CHAPTER 8 - ELECTRIC POWER

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DRAWINGS CITED IN THIS CHAPTER*

* The listed drawings are included as "General References" only; i.e., refer to the drawings to obtain additional detail or to obtain background information. These drawings are not part of the USAR. They are controlled by the Controlled Documents Program.

DRAWING*	SUBJECT
762E298AC	High Pressure Core Spray System Power Supply
E02-1AP03	Electrical Loading Diagram
E02-1DC06	125V DC & Uninterruptible Power Supply Systems Single Line Diagram
E02-1HP99	Schematic Diagram - High Pressure Core Spray System
E02-1RP99	Schematic Diagram - Reactor Protection System
E26-1002-00A-CPR	Cable Tray Routing Fuel and Auxiliary Buildings Mezzanine Floor El 755'-0" & 762'-0"
E26-1003-00A-CPR	Cable Trays Auxiliary and Fuel Buildings Intermediate Floor El 781'-0"
E27-1002-00B-CPR	Cable Tray Routing Containment Building El 766'-0"
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M01-1112	General Arrangement - Sections "F1-F1", "F2-F2" and "G-G"
M01-1113	General Arrangement - Sections "H-H" and "J-J"
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CHAPTER 8 - ELECTRIC POWER

8.1 INTRODUCTION

Clinton Power Station (CPS) includes safety-related systems and components that require electrical power to perform their nuclear safety functions. The electric power systems associated with or contained within the station provide electrical power to nuclear safety-related loads as well as to other station electrical loads.

This chapter has a threefold purpose: (1) to identify the nuclear safety-related electrical loads of the station, (2) to identify and define the nuclear safety criteria to be used in the design and construction of the station electrical systems, and (3) to describe the offsite and onsite power systems and to establish the adequacy of these systems to meet the nuclear safety criteria.

The descriptions and analysis in this chapter apply primarily to Class 1E components that generate, transmit, or use electrical power to perform a nuclear safety function. Those components which generate, transmit, or use electrical signals are discussed in Chapter 7. However, various aspects of physical division isolation and identification of power, instrumentation and control Class IE components also are discussed in this chapter.

8.1.1 Utility Grid Description

In 2007, the U.S. Federal Energy Regulatory Commission (FERC) granted North American Electric Reliability Corporation (NERC) the legal authority to enforce reliability standards with all U.S. users, owners, and operators of the bulk power system. Regional reliability organizations enforce compliance with NERC Reliability Standards. Exelon is part of the South East Reliability Corporation (SERC).

The Midcontinent Independent System Operator (MISO), is the reliability coordinator between transmission operators and nuclear plant operators, and is responsible for ensuring reliable off-site power.

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8.1.2 Offsite Power Systems - Summary Description

Two offsite power systems provide electrical power to the station: the 138-kV offsite power system, and the 345-kV offsite power system. These systems are described in detail in Section 8.2.

8.1.2.1 138-kV Offsite Power System

The 138-kV offsite power system provides power to the station by one, two-terminal transmission line. This line connects the station to the Ameren Illinois grid at the South Bloomington and Clinton Route 54 Substations. Electrical power can be fed to the station through this line from South Bloomington or North Decatur (via Clinton Route 54 Substation) or both. The line terminates directly (through a circuit switcher) at the Emergency Reserve Auxiliary Transformer (ERAT), which transforms the electrical power to 4160-V auxiliary bus voltage.

8.1.2.2 345-kV Offsite Power System

The 345-kV offsite power system provides power to the station through three transmission lines. These lines connect the station to the Ameren Illinois Company grid at Brokaw, Goose Creek-Oreana, and Oreana Substations. All three lines terminate at the station switchyard ring bus which feeds Reserve Auxiliary Transformers (RAT) A, B, and C, which in turn transforms the electrical power to the 6900-V and 4160-V auxiliary bus voltages.

8.1.3 Onsite Power System - Summary Description

The unit includes four onsite power systems, each with its own independent power source. These are:

a. unit auxiliary a-c power system,

b. unit Class 1E a-c power system,

c. unit auxiliary d-c power system, and

d. unit Class 1E d-c power system.

The instrument power system and the low voltage power system derive their power from the above and are subsystems of those systems. The unit Class 1E a-c power system and the unit Class 1E d-c power system are Class 1E. The portion of the instrument power system and low voltage power system connected to these two main systems are also Class 1E.

The above systems are described in detail in Section 8.3. The one-line diagram for the auxiliary power system is shown on Drawing E02-1AP03.

8.1.3.1 Unit Auxiliary A-C Power System

The unit auxiliary a-c power system supplies power to the unit loads which are not nuclear safety-related. The system uses the unit main generator as a power source. The unit auxiliary transformers step down the main generator voltage to the 6900-V and 4160-V auxiliary bus voltages. This system consists of 6900-V and 4160-Vac switchgear, 480-Vac unit substations, and

480-Vac motor control centers (some of which include 480-120/208-Vac transformers and distribution panels).

8.1.3.2 Unit Class 1E A-C Power System

The unit Class 1E a-c power system supplies power to the unit Class 1E loads. This system consists of 4160-V switchgear, 480-Vac unit substations, and 480-Vac motor control centers (some of which include 480-120/208-Vac transformers and distribution panels). Division III utilizes a 480-120-Vac regulating transformer. The offsite power source converges at the system. The system includes diesel generators that serve as standby power sources, independent of any other onsite or offsite source. Therefore, the system has one onsite and two offsite immediate sources of electrical power for serving the unit Class 1E a-c loads. Furthermore, the onsite system is divided into three divisions, each with its own independent distribution network, diesel generator, and redundant load group.

8.1.3.3 Unit Auxiliary D-C Power System

The unit auxiliary d-c power system supplies power to unit d-c loads that are not nuclear safety-related. The system consists of uninterruptible power supplies, batteries, motor control centers, distribution panels, and two regular and one spare battery chargers. The spare battery charger normally is not connected to the system.

8.1.3.4 Unit Class 1E D-C Power System

The unit Class 1E d-c power system supplies 125-Vdc power to unit Class 1E loads. The primary power sources are battery chargers. The system includes batteries, battery chargers, motor control centers, and d-c distribution panels. The system is divided into four divisions, each with its own independent distribution network, battery, battery charger, and redundant load group. A non safety-related swing battery charger is also part of the system that will be connected to the 125-Vdc buses for supplying backup power during periods when the normal battery charger for the Division 1, 2 or 4 bus is being maintained.

8.1.3.5 Unit Class 1E Instrument Power System

The unit Class 1E instrument power system supplies 120-Vac power to the nuclear system protection system and miscellaneous Class 1E loads. The system includes uninterruptible power supplies and buses.

8.1.4 Safety Loads

Nuclear safety-related systems and components that require electrical power to perform their nuclear safety function are defined as Class 1E loads. All Class 1E loads are fed from the Class 1E power system.

8.1.4.1 NSPS Power Supply System Loads

The Nuclear System Protection System (NSPS) power supply system is designed to provide adequate uninterrupted power to all the NSPS loads during all modes of operation including abnormal and accident conditions. Loads include NSPS logic power, neutron monitoring, process radiation monitoring, portions of the leak detection system, reactor water cleanup and

RHR system sample line valves, and scram discharge volume controls and indication. See Drawing E02-1RP99 for the NSPS power supply loads arrangement.

Drawing E02-1RP99 also shows the nondivisional portion of the NSPS power supply system which powers the RPS scram solenoids and the MSIV's.

8.1.4.2 HPCS Power System Loads

Included in the Class 1E loads in nuclear safety-related systems is the high-pressure core spray (HPCS) power system. The loads consist of the HPCS pump motor and associated auxiliaries, such as motor-operated valves and miscellaneous engine auxiliary loads. The applicable regulatory guides and standards implemented in the design are listed in Subsection 8.1.6.

8.1.5 Design Bases

8.1.5.1 Safety Design Bases - Offsite Power

a. Two offsite sources of power provide the a-c power requirements of the station.

b. One source of offsite power, at 345 kV, connects the switchyard to RAT B which, in turn, supplies-power to the three ESF buses of the unit.

c. The other source of offsite power, at 138 kV, connects a transmission line to the ERAT, which in turn supplies power to the three ESF buses.

d. The ERAT is designed to start and carry the auxiliary load required for LOCA of the unit.

8.1.5.2 Safety Design Bases - Onsite Power

8.1.5.2.1 Engineered Safeguard Features

a. The unit's nuclear safety-related loads are divided into three division load groups. Each load group is an independent Class 1E subsystem (except for access to both sources of offsite power) having its own distribution equipment, controls and control power supplies.

b. Each of the three engineered safety features a-c buses has access to two sources of offsite power as well as from its respective diesel-generator.

c. One diesel-generator set and one 125-Vdc battery system are provided for each division load group.

d. An independent raceway system for each ESF division is provided to meet load group cable separation requirements

8.1.5.2.2 High-Pressure Core Spray (HPCS) Power Supplies Design Bases

a. As one of these three division load groups, the HPCS power system loads consist of HPCS pump motor and associated 480-Vac auxiliaries such as motor-operated valves, engine cooling water pump and miscellaneous engine auxiliary loads. Drawing 762E298AC shows the basic one-line diagram of the system.

b. The HPCS power system is self-contained except for access to both sources of offsite power, directly by connection through the plant a-c power distribution system, and for the system initiation signal source. It is operable as an isolated system independent of the electrical connection to any other system by use of the HPCS diesel generator. Standby auxiliary equipment such as heaters, air compressor, cooling water pumps and battery charger are supplied from the same power source as the HPCS motor. The diesel generator is compatible with power available from the plant a-c power system.

c. The HPCS diesel generator has the capability to restore onsite power quickly to the HPCS pump motor in the event offsite power is unavailable, and to provide all power for startup and operation of the HPCS system. The HPCS diesel generator will start automatically on signal from the plant protection system or HPCS supply bus undervoltage, and when both plant offsite sources are not available, will be automatically connected to the HPCS bus. An automatic start signal overrides the test mode.

d. The HPCS electric system is capable of performing its function when subjected to the effects of design basis natural phenomena. In particular, it is classified as Class 1E and Seismic Category I and is housed in a Seismic Category I structure.

e. The HPCS power system has its own fuel day tank and storage tank with sufficient capacity to operate the standby power source while supplying maximum postaccident HPCS power requirements for a time sufficient to put the plant in a safe condition. Tank size is consistent with availability of backup fuel sources.

f. Manual controls are provided to permit the operator to select the most suitable distribution path from the power supply to the load. Provisions are made for control from the main control room and another location external to the control room.

g. A Class 1E d-c power supply system provides the HPCS system d-c power requirements for control and protection.

8.1.5.2.3 NSPS Power Supply System Design Bases

a. The NSPS power supply supplies uninterruptible power, capable of sustaining output voltage and frequency when momentary loss of input power occurs, e.g., due to switching.

b. NSPS power is supplied by four separate and independent, divisional (Class 1E) uninterruptible power supplies (inverters fed by station battery chargers with floating batteries). Each independent Class 1E uninterruptible power supply is backed up by an alternate Class 1E power source. Provision is made for automatic switching to the alternate source in case of a failure of the inverter power supply. The inverter power supply shall be synchronized in both frequency and phase with the alternate power supply, so that voltage spikes will be minimized in case of a transfer. “Refer to USAR Section 7.2.1.1.3.1 for the discussion and definition of an inverter failure.”

c. RPS and NSSS solenoid power is supplied by two separate and independent nondivisional (Class 1E qualified) uninterruptible power supplies (inverters fed by station battery charges with floating batteries). In the unlikely event of an inverter failure, a manual bypass switch is provided to transfer to an alternate power path derived from the same 480-Vac source but directly through a 480-120-Vac isolation regulating transformer.

d. The NSPS power supply system is designed to provide uninterruptible Class 1E power to NSPS loads at acceptable voltage and frequency (nominal 120-Vac, 60 Hz) for both a 100% load change and loss of normal input source.

8.1.6 Design Criteria, Regulatory Guides and IEEE Standards

This subsection discusses compliance with regulatory guides and industry nuclear safety-related electrical standards and codes considered for the Clinton Power Station.

8.1.6.1 Compliance with Regulatory Guides

8.1.6.1.1 Regulatory Guide 1.6 “Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems”

Conformance with this regulatory guide is described in detail in Subsections 8.3.1.2.2 and 8.3.2.2.2.

8.1.6.1.2 Regulatory Guide 1.9 “Selection, Design, and Qualification of Diesel-Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants”

Conformance with this regulatory guide is described in detail in Subsection 8.3.1.2.2.

8.1.6.1.3 Regulatory Guide 1.22 “Periodic Testing of Protection System Actuation Functions”

Conformance with this regulatory guide is as described in Subsection 7.1.2.6.5.

8.1.6.1.4 Regulatory Guide 1.29 “Seismic Design Classification”

Conformance with this regulatory guide is described in detail in Section 3.2 and Table 3.2-1.

8.1.6.1.5 Regulatory Guide 1.30 "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment"

Conformance with this regulatory guide requires acceptance of the provisions of ANSI N45.2.4 1972. This standard has been accepted and utilized in the development of the quality assurance program described in Chapter 17 and the initial test program described in Chapter 14. Provisions for testability are described for various subsystems in Chapter 7. The only exception taken to the standard concerns equipment labels and is described in Section 1.8.

The referenced standard IEEE 336 concerns requirements for installation, inspection, and testing of Class 1E instrument and control equipment and systems during construction. These requirements have been met through the quality assurance program described in Chapter 17.

8.1.6.1.6 Regulatory Guide 1.32 "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants

Conformance with this regulatory guide is described in detail in Subsections 8.3.1.2.2 and 8.3.2.2.2.

8.1.6.1.7 Regulatory Guide 1.40 "Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants"

Conformance with this Regulatory Guide is described as follows for the regulatory positions:

Position C.1 Auxiliary equipment supplied with the hydrogen control system compressor blower motor has been tested with the motor.

Position C.2 The qualification tests simulate the design-basis conditions.

Position C.3 No response required. This position merely states that the other IEEE standards will be addressed in other regulatory guides where appropriate.

8.1.6.1.8 Regulatory Guide 1.41 "Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments"

Conformance with this regulatory guide was incorporated into the initial test program described in Chapter 14.

8.1.6.1.9 Regulatory Guide 1.47 "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems"

Conformance with this regulatory guide is described as follows for the regulatory positions:

Positions C.1, C.2 and C.3

Automatic indication is provided in the control room to inform the operator that a system is inoperable. Annunciation is provided to indicate a system or part of a system is not operable. For example, the reactor protection (trip) system and the containment and reactor vessel isolation system have annunciators (both visible and audible) whenever one divisional sensor channel is bypassed, reducing the logic from two out of four to two out of three. Only one division can be bypassed at a time. The HPCS, LPCS, RHRS, and ADS have keylock operating bypasses and test bypasses. Any operating or test bypass will annunciate at the system level, e.g., "HPCS in test." Bypasses of certain infrequently used pieces of equipment, such as manual locked open valves, are not automatically annunciated in the control room, however capability for manual activation of each system level bypass indicator is provided in the control room for those systems that have these infrequently used bypasses. An administratively controlled switch is used for this manual activation. Further examples of automatic indication of inoperability are listed below.

If any circuit breaker of an engineered safety feature system is racked out, indication is provided in the control room.

All motor control center control circuits related to engineered safety feature systems are individually monitored. If control voltage is lost as a result of tripping of a motor starter feeder breaker or removal of a fuse in the control circuit, indication is provided in the control room.

Any engineered safety feature system which contains a control switch with "Lock-out" or "Test Mode" capability, is designed to provide continuous control room indication that "Lock-out" or "Test Mode" has been selected.

Position C.4

All the annunciators can be tested by depressing the annunciator test switches on the control room benchboards.

Individual indicators are arranged together on the control room panel to indicate what function of the system is out of service, bypassed or otherwise inoperable. All bypass and inoperability indicators at both the system level and the component level are grouped only with items that will prevent a system from operating if needed. Indication of pressures, temperatures, and other system variables that are a result of system operation are not included with the bypass and inoperability indicators.

As a result of design, preoperational testing, and startup testing, no erroneous bypass indication is anticipated.

These indication provisions serve to supplement administrative controls and aid the operator in assessing the availability of component and system level protective actions. This indication does not perform functions that are essential to the health and safety of the public.

All circuits are electrically independent of the station safety systems to prevent the possibility of adverse effects. The annunciator initiation signals are provided by independent relay contacts, control switch contacts, or solid-state devices, and can in no way prevent protective actions.

Each indicator is provided with dual lamps. Testing is included on a periodic basis.

Neutron Monitoring System

For the source range neutron monitoring subsystem, manual bypasses are initiated by the operator from the central console. For the intermediate range neutron monitoring subsystem, manual bypasses are initiated by the operator from the back-row panels. For the average power range neutron monitoring subsystem, manual bypasses are initiated by the operator from the back-row panels. At these locations the operator has bypass switch position as indication of channel bypass. No manual system channel bypasses are possible from any other location. At the central console, the operator has two-lamp indicators for each channel, which illuminate when the bypass relays in that channel are energized. All three NMS subsystems have indicators for each channel, at the back-row panels, which illuminate when the bypass relays in that channel are energized. An adequate number of channels are provided to permit continuous bypass of selected channels. Failures in the lamp bulbs cannot propagate back into the station trip systems. The indicating function can be tested by operating the bypass switch and observing the indicator lights.

8.1.6.1.10 Regulatory Guide 1.53 "Application of the Single-Failure Criterion toNuclear Power Plant Protection Systems"

Conformance with this regulatory guide is described in detail in Chapter 7.

8.1.6.1.11 Regulatory Guide 1.62 "Manual Initiation of Protective Actions

Conformance with this regulatory guide is described in detail in Chapter 7.

8.1.6.1.12 Regulatory Guide 1.63. "Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants"

Conformance with this regulatory guide is described as follows for the regulatory positions:

Position C.1 The electric penetration assemblies are designed withstand, without loss of containment integrity, the maximum overcurrent vs. time conditions that could occur given single random failures of circuit overload protection devices.

Position C.2 The maximum short-circuit current assessed at the penetration assembly is consistent with the criteria used to establish the interrupting capability of the penetration assembly conductors protective device. In addition, the rated short circuit for a-c circuits regarding x/r ratios is as modified in the regulatory position.

Position C.3 The durations of maximum short-circuit current as stated in this regulatory guide were used.

Position C.4 Each medium-voltage power conductor was given an impulse withstand test per the regulatory position.

Position C.5 Aging time at the minimum aging temperature was at least 5,000 hours.

Position C.6 No discussion required. The position is merely a correction of a printing error in IEEE 317.

Position C.7 No discussion required. This position indicates that specific applicability or acceptability of codes, standards, and guides referenced in Section 3 of IEEE 317 will be covered separately in other regulatory guides where appropriate.

8.1.6.1.13 Regulatory Guide 1.73 Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants",

Conformance with this Regulatory Guide is described as follows for the regulatory guides:

Position C.1 To the extent practicable, auxiliary equipment has been tested in accordance with IEEE 382.

Position C.2 The valve operators have been tested according to their anticipated actual service operating sequence.

Position C.3 The magnitude of the environmental conditions that simulate actual expected conditions are based on conservative figures and use IEEE 323 as a basis.

Position C.4 The radiological source term used is that used for qualifying all Class 1E equipment per NUREG-0588.

Position C.5 Not applicable. Position deals with qualification testing for gas-cooled reactor.

Position C.6 No discussion required. Position states that other IEEE standards will be addressed with other regulatory guides as appropriate.

8.1.6.1.14 Regulatory Guide 1.75 "Physical Independence of Electric Systems"

Conformance with this regulatory guide is described as follows for the regulatory positions:

Position C.1 Single circuit breakers in power circuits are used as isolation devices only if they trip on receipt of an accident (LOCA) signal, as shown in Figure 8.3-6.

Two fuses or circuit breakers actuated only by fault current are used in series as isolation devices as shown in Figure 8.3-6.

