker to clear a fault	
3. 480 V loads	a. Feeder cable fault	The result will be the loss of the affected actuated component. The redundant component on the other division will perform the safety function.
	b. Stalled motor	

TABLE 8.3-8

208Y/120 V AC SYSTEM SINGLE FAILURE ANALYSIS

FAILURE	CAUSE	CONSEQUENCES AND COMMENTS
1. Power to bus	a. Failure of associated transformer	a, b, c, d: Any of these events will result in the loss of power to the 208 or 120 V loads of one division. The unaffected bus will supply the redundant ESF loads.
	b. Cable fault	
	c. Failure of any load breaker to clear a fault	
	d. Bus fault	
2. Any distribution feeder	a. Cable fault	a. This will result in loss of power to the connected loads. The redundant loads on the unaffected division are adequate to insure safety.

TABLE 8.3-9 Revision 309 (06/16)

120 V UNINTERRUPTIBLE VITAL AC SYSTEM SINGLE FAILURE ANALYSIS

FAILURE	CAUSE	CONSEQUENCES AND COMMENT
→(LBDCR 15-008, R309, LBDCR 15-009, R309)		
1. 120 V ac power to buses 3A1-S, 3MB-S, or 3B1-S ←(LBDCR 15-008, R309, LBDCR 15-009, R309)	a. Bus Fault b. Cable Fault c. Failure of a distribution breaker to clear a fault → (LBDCR 15-008, R309, LBDCR 15-009, R309) d. Inverter/Static switch failure ←(LBDCR 15-008, R309, LBDCR 15-009, R309)	A,b,c,d. The result will be the loss of 120 volt uninterruptible ac power supply to one of the four channels of the protection system. As a two out of four criterior is used in all logic circuits, the remaining three channgels ensure safe, but not false, shutdown. The 120 V uninterruptible ac system has been designed as an ungrounded system. The reliability of any channel is consequently greatly enhanced.
2. Any distribution feeder	a. Cable Fault	a. This will result in the loss of power to the connected loads. The redundant loads in the remaining three channels are adequate to ensure safety.
3. Loss of 480VAC power to SUPS	a. MCC bus fault b. Cable Fault	a,b. The SUPS will be supplied by the battery without interruption of output power.
	c.	

TABLE 8.3-10 Revision 15 (03/07)

125 V DC ENGINEERED SAFETY FEATURE SYSTEM SINGLE FAILURE ANALYSIS

FAILURE	CAUSE	CONSEQUENCES AND COMMENTS	
1. 125 V dc power to bus 3A-DC-S or 3B-DC-S	a. Bus fault b. Battery fault c. Failure of load breaker to clear fault.	a, b, c.	In the event of the loss of one dc bus, the redundant bus will supply control power to the ESF load of corresponding channel.
2. 125 V dc power to bus 3AB-DC-S	a. Bus fault b. Failure of load breaker to clear fault.	a, b.	Buses 3A3-S and 3B3-S will still be separated from preferred power system because the control circuits for their incoming breakers are supplied from batteries 3A-S and 3B-S respectively.
3. Battery Charger	a. Charger fault	a, b.	Other charger supplies dc load and maintains battery in fully charged state.
→(DRN 06-709, R15)	b. Loss of feeder to charger.	c.	The other charger may not be able to supply dc load and inverters fed from the failed MCC. The consequences will be loss of one DC bus, as analyzed in item 1 above.
←(DRN 06-709, R15)	c. Loss of MCC supplying a charger.		
4. Loss of any dc load breaker	a. Cable fault	a.	A cable fault will trip the feeder breaker and will result in loss of control power to the connected ESF loads. The redundant loads connected to the redundant dc system will ensure safe shutdown.
	b. Distribution feeder fault not cleared by associated breaker.	b.	An uncleared fault will result in loss of all dc on the bus concerned. The redundant loads will ensure safe shutdown as in (a).

TABLE 8.3-11 Revision 9 (12/97)

SINGLE FAILURE ANALYSIS OF TRANSFER TO PREFERRED POWER SOURCE UPON UNIT TRIP

FAILURE	CAUSE	CONSEQUENCES AND COMMENTS	
➞ 1. Loss of dc power supply to one generator lockout relay	a. Loss of dc feeder from distribution panel.	a.	No effect. The duplicate set of lockout relays powered from its associated dc distribution panel will perform all emergency functions and ensure transfer of one division to the preferred power source. If the preferred power sources is not available, the under-voltage relays on the 4.16 V ESF buses will start the diesel generators (DG) automatically to meet the load requirements. ←
2. Loss of dc power to both generator lockout relays	a. Earthquake or foreign objects falling on the non-class 1E raceways b. Loss of dc distribution panel bus	a, b.	This is the worst case failure. Complete destruction of all non-class 1E cables or loss of dc bus will disable control circuits of unit auxiliary and pre-ferred source switchgear. Hence, tripping of unit auxiliary transformer breakers or transfer to the preferred source cannot occur. Undervoltage relays on the 4.16 kV buses will isolate the DG buses by tripping the incoming feeder breakers which are con-trolled from Division A or B batteries. Consequently, the functioning of the safety related loads will not be affected.
3. Unit auxiliary transformer breaker	a. Mechanical failure to trip on trip signal	a.	This will lead to the loss of one of the bus sections 3A3 or 3B3. The remaining bus section will be trans-ferred to the preferred source, while the lost bus will cause the DG to start because of undervoltage, as in Failure 2a above.