The accident (LOCA) signal which trips the Post Accident Sample System (non-safety-related) can be bypassed to allow operability as described in Subsection 9.3.7.3 and as required by NUREG-0737, Item II.B.3, and NRC letter from R. L. Tedesco (NRC) to G. E. Wuller (IPC) dated August 3, 1981.

Isolation of control, information, and power circuits may be accomplished by the use of a single isolation device as shown in Figure 8.3-6. If the single isolation device is actuated by fault current only (i.e., "unacceptable"), the circuit beyond the isolation device must be treated as an associated circuit. An unacceptable isolation device can be used only if an analysis has demonstrated that the non-Class 1E load has the same qualifications as the Class 1E power circuit and that it will not degrade the Class 1E power source. If the single isolation device is an acceptable isolation device (e.g., relay), the circuit can be considered non-Class 1E.

Position C.2 Interlocked armor enclosing cable is not construed as a raceway.

Position C.3 In general, redundant equipment, and therefore circuits, are located in separate safety class structures.

Position C.4 Agree with position.

Position C.5 Clinton Power Station complies with the requirements of General Design Criterion 17.

Position C.6 The analyses performed in accordance with Section 4.5(3), 4.6.2 and 5.1.1.2 of IEEE 384-1974 shall be prepared on a case by case or generic basis and shall be on permanent file available for NRC review but will not be an integral part of the Safety Analysis Report.

Position C.7 Non-Class 1E instrumentation and control circuits are separated from associated circuits in the same manner that Class 1E circuits are separated from non-Class 1E circuits.

Position C.8 Redundant cables are not run within a confined space such as a cable tunnel that is effectively unventilated.

Position C.9 Cable splicing in tray is not permitted. An analysis was performed, and accepted by the NRC Staff, to justify the use of cable splices in conduit.

Cable splices are permitted in conduit as needed. In general, they are used for terminating to equipment pigtails.

Position C.10 Class 1E and associated cables have color-coded jackets or have black jackets marked with divisional color at the cable ends and at a maximum of 5-foot intervals prior to its installation in the raceways. If color coded mylar wraps are used to achieve divisional identification, the marking may be delayed until completion of the cable pull to avoid unnecessary marking of long lengths in the duct runs and conduits. In such cases, cables are marked with the divisional color code every five feet or less in the exposed part of the raceway and at every manhole, junction box and pull box.

Position C.11 Class 1E raceways are equipped with color-coded markers. Class 1E and associated cables have color-coded jackets or have black jackets marked with divisional color at the ends and either at a maximum of 5-foot intervals in open raceways (including trays with covers) or at every exposed man-hole, junction box and pull box when a cable is pulled into enclosed raceways. Reference materials are not required to distinguish between Class 1E and non-Class 1E circuits, between non-Class 1E circuits associated with different redundant Class 1E systems, and between redundant Class 1E systems.

Position C.12 Although redundant cable spreading areas are not utilized at CPS, sufficient separation to meet the requirements of IEEE 384-1974 has been maintained between redundant circuits and between Class 1E to non-Class 1E raceways. For example, Division 1 and 2 cables are routed in separate rooms within the cable spreading area; Division 3 and 4 cables are routed outside the cable spreading area and enter the control room from overhead on opposite sides of the control room. Power cables, when routed in the cable spreading rooms and control room, are necessary to feed equipment associated with the area, and are installed in conduit only.

All raceways meet the requirements of separation distance per IEEE 384-1974 Subsection 5.1.1.2. The acceptable separation distances for both Class 1E and non-Class 1E circuits were established by tests and analysis in conjunction with tests, as defined in Subsection 8.3.1.4.2.2.3 and Figure 8.3-8. Power cables, when routed in the cable spreading rooms and control room, are necessary to feed equipment associated with the area, and are installed in conduit only. Cables are color coded as identified in Subsection 8.1.6.1.14, Position C.IO. (Q&R 430.131)

Position C.13 In compliance with the regulatory position, no significance has been attached to the different tray widths illustrated in Figure 2 of IEEE 384.

Position C.14 The diesel generators all have independent air supplies.

Position C.15 The four safety-related batteries are in separate rooms. The Division 1 battery room is served by a Division 1 exhaust fan. The Division 2 battery room is served by a Division 2 exhaust fan. The Division 4 and balance of plant battery rooms are served by different Division 1 and 2 exhaust fans. The Division 3 Battery Room is served by a Division 3 powered exhaust fan which is connected via duct to the same Division 1 and 2 powered exhaust fans which serve the Division 4 and BOP battery rooms.

Position C.16 The same separation requirements are placed on instrumentation cabinets as are placed on control switchboards.

See also Subsection 8.3.1.4.

8.1.6.1.15 Regulatory Guide 1.81 "Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants"

Conformance with this regulatory guide is not applicable because CPS is a one-unit facility.

8.1.6.1.16 Regulatory Guide 1.89, Qualification of Class 1E Equipment for Nuclear Power Plants"

Conformance with this regulatory guide is described as follows for the regulatory positions and as indicated in Section 3.11:

Position C.1 No response required because the position is merely a confirmation that IEEE 323 and IEEE 344 are acceptable.

Position C.2 The radiological source term for qualification tests is based on the same source terms as used in NUREG-0588.

8.1.6.1.17 Regulatory Guide 1.93 "Availability of Electric Power Sources"

The limiting conditions for operation specified in the CPS Technical Specifications satisfy the requirements of Regulatory Guide 1.93. Exceptions to this Regulatory Guide are:

a) the time limit for inoperability for Division 3 diesel generator and the Divisions 3 and 4 batteries. The exception is based on the fact that the only load on Division 3 is the high pressure core spray system (HPCS), and the Division 4 battery support for HPCS initiation. The CPS Technical Specifications require HPCS power source availability similar to the requirements contained in NRC Standard Technical Specifications (NUREG 1434).

b) The Division 1 and 2 diesel generators have allowed outage time (AOT) of 14 days rather than 72 hours and this time may be used for preventive maintenance. The basis for this change is risk-informed Technical Specification Amendment 141.

8.1.6.1.18 Regulatory Guide 1.100 "Seismic Qualification of Electric Equipment for Nuclear Power Plants"

Conformance with this regulatory guide is indicated in Section 3.10.

8.1.6.1.19 Regulatory Guide 1.106 "Thermal Overload Protection for Electric Motors on Motor-Operated Valves"

Conformance with this regulatory guide is described as follows for the regulatory positions:

Position C1: Clinton Power Station complies with the intent of this Reg. Guide. Thermal overload protection is continuously bypassed with the exception that it may be temporarily placed into service for short periods of time during valve maintenance, testing or repositioning during normal plant operation. ORM 2.5.2 provides limitations on amount of time the overloads may be placed into service. Since the overloads are continuously bypassed at all other times, they will be bypassed during accident conditions. Automatic actuation devices to bypass them during accident conditions is not required. As such, the CPS program for control of MOV thermal overload protection devices complies with the requirements of Reg. Guide 1.106 to prevent overload protection circuitry from inhibiting the ability of MOVs to perform their safety function.

ORM Operational Requirement 2.5.2 (MOV thermal Overload Protection) provides the limitations on use of MOV thermal overload protection. It also identifies the actions to be taken if the limitations are not met. Annunciators are used to indicate switches that are in the test (overload protection) position.

Test procedures have sign-off steps for restoring bypass switches to the normal position. In addition, annunciators indicate switches that are in the test position. (Q&R 430.127)

8.1.6.1.20 Regulatory Guide 1.108 "Periodic Testing of Diesel-Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants"

Conformance with this regulatory guide is described in Subsection 1.8.

8.1.6.1.21 Regulatory Guide 1.118 "Periodic Testing of Electric Power and Protection Systems"

Conformance with this regulatory guide is described in Chapters 7 and 8.

8.1.6.1.22 Regulatory Guide 1.128 "Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants"

Conformance with this Regulatory Guide is described as follows for the regulatory positions:

Position C.1 The design of the battery room ventilation system is such that the hydrogen accumulation will be limited to less than 2% of the total volume of the battery area. The regulatory position to limit concentration to less than 2% by volume at any location within the battery area would be impossible to verify.

Position C.2 For compliance see Section 9.5.1 and Appendix E.

Position C.3 Restraining channel beams and tie rods of the battery racks are provided with plastic covers, which act as electrical insulators as well as moisture and acid resistors.

Position C.4 Any capacity discharge tests will be in accordance with IEEE 450.

Position C.5 No response is required. The position merely states that specific responsibility of referenced documents is to be covered separately in other regulatory guides where appropriate.

Positions C.6a through C.6j Clinton Power Station complies with the requirements of IEEE 484. In addition, the recommendations of IEEE 484 indicated with the word "should" are being followed.

8.1.6.1.23 Regulatory Guide 1.129 "Maintenance, Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants"

Conformance with this regulatory guide is provided by the maintenance and testing program described in the CPS Technical Specifications.

8.1.6.1.24 Regulatory Guide 1.131 "Qualification Tests of Electric Cables, Field Splices and Connections for Light-Water-Cooled Nuclear Power Plants"

Conformance with this regulatory guide is described as follows for the regulatory positions:

Position C.1 Cables, field splices and connections have been qualified to the worst-case design-basis event except for electrical tape for splicing and termination provided by UCI (part # UCI-003XS) which was qualified to a different design-basis accident profile and will only be utilized where analysis shows that the tape can perform its design function.

Position C.2 Cables, field splices and connections have been type tested in accordance with IEEE 383, including the margins specified by IEEE 323. The environmental conditions used for qualification were those of CPS except that the testing on UCI tape was performed to generic environmental conditions and will only be utilized where analysis shows that the tape can perform its design function.

Position C.3 The type tests environmental values enveloped the worst case applicable CPS design-basis event plant profile.

Position C.4 Aging data were used in the qualification to establish the long-term performance of the insulation.

Position C.5 The radiological source term used for cables is per NUREG-0588.

Position C.6 This position states 'In lieu of Section 2.5.1, "General," the following should be used: "This section describes the method for type testing of grouped cables via the vertical tray flame test to determine their relative self-extinguishing tendencies. Testing shall include both aged and unaged cable specimens."

Aged and non-aged cables were used in the testing to verify their self-extinguishing properties.

This Regulatory Guide position deals with flame testing of cables and does not mention cable splices. Flame tests on UCI tape splices were only performed on unaged splices. However in position C.7, the NRC states, "The fire test provisions of the standard are useful in screening out cable insulation materials that are inadequately self-extinguishing, but they shall not be construed as qualification of any installed cable system configuration. If field splices are to be used in cable trays, special provisions shall be made to demonstrate that the fire retardant properties of the cable are not altered unacceptably in an adverse way by the field splice."

Since cable splicing is not permitted in tray at CPS (see response to position C.7) there is no requirement for our site to have data on flame testing of splices. Accordingly, since the flame testing performed by UCI on their splice material was not necessary for our site, it makes no difference whether both aged and unaged flame test samples were used by UCI.

Position C.7 Cable splicing in trays is not permitted. An analysis was performed, and accepted by the NRC Staff, to justify the use of cable splices in conduit.

Cable splices are permitted in conduit as needed. In general, they are used for terminating to equipment pigtails.

Position C.8 Vertical tray configuration (perpendicular to the plane of the horizon) was used for the flame test.

Position C.9 A 70,000-Btu per hour propane gas burner was used in the flame tests performed except for the tests of UCI tape splices where the alternate flame source described in IEEE 383-1974 was utilized.

Positions C.10 and 11 Supplier has complied when the propane gas burner was used.

Position C.12 The alternative flame sources allowed by IEEE 383 were not used in the CPS qualification except in the tests on cable splices prepared with UCI-003XS tape.

Position C.13 For cable, the sections of IEEE 383 referred to in this regulatory position have been treated the same as the requirements of the standard.

Position C.14 No discussion is required. The position states that additional applicable IEEE standards will be covered in separate regulatory guides.

8.1.6.2 Conformance to IEEE Standards

8.1.6.2.1 IEEE 279 "Criteria for Protection Systems for Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 279.

8.1.6.2.2 IEEE 308 "Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations"

The non-NSSS design of the Clinton Power Station is in accordance with the requirements of IEEE 308 as clarified in Subsections 8.3.1.2.2 and 8.3.2.2.2, which discuss compliance with Regulatory Guide 1.32.

All the electrical system components supplying power to the HPCS and NSPS Class 1E electrical equipment are designed to meet their functional requirements under the conditions produced by the design-basis events. All of this equipment is physically separated from redundant equipment to maintain independence. All of these components are located in Seismic Category I structures.

8.1.6.2.3 IEEE 317 "Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 317 as explained in Subsection 8.1.6.1.12, which discusses compliance with Regulatory Guide 1.63.

8.1.6.2.4 IEEE 323 "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 323 as clarified in Subsection 8.1.6.1.16. In addition, for the HPCS power supply system, the qualification requirements of IEEE 323 are considered fulfilled by test and/or operating experience on similar equipment in similar environments in other plants. For the HPCS diesel generator, see compliance to IEEE 387 in this section.

8.1.6.2.5 IEEE 334 "Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 334 as clarified in Subsection 8.1.6.1.7, which discusses compliance with Regulatory Guide 1.40.

8.1.6.2.6 IEEE 336 "Standard for Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment during the Construction of Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 336 as indicated in Chapters 7 and 8 with one exception specified in Section 1.8 under Regulatory Guide 1.30.

8.1.6.2.7 IEEE 338 "IEEE Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems"

The protection systems, including the actuation devices, are designed to permit periodic testing. The subject of periodic testing of protection systems is presented in Section 7.1. The subject of periodic testing of Class 1E power systems is discussed in Subsection 8.3.1.2.1.

8.1.6.2.8 IEEE 344 "Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 344 as clarified in Subsection 8.1.6.1.18, which discusses compliance with Regulatory Guide 1.100.

8.1.6.2.9 IEEE 379 "Application of the Single Failure Criterion to Nuclear Power Generating Station Class 1E Systems"

The non-NSSS design of the Clinton Power Station is in accordance with the intent of IEEE 379.

The design of the NSPS power supply is in accordance with the intent of IEEE 379.

8.1.6.2.10 IEEE 382 "Trial-Use Guide for Type Test of Class I Electric Valve Operators for Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 382 as clarified in Subsection 8.1.6.1.13, which discusses compliance with Regulatory Guide 1.73.

8.1.6.2.11 IEEE 383 "Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 383 as clarified in Subsection 8.1.6.1.24, which discusses compliance with Regulatory Guide 1.131.

8.1.6.2.12 IEEE 384 "Standard Criteria for Independence of Class 1E Equipment and Circuits"

The non-NSSS design of the Clinton Power Station is in accordance with the requirements of IEEE 384 as clarified in Subsection 8.1.6.1.14, which discusses compliance with Regulatory Guide 1.75, The design of the NSPS power supply is in accordance with the intent of IEEE 384.

8.1.6.2.13 IEEE 387 "Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations"

The design of the Clinton Power Station Division 1 and 2 diesel generator units is in accordance with the requirements of IEEE 387 as clarified in Subsection 8.3.1.2.2, which discusses compliance with Regulatory Guide 1.9.

Except as also clarified in Subsection 8.3.1.2.2, the HPCS (Division 3) diesel-generator unit meets the applicable requirements of IEEE 387 to:

a. Operate in its service environment during and after any design-basis event without support from the preferred power supply.

b. Start, accelerate, and be loaded with the design load within an acceptable time,

    1. from the normal standby condition;

    2. with no cooling available, for a time equivalent to that required to bring the cooling equipment into service with energy from the diesel generator unit; and

    3. on a restart with an initial engine temperature equal to the continuous rating, full load engine temperature.

c. Carry the design load for 2000 hours.

d. Maintain voltage and frequency within limits that will not degrade the performance of any of the loads composing the design load below their minimum requirements, including the duration of transients caused by load application or load removal.

e. Withstand any anticipated vibration and overspeed conditions. There is no flywheel coupled with the HPCS diesel-generator. The generator and exciter are designed to withstand 25% overspeed without damage.

The HPCS diesel-generator has continuous and short term ratings consistent with the requirements of IEEE 387.

Mechanical and electrical system interactions between the HPCS diesel-generator unit and other units of the standby power supply, the nuclear plant, the conventional plant, and the class 1E Electrical Systems are coordinated so that the HPCS diesel generator unit design function and capability are realized for any design-basis event, except failure of the HPCS diesel-generator unit.

8.1.6.2.14 IEEE 415 "IEEE Guide for Planning of Pre-Operational Testing Programs for Class 1E Power Systems for Nuclear-Power Generating Stations"

The pre-operational testing program at the Clinton Power Station is in accordance with IEEE 415 as clarified in the following paragraphs.

a. Standby Diesel Generator

1. Compliance with the following tests is established by our commitment in Table 1.8-1 to IEEE 387:

   Starting Test
   Load Acceptance Test
   Design Load Test
   Load Rejection Test
   Electric Test
   Functional Test

2. Compliance with the Independence Test is as indicated in Subsection 14.2.12.1.40.

b. Preferred A-C Power Supply

1. Compliance with the Load Acceptance Test is as indicated in Subsection 14.2.12.1.40.

2. For the Design Load Test, the preferred source will be operated in a variety of normal load conditions. A specific Design Load Test is not planned.

3. For the Electric Test, individual tests performed during the checkout and Initial Operation testing phase will verify compliance.

4. Compliance with the Functional and Independence Tests is as indicated in Subsection 14.2.12.1.40.

c. A-C Power Distribution System

1. Compliance with the Load Acceptance Test is as indicated in Subsection 14.2.12.1.40.

2. Compliance to the Design Load Test will be accomplished by utilizing normal loads plus loss of off-site power emergency test loads. It is not planned to load the distribution system to greater than those loads nor to monitor the temperature of the bus.

3. For the Electric Test, individual tests performed during the Checkout and Initial Operation Testing Phase, will verify compliance.

4. The Functional Test will be accomplished during the pre-operational tests of the 4160-V and 6900-V power systems.

5. Compliance with the Independence Test is as indicated in Subsection 14.2.12.1.40.

d. Battery Supply

Compliance to the Battery Capacity Test is established by our commitment in Table 1.8-1 to IEEE 450.

e. Battery Charger

Compliance to the Battery Charging System Test is as described in Subsection 14.2.12.1.38.

f. D-C Power Distribution System

1. Compliance to the Load Acceptance Test and Design Load Test is as described in Subsection 14.2.12.1.38.
2. For the Electric Test, individual tests performed during the Checkout and Initial Operation Testing Phase will verify compliance.
3. Compliance to the Functional Test is as described in Subsection 14.2.12.1.38.
4. Compliance to the Independence Test is as described in Subsection 14.2.12.1.40.

g. Vital I and C Power Supplies

1. Compliance to the Starting Test is accomplished by tests performed during Pre-Operational Testing Phase.
2. Compliance to the Load Acceptance Test is as described in Subsection 14.2.12.1.40.
3. Compliance to the Design Load Test is accomplished by tests performed during the Pre-Operational Testing Phase.
4. Compliance to the Load Rejection Test is as described in Subsection 14.2.12.2.24.
5. Compliance to the Electric Test will be by individual tests performed during the Checkout and Initial Operation Testing Phase.
6. Compliance to the Functional Test and Independence Test is as described in Subsection 14.2.12.1.40.

h. Vital I and C Distribution System

1. Compliance to the Load Acceptance Test is as described in Subsection 14.2.12.1.40.

2. Compliance to the Design Load Test will be accomplished by utilizing normal loads plus loss of offsite power emergency test loads. It is not planned to load the distribution system to greater than those loads nor to monitor the temperature of the bus.

3. Compliance to the Electric Test is accomplished by individual tests performed during the checkout and Initial Operation Testing Phase.

4. Phase and by individual tests performed during Checkout and Initial Operation Testing Phase.

5. Compliance to the Independence Test is as described in Subsection 14.2.12.1.40.

8.1.6.2.15 IEEE 450 "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications"

The surveillance requirements for d-c electrical power systems specified in the Technical Specifications satisfy the requirements of IEEE 450.