TABLE 8.3-12 (Sheet 1 of 4) Revision 7 (10/94)

EQUIPMENT IDENTIFICATION

A. POWER AND CONTROL EQUIPMENT

→

Division/Channel	Label Border	Lettering	Class Designator (3)
Safety - A(2)	White	Black	-SA
Safety - B(2)	Black	Black	-SB
Safety - AB(2)	Brown	Black	-SAB
RPS Channel MA(1)(2)	Red	Black	-SMA
RPS Channel MB(1)(2)	Yellow	Black	-SMB
RPS Channel MC(1)(2)	Green	Black	-SMC
RPS Channel MD(1)(2)	Blue	Black	-SMD
Associated Ckt - Div A	White	Black	-PA
Associated Ckt - Div B	Black	Black	-PB
Associated Ckt - Div AB	Brown	Black	-PAB

Note:

1. RPS channels MA and MC are in Division A; MB and MD in Division B.
2. Class 1E Power and Control equipment have an additional label containing the words: (Class 1E).
3. Class 1E and associated power and control equipment have an additional label containing the appropriate Class Designator

←

TABLE 8.3-12 (Sheet 2 of 4) Revision 7 (10/94)

B. RACEWAYS (TRAYS, BOXES, CONDUITS) AND CABLES(4) (EXCEPT ITEM C BELOW)

Division/Channel	Left Side (1)	Right Side (1)	Final Letters
Safety - A	White	None	-SA
Safety - B	Brown	None	-SB
Safety - AB	Orange	None	-SAB
RPS Channel MA	Red	None	-SMA
RPS Channel MB	Yellow	None	-SMB
RPS Channel MC	Green	None	-SMC
RPS Channel MD	Blue	None	-SMD
Associated Ckt - Div A	Purple(3)	White	-PA(3)
Associated Ckt - Div B	Purple(3)	Brown	-PB(3)
Associated Ckt - Div AB	Purple(3)	Orange	-PAB(3)

Note:
1. The spots referred to are colored dots (raceways) and colored bands (cables) located at the side of the legend.
2. All labels are white background with black lettering.
3. Associated circuits are usually run in Class 1E trays, but if run separately, this color-coding and final lettering apply.

→

4. Cables installed during the construction of the plant are color-coded and use the "Final Letters" suffix in their labeling. Post-construction cable installations do not require the color coding, but the "Final Letters" suffix is applied to all cable installations.

←

TABLE 8.3-12 (Sheet 3 of 4) Revision 7 (10/94)

→
C. INFORMATION CABLES(3)
←

	Left Side (1)	Right Side (1)	Final Letters
Safety - A	Black	White	-XA
Safety - B	Black	Brown	-XB
Safety - AB	Black	Orange	-XAB
RPS Channel MA	Black	Red	-XMA
RPS Channel MB	Black	Yellow	-XMB
RPS Channel MC	Black	Green	-XMC
RPS Channel MD	Black	Blue	-XMD

→

Note: 1. The spots referred to are colored bands located at the side of the legend.

←

2. All labels are white background with black lettering.

→

3. Cables installed during the construction of the plant are color-coded and use the "Final Letters" suffix in their labeling. Post-construction cable installations do not require the color coding, but the "Final Letters" suffix is applied to cable installations.

←

D. CONDUCTORS (INSIDE INSTRUMENT PANELS)

Division/Channel	Group	Color-Code
SMA	Protective	Red
SMB	Protective	Yellow
SMC	Protective	Green
SMD	Protective	Blue
SA (PA)	Safety (Associated) Control	White (White-purple)
SB (PB)	Safety (Associated) Control	Brown (Brown-purple)
SAB	Safety Control	Orange

TABLE 8.3-12 (Sheet 4 of 4)

Division/Channel	Group	Color-Code
Non-Safety		Black
XMA	Information (Protective Channel)	Red-black
XMB	Information (Protective Channel)	Yellow-black
XMC	Information	Green-black
XMD	Information (Protective Channel)	Blue-black
XA	Information (Safety Division)	White-black
XB	Information (Safety Division)	Brown-black
XAB	Information (Safety Division)	Orange-black

TABLE 8.3-13 Revision 11 (05/01)

DESIGN BASIS OF ONSITE POWER SOURCE UNDERVOLTAGE PROTECTION
(See Figures 8.3-5, 8.3-6 and 8.3-37)

Undervoltage Relays 27-1, 2, 3/A, A1 and 27-1, 2, 3/B, B1 detect a degraded voltage condition on the 4160V ESF bus 3A3-S and 3B3-S respectively.

These relays will not trip:

a) When voltages are greater than 88.3 percent for relays 27-1, 2, 3/A(B) or greater than 93.1 percent for relays 27-1, 2, 3A1(B1).

b) When starting the largest motor in the plant auxiliary system.

c) During fast dead automatic bus transfer from Unit Auxiliary to startup Transformers (Subsection 8.2.1.6.5) as a result of main generator lockout relay operation (Subsection 8.2.1.6.3).

d) During automatic sequential starting of ESF loads with bus voltage transients as shown on Figure 8.3-37.

e) For short circuit current on load feeders which will be first cleared by the feeder overcurrent protection (within 0.14 seconds, Subsection 8.3.1.1.2.8).

→ (DRN E9900733)

These relays will trip for a sustained degraded voltage equal to or less than 88.3 percent for relays 27-1, 2, 3/A(B) and equal to or less than 93.1 percent for relays 27-1, 2, 3/A1(B1) with time delays as shown on the time-voltage curve of figure 8.3-37.

← (DRN E9900733)

TABLE 8.3-14 (Sheet 1 of 4) Revision 11 (05/01)

SEQUENCE OF EVENTS UNDER DEGRADED VOLTAGE CONDITIONS
(See Figures 8.3-5, 8.3-6 and 8.3-37)

A - Emergency diesel generator in standby mode.

→ (DRN E9900733)

		Elapsed time (seconds)
1 -	Voltage is equal to or less than 88.3 percent of rated bus voltage for relays 27-1, 2, 3/A and/ or 27-1, 2, 3/B or equal to or less than 93.1 percent for relays 27-1, 2, 3/A1 and/or 27-1, 2, 3/B1. ← (DRN E9900733)	0
2 -	Relays 27-1, 2, 3/A and/or 27-1, 2, 3/B or relays 27-1, 2, 3/A1 and/or 27-1, 2, 3/B1 trip and generate a LOVS (See Figure 8.3-37 and note 5.4. Also Subsection 8.3.1.1.2.8).	2 to 12.5 (See note a)
3 -	Tie breaker opens automatically and all loads except one of the ESF power centers are de-energized, (within 3 Hz, 0.18 sec)	2.18 to 12.68 (See note b)
4 -	Emergency diesel generator reaches full speed and rated voltage within 10 seconds and generator breaker closes. Automatic loading sequence commences when: a) Bus undervoltage relays 27-1, 2, 3/A1 and/or 27-1, 2, 3/B1 reset at 93.5% of rated voltage → (DRN 99-2345) and b) Bus undervoltage relays 27-1, 2, 3/A and/or 27-1, 2, 3/B reset within the minimum required EDG output voltage ← (DRN 99-2345)	12 to 22.5
5 -	Emergency loads are connected automatically within the maximum times shown in Table 8.3-1.	(See note c)

B - Emergency diesel generator in test mode.

		Elapsed time (seconds)
1 -	Voltage is equal to or less than 88.3 percent of rated bus voltage for relays 27-1, 2, 3/A and/or 27-1, 2, 3/B or equal to or less than 93.1 percent for relays 27-1, 2, 3/A1 and/or 27-1, 2, 3/B1.	0

SEQUENCE OF EVENTS UNDER DEGRADED VOLTAGE CONDITIONS
(See Figures 8.3-5, 8.3-6 and 8.3-37)

2 -	Relays 27-1, 2, 3/A and/or 27-1, 2, 3/B or relays 27-1, 2, 3/A1 and/or 27-1, 2, 3/B1 trip and generate a LOVS (See Figure 8.3-37 and note 5.4. Also Subsection 8.3.1.1.2.8).	2 to 12.5 (See note a)
3 -	Tie breaker opens automatically and all loads except one of the ESF power centers are shed, (within 3 Hz, 0.18 sec.). In addition, the emergency diesel generator breaker trips.	2.18 to 12.68 (See note d)
4 -	Emergency diesel generator breaker re-closes within 10 seconds. Automatic loading sequence commences when:	12 to 22.5 (See note e)
	a) Bus undervoltage relays 27-1, 2, 3/A1 and/or 27-1, 2, 3/B1 reset at 93.5% of rated voltage	
→ (DRN 99-2345) and	b) Bus undervoltage relays 27-1, 2, 3/A and/or 27-1, 2, 3/B reset within the minimum required EDG output voltage ← (DRN 99-2345)	
5 -	Emergency loads are connected automatically within the maximum times shown in Table 8.3-1.	(See note c)

SEQUENCE OF EVENTS UNDER DEGRADED VOLTAGE CONDITIONS
(See Figures 8.3-5, 8.3-6 and 8.3-37)

Notes:

a) From the time-voltage curve of Figure 8.3-37 relays 27-1, 2 3/A1(B1) sense degraded voltage instantaneously at approximately 93.1 percent of bus voltage. Each relay is set to provide a 12.5 second time delay before generating a LOVS. Below approximately 79.5 percent to zero bus voltage, relays 27-1, 2, 3/A(B) operating times are from 9 to 2 seconds respectively, consequently they will be the first to generate a LOVS.