8.1.6.2.16 IEEE 484 "Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations"

The design of the Clinton Power Station is in accordance with the requirements of IEEE 484 as clarified in Subsection 8.1.6.1.22, which discusses compliance with Regulatory Guide 1.128.

8.1.7 References

1. Letter from R. L. Tedesco (NRC) to G. E. Wuller (IPC) dated August 3, 1981.

Tables 8.1-1 and 8.1-2

have been intentionally deleted.

Table 8.1-3

LIST OF NUCLEAR SAFETY ELECTRICAL CRITERIA CONSIDERED

10 CFR 50 App. A Criterion 17: Electric Power System

10 CFR 50 App. A Criterion 18: Inspection and Testing of Electric Power Systems

IEEE 279: Criteria for Protection Systems for Nuclear Power Generating Stations

IEEE 308: Criteria for Class 1E Power Systems for Nuclear Power Generating Stations

IEEE 317: Standard for Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations

IEEE 323: Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

IEEE 334: Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations

IEEE 336: Standard for Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment during the Construction of Nuclear Power Generating Stations

IEEE 338: Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems

IEEE 344: Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

IEEE 379: Standard Application of the Single Failure Criterion to Nuclear Power Generating Station Class 1E Systems

IEEE 382: Trial-Use Guide for Type Test of Class I Electric Valve Operators for Nuclear Power Generating Stations

IEEE 383: Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

IEEE 384: Criteria for Independence of Class 1E Equipment and Circuits

IEEE 387: Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations

IEEE 415: IEEE Guide for Planning of Pre-Operational Testing Programs for Class 1E Power Systems for Nuclear Power Generating Stations.

IEEE 450: IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications

IEEE 484: Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations

TABLE 8.1-3 (Cont'd)

NRC Regulatory Guide 1.6: Independence between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems

NRC Regulatory Guide 1.9: Selection, Design, and Qualification of Diesel-Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants

NRC Regulatory Guide 1.22: Periodic Testing of Protection System Actuation Functions

NRC Regulatory Guide 1.29: Seismic Design Classification

NRC Regulatory Guide 1.30: Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment

NRC Regulatory Guide 1.32: Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants

NRC Regulatory Guide 1.40: Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water Cooled Nuclear Power Plants

NRC Regulatory Guide 1.41: Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load Group Assignments

NRC Regulatory Guide 1.47: Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems

NRC Regulatory Guide 1.53: Application of the Single-Failure Criterion to Nuclear Power Plant Protection System

NRC Regulatory Guide 1.62: Manual Initiation of Protective Actions

NRC Regulatory Guide 1.63: Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants

NRC Regulatory Guide 1.73: Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants

NRC Regulatory Guide 1.75: Physical Independence of Electric Systems

NRC Regulatory Guide 1.81: Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants

NRC Regulatory Guide 1.89: Qualification of Class 1E Equipment for Nuclear Power Plants

NRC Regulatory Guide 1.93: Availability of Electric Power Sources

NRC Regulatory Guide 1.100: Seismic Qualification of Electric Equipment for Nuclear Power Plants

NRC Regulatory Guide 1.106: Thermal Overload Protection for Electric Motors on Motor-Operated Valves

TABLE 8.1-3 (Cont'd)

NRC Regulatory Guide 1.108: Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Syystems at Nuclear Power Plant

NRC Regulatory Guide 1.118: Periodic Testing of Electric Power and Protection Systems

NRC Regulatory Guide 1.128: Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants

NRC Regulatory Guide 1.129: Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants

NRC Regulatory Guide 1.131: Qualification Tests of Electric Cables, Field Splices and Connections for Light-Water-Cooled Nuclear Power Plants

NRC Regulatory Guide 1.155: Station Blackout

8.2 OFFSITE POWER SYSTEM

8.2.1 Description

8.2.1.1 Transmission System

The Ameren Illinois system supplies the offsite a-c power for startup, normal operation, and safe shutdown of the unit. A site-specific procedure outlines the responsibilities of Ameren Illinois and the site for switchyard and substation interfacing activities.

The offsite power source to the 345-kV switchyard is from the 345-kV lines, as shown in Figure 8.2-1. These consist of the Clinton-Brokaw line (approximate transmission line length of 22.4 miles), the Clinton-Oreana line (approximately transmission line length of 18.1 miles), and the Clinton-Goose Creek-Oreana line (approximate transmission line length of 34.4 miles). Approximately 15.6 pole-miles of the 345-kV lines running from Clinton to Oreana and from Clinton to Goose Creek-Oreana and are double-circuit structures. The remainder of both lines and the Clinton to Brokaw line are single-circuit structures.

The offsite power source to the 138-kV ERAT is from a 138-kV line, 1372B, as shown in Figure 8.2-1. This is an 8.4 mile line tapped from a 138-kV line running between the Clinton Rt. 54 and South Bloomington Substations.

The Brokaw, Goose Creek, Oreana, Clinton Rt. 54, and South Bloomington Substations are part of the Ameren Illinois Company grid system. The lines described normally will not be subjected to any unusual operation restrictions.

Chapter 15 of the Clinton USAR discussed the effects of anticipated process disturbances to determine their consequences and the capability of the plant to control or accommodate such events. Subsection 15.2.6 discusses loss of a-c power, including loss of grid. This discussion demonstrates that fuel design limits and reactor coolant pressure boundary design conditions are not exceeded.

The two offsite power sources to Unit 1 normally consist of one 345-kV circuit from the switchyard to the RATs and one 138-kV circuit from the Ameren Illinois Company grid system to ERAT. Out-of-service spares for ERAT and each RAT type are stored on site.

The 138-kV line routing from the Clinton Power Station terminates at the South Bloomington and Clinton Rt. 54 substations without crossing any of the 345-kV outlet lines from the Clinton Power Station. A fully automated circuit switcher is located north of the ERAT tap point on the South Bloomington-Clinton Rt. 54 138-kV line and is operated normally closed. If this 138-kV line is faulted, undervoltage relays will automatically open the circuit switcher with the line de-energized. The unfaulted portion of this 138-kV line is then re-energized. The 138-kV line continues from the Clinton Rt. 54 Substation and terminates at the North Decatur Substation.

The d-c supply for the 138-kV yard is from the station battery and therefore separate from the CPS switchyard d-c supply.

For the 345-kV switchyard, each battery and bus has its own charger. Each charger is fed from the 208-Vac switchyard bus which is supplied a-c power by three sources of switched feeds, one from a station "A" bus, one from a station "B" bus, and the third one primarily from the 138-kV offsite power sources.

The 138-kV line also supplies power to two 138-kV/12-kV substations (Supplemental Cooling and Auxiliary Boiler (SCAB) Transformer/Bus and Construction (CONST) Transformer/Bus) located approximately 50 yards from the 138-kV line. The SCAB substation normally provides power to CPS electrode boilers and other out-building loads. The CONST substation normally serves other out-buildings and a customer substation loads. Both the SCAB and CONST Busses are capable of being cross-connected with either substation transformer supplying one CPS electrode boiler with other loads.

The 138-kV line has sufficient capacity to serve the ERAT load requirements as well as station electrode boilers, station outbuildings, and the customer substation loads. Due to degraded voltage issues, the 138-kV line can not be considered operable per Technical Specifications if loading on SCAB substation is increased above 18,904 kVA (18.904 MVA). Electrical feeder from 12-kV construction substation to customer’s substation (Shell Oil pumping station) is provided with protective relays such that faults on the customer's system or the line to the customer substation will be cleared without deenergizing the 138-kV line to the ERAT transformer.

The 138-kV service to the two 138-kV/12-kV substations does not alter the separation of the 345-kV lines and the 138-kV line. (Q&R 430.95)

8.2.1.2 Switchyard

The 345-kV switchyard consists of circuit breakers, disconnect switches, buses, and associated equipment arranged in a ring bus configuration as shown in Figure 8.2-2.

Two independent and redundant relaying systems are provided for each transmission circuit. The line relaying systems operate redundant breaker trip coils, and are fed from separate switchyard batteries 1 and 2 (see Figure 8.2-3) located in the relay house. The relaying and control cables within the switchyard and associated relay house (where the switchyard relays are located) are installed in separate System 1 and 2 trenches and cable trays, and the cables are routed in separate duct runs from the station (where the controls are located) to the switchyards. The 345-kV switchyard relay and control cables are designed for wet locations normally encountered in duct runs. (Q&R 430.104)

A 138-kV circuit switcher is located between the 138-kV transmission line and ERAT. This circuit switcher will open on operation of ERAT differential relays, sudden pressure relays, primary phase overcurrent relays, and secondary neutral overcurrent relay. The circuit switcher will also open on operation of a 4160-V ERAT bus differential relays when the ERAT bus is energized from the ERAT transformer.

The RAT circuit switcher does not have the capability to interrupt the fault current available given a bolted three-phase fault at the primary terminals of any RAT. If the fault current exceeds the capability of the RAT switcher, the upstream breakers in the CPS switchyard will trip and isolate the fault.

The ERAT circuit switcher does have the capability to interrupt the fault current available given a bolted three-phase fault at the primary terminals of ERAT.

Both switchers do have sufficient fault capability for any transformer secondary faults.

The RAT circuit switcher d-c control power (including closing and tripping energy) is from the switchyard battery. The ERAT circuit switcher d-c control power (including closing and tripping energy) is from the station battery.

The RAT circuit switcher is equipped with one closing and one tripping circuit. The ERAT circuit switcher is equipped with one closing and one tripping circuit. Controls for the opening and closing of RAT and ERAT circuit switchers are provided in the main control room. (Q&R 430.96)

The 345-kV line from the RAT Circuit Switcher feeds three RATs, RAT A, RAT B, and RAT C, and each transformer has it own 345-kV manually operated disconnect switch. These switches have sufficient capability to interrupt the magnetizing current of its respective transformer, after the transformer low side bus connections have been isolated from the transformer. Remote indication of each switch position is provided in the Main Control Room.

The following provisions have been made to assure automatically the electrical isolation of various power sources from each other and to assure non-paralleling of power sources at the ESF (Class 1E) buses or through the manually operated disconnect switches.

1. Class 1E buses cannot be fed from UAT's. UAT's feed only non-Class 1E buses.
2. UAT feed breakers and RAT feed breakers on non-Class 1E buses are interlocked per bus such that closure of either breaker causing paralleling of transformers automatically trips the opposite breaker similar to the description in Subsection 8.3.1.1.2 for Class 1E buses. (Reference: E02-1AP99, Sheets 1-8.) ERAT feeds only Class 1E buses.
3. RAT feed breakers and ERAT feed breakers are interlocked per bus such that closure of either breaker causing paralleling of transformers automatically trips the opposite breaker. (See Subsection 8.3.1.1.2.)
4. The disconnect switches for ET4 bus which allow transfer of the source buses are key interlocked such that only one switch can be closed to connect the bus group to a transformer at any time, and the switch must be opened locally before the key can be removed to be taken locally to the next switch to unlock that switch and close it into the alternate source.

Further response dealing with isolation of Unit 1 and Unit 2 transformers is no longer applicable because Unit 2 has been cancelled. (Q&R 430.98)

Manual, fast, and slow transfer is possible between RAT B and ERAT

Manual transfer is described in Subsection 8.3.1.1.2.

The fast and slow transfer schemes do not lend themselves to practical testing during plant operation. Also the relaying involved in the automatic fast and slow transfer schemes is not essential to the safe shutdown of the plant and therefore is not required to be tested during plant operation in accordance with Regulatory Guide 1.118. However, the relays will be periodically tested during plant outages.

Channel functional test, channel calibration, and logic system functional test will be performed on the second level of undervoltage relays per Clinton Power Station Technical Specifications.

The design of the 4160-V emergency bus undervoltage protection permits the surveillance requirements of the Technical Specification to be fulfilled. (Q&R 430.132)

8.2.2 Analysis and Compliance with Criteria

8.2.2.1 Compliance with NRC General Design Criterion 17

Offsite a-c power is supplied to the Clinton Power Station (CPS) switchyard from the Ameren Illinois grid system and meets the requirements of General Design Criterion 17 of Appendix A to 10 CFR 50.

Offsite a-c power to RATs A, B, and C is supplied by three 345-kV transmission lines. Offsite a-c power to Emergency Reserve Auxiliary Transformer is supplied by one 138-kV transmission line.

Illinois Power Company classified line outages as temporary or permanent. Temporary forced outages are outages where automatic reclosing is successful and the duration of the interruption is 1 minute or less. Permanent forced outages are outages where automatic reclosing is not successful, the circuit breakers are locked open, and the duration of the interruption is greater than 1 minute.

Tables 8.2-1 and 8.2-2 illustrate the historical temporary and permanent forced outage records for IP's 345-kV transmission line. Since these numbers are considered typical for the 345-kV System, this data will not be updated in the USAR. Ameren Illinois Electrical Supply Department maintains historical forced outages records.

Historical records (1983-1992) of IP transmission line outages indicate that the majority of temporary forced outages of 345-kV transmission lines on the system is the result of lightning flashover. Permanent forced outages of 345-kV transmission lines on the system are caused by various factors, and the average duration of such an outage is 83 hours and 57 minutes. This average duration of permanent forced outages is typical for the EHV systems of MISO companies.

The RATs are sized to carry the portion of auxiliary load required for the unit connected buses. In addition, RAT B is sized to carry the total coincidental auxiliary load required for LOCA of the unit.

The RATs are sized to carry the auxiliary load required startup of the unit.

The ERAT is designed to start and carry the auxiliary load required for LOCA on the unit.

A voltage analysis was run on the ERAT and the RAT B to determine the transient and steady state voltages at the Class 1E buses during LOCA and shutdown conditions. The worst case minimum voltage was calculated and a Static Var Compensator was added to the RAT B and ERAT to assure that bus voltages during LOCA and shutdown conditions would be above the minimum acceptable voltage levels for equipment protection, starting, and continued operation.

All continuous duty motors are capable of delivering full load torque without damage at 75% of rated voltage for infrequent 1-minute intervals, which is substantially longer than the longest motor acceleration time. The safety related motors are designed to operate continuously when voltage at the terminals is within plus or minus 10% of the motor nameplate rating. (Q&R 040.11)

The 345-kV and 138-kV transmission lines and their associated structures are designed to withstand successfully environmental conditions prevalent in the area (for example, wind, temperature, lightning, flood, etc.), thus minimizing simultaneous failure.

The 345-kV transmission lines approach the switchyard on two separate rights-of-way. The 138-kV transmission line right-of-way is physically separated from the right-of-way of the 345-kV transmission lines. The 138-kV transmission line does not enter the 345-kV switchyard. Because of this separation, failure of one line cannot cause failure of all lines. Drawings M01-1101-2 and M01-1102-1 were revised in FSAR Amendment 6 showing the separated line routings. (Q&R 430.104)

The RATs (which are supplied from the 345-kV offsite power system) and the ERAT (which is supplied from the 138-kV offsite power system) establish two independent circuits to the onsite electrical distribution system.

8.2.2.2 Compliance with NRC General Design Criterion 18

The offsite a-c power system meets the requirements of inspection and testing in accordance with General Design Criterion 18 of Appendix A to 10 CFR 50.

The MISO and Transmission Operator (TO) will model and analyze the impact of events within their system on the reliability of the electric system within the area of responsibility.

MISO will model and analyze the impact of events in adjacent systems and across the MISO system. MISO will coordinate and communicate these impacts to the TO.

TO will immediately initiate communication with CPS and MISO if TO verified an actual violation to the operating criteria affecting CPS. The TO and MISO will immediately initiate steps to mitigate the violation.

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TABLE 8.2-1
TEMPORARY FORCED OUTAGE DATA - 345 kV LINES
(Taken From 345 kV Line Outage Reports)

Lines	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Total 1983-1992	Causes of Interruptions	Circuit Length (Mi.)	Total Line Exposure (Mile-Yrs.)	No. of Outages /Yr./ 100 Mi.
Sidney-Bunsonville-Eugene	0	1	0	0	0	0	1	2	0	1	5	4-Lightning 1-Wind & Ice	31.60	284.28	1.76
Baldwin-Cahokia	1	1	0	0	0	0	0	0	0	1	3	2-Lightning 1-UE Problem on Cahokia-Roxford	36.23	362.30	0.83
Baldwin-Turkey Hill	0	0	0	0	1	0	2	1	1	0	5	3-Lightning 1-Storm 1-Unknown	20.78	207.80	2.41
Baldwin-Stallings	1	0	0	0	2	0	0	1	0	0	4	3-Lightning 1-Tree	46.29	462.90	0.86
Baldwin-W. Mt. Vernon	0	0	0	0	3	0	0	3	2	0	8	2-Lightning 1-Wind 3-Storm 2-Unknown	50.80	508.00	1.57
Coffeen-Roxford-Stallings	2	0	0	0	0	3	1	0	2	0	8	6-Lightning 1-False trip (relay tester) 1-Storm	58.51	585.10	1.37
W. Mt. Vernon-Shawnee	0	1	0	0	4	1	0	2	0	0	8	4-Lightning 2-False trip 1-Storm 1-Unknown	88.21	881.50	0.91
W. Mt. Vernon-Newton	1	0	1	1	1	0	1	1	0	1	7	4-Lightning 1-Wind & Rain 1-Tree 1-Unknown	61.02	610.20	1.15

TABLE 8.2-1 (Cont'd)
TEMPORARY FORCED OUTAGE DATA - 345 kV LINES
(Taken From 345 kV Line Outage Reports)

Lines	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Total 1983-1992	Causes of Interruptions	Circuit Length (Mi.)	Total Line Exposure (Mile-Yrs.)	No. of Outages /Yr./ 100 Mi.
Sidney-Kansas	0	0	0	0	2	1	1	5	0	2	11	5-Lightning 1-Rain & Ice 1-Wind & Ice 3-Unknown 1-Other	56.39	563.90	1.95
Clinton-Oreana-Rising	0	2	3	1	2	4	1	3	2	3	21	16-Lightning 3-Wind & Rain 1-Wind 1-Unknown	51.31	513.10	4.09
Cinton-Brokaw	0	0	0	2	0	1	0	2	2	0	7	4-Lightning 2-Rain & Ice 1-Unknown	22.41	224.10	3.12
Clinton-Latham	0	0	1	0	2	1	2	0	0	3	9	5-Lightning 1-Wind & Rain 1-Wind 2-Unknown	29.19	291.90	3.08
SYSTEM TOTAL											96	58-Lightning 3-Wind 5-Wind & Rain 2-Wind & Ice 2-Rain & Ice 2-Tree 6-Storm 3-False Trip 1-Other 12-Unknown		5495.08	
SYSTEM AVERAGE															1.75

TABLE 8.2-2
PERMANENT FORCED OUTAGE DATA - 345 kV LINES
(Taken From 345 kV Line Outage Reports)

Lines	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Total 1983-1992	Outage Duration (hr : min)	Circuit Length (Mi.)	Total Line Exposure (Mile-Yrs.)	No. of Outages/ Yr./ 100 Mi.
Sidney-Bunsonville-Eugene	0	0	0	0	0	0	1	0	0	0	1	182 : 32	31.60	284.28	0.35
Baldwin-Cahokia	0	0	1	1	3	0	0	0	0	0	5	51 : 39	36.23	362.30	1.38
Baldwin-Turkey Hill	0	0	0	0	0	0	0	0	0	2	2	241 : 32	20.78	207.80	0.96
Baldwin-Stallings	0	2	0	1	0	1	0	0	0	1	5	936 : 32	46.29	462.90	1.08
Baldwin-W. Mt. Vernon	0	4	0	0	0	3	1	0	0	1	9	1859 : 37	50.80	508.00	1.77
Coffeen-Roxford-Stallings	0	0	3	0	2	0	0	1	0	0	6	5 : 22	58.51	585.10	1.03
W. Mt. Vernon-Shawnee	1	0	0	0	1	0	2	0	1	1	6	380 : 35	88.21	881.50	0.68
W. Mt. Vernon-Newton	1	0	1	2	1	0	0	0	1	0	6	34 : 18	61.02	610.20	0.98
Clinton-Latham	1	0	0	0	0	0	0	1	0	0	2	64 : 04	29.19	291.90	0.69
Clinton-Oreana-Rising	1	1	0	0	0	0	0	0	0	0	2	0 : 30	51.31	513.10	0.39
Clinton-Brokaw	0	0	0	0	0	0	0	0	0	0	0	0 : 00	22.41	224.10	. 0
Sidney-Kansas	0	0	0	0	0	0	0	1	0	0	1	21 : 02	56.39	563.90	0.18
SYSTEM TOTAL											45	3777 : 43		5495.08	
SYSTEM AVERAGE												83 : 57			0.82

Tables 8.2-3 and 8.2-4 have been deleted.

8.3 ONSITE POWER SYSTEM

The following onsite power systems supply electrical power to the auxiliary electrical loads for the unit:

a. the unit auxiliary a-c power system,

b. the unit Class 1E a-c power system,

c. the unit auxiliary d-c power system, and

d. the unit Class 1E d-c power system.

The instrument power system and the low voltage a-c power system derive their power from the above, they are subsets of those systems. The unit auxiliary a-c, the unit auxiliary d-c, and portions of the instrument power system and low voltage power system are not Class 1E and are described here only in sufficient detail to permit an understanding of their interactions with the unit's Class 1E systems.

The design of the electrical control circuits for all safety related equipment precludes the inadvertent disabling of a component by racking out the circuit breakers for a different component on an intersystem or interchannel basis. This condition is not prohibited provided that equipment in no more than one division is affected at any given time. (Q&R 040.5)

8.3.1 A-C Power Systems

8.3.1.1 Description

The Class 1E and non-Class 1E power distribution systems are shown in simplified form in Drawings E02-1AP03, E02-1RP99 and 762E298AC.

8.3.1.1.1 Unit Auxiliary A-C Power System

The loads served by the unit auxiliary a-c power system are those loads which are classified non-Class 1E. 6900-V switchgear cubicles and 480-Vac motor control centers which feed non-Class 1E loads located within the containment are qualified as Class 1E (for protection of containment electrical penetrations) but are not required to furnish power under accident conditions.

The major components of the unit auxiliary a-c power system are:

a. unit auxiliary transformers (UAT) 1A and 1B,

b. reserve auxiliary transformer (RAT) A, B, and C,

c. 6900-V switchgear 1A and 1B,

d. 4160-V switchgear 1A and 1B,

e. 480-Vac unit substations,

f. 480-Vac motor control centers,

g. 480/277-Vac lighting distribution cabinets,

h. uninterruptible power supplies 1A and 1B, and

i. static var compensators (SVC).

The primary 6900-V and 4160-V power sources for the unit auxiliary a-c power system are the two UAT's associated with the unit. Each UAT is rated 22.4/29.9/37.4 MVA OA/FA/FA, 65°C rise. Each UAT is nominally sized to carry one-half of the full-load requirements of the unit. Each UAT is connected by cable to the main generator bus duct. The cable is sized to carry the full load of the transformer winding to which it is connected.

The secondary source of unit auxiliary a-c power is the three RATs, A, B, and C. Each RAT is rated 20/26.7/33.3MVA at OA/FA/FA 65 C° rise. RAT A feeds the 6900-V switchgear buses and is sized to carry the startup load of the unit from these buses. RAT B feeds the 4160-V Class 1E Buses 1A1, 1B1, and 1C1 along with 4160-V non-Class 1E Bus 1A, and is sized to carry the startup and running load for these buses as well as the total coincidental LOCA load for the unit. RAT C feeds the 4160-V non-Class 1E Bus 1B and is sized to carry the startup and running load of this bus. All three RATs are connected to the 345-kV switchyard through individual high side disconnects by a common overhead transmission line

Both the UAT's and RAT's are connected to 4160-V and 6900-V switchgear by bus duct. The main bus duct connections to the 4160-V and 6900-V windings of the transformers are sized to carry the full load of the transformer windings. Each branch connection from the main bus duct to 4160-V and 6900-V switchgear is sized to carry a load equal to the maximum switchgear continuous rating.

The RATs secondary leads are outdoor and indoor nonsegregated buses which distribute to the Class 1E and non-Class 1E buses, and main indoor run being located in the Turbine and Radwaste Buildings. The RAT SVC bus is exposed outdoor tubular bus. The bus is protected from surges by the existing 345-kV overhead static lines and towers. The Generator Main Transformer connections are Isolated Phase buses located at the opposite end of the Turbine Building with the Unit Auxiliary Transformer connections in underground concrete encased duct runs separate from the ERAT duct run. (Q&R 430.104)

When the unit is synchronized to the system and carrying load, the preferred configuration is to have the UAT's as the primary source (from the generator) of balance of plant load and the system (RAT) breakers (secondary source) open.

The main power transformer bank is rated 1425 MVA, FOA, 65°C rise. Maximum loading supplied to the Main Power Transformer bank is below the rated value.

Normally, when the unit is not synchronized to the system, the system breakers will provide power for balance of plant loads. The primary source (UAT) breakers will be open, unless they are closed to allow generator backfeed while shutdown.

In order to assure available sources of offsite power with the unit offline, a Static Var Compensator (SVC) is connected by redundant breakers to the 4160-V side of the RAT B and ERAT. Each SVC is rated at +28.5/-14.0 MVAR and includes a thyristor controlled reactor bank rated at 21.5 MVAR, a thyristor -switched capacitor bank rated at 21.0 MVAR, and a harmonic filter bank rated at 7.5 MVAR. The SVCs are shown on Drawings M01-1103-1 and E02-1AP03. The filter bank is always connected to the 4160-V bus whenever the SVC output breakers are closed and provides a capacitive 7.5 MVAR supply. The SVC normally maintains operation in the lower inductive range, typically 0-7 MVAR inductive, in order for the SVC to retain its full capacitive range in reserve to counteract large system voltage drops and/or motor starting.

Both ERAT and RAT B transformers have an open phase protection relay to sense and protect from the loss of any combination of phases from their respective offsite source connection. Upon a detected open phase condition a MCR alarm alerts the operator. Operator procedures are established to determine extent of open phase condition and actions to follow to protect safety-related busses.

For single plant operation the loads are all within the capabilities of the respective transformers for the following four plant conditions: startup, full power operation, LOCA, and shutdown. (Q&R 430.101)

The uninterruptible power supply (UPS) system serves 120-Vac single phase non-Class 1E instrument and control loads which require an uninterruptible source of power. Major loads on the UPS are the Plant Process Computer (PPCS) Compoments.

The principal components of each UPS are an inverter, static transfer switch, regulating transformer, and a fused distribution panel. The unit has two non-divisional UPS's.

The primary source of power to each UPS is from a non-Class 1E d-c MCC which is fed from a battery charger or battery. Upon loss of this source, power is automatically transferred by the static transfer switch to the alternate source which is fed from a non-Class 1E a-c motor control center. A manual bypass switch is also provided to allow the manual selection of either source.

8.3.1.1.2 Unit Class 1E A-C Power System

The loads served by the unit Class 1E a-c power system include all Class 1E a-c loads. Division 1 and 2 Class 1E power systems each provide a source of power to two 480-Vac unit substations.

Class 1E loads required for LOCA are shown in Table 8.3-13 for Divisions 1, 2 and 3.

The Class 1E components of the unit are assigned to three electrically and physically independent divisions as follows:

Division 1	Division 2	Division 3
Diesel Generator 1A	Diesel Generator 1B	Diesel Generator 1C
4160-V Bus 1A1	4160-V Bus 1B1	4160-V Bus 1C1
480-Vac Unit Subs 1A, A	480-Vac Unit Subs 1B, B	480-Vac HPCS Transformer 1C
Aux. Bldg MCC's 1A1, 1A2, 1A3, 1A4	Aux. Bldg MCC's 1B1, 1B2, 1B3, 1B4	Aux. Bldg MCC's 1C1
Shutdown Service Water MCC 1A	Shutdown Service Water MCC 1B	Shutdown Service Water MCC 1C
Diesel Generator MCC 1A	Diesel Generator MCC 1B	HPCS MCC 1C
Cont. Bldg. MCC's E1, E2, G	Cont. Bldg MCC's F1, F2, H	
Damper MCC A	Damper MCC B	

Class 1E loads with redundant safety functions are assigned to different divisions.

An offsite 4160-V source of power for the unit Class 1E a-c power system is the RAT B. It is connected by bus duct to Divisions 1, 2, and 3 4160-V switchgear buses. The main bus duct to the 4160-V winding is sized to carry the full rating of that transformer winding. Each branch bus duct is sized to carry a load equal to the maximum switchgear continuous rating. A static var compensator maintains acceptable voltages to the 4160-V switchgear buses under all postulated degraded grid conditions.

A second offsite 4160-V source of power for the unit Class 1E a-c power system is the ERAT. It is connected by cable and bus duct to Divisions 1, 2, and 3 4160-V switchgear buses. A static var compensator maintains acceptable voltages to the 4160-V switchgear buses under all postulated degraded grid conditions. The RAT B and ERAT are functionally equivalent in their ability to support Class 1E power requirements. The Class 1E buses have a nominal rating of 4160-Vac. The maximum steady state Class 1E bus voltage is 4300-Vac. Operation above 4300-Vac but less than 4454-Vac is allowed for 30 minutes.

ERAT secondary leads are underground in a concrete encased duct run connected to non-segregated bus duct, then are run to the Control Building termination for the nonsegregated bus connection, which then distributes to the Class 1E buses, the main run being located in the Control and Auxiliary Buildings . The ERAT Cables are designed for wet locations normally encountered in duct runs. (Q&R 430.104) The ERAT SVC bus is exposed outdoor tubular bus. Two static shield poles have been installed in the SVC switchyard to protect the 4160-V bus against surges. Also, two static shield poles have been added to the SVC disconnect switch located at the ERAT LTC.

The onsite 4160-V power sources for the unit Class 1E a-c power system are diesel generators, one for each of the three divisions.

The unit Class 1E a-c power systems have the following operating configurations (refer to Drawing E02-1AP03 for disconnect switch numbering)

a. No Transformer Outages - For this case, the preferred configuration is to have 4160-V disconnect switches RT14 and ET4 closed; switches ET14 and RT4 open. Thus, the offsite sources of power to the unit Class 1E power system are RAT B and the ERAT.

b. Reserve Auxiliary Transformer Outage - For this case, the configuration is to have 4160-V disconnect switch ET4 closed; switches ET14 and RT14 open. Thus, the offsite source of power to the unit Class 1E power system is the ERAT.

c. Emergency Reserve Auxiliary Transformer Outage - The configuration for this case is to have 4160-V disconnect switch RT14 closed; switches ET4 and ET14 open.

The first level of under voltage relays are set at approximately 69% of 4160-V (time dial 2) for Divisions 1 and 2. A similar characteristic for Division 3 has been created using instantaneous undervoltage relays with a timer. The Division 3 setting is approximately 60% of 4160-V. Spurious transfers are precluded by the 69% setting (Divisions 1 and 2) and 60% (Division 3), which is sufficiently lower than the minimum transient voltages that occur while starting motors from the offsite or onsite sources.

Load shedding for Divisions 1 & 2 is initiated by loss of voltage at the 4160-V ESF Buses. During a Loss of Offsite Power, the loss of voltage at the ESF Buses sheds the loads and starts the diesel generator. After each diesel generator has accelerated to approxmiately rated frequency and attained approximately rated voltage, its feeder breaker will close if normal a-c power has not been restored to either of the offsite sources. The voltage at the ESF Buses resets the load shedding scheme and the loads are sequenced onto the ESF bus.

An independent second level of undervoltage protection is provided at 4160-V Class 1E buses 1A1, 1B1, and 1C1. Class 1E buses 1A1, 1B1, and 1C1 have a second level under voltage scheme that utilizes two undervoltage relays; one sensing voltage across A-B phase, and the other across B-C phase. The output contacts of all the second level of undervoltage relays are wired in series requiring both relays for a bus to be picked up before a timer starts. Once the undervoltage relays indicate degraded voltage causing the 15-second time delay relay to time out, the system automatically trips the offsite sources causing load shedding and the "slow" transfer to the onsite power source.

All undervoltage, time delay and auxiliary relays used in the scheme are qualified for Class 1E use and are located at the respective Class 1E 4160-V buses.

A voltmeter in the control room piloted from the same set of potential transformers as the second level undervoltage relays allows the control room operator to determine the undervoltage sensing PT's voltage output during power operation.

Test switches allow the relay operation to be verified during full power operation. This is accomplished by opening the test switches or lifting a lead and observing that the relay operates on loss of voltage. Since all undervoltage relays on the bus are required to operate before automatic transfer is initiated, testing of one relay will not cause spurious transfer of the system to the onsite source during the relay check during power operation.

There are no bypasses incorporated in the design, consequently, no bypass annunciation is provided in the control room. CPS Technical Specifications include the information concerning limiting conditions for operations, surveillance requirements, and pickup and dropout allowable values for the second-level voltage protection sensors and associated time delay devices required by STS as applicable to Clinton. The pickup trip and dropout setpoints with maximum and minimum limits are in the Operational Requirements Manual (ORM).

The starting time of the largest 1E motor, with offsite voltage at the minimum expected value, is approximately 10 seconds or less. Based on this information, the timer is set at 15 seconds. Motor starting time has been verified. After this timer has timed out, the loads will automatically transfer to the onsite power source. Instrumentation and controls will not be damaged by this degraded voltage for this short time period.

The basis for establishing the setpoints of these relays is to select a voltage high enough at the 4160 V level to ensure all Class 1E equipment down to the 120-Vac level will start and continue to operate properly while minimizing the possibility of spurious transfer to the diesel generators.

The minimum expected voltages at the 4160-V level were determined by a voltage analysis that determined the voltage levels at the 4160-V and 480-Vac Class 1E buses for maximum and minimum level conditions expected for the anticipated voltage range of the offsite sources. All three RATs and the ERAT have onload tap changing capability. For the ERAT, the number of effective primary windings can be varied over a range of 1.06 pu to 0.81 pu by a load tap changer (LTC) mounted on the ERAT to provide a consistent 4160-V output. The LTC is only operated manually. When operated manually, an operator can make tap changes locally at the ERAT, and the changes may be made with the ERAT in service.

For RAT B, the secondary winding taps can be varied over a range of 1.04 PU to 0.77 PU with an LTC mounted on the RAT B to provide a consistent secondary voltage output. The LTC is only operated manually. When operated manually, an operator can make tap changes locally at RAT B with the transformer in service.

After performing an extensive voltage analysis to determine the most voltage-sensitive element at each voltage level, it was determined that the selection of the second level undervoltage relay setpoint is governed by the minimum acceptable voltage at the following equipment:

a. Certain devices at the 120-Vac level that require a minimum pickup operating voltage at the relay terminals.

b. 480- to 120-Vac regulating transformers that among other things supply control power to the solid state NSPS control system.

c. Continuous duty motors at 460-Vac can continuously operate at + 10% of 460-Vac.

From the equipment critical voltage analysis, it was determined that a minimum of 4084-V at the 4160-V buses will prevent the voltage at the equipment terminals of the above items from falling below their minimum acceptable voltage levels for equipment protection, starting and continued operation. Degraded voltage for motor operated valves has been properly considered in evaluating motor operated valve capability under NRC Generic Letter 89-10.

Based on setpoint calculations, a relay pickup setting was selected that allows sufficient margin between the minimum expected offsite voltage and the minimum required voltage at the 4160-V buses in conjunction with SVC operation.

When no offsite power is available, the operating configuration is to have the diesel generators as the source of power to the Class 1E power system.

The transfer of a 4160-V Class 1E bus from one source (RAT B to ERAT, etc.) to another can occur by: (a) manual transfer, (b) automatic fast transfer, or (c) automatic slow transfer (after loads have been shed).

The procedure for manually transferring a bus from one source to another is as follows:

a. Turn the incoming breaker synchronizing switch to ON

b. Verify synchronism or bring the incoming source into synchronism (if a diesel generator) with the bus and adjust the incoming voltage to nominally match the bus voltage.

c. Turn the incoming breaker control switch to CLOSE.

d. Once the incoming breaker closes, release the incoming breaker control switch to NORMAL. The outgoing breaker is tripped automatically as a result of the release action. This prevents continuous operation with two offsite sources in parallel. If the incoming source is the diesel generator, however, the other breaker will not trip, thus allowing the parallel operation of the diesel generator and an offsite source (for testing only). Applicable Diesel Generator and support systems (DG) Operating Procedures prevents the parallel operation of more than one diesel generator at a time with an offsite source (for testing only). If, while the diesel generator is being tested, a LOCA signal appears, and an offsite source is connected to the bus, the diesel-generator source breaker will be tripped. The diesel generator control will then return to automatic mode.

The circulating current through the incoming and outgoing sources (ERAT and RAT B) has been calculated assuming the maximum expected voltage magnitude difference and the maximum expected phase angle difference. Based on design relay settings, the sources can be operated in parallel under the assumed condition for approximately 5 seconds before any breaker would trip. This is sufficient time for the operator to release the incoming breaker switch, thus disconnecting the outgoing source. (Q&R 430.110)

Automatic fast offsite source transfer (i.e., automatic fast closing of a source breaker) of a bus occurs if the following conditions are fulfilled:

a. All source breakers become open as a result of the present source breaker opening on its feeder bus "fast" lockout protection actuation.

b. The other source is "available" to the bus at the instant all source breakers become open.

c. The synchronism checking relay permits closure.

If both RAT B and ERAT source breakers are available to the bus, the reserve transformer source will have closing priority.

Automatic fast closing of the diesel-generator source breaker is not employed.

Manual operator action is required to transfer from the diesel generator to the offsite sources.

Following a slow transfer LOCA loads are not sequenced to the RAT B or ERAT.

The Class 1E 4160-V ESF loads are sequenced only for operation from their divisional diesel generators. (Q&R 430.106)

Automatic slow source transfer of a bus occurs if the following conditions are fulfilled:

a. All source breakers are open for any reason.

b. Fast source transfer has not resulted due to bus protective action or source availability at the instant all source breakers became open.

c. A source becomes "available" to the bus after the bus undervoltage relays have tripped all bus breakers feeding motor services (e.g., diesel generator becomes ready to accept the load, or an auxiliary transformer is re-energized by its respective offsite source).

If several sources become available to the bus after the motor loads are shed due to bus undervoltage, the breaker for the source that becomes available first is closed. If several sources become "available to the bus" at the same instant, the reserve transformer source breaker will have first preference and the ERAT will have second preference.

A source is available to the bus if the following conditions have been met:

a. The breaker is in the operate position.

b. Closing and tripping d-c control power for the breaker is available.

c. The breaker control switch is not in the PULL TO LOCK position.

d. There is sufficient voltage on the source side of the breaker.

e. The source (bus, transformer, or generator) lockout relay is not tripped.

f. Neither of the overcurrent lockout relays for the main and reserve feed breakers are tripped (applies to the closing of main and reserve feed breakers only).

g. The second level undervoltage timing relay has not been actuated.

If an offsite source is not available, an alarm appears on the annunciator in the main control room.

The power circuits are designed with protective devices and systems to: (a) disconnect circuit faults from power sources, (b) disconnect the faulted component with minimum disturbance to the unfaulted portions of the system, and (c) secure the system from false disconnecting operations for any anticipated normal event.

Tables 8.3-1 and 8.3-2 list the 4160-V circuit protective devices and their actions for various faults.

Devices fed from 480-Vac unit substations also have instantaneous and time overcurrent protection that is applied in accordance with latest industry practice.