In order to provide the control room operator with an early warning, bus voltage transducers send a signal to the plant computer as soon as the bus voltage drops to 94.7 percent. The signal from the plant computer is processed and displayed in the control room operator's console CRT. Also, annunciators on CP-1 are provided for 4.16 KV BUS 3A3-S VOLTAGE LOW and 4.16 KV BUS 3B3-S VOLTAGE LOW when the voltage remains at 94.7 percent for 12 or more seconds. These annunciators are driven from the PMC input signals through output relays.

b) If the tie breaker is manually opened, relays 27-1, 2, 3/A and/or 27-1, 2, 3/B trip and generate a LOVS in 2 seconds.

c) As bus voltage may immediately drop to 75 percent (minimum allowed by Regulatory Guide 1.9) due to the sudden application of loads in block 1, (see Figure 8.3-37) the undervoltage relays are temporarily locked out for the first 17 seconds of the loading sequence to prevent a false LOVS. During these 17 seconds the relays will experience the following cycles above and below 97 percent of bus voltage (see Figure 8.3-37, test curve for relays).

→ (DRN E9900733)

Bus Voltage (percent of 4160V)	Time Elapsed (Seconds)
75	2
100 Load Block 1	5
75	9
100 Load Block 2	17

← (DRN E9900733)

Load Block 3 energized
& UV Lockout removed

The net result of the above voltage variations is to reset the relays in steps. This type of resetting continues throughout the automatic loading.

The temporary lockout of the undervoltage relays is accomplished by electrical interlocking the sequencer with the undervoltage relay output signals.

TABLE 8.3-14 (Sheet 4 of 4) Revision 11 (05/01)

SEQUENCE OF EVENTS UNDER DEGRADED VOLTAGE CONDITIONS
(See Figures 8.3-5, 8.3-6 and 8.3-37)

Notes:

→ (DRN E9900733)

The sequencer consists of a number of time delay relays. In order to start sequential action, the sequencer circuit is momentarily de-energized allowing all time delay relays to drop out and then is re-energized, which results in sequential action when they start to pick-up. The sequencer circuit will respond to a loss of voltage on the 4.16 kV ESF bus signal and is started when the voltage is re-established on the 4.16 kV ESF bus. The first signal, transformer 3A32-S/3B32-S breaker (Load Block 1b) is also used to block the undervoltage relays output signal. The signal remains blocked until the fifth signal from the sequencer (17 seconds later) removes the undervoltage relays from the lockout condition.

← (DRN E9900733)

However, if an abnormal situation exists and the bus voltage drops to a sustained level of 93.1 percent or below after automatic sequencing begins, the undervoltage relays will trip and generate a LOVS and the automatic sequencer resets and stops until manually restarted.

As described in Subsection 8.3.1.1.2.8 a sustained degraded voltage may bring the motors to a locked rotor condition.

→ (DRN E9900733)

The time of the lockout interval selected will not affect the Class 1E motors connected to Load Block Nos. 2, 3, 4, 5a, 5b, 6a and 6b because this time does not exceed their safe stall time. However, during sustained degraded voltage conditions, motors on Load Block Nos. 1a and 1b may experience a locked rotor condition that can exceed their safe stall time (10 seconds) for approximately five to seven seconds. This lockout interval (17 seconds) covers the period of time between the start of Load Block No. 1b and the end of Load Block No. 2.

d) If the tie breaker is manually opened, the diesel-generator breaker automatically opens (on LOV), consequently relays 27-1, 2, 3/A and/or 27-1, 2, 3/B trip and generate a LOVS in 2 seconds.

← (DRN E9900733)

e) In the test mode the diesel generator is protected from overload by overcurrent with voltage restraint relays. The relays initiate a diesel generator trip when the voltage is $\leq$80 percent and generator current is $\geq$800 amps. When a low voltage condition occurs in a range from >80 to 93.1 percent, a LOVS will initiate the trip. The diesel generator will continue to run and will reclose on the bus in five seconds. The five second time delay allows motors that were running to stop prior to the reclosure. When the low voltage occurs in a range from 80 percent to a complete loss of offsite power, a relay race may occur. The race is between the overcurrent with voltage restraint relays and the undervoltage relays. If the undervoltage is of sufficient magnitude to cause the diesel generator amps to be $\geq$800, the overcurrent with voltage restraint relays will trip the diesel generator. After the diesel generator trips, a LOVS will occur and the diesel generator breaker will close within 10 seconds.