Devices such as motors fed from motor control centers are protected by circuit breakers and thermal overload devices. Overload protection of Class 1E motor-operated valves is continuously bypassed with the exception that it may be placed into service for short periods of time during valve maintenance, testing, and repositioning during normal plant operation.

Each division of the unit Class 1E a-c power system has a diesel generator which serves as an independent onsite power source in the unlikely event that both offsite power sources are lost simultaneously.

The diesel generators are rated as indicated in Table 8.3-3. The 2000-hour ratings of the diesel generators are greater than the maximum coincidental LOCA or shutdown load expected.

There are two diesel engines which drive a common generator for each of the diesel-generator sets 1A and 1B.

The starting systems for the diesel engines are described in Subsection 9.5.6.

High-resistance grounding method has been employed in the diesel generator power system design because of the importance of detecting small ground faults and the possible need to keep the entire system operable with a ground fault in existence.

In the event of loss of both normal sources of power (reserve and emergency reserve transformers) to the Class 1E a-c power system, each diesel-generator set is automatically started and loaded by controls and circuitry which are independent of that used to start and load the redundant buses. The starting circuitry and control power is provided by a 125-Vdc battery for each division load group. The diesel-generator automatic starting and loading will proceed as follows:

a. Each diesel generator is automatically started by one of the following events:

    1. associated bus voltage and both offsite power source voltages below the preset values; or

    2. reactor low water level (Subsection 7.3.2); or

    3. high drywell pressure (Subsection 7.3.2); or

    4. associated bus second level under-voltage below the preset values (degraded voltage condition).

b. Upon loss of voltage at the 4160-V division buses, all 4-kV motor loads on the Division 1 and Division 2 buses will be shed. Division 3 loads are not shed following a loss of bus voltage.

c. After each diesel-generator set has accelerated to approximately rated frequency and voltage, its breaker will close if normal a-c power has not been restored to either of the other sources. A small amount of 480-Vac MCC load will be applied immediately when the circuit breaker closes.

d. If normal a-c power is still present and the diesel generator was started by signals indicated in Items a.2 or a.3, the diesel-generator breaker will not close, and the set will remain unconnected at rated frequency and voltage until manually shut down.

e. If normal a-c power is lost and signals indicated in Items a.2 and a.3 are not present, all loads will be connected automatically or manually by the operator's action as station conditions require.

f. If, while operating as per Item e, a LOCA signal is received, any nonemergency load that is running will be automatically tripped, and the required Class 1E loads will be started automatically.

g. The sequential starting of Class 1E loads will take place as shown in Table 8.3-13 for Division 1, 2 and 3 as required.

Table 8.3-13 delineates the size and, sequence time of Class 1E loads on Divisions 1, 2 and 3 standby power supplies.

Site calculations evaluate the total starting and running KVA per time sequence per division. For details, refer to the current revision of calculation EAD-DG-1.

h. During sustained low grid voltage conditions which cause Class 1E equipment to operate at voltages outside their recommended continuous operating limits, a second level of relays is provided which will automatically disconnect offsite power sources and start diesel generators whenever the voltage setpoint and time delay limits have been exceeded.

After each diesel generator has accelerated to approximately rated frequency and attained approximately rated voltage, its feeder breaker will close if normal a-c power has not been restored to either of the offsite sources.

Each diesel generator unit is operated within the TS limits of 4084-V to 4300-V.

Additional interlocks prevent automatic closure of the diesel generator breaker (after an automatic start) unless the normal and reserve source breakers are open.

All control circuits and their components including the bus transfer system are provided with means for manual testing during normal station operation and will meet IEEE 279 criteria.

Each diesel generator is capable of being started or stopped manually from the control room as well as from local control panels near the engines.

The Division I and II diesel generators have local handswitches which allow the operation of the diesel generators at idle speed, approximately 400 RPM. This is done to reduce wear on the diesel generators when performing maintenance or surveillance which does not require normal speed (900 RPM) operation. The idle operation of the diesel generator will not excite the generator's exciter field. The diesel generator will still be operable when operating in the idle mode since an automatic start signal [LOCA or LOOP] will bypass the idle operation feature and cause the diesel generator to accelerate to the normal speed with generator excitation.

Table 8.3-4 shows the protective and supervisory functions for Divisions 1 and 2 diesel generators. Division 3 diesel generator functions are described in Table 8.3-18. All Divisions 1 and 2 diesel generator trips are bypassed on LOCA except the generator differential and engine overspeed protective trips. A failure of a diesel generator to start (overcrank) will lock out the control logic under all conditions.

All alarms delineated in Table 8.3-4 are annunciated in the control room on its individual or common window.

With the exception of the "normal/inoperable" switches 1HS-DG836 and 1HS-DG838 (Divisions 1 and 2, respectively), the single annunciators are local and are located on the Diesel Generator Control panels 1PL12JA and 1PL12JB, which are located in the Diesel Generator rooms. (Q&R 430.102)

Those conditions which render the diesel generator incapable of responding to an automatic emergency start are grouped in the window "Diesel Generator (X) Out of Service," “Diesel Generator (X) Tripped,” and “Diesel Generator (X) Not in Auto Start Mode”. Additionally, certain conditions which actuate window “Diesel Generator (X) Trouble” may also cause the diesel generator to trip and render the diesel generator unavailable for auto restart on loss of offsite power (LOOP) and test modes.

The following conditions render the Division 3 diesel generator incapable of responding to an automatic emergency start signal:

a. Diesel generator lockout relay not reset.

b. Diesel Engine control switch not in Auto position.

c. Regulator selector switch not in Auto position.

d. Engine Safety Shutdown circuit not reset.

e. Loss of d-c power to diesel generator controls.

f. Diesel generator output breaker in racked-out position.

g. Loss of d-c power to diesel generator output breaker control.

All of the above have a common alarm at the control room "HPCS Not Ready for Auto Start Breaker in Lower Position."

The following alarms are provided at the Division 3 local panel which in turn provides an alarm, "Trouble Diesel Gen. 1C" annunciation in the main control room.

1. Fail to Start/Run (Overcrank)
2. Overspeed
3. Low Fuel Level
4. Crankcase Pressure High
5. High Lube Oil Temperature
6. High Water Temperature
7. Charger Failure
8. Low Starting Air Pressure
9. Engine Tripped
10. Main Fuel Pump Failure
11. Low Lube Oil Temperature
12. Low Expansion Tank Water Level
13. Control Power Failure
14. Low Lube Oil Level
15. Reserve Fuel Pump Failure
16. Low Lube Oil Pressure
17. Low Cooling Water Pressure
18. 125V DC Ground
19. Low Circulating Oil Pump Pressure
20. Restricted Fuel Oil Filter
21. Restricted Lube Oil Filter

Table 8.3-18 shows the protective and supervisory functions for Division III diesel generator. All Division III diesel generator protective trips except generator differential and engine overspeed are bypassed on LOCA. A failure of the Division III diesel generator to start (overcrank) will lockout the control logic under all conditions except LOCA.

All conditions that render the diesel generators "inoperable" (i.e., unable to respond to an automatic emergency start signal) are annunciated in the control room. (Q&R 040.9)

Heavy-duty, turbocharger gears have been installed on Division 1, 2 and 3 diesel generators prior to the end of the first plant refueling. (Q&R 040.19)

Operators and selected supervisory personnel have received training on the diesel generators as a part of the cold license training program. In addition, these personnel have received training and experience through assisting vendor representatives and startup engineers during preoperational testing of the diesel generators. Selected maintenance personnel have received vendor training, and this training was incorporated into maintenance department training. Maintenance on diesel generators was performed or directly supervised by personnel who have received this training. Ongoing training includes the requalification training program required by 10CFR55 for operational personnel, and maintenance departmental training for maintenance personnel.

Efficient utilization of manpower precludes dedicating any personnel solely to the operation and maintenance of diesel generators. Since remote operation of diesel generators is normally performed by licensed operators and local operation is normally performed by non-licensed operators, personnel in these categories met the respective education and experience requirements of ANS 3.1-1978. Similarly, maintenance personnel meet the education and experience requirements of ANS 3.1-1978 for technicians or maintenance personnel.

The diesel generators are covered by the operational quality assurance program which meets the applicable requirements of ANSI-N18.7 (1976) as endorsed by Regulatory Guide 1.33, Rev. 2, Feb. 1978.

Quality Assurance personnel have been given training as required by ANSI-N45.2.12 (1977) as endorsed by Regulatory 1.144, Rev. 0, Jan. 1979. Personnel selected for quality assurance auditing assignments have experience or training commensurate with the scope, complexity or special nature of the activities to be audited. (Q&R 040.20)

Clinton Power Station recognizes the need for periodic testing coupled with good preventative maintenance practices.

1. Whenever possible, the diesel generators are loaded to 25% or more during periodic testing. Trouble shooting system failures may require operation at less than 25% load. This type of operation will be minimized.

2. Surveillance testing is conducted in accordance with CPS Technical Specifications.

3. Diesel generator component malfunctions that affect diesel generator operability will initiate an investigation that will include a review of previous occurrences and recommendations for permanent corrective actions. Further, CPS is utilizing the Equipment Performance and Information Exchange System (EPIX) as an aid in evaluating industry history for diesel generator component failure. These activities are governed by station administrative procedures. CPS also reviews operating experience from other utilities to aid in identifying problems.

4. Normal maintenance procedures require a visual inspection following maintenance to insure that test equipment is accounted for, fuses are in place and switches are in the correct position. Station procedures insure that lifted leads are replaced and that breakers and valves are returned to the correct position. (Q&R 040.21)

The diesel generator control devices, including relay contacts for alarms and instruments which require setpoint calibrations, are located on a free-standing, floor-mounted panel separate from the engine skids. The only instruments located on the engine skid are the engine sensing devices and sensing device gauges, or the engine gauge panel, which, except for the governor overspeed lockout, perform no safety-related function. Various owners of Stewart and Stevenson equipment have completed a testing program with Stewart and Stevenson for qualification of Class 1E electrical components to IEEE 323-1974. Non-1E instrumentation are shown by failure analysis not to impact on the availability of 1E components. The results of this test in regard to vibration analysis of skidmounted instrumentation were provided when available.

Corrective actions that were required as a result of the test program analysis have been implemented. (Q&R 040.22)

The fuel oil storage and transfer systems are described in Subsection 9.5.4; the lubrication systems are described in Subsection 9.5.7; and, the cooling systems are described in Subsection 9.5.5.

If a Division 1 or Division 2 diesel generator is automatically connected to its associated bus after the bus motor loads have been shed (automatic slow transfer), the bus loads (if required) are sequentially started. This sequence will keep the bus voltage and frequency within the limits of Regulatory Guide 1.9. Sequence times between source breaker closure and service breaker closures are shown in Table 8.3-13. Division 3 loads are not shed following a loss of bus voltage, nor are they sequenced following a restoration of bus voltage.

All 4160-V loads for ESF Divisions 1 and 2 are tripped on loss of bus voltage, except feeders to 480-Vac Unit Substations A, B, 1A, and 1B. Drywell Chillers (1VP04CA and 1VP04CB) and Fuel Pool Cooling Pumps (1FC02PA and 1FC02PB) are not automatically restarted after bus load shedding occurs, but require manual operator action to energize. The LPCS pump motor and the Residual Heat Removal pump "C" motor do not utilize timers.

The remaining loads on these buses are the Shutdown Service Water Pumps (1SX01PA and 1SX01PB). and Residual Heat Removal Pumps A and B (1E12-C002A, 1E12-C002B). After restoration of bus voltage, these motors are each sequenced on their respective divisional buses by electrically independent class 1E timers (if required).

Each Shutdown Service Water Pump utilizes a timer located in its respective switchgear cubicle (Cubicle 1AP07ED for 1SX01PA and Cubicle 1AP09EG for 1SX01PB).

The RHR pump motors utilize independent Class 1E solid State timers at their respective divisional panels in the main control room (Division 1 is at 1H13-P661 and Division 2 is at 1H13-P662).

All timers on 480-Vac unit substations are located in the respective 480-Vac switchgear.

All timers are load independent and are qualified for Class 1E use.

The worst-case fault currents and corresponding interrupting capacities for the Class 1E switchgear, motor control centers, and 120-Vac/208-Vac distribution panels located in the motor control centers are presented in Table 8.3-19 (Q&R 430.108)

The worst-case full-load and fault currents, and capabilities for each of the 4160-V and 6900-V manually-operated disconnect switches are provided in Table 8.3-20.

References to ET24 and to connections between the two units are no longer pertinent because Unit 2 has been canceled. (Q&R 430.109)

Diesel generators are used only for emergencies and testing. They are not used for peaking during normal operation of the station.

Division 1 and 2 diesel generators have been qualified to the requirements of IEEE Standard 387-1977. A 24-hour, continuous test was run at CPS during preoperational testing. (Q&R 430.112)

A voltage and speed stability transient response test was conducted by the diesel generator manufacturer (at the factory) to verify that each of the diesel generators is capable of sequentially accepting all loads without the voltage ever falling below 75% of rated or frequency falling below 95% of rated.

Testing was repeated onsite during preoperational testing in accordance with Regulatory Guide 1.108, Regulatory Position C.2 (2). Periodic testing is conducted in accordance with the Technical Specifications.

Test results were sent to the NRC when they became available. (Q&R 430.114)

The loss of exciter voltage sensing (due to inadvertent operator action) interlock has been removed completely. Before, diesel generator voltage was sensed at the 4160-V switchgear by 4160-V to 120-Vac potential transformers (PT) located at the switchgear. Therefore, due to the inherent design of the switchgear, anyone opening the PT cubicle at the switchgear would disconnect the PT fuses. Since this would result in the excitation system reading 0 volts when in fact the diesel generator voltage was at nominal, the exciter breaker was interlocked to trip when the PT fuses were disconnected. This design has been abandoned and presently the excitation voltage is sensed via PT's at the diesel generator transformer panel contiguous to the diesel generator. This panel does not have a door interlock which disconnects PT fuses when the door is opened.

See Table 8.3-4 and Position C.8 of Regulatory Guide 1.9 in Subsection 8.3.1.2.2 for a description of all Division 1 and 2 diesel generator trips, including generator differential, overcrank and engine overspeed which are not bypassed on LOCA. (Q&R 430.115)

The testing described in Chapter 14 for the Division 1 & 2 diesel generators is intended to meet Regulatory Guide 1.108, with exception of paragraph 7 of the Regulatory Guide which addresses transferring of fuel oil from one supply to another. In regard to this item we meet the intent of the Regulatory Guide. Each diesel supply tank is sized to supply 7 days of maximum post demand loads. Subsection 9.5.4.1 addresses the capacity of the fuel oil system.

As stated in Chapter One of the USAR, CPS has committed to meeting the requirements of Regulatory Guide 1.108. The diesel generator preoperational test procedures were delineated in detail to fulfill the requirements of 1.108. (Q&R 430.123)

Diesel generators are used only for emergencies and testing. They are not used for peaking during normal operation of the station.

The diesel generators operate unloaded only during a LOCA when offsite power is available. They can operate for four (4) hours in a no-load condition without reducing the engine availability. By operating procedure, during extended periods of standby operation at synchronous speeds, the diesel generators will be paralleled one at a time with offsite power (test mode) and loaded to 40% of their rated load for a period of 30 minutes to remove excess fuel deposits from the exhaust ports. (Q&R 040.45) While the Divisions 1 and 2 diesel generators are in the test mode, diesel generator lockout is precluded for overloads on subsequent loss of offsite power. The design of Division 3 is as follows:

Periodic testing of the HPCS Diesel Generator is performed from the control room by manual initiation or simulation of LOCA. This testing does not impair the capability of starting the HPCS pump within the required time. The test controls are overridden by the LOCA event, except as described in Subsections 8.3.1.1.2.1 and 8.3.1.2.2.

The local Engine Control Switch is usually in the automatic position to allow operation and periodic testing from the control room. The local engine control switch also provides a maintenance and test position. The maintenance position places the HPCS diesel generator in "out of service". The test position is used only for test after maintenance prior to transferring to automatic operation. The LOCA signal will not start the engine when the engine control switch is in the test position.

The following information is historical:

The diesel-generator sets selected are qualified in accordance with Regulatory Guides 1.6 and 1.9 as follows:

a. At least two tests were performed on each diesel generator not previously qualified to demonstrate the start and load capability of these units with some margin in excess of the design margin.

b. Prior to initial fuel loading, a total of 300 start and load tests were performed on each diesel generator.

The start and load test consists of 270 starts from warm standby conditions and 30 tests from normal operating temperatures with loading to at least 50% of the nameplate continuous rating within the requested time interval and continued operation until temperature equilibrium is attained.

c. Further testing will be performed if the failure rate is greater than one per hundred.

Qualification of the diesel generators is per the requirements of IEEE 344, Regulatory Guide 1.100 and 10 CFR 50.49.

The Class 1E a-c power system is designed to permit inspection and testing of all important areas and features, especially those whose operation is not normally demonstrated. As detailed in the CPS Technical Specifications, periodic component tests are supplemented by extensive functional tests during refueling outages, the latter based on actual accident simulated conditions. These tests demonstrate the operability of diesel generator, station battery system components, and logic systems, and thereby verify the continuity of the systems and the operation of components.

8.3.1.1.2.1 High-Pressure Core Spray System (HPCS) Power System

The HPCS power supply system is self-contained except for the initiation signal source and access to both offsite power sources through the plant a-c power distribution system. It has a dedicated diesel generator and is operable as an isolated system independent of electrical connection to any other system. The standby auxiliary equipment such as heaters, air compressor, and battery charger are supplied from the same power source as the HPCS motor. Voltage and frequency of the HPCS diesel generator is compatible with that available from the plant a-c power system.

The General Electric HPCS system power supply unit Licensing Topical Report, NEDO 10905, gives the starting and accelerating characteristics of the diesel generator set with the various loads in the proper sequence. Although the voltage and frequency characteristics do not meet NRC Regulatory Guide 1.9, justification for this is given because of the unique requirements of the system. The HPCS diesel generator is unique in that its load is composed predominantly of one large motor whose horsepower is approximately the same as the diesel-engine. The analytical results from a digital dynamics stability program, and prototype tests performed, demonstrate the capability of the diesel-generator and of the equipment associated with the system to meet all necessary requirements. The NRC has previously accepted this analysis which is contained in the NEDO 10905 document. (Q&R 040.15)

The safety related motors are designed to operate continuously when voltage at the terminals is within plus or minus 10% of the motor nameplate rating. These motors can also deliver their full load torque without damage when the voltage at the terminal drops to 75% for infrequent one-minute intervals.

The starting sequence provides for containing HPCS diesel generator voltage drops down to 62% of rated voltage. This dip in voltage lasts for 1 second and would recover to 75% volts after this time frame. This time frame is short enough to prevent the loss of flux to the field. Therefore no motor damage or malfunction will occur and the present supply to the motor is adequate. A similar motor is being utilized at LaSalle and other plants and performance is covered by NEDO 10905 and is accepted by the NRC. (Q&R 040.16)

The Division 3 HPCS diesel generator is capable of starting the HPCS motor within the required time in accordance with NED0-10905 although voltage and frequency drop will exceed the limits specified in NRC Regulatory Guide 1.9.

In addition, and as also stated in Subsection 8.3.1.2.2, the HPCS diesel generator design includes override capability to ensure automatic switchover from the test mode to ready-to-load operation upon receipt of a LOCA initiation signal consistent with the requirements of IEEE 308 and 387. However, the HPCS diesel generator is equipped with a mechanical governor that operates only in a droop mode. Normally, the droop setting is set to zero, but during testing (i.e., while the diesel generator is in the test mode) a non-zero droop setting may be utilized to support paralleling the diesel generator with the offsite power source. Under such conditions, the droop may be set such that, if a LOCA initiation signal were received concurrent with no offsite power available to the Division 3 bus, operator action may be required to reset the governor and thus ensure bus frequency is within required limits when the diesel generator alone is supplying power to the bus.

The droop mode, as described above, is utilized only during testing, and the potential need for operator action to reset the governor after receipt of a LOCA signal (concurrent with a loss of offsite power) exists only during that portion of the test when the diesel generator is unloaded or lightly loaded while paralleled to the offsite source. A risk assessment performed for this condition demonstrates that the associated risk is very small. On this basis, the Division 3 diesel generator design, with respect to automatic switchover capability from the test mode to ready-to-load operation, has been determined to be acceptable.

Mechanical safety trips recommended by the Division 3 diesel generator vendor and the electrical protective tripping scheme (identified on drawings E02-1HP99 sheets 101 through 114) are consistent with the Division 1 and 2 diesel generator tripping schemes and meet the requirements of Regulatory Guide 1.9. All trips except overspeed and generator differential are bypassed on a LOCA. (Q&R 040.14)

In this way, the diesel generator availability is fully assured during an offsite power loss.

8.3.1.1.3 Instrument Power System

The NSPS power supply is in full compliance with Regulatory Guide 1.75, and no deviations will be taken. The final NSPS power supply design was available by November of 1981. (Q&R 430.92)

The instrument power system consists of the following major components:

a. (4) - 120-Vac nuclear system protection system uninterruptible power supplies and buses.

b. (2) - 120-Vac nuclear system protection system RPS uninterruptible power supplies and buses.

c. (2) - 120-Vac computer uninterruptible power supplies.

d. (2) - 120-Vac BOP instrument buses (120-Vac MCC distribution panels with regulating transformers).

e. (3) - 120-Vac Class 1E instrument buses (120-Vac MCC distribution panels with regulating transformers).

The subsystem consisting of the (4) NSPS UPS's and associated buses, (divisional) the (2) RPS UPS's excluding associated buses, (nondivisional) and the (3) 120-Vac instrument buses are Class 1E. The remainder of the subsystems listed above are non-safety related.

Selected 120 volt Class 1E non-instrument loads requiring a regulated supply to ensure minimum required operating voltage are also supplied by the 120-Vac MCC distribution panels with regulating transformers.

8.3.1.1.3.1 NSPS Power Supply System

The Nuclear System Protection System (NSPS) power supply system is designed to provide essential power to the four channel divisional solid state protection system (which includes the engineering safety features actuation system) and the two channel non-divisional solid state protection system (which includes the reactor protection system and the nuclear steam supply shutoff system).

The principal elements of the NSPS power supply system are shown in Drawing E02-1RP99. For each unit, the divisional portion of the system includes four independent Class 1E 120-Vac uninterruptible power supplies (UPS) and their respective NSPS power buses. Each UPS consists of a battery charger, a station battery, an inverter, and a solid-state transfer switch. Alternate power is available to each NSPS power bus from a Class 1E power supply, step-down transformer, and isolation transformer. The solid state transfer switch is used to automatically transfer from preferred to alternate power in case of inverter failure. Also, 120-Vac can be supplied to the Division A and B NSPS buses by manual transfer to an inverter maintenance bypass feed. The UPS is powered by a Class 1E power supply. "Refer to USAR Section 7.2.1.1.3.1 for discussion and definition of an inverter failure."

Separate non-divisional Class 1E 120-Vac uninterruptible power supplies (UPS) are provided for. the reactor protection system "A" and "B" solenoids and the MSIV "A" and "B" solenoids. Each UPS consists of a battery charger, a station battery, an inverter, a manual bypass switch, and a non-divisional power distribution cabinet. The manual bypass switch is used to transfer from the preferred battery charger supply to the alternate power path in the case of inverter failure. The alternate power path originates from the same 480-Vac non-divisional source that the battery charger is powered from, but instead feeds a 480-Vac/120-Vac isolation regulating transformer which supplies 120-Vac to the UPS.

8.3.1.1.3.1.1 Components

Each of the four divisional NSPS power supplies includes the following components:

a. A power distribution cabinet, including the NSPS 120 Vac bus and circuit breakers for the individual loads.

b. A solid-state inverter, to convert 125-Vdc battery power to 120-Vac NSPS power.

c. A solid-state transfer switch to sense inverter failure and automatically switch to alternate power.

d. A 120-Vac/120-Vac isolation transformer to provide noise isolation for the alternate 120-Vac power supply.

e. A 480-Vac/120-Vac transformer for the alternate power supply.

Each of the two non-divisional Class 1E NSPS power supplies includes the following components:

a. A power distribution cabinet, including the 120-Vac non-divisional bus and circuit breakers for the individual loads.

b. A solid state inverter to convert 125-Vdc power to 120-Vac RPS power.

c. A 480-Vac/120-Vac transformer for the alternate power supply.

d. A manual bypass switch.

8.3.1.1.3.1.2 Sources

The Nuclear System Protection System power supply provides two types of power; divisional 120-Vac and nondivisional 120-Vac.

a. Divisional 120-Vac. Four divisional 120-Vac buses are provided. Each bus is fed by a 480-Vac divisional Class 1E power supply via two paths. The normal path is from an inverter, station battery, and battery charger. The alternate path is direct, through a step-down transformer and an isolation transformer.

b. Non-Divisional 120-Vac. Two non-divisional 120-Vac buses are provided. Each bus is fed by a 480-Vac non-divisional power supply via two paths. The normal path is from an inverter and station battery charger (with floating battery). The alternate path is direct, through a step-down isolation regulating transformer. These non-divisional 120-Vac buses, along with their inverters and regulating transformers, comprise the NSPS 120-Vac reactor protection system (RPS) power supplies. The RPS power supply system was designed and is maintained as a Class 1E system.

8.3.1.1.3.1.3 Operating Configuration

The four 120-Vac divisional power supplies operate independently, providing four divisions of uninterruptible Class 1E power for the nuclear system protection system. The normal lineup for each division is through a Class 1E 480-Vac power supply, the normal battery charger and the inverter. Transfer from the inverter, directly to the divisional a-c source is done automatically in case of inverter failure, or manually for maintenance or testing. Also, 120-Vac can be supplied to the Division A and B NSPS buses by manual transfer to an inverter maintenance bypass feed. Annunciation in the control room is provided for the following: UPS switched to the alternate source; UPS failure; and manual bypass. “Refer to USAR Section 7.2.1.1.3.1 for the discussion and definition of an inverter failure.”

The two nondivisional (Class 1E qualified) 120-Vac power supplies supply independent power to the "A" and "B" SCRAM solenoids and the "A" and "B" MSIV solenoids for isolation. Each nondivisional 120-Vac bus is normally lined up to the 480-Vac non-divisional power supply through the preferred battery charger and inverter path. Transfer to the alternate non-divisional power path is through the isolation transformer and is done manually in the case of inverter failure or for maintenance. Control room annunciation is provided to alert the operator of RPS solenoid inverter trouble.

8.3.1.1.4 Low Voltage Power System

The principal components of the Division I & II are several 480-208/120-Vac, three-phase, or 480-120/240-Vac single phase load distribution centers. These load distribution centers are located in motor control centers and are composed of a 480-Vac transformer feeder breaker, a transformer, and a circuit breaker distribution panel. Division III utilizes a 480-120-Vac regulating transformer located outside the MCC and a modular distribution panel with fuses inside the MCC. Load centers serving safety-related loads are located in and supplied from Class 1E motor control centers.

The loads served by this system are those 208-Vac, three-phase and 120-Vac or 240-Vac, single-phase control loads and low voltage power loads which do not require an uninterruptible source of power.

8.3.1.1.5 Motors

The NSSS and large non-NSSS supplied Class 1E motors have sufficient starting torque to accelerate the pumps to rated speed within 10 seconds at 75% of motor rated voltage. The diesel generator is sized such that, during the loading sequence, the voltage will not decrease below 75% of normal and will be restored to within 10% of nominal within the time constraints stated in Regulatory Guide 1.9.

The Class 1E motors of Motor-Operated-Valves (MOV's) are designed to open or close the valve against specified differential pressure, without damage, at 90% of rated voltage.

Division III (HPCS) Diesel Generator cannot maintain these limits during initial loading. This does not, however, reduce the reliability of the HPCS system.

The shutdown service water pump 1A and 1B motors have embedded RTD's in the stator windings which are input to the plant computer.

For the HPCS motor, the minimum difference between the motor torque and the pump torque at any given speed during acceleration is 10% of motor rated torque. The HPCS motor is provided with thermocouples on bearings and in windings to verify that temperature rise is acceptable.

Pump motors fed from the Class 1E, 4160-V buses are identified in Table 8.3-13 and include RHR (A/B/C), LPCS, Shutdown Service Water (A/B), Fuel Pool Cooling (A/B) and HPCS pumps. Automatic and manual operation of the pumps, and associated instrumentation, is described in the following subsections:

RHR - 6.3.2.2.4, 7.3.1.1.1.6
LPCS - 6.3.2.2.3, 7.3.1.1.1.5
HPCS - 6.3.2.2.1, 7.3.1.1.1.3
Shutdown Service Water - 7.3.1.1.5, 9.2.1.2
Fuel Pool Cooling - 7.6.1.9, 9.1.3

As discussed in the above listed subsections, HPCS, LPCS, RHR and Shutdown Service Water pump motors are automatically started by low reactor water level and/or high drywell pressure (LOCA) signals. In addition, Shutdown Service Water pumps are automatically started by a low system pressure signal. Control circuits for these pumps do not contain any process sensor permissives (e.g., suction pressure) which need to be satisfied for automatic or manual operation of the pumps in support of LOCA conditions.

Fuel Pool Cooling pumps are not automatically started. Refer to the above listed subsections for a discussion of Fuel Pool Cooling pump and system operation, including process permissive (suction pressure) interlock and redundancy/diversity. (Q&R 040.6)

8.3.1.2 Analysis

The following analyses demonstrate compliance with NRC General Design Criteria 17 and 18 and conformance with NRC Regulatory Guides 1.6, 1.9, and 1.32.

8.3.1.2.1 Compliance with NRC General Design Criteria

The Class 1E system is designed with sufficient capacity, independence, and redundancy to ensure that core cooling, containment integrity, and other vital functions are maintained in the event of postulated accidents, assuming a single failure. The design of the onsite and offsite electrical power systems provides compatible independence and redundancy to ensure an available source of power to these engineered safety loads.

Electrical power from the transmission network to the station is provided by two physically independent offsite power systems, as required by the criterion.

The switchyard arrangement and the routing from the switchyard to the RAT are illustrated in drawing M01-1103.

On the loss of the normal power source to any unit Class 1E power system bus, a second power source is automatically connected to the bus.

The NSPS power supply system is designed with sufficient capacity and independence to ensure the operability of the ESF and shutdown functions which it serves, in the event of a postulated accident. Power to each of the four divisions is provided by offsite power, backed up by standby onsite power. In addition, the station batteries provide "ride-through" ability and continuity of service. The degree of reliability of the power sources required for safe shutdown is high, because of the independence and redundancy, and equals or exceeds all of the requirements of the criterion.

There are no motor-operated valves that require power lockout in order to meet single-failure criteria. Furthermore, there are no cases where valve failure will prevent performance of safety functions. (Q&R 430.124)

NRC General Design Criterion 18

The auxiliary power system is designed to permit periodic testing and inspection of the systems as a whole and the operability and functional performance of the components of the systems in accordance with General Design Criterion 18. Preoperational testing was performed to verify that all components automatic and manual controls and sequences of the standby power systems function as required. Preoperational testing of redundant onsite electrical power systems to verify proper load group assignments was performed in accordance with Regulatory Guide 1.41.

Prior to station startup and at periodic intervals when the station is not at power operation, tests simulating loss of normal power in conjunction with a design-basis accident are performed to demonstrate the capability of the power sources to meet the bus transfer, load starting, and sequencing requirements.

Periodically during station operation, each diesel generator, individually in turn, will be manually started, synchronized with its bus, connected to the station auxiliary power system, and loaded. Each generator will be run under load in this manner in accordance with General Design Criterion 18 and IEEE-308. The testing program is designed to ensure that cooling and lubrication are adequate for extended periods of operation.

Sufficient testability, alarms, and fault detection equipment are provided to give assurance that the standby power sources are able to perform their safety function with adequate reliability at all times.

The NSPS power supply system is designed to permit inspection and testing of all important equipment and features. This capability is provided by the inclusion of alternate power to each bus. Provision is made for periodic testing of all switching functions in both activation directions.

8.3.1.2.2 Conformance with NRC Regulatory Guides

Regulatory Guide 1.6, "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems"

Conformance with this regulatory guide is described as follows for each regulatory position:

Position C.1

Each Class 1E load is assigned to a Division 1, 2, or 3 load group. Assignment is determined by the nuclear safety functional redundancy of the load.

Usually one (two at the most) division load group is required to perform safety functions.

The four divisions of essential power of the NSPS power supply system are each fed by a 480-Vac essential power supply. Division 1 is fed by the Division 1 480-Vac essential power supply; Divisions 2 and 4 are fed by the Division 2 480-Vac power supply, and Division 3 is fed by the Division 3 480-Vac power supply.

Position C.2

Each division a-c load group has a feed from two auxiliary transformers RAT B and ERAT (offsite) and one diesel generator (onsite) as shown in Drawing E02-1AP03.

The diesel-generator breaker can be closed automatically only if the other source breakers to that load group are open. The diesel generators have no connections to any other redundant load group.

Position C.3

Not applicable. Position C.3 addresses d-c load groups, whereas this subsection addresses a-c power.

Position C.4

a. The diesel-generator breaker can be closed to its associated load group automatically only if the other source breakers to that load group are open.

b. When the diesel-generator breaker is closed, no other source breaker can be closed automatically. No other means exist for connecting redundant load groups with each other.

c. Each of the redundant load groups is fed from only one diesel generator, as shown in Drawing E02-1AP03. No means are provided for transferring loads between the redundant diesel generators.

d. Sufficient interlocks are provided to prevent paralleling the diesel generators manually by operator error as previously discussed in Subsection 8.3.1.1.2.

Position C.5

Division 1 and 2 diesel-generators have tandem prime movers for each generator.

Regulatory Guide 1.9 “Selection, Design, and Qualification of Diesel-Generator Units Used as Onsite Electric Power System at Nuclear Power Plants”

Conformance with this regulatory guide is described as follows for each regulatory position. (Information regarding the conformance of Division 3 components and design to Regulatory Guide 1.9 may be found in General Electric Topical Report NED0-10905.)

Position C.1

The following tabulation compares the maximum expected coincidental loads with the diesel generator ratings:

Diesel Generator	2000-hour Rating (kW)	Maximum Coincidental Load* (kW)	Condition for Maximum Coincidental Load
1A	4078	3851	LOCA (Table 8.3-13)
1B	4082	3365	LOCA (Table 8.3-13)
1C	2350	2020	LOCA (Table 8.3-13)

* Maximum coincidental loadings shown are conservative estimates based on rated voltage and frequency. Monitoring the diesel generator (DG) loading to confirm that the 2000-hour rating is not exceeded is performed in the site calculations. For detailed evaluation of the DG loading, refer to the most recent revision of the load flow analysis.

Position C.2

Predicted loads do not exceed the 2000-hour rating of the diesel generators.

Position C.3

See Subsection 8.3.1.2.2, Conformance with NRC Regulatory Guide 1.32.

Position C.4

During the loading sequence, the diesel generator has the capability of frequency restoration to within 2% of normal and voltage restoration to within 10% of nominal within 2 seconds after loading is applied, which is within 60% of the load sequence time interval.

During recovery from transients caused by step load increases or resulting from the disconnection of the largest single load, the speed of the diesel generator will not exceed the nominal speed plus 75% of the difference between nominal speed and the overspeed trip setpoint or 115% of nominal, whichever is lower.

Position C.5

See Subsection 8.1.6.1.16, Conformance with NRC Regulatory Guide 1.89.

Position C.6

The diesel generators are designed to be testable during the operation of the plant as well as during shutdown. The diesel generator instrumentation sensors will be tested by disconnecting instrument lines and either testing in place or at a remote location.

Position C.7

Section 5.6.2.2(1) of IEEE-387-77 (endorsed by Regulatory Guide 1.9 Revision 2) requires that a start-diesel signal shall override all other operating modes and return control of the diesel-generator unit to the automatic control system.

With respect to this requirement, which is consistent with the requirement of Section 5.6.1.4 (of the same standard) regarding governor operation for a diesel generator, the Division 3 diesel generator design is provided with automatic switchover capability from the test mode to automatic operation upon receipt of a LOCA initiation signal. However, as further discussed in Subsection 8.3.1.1.2.1, during testing with a non-zero droop setting in effect (to support paralleling the diesel generator with the offsite power source), in the event of a LOCA initiation signal concurrent with a loss of the offsite power source to the bus, operator action may be required (in addition to the automatic actions) to reset the governor and thus ensure bus frequency is within required limits when the diesel generator alone is subsequently supplying power to the Division 3 bus.

The CPS diesel generator control schemes meet this requirement except that upon receipt of LOCA signal all protective trips are bypassed except generator differential, engine overspeed and engine overcrank for Divisions I and II diesel generators and generator differential and engine overspeed for Division III diesel generator. [Q&R 430.134]

The design of the bypass circuitry satisfies the requirements at the diesel generator level and includes the capability for (1) testing the status and operability of the bypass circuits, (2) alarming in the control room abnormal values of all bypass parameters, and (3) manually resetting the trip bypass function. The bypass circuitry is manually reset.

Position C.8

Protective trips provide inputs to annunciators for Division 1 and 2 at the local diesel generator control panels. The feature of identifying the “first out” annunciators is not designed into CPS Div 1 and 2 diesel generators annunciators.

Position C.9

A prototype test and analysis program for the diesel generators was conducted in accordance with the requirements of IEEE 344. Compliance with Regulatory Guide 1.100 is discussed in Subsection 8.1.6.1.

Position C.10

Tests performed in the process of troubleshooting were disregarded during the 300 start and load acceptance qualification.

The diesel generator manufacturer has verified that tests performed to verify correction of a problem were counted as part of the valid start and loading requirements. (Q&R 430.116)

Testing of the CPS HPCS Diesel Generator was done in accordance with NEDO 10905. Additionally, site testing in accordance with Regulatory Guide 1.108 was accomplished and test results made available.

It is our understanding that the 69 start test for reliability is acceptable to NRC (La Salle and Grand Gulf). A similar test was performed at CPS to meet the objective of establishing a 0.99 reliability for this particular diesel generator design. (Q&R 430.143)

Position C.11

See Subsection 1.8, Conformance with NRC Regulatory Guide 1.108.

Position C.12

Not applicable. This position addresses other IEEE standards which will be covered by additional regulatory guides when necessary.

Position C.13

This position addresses the case of one large load which applies to Division 3 which is addressed in NED0-10905.

Position C.14

The diesel generators were tested in accordance with this Regulatory Guide Position.

Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants"

Conformance with this regulatory guide is described as follows for each regulatory position:

Position C.1a

Two immediate-access circuits are available from the transmission network to the Class 1E a-c power system of each unit.

Position C.1b and C.1c

Not applicable because the regulatory position addresses battery and charger, whereas this USAR section deals only with a-c power.

Position C.1d

See above discussion of Regulatory Guide 1.6 and Subsection 8.1.6.1.14 for discussion of Regulatory Guide 1.75.

Position C.1e

See Subsection 8.1.6.1.14, Conformance with NRC Regulatory Guide 1.75.

Position C.1f

See above discussion on Conformance with NRC Regulatory Guide 1.9.

Position C.2

This position is not applicable since CPS is a single unit plant.

8.3.1.3 Physical Identification of Safety-Related Equipment

8.3.1.3.1 General

Two methods of identification (color code and segregation code) generally are used to distinguish between Class 1E and Non-Class 1E components, and between components of different divisions.