TABLE 8.3-15 (Sheet 1 of 2)

INFORMATION CIRCUIT ANALYSIS

OBJECTIVE:	Prove sufficient documentation to demonstrate that postulated failure in non-safety related circuits, equipment or components will not degrade the safety related function of the equipment where the information circuits emanate.
DESCRIPTION:	Information circuits consist of: a - A contact (normally open or closed) located in Class 1E equipment. b - Non-safety related raceways. c - Cables in direct contact with non-safety related cables, all qualified in accordance with IEEE-383. d - Non-safety related computer multiplexors and e - Non-safety related annunciator logic cabinet.
IDENTIFICATION:	Information circuits, are color coded the same as safety related circuits where they emanate but with an additional purple band or dot as specified on drawing LOU 1564 B-288 notes, sheet 7, 13, and 13a. Information cables are identified with a suffix XA, XB, XAB, XMA, XMB, XMC, and XMD. (See FSAR Subsection 8.3.1.3).
CABLE ROUTING:	Information circuits connected to computer multiplexors (MUX) or to annunciator logic cabinet (CP-19) are routed in non-Class 1E low level raceways, e.g. raceway NA, NB, or NBA. Drawing LOU 1564 B288 notes, sheet 8 shows the table of permitted cable routing. Figures 8.3-12 and 8.3-20 show a typical routing of information circuits.
INSTALLATION VERIFICATION:	The following basic documents are used to verify proper installation:

	DESCRIPTION	DOCUMENT
a - Conduits	Installation	LOU 1564 B288 notes, sh 3, 4

TABLE 8.3-15 (Sheet 2 of 2)

INFORMATION CIRCUIT ANALYSIS

INSTALLATION
VERIFICATION: (Cont'd)

		Physical Separation	LOU 1564 B288 note, sh 9, 10
		Conduit list	LOU 1564 B288, Various sheets
		Conduit slips	LOU 1564 B288, Various sheets
	b - Trays	Installation	LOU 1564 B288 notes, sh 4, 5
		Physical Separation Trays drawings	LOU 1564 B288 notes sh 9, 10
	c - Cables	Installation Cable pull slips Cable list	LOU 1564 B288 notes, sh 5, 6
LIST OF	A computerized "device list" (see Samples on Figures 8.3-13 and 8.3-14) obtained as a subroutine of the computerized "cable list" (see Samples on Figures 8.3-15 and 8.3-16) shows non-safety and information cables connected to CP-19 and MUX. Information circuits failure analysis are shown on Tables 8.3-16 and 8.3-17.		

TABLE 8.3-16 (Sheet 1 of 3) Revision 301 (09/07)

INFORMATION CIRCUITS FAILURE ANALYSIS FOR ANNUNCIATOR SYSTEMS

Event	Cause		Consequences & Comments
1 -	Short circuit or open circuit between any two wires of information cables (see Figure 8.3-17)	a -	The operation of information circuit cables is with their conductors in short circuit or open circuit. The maximum current under short circuit condition is 1.2 ma dc. The circuits are ungrounded (see Figure 8.3-17). The minimum insulation level of information cables and device contacts in safety related equipment is 300 volts; their current carrying capacity is substantially higher than 1.2 ma dc. It is therefore concluded that under above normal operating conditions the safety related equipment where the information signal emanates is not degraded.
→(EC-5000082263, R301)			
2 -	Maximum credible fault available at CP-19 is applied to information cables (see Figure 8.3-17)	b -	The annunciator logic cabinet (CP-19) which is located in the main control room consists of eight sections. Power input is 125 V dc or 120 V ac at bays 3 and 5; the input power terminals boards are separated from the field contact terminal boards (see Figure 8.3-18). Figure 8.3-17 shows a portion of the power supply and point card schematic wiring. From this figure it can be seen that a short circuit between (+) and (S) in the point card is the maximum credible fault which may be postulated. If the remote field contact at the Class 1E equipment is closed, the maximum short circuit current available will be limited by the one ampere output in the power supply units.
←(EC-5000082263, R301)			
→(DRN E9900733)			
			The minimum wire size used for information circuits is #18 AWG. Cu. with a 90°C conductor rating. the continuous current carrying capacity of this cable is 21 amperes at 30°C ambient per NEC table 310-16.
←(DRN E9900733)			

TABLE 8.3-16 (Sheet 2 of 3) Revision 301 (09/07)

INFORMATION CIRCUITS FAILURE ANALYSIS FOR ANNUNCIATOR SYSTEMS

Event	Cause		Consequences & Comments
2 -	(Cont'd)		This cable "ampacity" is also based upon the fact that other cables installed in same raceways carry negligible currents and for this reason no "ampacity" derating is required.
→(EC-5000082263, R301)			
			The short circuit current will flow through the remote field contact in the Class 1E equipment. The contacts are rated in the range of 10-20 amperes continuous. From above analysis it can be concluded that the information circuit cable and field contact can withstand the maximum continuous current as limited by the fuse. In addition, their short time rating will not be exceeded as the short circuit current available will be limited by the 1 ampere fuse in the power supplies as shown on Figure 8.3-19.
←(EC-5000082263, R301)			
			Above analysis demonstrates that the maximum credible fault at the point cards will not degrade the Class 1E device where the information circuit emanates.
3 -	Non Class 1E annunciator cable and information cable conductors accidentally come in contact (see Figure 8.3-12)	c -	Non-Class 1E Annunciator cables are routed in the non-safety related control raceway system while the information cables are routed in the low level raceway system. There is no interconnection between control and low level raceway systems, therefore non-Class 1E annunciator and information cables are separated in raceways. The only place where these cables are in close proximity is at their convergence in CP-19 panel (see Figure 8.3-12). As described in Item (1), these cables carry a signal of negligible power consequently any accidental contact between their conductors will not affect or degrade the Class 1E device where the information signal emanates.