8.3.1.3.1.1 Color Code

Color codes are assigned to electrical components as follows:

Description	Color
Class 1E Division 1 Components	Yellow
Class 1E Division 2 Components	Blue
Class 1E Division 3 Components	Green
Class 1E Division 4 Components	Orange
Non-Class 1E Division 1 Associated Components	Yellow - White
Non-Class 1E Division 2 Associated Components	Blue - White
Non-Class 1E Division 3 Associated Components	Green - White
Non-Class 1E Division 4 Associated Components	Orange - White
Non-Safety-Related Division 1	Black or Gray
Non-Safety-Related Division 2	Black or Gray
Non-Safety-Related Division X	Black or Gray

8.3.1.3.1.2 Segregation Codes

Segregation codes are assigned to equipment according to Note 1 of Table 8.3-7.

8.3.1.4 Independence of Redundant Systems

This subsection presents: (a) the criteria used to evaluate the physical independence of all station Class 1E components, including Class 1E control and instrumentation components as noted in Subsection 8.1.3; (b) the control procedures to implement design and construction compliance with these criteria: and (c) the general arrangement of station Class 1E components.

8.3.1.4.1 General Criteria

8.3.1.4.1.1 Single Failure

The simultaneous occurrence of: (a) a single failure, (b) a loss of all offsite power, and (c) a design-basis event will not disable any nuclear safety function.

8.3.1.4.1.2 Assignment

Each Class 1E component is assigned to a division.

8.3.1.4.1.3 Redundancy

Class 1E components with redundant safety functions are assigned to separate divisions (IEEE 308/5.2.1, 5.3.1; IEEE 279/4.6). Assignment has been made in accordance with Table 8.3-5.

8.3.1.4.1.4 Electrical Isolation

Non-Class 1E non-division associated components are electrically isolated from the Class 1E system by an acceptable isolation device as indicated in Figure 8.3-6, except where justified by analysis.

The non-Class 1E equipment is fed by non-Class 1E power sources, or in some cases by Class 1E power sources. The devices fed by the non-Class 1E power sources will have no effect on the Class 1E power sources during a LOCA. The devices fed by the Class 1E sources will have circuit breakers tripped on a LOCA, except for circuits appropriately isolated as indicated on Figure 8.3-6. Therefore, there will be no safety significance or degradation of Class 1E electrical power sources as a result of non-Class 1E electrical equipment that is not qualified for such service.

For Class 1E electrical equipment, submergence is discussed in Section 3.11. (Q&R 040.7)

8.3.1.4.2 Physical Separation Criteria

Class 1E components of a division are physically separated from the Class 1E components of any other division. Class 1E components are physically separated from non-Class 1E or non Seismic Category I, high-energy components that could cause loss of redundancy as the result of a design-basis event effecting failure of these components.

The separation requirements of this subsection are minimum requirements unless the adequacy of a particular design can be demonstrated by analysis. The cable separation criteria covered in this subsection applies only to field-pulled cables.

The power generator control complex (PGCC) cables separation criteria is covered in GE Topical Report NED0-10466, "Power Generation Control Complex Design Criteria and Safety Evaluation" with the clarifications noted in Subsection 8.3.1.4.5.5.

8.3.1.4.2.1 Cable Routing

8.3.1.4.2.1.1 Division Assignment

Each Class 1E cable is assigned to Division 1, 2, 3, or 4 according to Table 8.3-7.

Each non-Class 1E cable which has any part of its length in a Division 1, 2, 3, or 4 raceway, connects to a Class 1E power system, shares an enclosure with a Class 1E circuit, or is not physically separated from Class 1E cables by acceptable distance, isolation device, or barriers, is an associated cable.

The use of associated cables is minimized.

Each non-Class 1E cable which is not an associated cable is a non-safety-related cable.

8.3.1.4.2.1.2 Routing Assignment

Cables assigned to a division are routed only in raceways of or associated with that division.

8.3.1.4.2.1.3 Reactor Protection System (RPS) Cables

The following separation criteria applies to RPS wiring: RPS cable in raceways outside the main protection system cabinets run with other divisional cables. Under-vessel cabling is not subject to external fires. However, these cables must be protected from mechanical damage. Flexible conduits are provided for the cable run between the cable trays and cable support structure to prevent mechanical damage. The cable run between the cable support structure and the vessel flange is through an area where no source of mechanical damage to these cables exists. Therefore, conduit is not required nor is provided in this area. Since there is no fire and mechanical damage potential existing in the under-vessel area, the damage potential is limited to failures or faults internal to the circuits only. These are low level information circuits and the cable insulation is adequate to provide sufficient separation between redundant circuits. Neutron monitor and preamplifier cables (SRM, IRM, LPRM) may be run in the same divisional raceway provided that the four divisional separation is maintained.

Wiring to duplicate RPS sensors on a common process tap run in separate raceways to their separate destinations.

Wires from the RPS load drivers to a single group of scram solenoids shall be run in a single division of raceways. However, a single raceway division shall not contain cables to more than one group of scram solenoids. (RPS wiring in any division raceway shall be separated from wiring to components of any other system by a metallic barrier capable of preventing "hot shorts" into the RPS.) Wiring for two solenoids on the same control rod may be run in the same raceway.

In general the field cable installation as well as the wire through the containment and drywell penetrations for RPS inputs and outputs are grouped such that failure of the wires in one group cannot prevent a scram.

8.3.1.4.2.2 Raceway/Cable Separation

8.3.1.4.2.2.1 Safety-Related Raceways

A raceway that carries a safety-related cable is a safety-related raceway. Each safety-related raceway is assigned to a single safety division.

Safety-related raceways are subject to the raceway separation requirements defined in Subsection 8.3.1.4.2.2.3.

8.3.1.4.2.2.2 Associated Raceways

A raceway that carries only associated cables (Subsection 8.3.1.4.2.1.1) is an associated raceway. Each associated raceway is assigned to a single safety division. Cables routed in associated raceways are subject to the same cable derating, environmental qualification, flame retardants, splicing restrictions, and raceway fill requirements as those cables routed in safety-related raceways. Associated raceways are subject to the raceway separation requirements defined in Subsection 8.3.1.4.2.2.3.

8.3.1.4.2.2.3 Minimum Electrical Separation Clearance

In all plant areas where damage is limited to failures or faults internal to electrical equipment or circuits, the minimum required separation distances have been established through analysis based on actual test data. The test data were compiled through the execution of an electrical separation test program performed by Wyle Laboratories for the Clinton Project. Specific minimum clearance criteria established through this program are noted below and shown in Table 8.3-17 and Figure 8.3-8. The minimum clearance dimensions identified are applicable to all raceways as follows:

a. The tray separation distances are based on open solid bottom type cable trays.

b. The conduit separation identified is applicable to either rigid steel, flexible, or EMT conduit.

c. Separation distances above open trays shall be taken from the top of the topmost cable in the tray or from the top of the tray siderails (whichever is higher).

d. Based on test results, for electrical separation purposes, a box is as a minimum, equivalent to conduit; therefore, unless specifically addressed, the separation distance for junction boxes and pull boxes shall be those shown for conduit.

e. Barriers may be utilized in lieu of the solid tray covers. When utilized, barriers shall conform to the requirements of IEEE-384-1974, Figures 2, 3, and 4.

8.3.1.4.2.2.4 Hazard Areas

8.3.1.4.2.2.4.1 Pipe Rupture Hazard Areas

An area is designated a pipe rupture hazard area if it contains high energy piping (larger than 1 inch).

Isolation of non-hazard areas from pipe rupture hazard areas is accomplished by the use of barriers, restraints, and/or separation distance.

In pipe rupture hazard areas, the routing of Class 1E or associated cables or raceways conforms to the following:

a. Where the piping involved is not assignable to a single division and the pipe rupture requires no protective action, Class 1E or associated cables or raceways routed through the area are limited to a single division.

b. Where the piping involved is assignable to a single division, Class 1E or associated cables or raceways routed through the area are limited to the same division as the piping.

c. Where the piping involved is not assignable to a single division and the pipe rupture requires protective action, Class 1E or associated cables or raceways are not routed through the area except those which must terminate at devices or loads within the area.

8.3.1.4.2.2.4.2 Missile Hazard Areas

An area is designated a missile hazard area if it contains any missile source having sufficient kinetic energy which could damage redundant Class 1E circuits separated as discussed below.

In missile hazard areas, the routing of Class 1E or associated cables or raceways conforms to the following:

a. Where the missile source involved is not assignable to a single division and the effect of the missile does not require protective action, Class 1E or associated cables or raceways through the area are limited to a single division.

b. Where the effect of the missile source involved requires protective action, Class 1E or associated cables or raceways are not routed through the area, except those which must terminate at devices or loads within the area.

c. Where the missile source involved is assignable to a single division, Class 1E or associated cables or raceways routed through the area are limited to the same division as the missile source.

Isolation of non-hazard areas from missile hazard areas is accomplished by the use of barriers, orientation and/or physical separation distance.

8.3.1.4.2.2.4.3 Fire Hazard Areas

The routing of safe shutdown related cables with respect to fire hazard areas is reviewed and evaluated in both the Fire Protection Evaluation Report and the Safe Shutdown Analysis.

8.3.1.4.2.3 Panels

8.3.1.4.2.3.1 Protected Areas

8.3.1.4.2.3.1.1 Main Control Room Panels

Class 1E panels of different divisions that are less than 1 foot apart are separated by a steel barrier between the two panels. Panel ends closed by steel end plates are considered to be acceptable barriers provided that terminal boards and wireways are spaced a minimum of 1 inch from the end plate.

Floor-to-panel, fire-resistant barriers must be provided between adjacent panels of different divisions.

Penetration of division separation barriers is permitted, provided that such penetrations are sealed or otherwise treated so that an electrical fire could not reasonably propagate from one division to the other and disable a safety function.

Where, for operational reasons, locating manual controls of two divisions on separate panels is considered to be prohibitively (or unduly) restrictive to manual operation of equipment, then the controls are located on the same panel, provided no credible single event in the panel can disable both sets of redundant manual or automatic controls. Wherever wiring of two different divisions exists in a single panel, separate terminal boards and wiring must be such as to preclude the possibility of a fire propagating from one division of wiring to another. One of a pair of devices of two different divisions within a single panel is considered adequately separated from the other if the wiring to the devices has flame-retardant insulation and is totally enclosed in fire-resistant material (including outgoing terminals at the control panel boundary as well as at the device itself) and they are at least 6 inches apart. However, consideration is given to locating switches of two different divisions on opposite sides of the barrier formed by the end closures of adjacent panels wherever operationally acceptable.

Wiring for digital information outputs, such as those to annunciators or data loggers, can be run between sections of a panel containing two different divisions if interposing relays or equivalent isolation is provided to prevent interaction. For example, 125-Vdc annunciator circuits may be connected through sensor relay contacts or more than one of the protection system panels to achieve an either-of-two alarm logic, but wiring for the annunciators are kept separate from the protective wiring by separate cabling or ducting. For the use of flexible conduit PGCC panels see Subsection 8.3.1.4.5.5.

8.3.1.4.2.3.1.2 Non Control Room Panels

Generally these panels contain no more than one division. For those panels which have more than one division where separation requirements have not been met, the interactions are analyzed to verify that no single credible event can disable both redundant functions.

8.3.1.4.2.3.2 Hazard Areas

Class 1E panels are evaluated for the consequences of a potential hazard. This evaluation assures that a safe shutdown can be achieved.

8.3.1.4.2.3.3 General Plant Areas

Generally, Class 1E panels in general plant areas contain no more than one division. For panels which have cables of more than one division where separation requirements have not been met, the interactions are analyzed to verify that no single credible event can disable both redundant functions.

Panels of different divisions shall be separated in the same manner as those in the protected area.

8.3.1.4.2.4 Containment Electrical Penetrations

The required physical separation for penetrations serving Class 1E circuits is that required for enclosed raceways. Penetrations are located according to Table 8.3-6.

The following types of electrical circuits penetrate the containment:

1. Medium voltage power
2. Low voltage power
    a. Power feeds from switchgear
    b. Power feeds from motor control centers
3. Low voltage control
    a. Control power feed from combination starters at motor control centers
    b. Control power feed from 120-Vac distribution panels
4. Low level signal and thermocouple instrumentation circuits.

Calculation 19-M-03, shows the thermal capability (I^2t) for each type of electrical penetration. The thermal capability curves were developed by combining an experimentally verified formula for the temperature rise of a conductor with the penetration service life characteristic. This approach has been verified by testing (Reference - Conax Report No. IPS-701).

The I^2t curves submitted with Amendment 2 have arbitrary maximum current lines. The revised curves now indicate the maximum current limitations based on electro-mechanical forces. (Q&R 430.129)

The protective circuit breaker or fuse tripping characteristics for each conductor size is also shown in calculation 19-M-03. The maximum calculated symmetrical fault current is also shown for voltage level and conductor size.

Instrument circuits listed in Item 4 above are inherently selflimiting and of such low power that their protection does not pose any concern.

The following is a typical description of the type(s) of circuit protection used for each type of penetration conductor:

Majority of penetration conductors described under types A through G are provided with protective scheme described below. Specific penetration conductors under types A through G which are not covered under below described schemes, have additionally been evaluated to be equivalent and to demonstrate adequacy of primary and backup protection.

A. Type A - 1000 MCM - 6900-V

The use of this type of penetration is limited to feeding the reactor recirculation pumps; redundant Class 1E circuit breakers are used to protect the penetration.

When the Low Frequency Motor Generator (LFMG) sets furnish power to the reactor recirculation pumps, the two (2) levels of protection are: 1) the voltage restrained overcurrent relay 51V for the generator, and 2) the generator itself since its maximum output under fault conditions is less than the penetration capability.

B. Type B - 2-350 MCM (paralleled) – 480-Vac

The use of this type of penetration is limited to feeding the Containment Building polar crane. The primary protection is provided by a 480-Vac Class 1E feeder breaker with Gould Type SS14 solid state trip. Backup protection is provided by the Class 1E main feed breaker to the 480-Vac bus which is tripped by a Westinghouse Type CO-8 relay.

C. Type C Single 350 MCM – 480-Vac and 125-Vdc

This type of penetration is protected by redundant series molded case circuit breakers with a maximum 150-A trip rating (480-Vac) or a 100-A trip rating (125-Vdc). The latter feed is used for containment emergency lighting and is the only d-c power feed using a penetration.

D. Type D - No. 2 AWG – 480-Vac and 120-Vac

This type of penetration is protected by redundant series fuses or molded case circuit breakers with a maximum trip rating of 50-A 480-Vac or 50-A 120-Vac 1P breaker or 15-A, 120-Vac fuse.

E. Type E - No. 6 AWG – 480-Vac and 120-Vac

This type of penetration is protected by redundant series fuses or molded case circuit breakers with a maximum trip rating of 40-A, 480-Vac or 20-A, 120-Vac, 1P breaker or 20-A, 120-Vac fuse.

F. <u>Type F - No. 12 AWG – 120-Vac and 125-Vdc</u>

This type of penetration is protected by redundant series fuses or molded case circuit breakers with a maximum trip rating of 30-A, 120-Vac fuses or 20-A, 120-Vac breakers or 15-A, 125-Vdc fuses.

G. <u>Type G - No. 16 AWG – 120-Vac</u>

This type of penetration is protected by redundant series fuses with a maximum trip rating of 10-A, 120-Vac.

Medium voltage field cables terminate at qualified bushings. All low voltage power field cables terminate at splices utilizing qualified lugs and insulating sleeving. All of the control cables terminate at qualified terminal blocks or at qualified splice connections. Coaxial type instrumentation cables terminate at qualified connectors.

All remaining instrumentation cables terminate at qualified terminal blocks or at qualified splice connections.

Supportive documentation of environmental qualification of penetration assemblies per IEEE 317-76, as well as the qualification of these interfaces, is contained in the respective CPS Environmental Qualification binders.

Periodic fault-current level testing of the penetrations and protective systems is not planned.

The trip circuits of the redundant class 1E circuit breakers for the reactor recirculation pump (type A) penetrations are controlled from separate d-c power supplies.

The penetration type C, D, and E redundant series molded case circuit breakers are all class 1E.

The Operational Requirements Manual (ORM) describes the surveillance requirements to be performed on the penetration conductor overcurrent protective devices which include the low and medium voltage circuit breakers.

The containment building polar crane is the only service using the Type “B” (2-350 MCM) penetration. If the loss of one of the 2-350 MCM penetration conductors is postulated, the thermal capability of the penetration would be the same as for a Type “C” (1-350 MCM) penetration.

The primary protective device is a 600 A frame circuit breaker with a Gould Type SS-14 solid state tripping device. This tripping device derives breaker magnetic latch trip current from power line sensors; therefore no separate d-c supply is required. The secondary protective device is a 1600 A frame circuit breaker with tripping initiated by relays on the containment building polar crane feeder. Power for tripping this breaker is from a 125-Vdc Division 1 Class 1E source. (Q&R 040.4)

8.3.1.4.3 Cable Tray Criteria

8.3.1.4.3.1 Fill

Where actual cable fill exceeds the tray depth and insufficient distance remains between the cables and adjacent raceways to preclude a separation violation, barriers or side rail extensions will be installed and covers will be added if necessary.

8.3.1.4.3.2 Classification

All trays in Seismic Category I structures are Seismic Category I unless it has been demonstrated by analysis that Seismic Category I trays are not required. The nuclear safety function of Divisions 1, 2, 3, and 4 trays in Seismic Category I structures is to carry Class 1E cables successfully (no damage to cables) during a safe shutdown earthquake. The nuclear safety function of non-safety-related divisional trays in Seismic Category I structures is not to become missiles during a safe shutdown earthquake.

8.3.1.4.3.3 Structure

Trays support (see Subsection 8.3.1.4.3.2 for safety functions) the maximum allowable cable load (see Subsection 8.3.1.4.3.1) plus a single concentrated load of 200 pounds at the tray center at mid-span between supports. Trays also support the maximum possible cable load without the single concentrated load during a safe shutdown earthquake.

8.3.1.4.3.4 Installation

Solid covers are generally provided for all instrumentation cable trays (refer to Subsection 8.3.1.4.4.3.4 for exceptions) and where required to meet physical separation requirements.

Refer to Subsection 8.3.1.4.2.2.3 for a discussion of cable tray separation criteria. For those installations where physical separation criteria does not apply, the minimum vertical distance in parallel runs between stacked trays of the same division or between stacked trays of a non-safety-related system is 1 foot from the bottom of the upper tray to the top rail of the lower tray, except in certain areas where interferences occur, in which case the vertical separation becomes less.

8.3.1.4.4 Cable Criteria

8.3.1.4.4.1 Ampacity

8.3.1.4.4.1.1 In Trays

The thermal ampacity of power cables that have some part of their length in solid-bottom trays are in accordance with manufacturers' instructions or with IPCEA publication P-54-440 (NEMA, WC51-1972), with appropriate rating factors applied for ambient, tray fill, tray covers, shields, and direct-current service.

Cable ampacities are limited to the values shown in Table 8.3-12. Values given here are based on IPCEA P-54-440 and P-46-426 with appropriate derating factor applied.

Cable ampacities for power cable are based on a 2-inch average calculated depth of fill. The normally allowed calculated depth of fill for cables (based on the square of the cable diameters) is 2 inches for power cable and 3 inches for control and instrumentation cable.

8.3.1.4.4.1.2 Not In Trays

The thermal ampacity of power cables with no part of their length in solid-bottom trays are in accordance with manufacturers' instructions or with IPCEA P-46-426-1962 (A1EE S-135-1), with appropriate rating factors applied for ambient, shields, and direct-current service.

8.3.1.4.4.2 Environment

8.3.1.4.4.2.1 Avoidance of Adverse Environmental Areas

Where reasonably possible, cables are not routed through a normally or potentially adverse environmental area if neither end of the cable terminates in that area.

8.3.1.4.4.2.2 Requirement for Performance

Class 1E cables perform their safety functions during the worstcase design-basis event environment (usually LOCA), following 40 years of the worst-case normal environment.

8.3.1.4.4.2.3 Normal and LOCA Environment

The normal and LOCA environments for station areas are given in Tables 3.11-5 thru 3.11-14.