TABLE 8.3-16 (Sheet 3 of 3)

INFORMATION CIRCUITS FAILURE ANALYSIS FOR ANNUNCIATOR SYSTEMS

Event	Cause		Consequences & Comments
4 -	Non-Class 1E annunciator cable and other non-class 1E control cable conductors accidentally become in contact (see Figure 8.3-12)	d -	120 ac or 125V dc is the nominal working voltage of cables routed in control raceway systems (see Figure 8.3-12). Accidental contact between the conductors of non-Class 1E control and annunciator cables (i.e., phase and neutral conductors of the non-Class 1E control cable in contact with the annunciator cable conductor pairs) when the field contact is open will result in a current $\frac{125}{24,700} = 0.005$ ampere (approx) through the two 10K ohm and 4.7k ohm resistors, assuming negligible resistance through the power supplies (see Figure 8.3-17). The thermal limit of a 10K ohm resistor 1/4 watt will be exceeded if a current greater than 0.005 ampere flows through it, eventually causing its failure. As the information circuit point cards remain unaffected it can be concluded that the Class 1E devices where the information circuits emanate are not degraded or affected by this event.
5 -	Non-Class 1E low level cable and information cable conductors accidentally come in contact (see Figure 8.3-12)		Non-Class 1E low level cables carry signals of negligible power, i.e., analog signals from transducers with outputs in the range of 4-20ma, 0-10V dc with low power available. They are routed in level raceway systems together with the information cables (see Figure 8.3-12). It can be concluded that accidental contact between the conductors of a non-Class 1E low level cables and information conductor pairs will not affect or degrade the Class 1E device where the information signal emanates.

TABLE 8.3-17 (Sheet 1 of 3)

INFORMATION CIRCUITS FAILURE ANALYSIS FOR COMPUTER SYSTEM

Event	Cause		Consequences & Comments
1.	Short circuit or open circuit between any two wires of information cables (See Figure 8.3-21)	a)	The operation of these information circuit cables is the same as for those described on Table 8.3-16, Item 1, except the maximum current under short circuit conditions is 2.4 ma dc. (See Figure 8.3-21.) It is therefore concluded that under above normal operating conditions, the safety related equipment where the information signal emanates is not degraded.
2.	Maximum credible fault available at computer multiplexor is applied to information cables (See Figure 8.3-21)	b)	The computer multiplexors are located at various elevations throughout the plant. Each one consists of three sections. Power input is 120V ac at each electronic section. The input signal terminal boards are located in the center section. (See Figure 8.3-22.) Figure 8.3-21 shows a portion of the power supply and digital input card schematic wiring. From this figure it can be noted that the maximum credible fault would result from the application of 48V dc to a remote Class 1E device due to an accidental contact between the positive and negative input power leads and a pair of input leads of the digital or analog signal cards. The application of 48V dc to the remote devices will produce the following effects on the information circuits or non Class 1E analog circuits: (See Figure 8.3-21.) 1) Remote Field Contact If the remote field contact is closed the maximum short circuit available will be limited by the 5A fuse in the power supply.

TABLE 8.3-17 (Sheet 2 of 3)

Event	Cause	Consequences & Comments
2.	(Cont'd)	b) (Cont'd) 1) (Cont'd) This event is the same as that described and analyzed on Table 8.3-16, Item 2, except the power supply output voltage is 48V dc. Consequently it can be concluded that the maximum credible fault at the digital input card will not degrade the Class 1E device where the information circuit emanates. 2) <u>Self-powered or Separate Powered Transmitter</u> The analog signals from these transmitters are connected to analog input cards in the MUX. These input cards are similar to the digital input cards with regard to the input power voltage, which is 48V dc. the transmitters constitute isolation devices in accordance with IEEE-384-1977. Therefore, the Class 1E equipment where the non Class 1E analog signals originate are isolated from the postulated fault and are not affected by this event. 3) <u>Resistance Temperature Detectors (RTD's) and Thermocouples (TC's) Sensors</u> Those sensors installed in safety related equipment providing signals to the multiplexors are dedicated sensors, that is, they do not share the same enclosure with sensors performing a safety function. Because of the physical separation between the sensor's enclosure and the safety related equipment, a sensor failure due to this event will not affect or degrade the safety related equipment where these non Class 1E analog signals originate.

TABLE 8.3-17 (Sheet 3 of 3)

Event	Cause		Consequences & Comments
3.	Non-Class 1E low level cable and information cable conductors accidentally come in contact (see Figure 8.3-20)	c)	This event is the same as that described and analyzed on Table 8.3-16, Item 5. The conclusion therefore is the same.

NOTE: There is one case where the remote field contact is shared between the annunciator logic cabinet (CP-19) and the computer multiplexor (MUX). Figure 8.3-23 shows the CP-19 and MUX cabinet arrangement in the control room. Figure 8.3-24 shows how the respective power supplies are interconnected with blocking diodes to avoid circulating currents between power supplies. For the purpose of this analysis the blocking diodes provide independence of power supplies, consequently, the failure analysis on Tables 8.3-16 and 8.3-17 also applies to this case.

TABLE 8.3-18

USERS OF GROUND SYSTEM DESIGN

COMPUTER PROGRAM

UTILITY AND UNIT	YEAR USED
LP&L - Waterford Steam Electric Station Units 1 & 2	1975
MP&L - Clay Boswell Generating Station Unit #4	1980
CP&L - H.B. Robinson Nuclear Electric Station Unit 4	1978
Texas Electric Service Co. Various of Steam Electric Stations	1970-1980
Arizona Public Service Co. Cholla Steam Electric Station Units 2 & 3	1973
GPU Service Corp. Homer City Steam Electric Station Unit #3	1977
Houston Lighting & Power Co. T.H. Wharton Generating Station Units #3 & #4	1974
Iowa Public Service Co. George Neal Unit No. 3	1975

TABLE 8.3-19 (Sheet 1 of 2) Revision 11 (05/01)

VITAL SUPPORTING SYSTEMS FOR CLASS 1E EQUIPMENT

	Class 1E Equipment	Vital Supporting Equipment	Design Basis, System Description, Safety Evaluation, Test, Inspection & Instrumentation Application
1)	Diesel Generators (RAB Elev +21)	a) Fuel Oil Storage and Transfer Systems	See FSAR Subsection 9.5.4
		b) Jacket Water Cooling System	See FSAR Subsection 9.5.5
		c) Engine Starting System	See FSAR Subsection 9.5.6
		d) Lubrication System	See FSAR Subsection 9.5.7
		e) Combustion Air Intake and Exhaust System	See FSAR Subsection 9.5.8
		f) Ventilation System	See FSAR Subsection 9.4.3.3
		g) Component Cooling Water and Auxiliary Component Cooling Water Systems	See FSAR Subsection 9.2.2
2)	Batteries (RAB Elev +21)	a) Ventilation System	See FSAR Subsection 9.4.3.5
→ (DRN E9900733)		b) Essential Services Chilled Water System	See FSAR Subsection 9.2.9
← (DRN E9900733)			
3)	Relay Room Panels (RAB Elev +35)	a) Ventilation System	See FSAR Subsection 9.4.3.5
		b) Essential Services Chilled Water System	See FSAR Subsection 9.2.9

TABLE 8.3-19 (Sheet 2 of 2)

VITAL SUPPORTING SYSTEMS FOR CLASS 1E EQUIPMENT

	Class 1E Equipment	Vital Supporting Equipment	Design Basis, System Description, Safety Evaluation, Test, Inspection & Instrumentation Application
4)	Control Room Panels (RAB Elev +46)	a) Air Conditioning System	See FSAR Subsection 9.4.1
		b) Essential Services Chilled Water System	See FSAR Subsection 9.2.9
5)	Fuel Handling Building Motor Control Centers (RAB Elev +1)	a) Ventilation System	See FSAR Subsection 9.4.2
6)	Switchgear Room Equip-ment (RAB Elev +21)	a) Ventilation System	See FSAR Subsection 9.4.3.5
		b) Essential Services Chilled Water System	See FSAR Subsection 9.2.9
7)	Emergency Shutdown Panel (LCP-43) (RAB Elev +21)	a) Ventilation System	See FSAR Subsection 9.4.3.5
		b) Essential Services Chilled Water System	See FSAR Subsection 9.2.9

TABLE 8.3-20 Revision 2 (12/88)

BACKUP PROTECTION FOR CONTAINMENT ELECTRICAL PENETRATIONS (CEP)

PENETRATION VOLTAGE		PENETRATION CAPABILITY		PROTECTIVE EQUIPMENT		MAXIMUM EXPECTED FAULT CONDITION		MAXIMIZING FAULT CONDITION (Note 1)		FSAR DESCRIPTION
RATING	SERVICE	CONDUCTOR SIZE	I^2t (AMP - SEC)	DEVICE	RATING/ SETTING	FAULT CURRRENT SYM(KA)	CLEARING TIME (CYCLES)	I^2t (AMP - SEC)	FSAR FIGURE	SUBSECTION 8.3.1.1.4 PARAGRAPHS
15kV	6.9kV	1500MCM	$1.16x10^{10}$	BREAKER	Note 2	39	6	$1.5x10^8$	8.3-28	a
600V	480V	500MCM	$2.56x10^9$	BREAKER	Note 3	30	6	$9x10^7$	8.3-29	b
600V	480V	250MCM	$5.05x10^8$	BREAKER	Note 4	25	6	$6.25x10^7$	8.3-30	b
600V	480V	#2/OAWG	$1.43x10^8$	FUSE OR BREAKER	Note 5	10	1	$1.6x10^6$	8.3-31	c,d
600V	480V	#4AWG	$1.41X10^7$	FUSE OR BREAKER	Note 5	7	1	$8.2x10^5$	8.3-31	c,d
600V	480V	#8AWG	$2.2x10^6$	FUSE OR BREAKER	Note 5	4	1	$2.7x10^5$	8.3-31	c,d
600V	120V	#14AWG	$1.36x10^5$	FUSE OR BREAKER	Note 6	1	1	$1.7x10^4$	8.3-32	d,e

Notes:

1 - Maximizing fault condition is defined as the maximum current that may flow through the CEP conductors during a period of time at the end of which the backup protection clears the fault preventing CEP degradation. Maximizing I^2t obtained from the maximum time-current curves shown on Figures 8.3-28 through 8.3-32 is always lower than the I^2t capability of the CEP.

→

2 - Refer to Drawing LOU-1564-B-289 Sheets 11A1 and 12A1, Lines 15 and 18.

←

3 - Refer to Drawing LOU-1564-B-289 Sheet 20A1, Lines 17 and 18, Sheet 20A3, Lines 23 and 24, Sheet 21A1, Lines 18 and 19, and Sheet 21A3, Lines 24 and 25.

4 - Refer to Drawing LOU-1564-B-289 Sheets 23A1 and 24A1, Lines 4, 5 and 6.

5 - Refer to table on Figure 8.3-31 for fuse-breaker combination ratings.

6 - Refer to table on Figure 8.3-32 for fuse-breaker combination ratings.

TABLE 8.3-21 (Sheet 1 of 2) Revision 307 (07/13)

INFORMATION CIRCUITS FAILURE ANALYSIS FOR ISOLATION PANEL
(POWER SUPPLIES WITH LOW VOLTAGE OUTPUT)

→(EC-38908, R307)

Event	Cause	Consequences & Comments
1	Short circuit or open circuit between any two wires of information cables	a - The operation of these information circuit cables is the same as for those described on Table 8.3-16, Item 1, except the maximum short circuit condition is less than 1 amp dc. The primary and secondary of the power supply is fused and isolation is provided between the primary and secondary of the power supply. The minimum insulation level of information circuits is 300 volts; their current carrying capacity is substantially higher than 1 amp dc. It is therefore concluded that under the above normal operating conditions the safety related equipment where the information signal emanates is not degraded.
2	Maximum credible fault available at the isolation Panel is applied to information cables	b - This circuit is located in the non-safety section of the Isolation Panel. The section of the panel is separated from the safety circuits by a physical fire barrier. The non-safety circuits power input to the circuit interface power supply is 120 V ac; the input power terminals are physically separated from the field contact terminal boards. A short circuit between the negative of the relay coil and the positive of the X relay contact is the maximum credible fault which can be postulated. If the remote relay contact at the Class 1E equipment is closed, the maximum short circuit current available will be limited by the 1/4 amp fuses at the input of the power supply. Further, the power supply isolation (between the primary and secondary) is 4KV @ 50Hz for 1 minute. The power supply output is fused and the output voltage is less than 48 V dc. ←(EC-38908, R307) →(DRN E9900733) The minimum wire size used for information circuits is #18 AWG. Cu. with a 90°C conductor rating. The continuous current carrying capacity of this cable is 21 amperes at 30°C per NEC table 310-16. This cable “ampacity” is also based upon the fact that other cables installed in the same raceways carry negligible currents and for this reason no “ampacity” derating is required. ←(DRN E9900733)

TABLE 8.3-21 (Sheet 2 of 2) Revision 307 (07/13)

INFORMATION CIRCUITS FAILURE ANALYSIS FOR ISOLATION PANEL
(POWER SUPPLIES WITH LOW VOLTAGE OUTPUT)

Event	Cause	Consequences & Comments
		➔(EC-38908, R307) The short circuit current will flow through the remote relay contact in the Class 1E equipment. The contacts are rated at 1.5 amps or greater continuously. From the above analysis it can be concluded that the information circuit cable and relay contacts can withstand the maximum continuous current as limited by the fusing. In addition, their short time rating will not be exceeded as the short circuit current is available will be limited by the 1/4 ampere fuse at the power supply input. 🡐(EC-38908, R307) Above analysis demonstrates that the maximum credible fault at the Isolation Panel power supply output will not degrade the Class 1E device where the information emanates.
	➔(EC-38908, R307)	
3	Non-Class 1E low level cable and information cable conductors accidentally come in contact	Non-Class 1E low level cables carry signals of negligible power, i.e. analog signals from transducers with outputs in the range of 4-20ma, 0-10v dc with low power available. They are routed in low level raceway systems together with information cables. It can be concluded that the accidental contact between the conductors of non-Class 1E low level cables and information conductor pairs will not affect or degrade the Class 1E device where the information emanates.
	🡐(EC-38908, R307)	