8.3.1.4.4.3 Voltage Level Separation

8.3.1.4.4.3.1 Voltage Classification

Cables are classified as power (P), control (C), or instrumentation (K) as follows:

a. Power cable - Power cables operate above 200 volts or carry more than 15 amperes continuously.

b. Control cables - Control cables operate between 24 and 200 volts and carry between .05 and 15 amperes continuously or operate below 200 volts and carry digital signals.

c. Instrumentation cables - Instrumentation cables operate below 24 volts or operate below 200 volts and carry analog signals of less than .05 ampere. Computer input cables (both analog and digital) are considered instrumentation cables.

8.3.1.4.4.3.2 Power Cables

Power cables are installed in a separate tray system and are not intermixed with any other cable types. Power cables installed in stacked trays are, where practical, located in the highest-level tray.

8.3.1.4.4.3.3 Control Cables

Control cables run in a tray system separate from power and instrumentation cables, except as noted in Subsection 8.3.1.4.4.3.4.

8.3.1.4.4.3.4 Instrumentation Cables

Instrumentation cables, in general, are installed in separate conduit or separate, non-ventilated, solid-bottom trays with covers to provide additional electromagnetic shielding (cables are of shielded construction), except where a high volume of cables enter over a short length of tray (e.g., protected areas, containment penetrations). In such applications, a solid bottom tray without covers, ladder rack (with or without covers), or raceways shared with control circuitry may be used. Raceways shared with control cables will not have instrument cables run parallel to control cables or will have internal barriers to provide added shielding except where analyzed on a case-by-case basis. In general, instrumentation trays occupy the lowest level of a stack of cable trays.

8.3.1.4.5 Cable Fire Protection Criteria

8.3.1.4.5.1 Flame-Retardant Cables

All Class 1E cables in open raceways are flame retardant. With the exception of a small percentage of special vendor-supplied non-Class 1E cables, all non-Class 1E cables in open raceways are flame retardant. The combustible effect of these cables is addressed in the Fire Protection Evaluation Report.

8.3.1.4.5.2 Vertical Raceways

Fire stops are installed in the tray system at all riser openings in floors where there exists the likelihood of fire migrating from one elevation to another. When a fire stop is required within a tray section, the fire stop is of wool or some other suitable nonflowing, fire-resistant compound.

8.3.1.4.5.3 Horizontal Raceways

In areas where pressure integrity between walls is required, a sleeve penetration filled with a nonflowing, fire-resistant material or other suitable fire stop is used.

8.3.1.4.5.4 Ionization Detectors

In areas of high cable concentration, such as a cable-spreading room, ionization detection devices are provided. The design and configuration of the area determines the actual location of such devices.

8.3.1.4.5.5 Flexible Conduit in PGCC Panels and Floor Sections

Fire tests have been performed which justify the use of flexible conduit as a fire barrier between wiring inside the conduit and wiring outside the conduit. As such, an air gap in addition to flexible conduit is not required. In floor section divisional ducts, the use of flex conduit will be limited to conduits which are grounded to ensure that hot shorts in internal wiring will melt upstream fuses, providing short circuit protection that limits the fault to the nondivisional cables. The CPS PGCC design has redundant overcurrent protective devices installed for these nondivisional circuits routed in the PGCC. Flexible conduit, which passes through a fire barrier between to divisional ducts, is considered an adequate integral part of that fire barrier. Fire seals are provided wherever conduit penetrates a divisional boundary (external to the conduit). Fire tests have shown that a fire in a wiring duct containing flexible conduit did not propagate through the fire barrier containing that conduit and that the fire barrier was effective in blocking the spread of fire into the adjacent duct. Additional thermal insulating materials may be added to the conduit for additional protection but are not required to provide separation.

8.3.1.4.6 Control Procedures - Independence

Procedures are established to implement design and construction compliance with the foregoing physical independence criteria.

8.3.1.4.6.1 Design Control

The design procedures include those which (1) assure adequate physical separation between redundant Class 1E components, and (2) assure the proper assignment of cables to raceways.

8.3.1.4.6.1.1 Physical Separation

The segregation codes of raceways and electrical equipment division assignments are identified on electrical layout drawings.

The architect-engineer construction drawings are in accordance with the station design criteria and as further specified in this section.

8.3.1.4.6.1.2 Cable-to-Raceway Assignment

The primary design document showing cable routing is the cable tabulation. Information on the cable tabulation includes the raceways in which the cable is routed and the cable segregation code. The data contained in the cable tabulation, as well as raceway identification numbers and segregation codes, are entered into a computer program. The program checks the cable routing for compliance with Table 8.3-7 by using the following decision rules:

a. The first (voltage classification), and second (division) characters of the cable segregation code must be identical to the corresponding characters of all raceways through which that cable is routed.

b. The third (safety function) character of the cable segregation code must be correlated to the corresponding characters of all raceways through which that cable is routed according to the following tabulation (X indicates permissible assignment):

	RACEWAYS				
CABLES	E	B	R	N	A
E	X				
B		X			
R	X		X		
N	X			X	
A	X				X

Note: Table 8.3-7 defines the letter designators.

8.3.1.4.6.2 Construction Control

The construction procedures include those that ensure that (1) the physical separation of Class 1E equipment and raceways is in accordance with the construction drawings, and (2) the cables have been pulled over the route specified on the pull cards.

8.3.1.4.6.2.1 Physical Separation

The constructor had installation traveller procedures with independent QC signoff, verifying that installed work conformed to the AE construction drawings.

8.3.1.4.6.2.2 Cable Routing

A pull card for each cable pulled was signed by a contractor's representative as verification that the cable actually was pulled over the route specified on the pull card. The cable pull card was generated by the AE from the same computer data base as the cable tabulation, which is a design document prepared, reviewed, approved and issued for construction by the AE.

Visual inspections of the cable and raceway color codes also verifies that proper separation of redundant Class 1E cables has been maintained.

8.3.1.4.7 General Arrangement of Class 1E Components

Physical independence of redundant Class 1E components is maintained primarily by the reservation of building segments for exclusive division use.

8.3.1.4.7.1 Equipment

Major electrical equipment locations are indicated in Drawings M01-1102, M01-1103, M01-1105 through M01-1116 and M01-1119.

Class 1E equipment in the containment building generally is allocated to building quadrants as follows:

Division	Quadrant
1	0-90°
2	180-270°
3	90-180°
4	270-360°

Class 1E equipment in the auxiliary building generally is assigned to areas on either side of the main steam tunnel as follows:

Division(s)	Area
1 and 3	East of main steam tunnel
2	West of main steam tunnel

8.3.1.4.7.2 Cables

Major cable raceway routes in the more congested areas of the auxiliary and containment buildings are shown on cable tray routing drawings E26-1002-00A-CPR, E26-1003-00A-CPR, E27-1002-00B-CPR, and E27-1003-00C-CPR.

8.3.1.4.7.3 Flood Protection

Flood protection is discussed in Attachment D3.6.4.

8.3.1.4.8 Conformance with NRC Regulatory Guide 1.75

Conformance with Regulatory Guide 1.75 is discussed in Subsection 8.1.6.1.

8.3.2 D-C Power System

8.3.2.1 Description

The d-c power system provides d-c control and motive power for vital equipment during all normal as well as emergency conditions of the plant. The system is designed to meet the requirements of General Design Criteria 17 and 18. Drawing E02-1DC06 shows the typical single line diagram for the 125-Vdc system.

The d-c power system of each unit consists of the following unit subsystems:

a. Two non-Class 1E, 125-Vdc subsystems (each with its own battery, battery charger, and associated equipment) which supply power to its d-c MCC and in turn to the generator air side seal oil pump, turbine d-c emergency bearing oil pump, 125-Vdc distribution panels and uninterruptible power supplies.

b. Four Class 1E, 125-Vdc power subsystems which are described in the following sections.

8.3.2.1.1 Class 1E 125-Vdc Power Systems

The unit is provided with four Class 1E sources of reliable, continuous and independent 125-Vdc power as shown in Drawing E02-1DC06. Each of these subsystems is self-contained with its own MCC, distribution panel, battery, battery charger, and accessory equipment. They are electrically isolated and physically separated so that any failure involving one source cannot jeopardize the function of the other source. There is no direct electrical connection between the corresponding d-c buses of each unit for Divisions 1, 2, 3 and 4.

The elimination of ties between d-c systems will prevent a single fault from affecting redundant load groups.

The system design allows for the single failure or loss of any redundant d-c subsystem during simultaneous accident and loss of offsite power conditions without adversely affecting safe shutdown of the plant. Only Division 1, Division 2, and Division 3 125-Vdc subsystems are required to be considered for safe shutdown analysis of the plant.

The system is divided into four electrically and physically independent divisions as follows:

Division 1	Division 2	Division 3	Division 4
125-Vdc Battery 1A	125-Vdc Battery 1B	125-Vdc Battery 1C	125-Vdc Battery 1D
125-Vdc Battery Charger 1A	125-Vdc Battery Charger 1B	125-Vdc Battery Charger 1C	125-Vdc Battery Charger 1D
125-Vdc MCC 1A	125-Vdc MCC 1B		125-Vdc MCC 1D
125-Vdc Distribution Panel 1A	125-Vdc Distribution Panel 1B	DG CP/PT Cubical	125-Vdc Distribution Panel 1D

125-Vdc batteries, chargers, motor control centers and distribution panels are classified as Class 1E equipment.

The four Class 1E, 125-Vdc distribution systems supply d-c power to station Class 1E control and instrumentation and for operation of d-c motor-operated equipment in their respective Class 1E divisions. Non-Class 1E loads connected to the Class 1E d-c buses are in conformance with the Clinton position on Regulatory Guide 1.75 as described in Subsection 8.1.6.1.14. To meet the requirement of Regulatory Guide 1.63 all the power feeds that penetrate through the containment have two molded case breakers in series to provide protection to the penetration conductors.

During normal operation the batteries are kept fully charged by battery chargers. The 125-Vdc motor control centers and each of the 125-Vdc distribution panels normally are fed from their primary (charger) and secondary (battery) sources operating in parallel in a "float-charge" configuration. Whenever a battery is discharged partially or fully, the voltage is raised for the equalization of the charge on the individual battery cells and to return the battery to the fully charged condition. Loss of either source does not interrupt power flow to the bus. Each battery system operates ungrounded. The d-c bus voltage will be dropped to 105-Vdc when the battery is discharged to its rated value.

The stored energy of each battery shall be sufficient to provide an adequate source of power for starting, and operating all required connected loads and operating all necessary circuit breakers during the interval of time when a-c power to battery charger is lost. If a-c power is lost to the battery charger, it will be restored through a standby a-c power source within 15 seconds. The battery chargers are adequately sized to meet the demand of the necessary d-c loads and to fully charge the battery from its minimum discharge condition within a reasonable time. Each Class 1E battery system is independent physically and electrically and meets the single failure criteria. Thus the basis for selecting 4 hours as the time needed for the batteries to supply their essential loads is good engineering practice and judgement.

The recommended battery operating temperatures are between 60° and 90°F. To compensate for age, the batteries are sized for at least 125% of the loads expected at the end of its service life. Therefore, the batteries have sufficient margin to supply the expected essential loads for a period of four hours at the minimum regulated temperature of 65°F at 80% of the battery service life. (Q&R 430.126)

8.3.2.1.2 Components

8.3.2.1.2.1 Batteries

Batteries are the secondary sources of power to the d-c system. The ampere-hour capacity of each battery is adequate to supply expected essential loads for a period of 4 hours following station trip and loss of all a-c power coincident with a design-basis accident without battery terminal voltage falling below 84% (105 volts). The batteries are sized to carry the loads as shown in calculations 19-D-23 to 30.

All the batteries are lead acid (calcium) type and have 58 cells. The minimum 8-hour, 77° F ampere-hour discharge capacity to 1.81 volts per cell for each battery is the following:

a. Division 1 - 125-Vdc battery 1708A-hr.

b. Division 2 - 125-Vdc battery 1138A-hr.

c. Division 3 - 125-Vdc battery 385A-hr.

d. Division 4 - 125-Vdc battery 385A-hr.

The batteries are located in separate rooms outside the containment in areas where the environment is essentially normal following a design-basis accident. The ventilation requirements for these battery rooms are satisfied as follows:

a. To purge the room of hydrogen gas liberated from the battery, each room ventilation system limits the hydrogen concentration to less than 2% by volume.

b. Filtered air is provided to maintain each battery area at an annual average temperature of approximately 77° F with a minimum temperature of 65° F and a maximum temperature of 95° F. The battery is sized to provide adequate capacity at 77° F plus sufficient margin to allow for the expected temperature variations. The battery room ventilation equipment is classified as Safety Class 3 and meets seismic requirements.

The batteries are specified to withstand the pressure, temperature, humidity, and radiation levels applicable to the area in which they are located, following the design-basis accident for that period of time without loss of function. Refer to Section 3.11 for discussion of environmental design and analysis of safety-related electrical components for post accident conditions. The 125-Vdc station batteries 1A, 1B, 1C, and 1D are classified as Class 1E equipment.

Division 1, 2 and 4 lead-calcium batteries are maintained in a fully charged condition by a float voltage of 2.25 nominal volts per cell (V/Cell) which eliminates the periodic equalization of batteries at regular intervals. However, the batteries are equalized whenever they are discharged partially or fully due to loss of a-c power or testing. The manually initiated equalizing charge timer is provided as an option. It may or may not be used. The battery charger is set to supply 2.33 nominal V/Cell to equalize the battery. All the d-c equipment connected to the d-c bus can tolerate the d-c bus equalizing voltage. The battery charger may operate stably as a battery eliminator; but it has not been qualified by the manufacturer as a battery eliminator.

Division 3 lead-calcium battery is maintained in a fully charged condition by a float voltage of 2.233 nominal V/Cell which eliminates the periodic equalization of the battery at regular intervals. However, the batteries are equalized whenever they are partially or fully discharged due to the loss of a-c power or testing. The charger is set to equalize at 2.35 nominal V/Cell. All DC equipment on the division - DC bus is specified for operation at the recommended equalizing charge voltage. The battery charger can supply DC loads to the bus without the batteries connected only if required during abnormal conditions. (Q&R 430.130)

The battery maintenance, inspection, and testing will be conducted in accordance with the requirements of IEEE 450, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications." See Technical Specification 5.5.14, “Battery Monitoring and Maintenance Program” and Operation Requirements Manual for details.

8.3.2.1.2.2 Battery Chargers

The primary sources for the Class 1E d-c power system are the battery chargers. Each battery charger is adequately sized to meet the demand of associated steady-state d-c loads during any mode of station operation while recharging the fully discharged battery to a fully charged state within a reasonable time. Each battery charger is fed from the Class 1E 480-Vac motor control center of the same division, except the battery charger of Division 4. The battery charger of Division 4 is fed from the Division 2 Class 1E 480-Vac motor control center. The battery charger is provided with (a) disconnecting devices both in the a-c input circuit and the d-c output circuit to isolate the battery charger, (b) feedback protection to prevent the a-c power supply from becoming a load on the battery, and (c) an automatic load limiting feature that shall limit the d-c output current to a value beyond which the battery charger may be damaged. The battery chargers are classified as Class 1E equipment.

The battery chargers have sufficient capacity to operate all non-accident shutdown loads assuming the battery is not available. The battery chargers are designed to maintain stable output from no load to 100% full load with ± 0.5% voltage regulation.

8.3.2.1.2.3 125-Vdc Motor Control Center and Diesel Generator CT/PT Cubicle

The 125-Vdc motor control center and diesel generator CT/PT cubicle is provided with the following devices:

a. Circuit breakers or fuses to connect batteries and battery chargers.

b. Contactors to provide 125-Vdc power controls for d-c operated equipment.

c. Instrument compartment to locate monitoring and protective instruments (Subsection 8.3.2.1.2.4).

8.3.2.1.2.4 Instrumentation

Each 125-Vdc subsystem has its own independent instrumentation. The following monitoring features are provided at 125-Vdc motor control center instrument compartments (for Division 1, 2, and 4) and diesel generator CT/PT cubicle (for Division 3):

a. d-c voltmeter to measure the bus voltage,

b. directional and dual range d-c ammeter to measure the output current of a battery when its is loaded and input current when it is on floating or equalizing charge condition,

c. recording type ground detector voltmeter and alarm (for Division 1, 2, and 4) and ground detection alarm (for Division 3), and

d. 125-Vdc bus undervoltage alarm relay.

For each Division 1, Division 2, and Division 4 d-c power system, an ammeter and a voltmeter are provided in the main control room to monitor the battery charge/ discharge current and d-c bus voltage, respectively. An ammeter and a voltmeter are provided locally to monitor battery charger output current and voltage. Any abnormal voltage and current conditions of the battery charger are alarmed in the main control room. DC bus undervoltage, bus grounding, tripping of the battery or battery charger feeds, and charger trouble alarms are provided in the main control room. DC bus high voltage condition is monitored by the bus voltmeter and battery charger high output voltage alarm. High discharge rate of the battery is monitored through the ammeter. These conditions are sufficient to monitor the d-c system status and its readiness to perform its cited function.

For Division 3, d-c bus voltage status (voltmeter), battery charger output breaker open (Division 3 battery charger trouble alarm), and battery breaker open (trouble 125-Vdc system alarm) are provided in the main control room.

Division 3 local alarms and indications consist of battery current, d-c bus voltage, battery charger output voltage, battery charger output current, and d-c bus undervoltage or ground detection (charger failure alarm).

The Division 3 alarms and indications meet the general requirements of IEEE 308-1974 and Regulatory Guide 1.47. These alarms and indications combined with the periodic test and surveillance requirements included in the Technical Specifications, are sufficient to provide reasonable assurance that the Class 1E d-c power system is ready to perform its intended safety function. (Q&R 430.133)

Each battery charger is provided with the following instrumentation for continuous supervision of the 125-Vdc subsystem:

a. d-c ammeter and d-c voltmeter to measure battery charger output current and voltage.

b. power failure alarm relay which indicates a loss of a-c power to the battery charger (for Division 1, 2, and 4),

c. charger low d-c voltage alarm relay (for Division 1, 2, and 4),

d. charger high d-c voltage shutdown relay (for Division 1, 2, 3, and 4).

e. a timer which shall be initiated manually to equalize the battery charge and return to floating charge automatically after the completion of equalizing charge (for Division 1, 2, and 4),

f. a-c power on pilot light (Divisions 1, 2, 3, and 4). and

g. battery charge failure relay (Divisions 1, 2, and 4).

Each battery charger is capable of recharging the battery from its design minimum discharge condition while supplying the steady-state dc loads.

Division 1, 2 and 4 batteries are normally maintained in a charged condition by a float voltage of 2.25 volts per cell. Anytime one of these batteries is discharged, it is recharged at the recommended equalizing charge voltage of 2.33 nominal volts per cell until the battery is fully charged.

Division 1, 2 and 4 batteries can be fully charged from the design minimum discharge condition in 12 hours or less. All loads on these system are specified and qualified for operation at the equalizing charge voltage.

Division 3 battery is normally maintained in a fully charged condition by a float voltage of 2.233 nominal volts per cell. Any time the battery is discharged, it is recharged at the recommended equalizing charge voltage of 2.35 nominal volts per cell.

Division 3 battery can be fully charged from the design minimum discharge condition in 12 hours or less.

All DC equipment on the Division 3 DC bus is specified for operation at the maximum recommended equalizing charge voltage. (Q&R 430.128)

To facilitate reliable supervision of the condition of the overall d-c system, the following instruments and alarms are provided in the main control room:

a. A directional and dual range d-c ammeter to measure the output current of the battery when it is loaded, and input current when it is on floating or equalizing charge condition (Divisions 1, 2 and 4).

b. d-c voltmeter to measure the bus voltage,

c. 125-Vdc motor control center feed trip alarm (for Division 1, 2 and 4),

d. battery breaker and battery charger breaker open alarm (for Division 3),

e. battery charger trouble alarm,

f. 125-Vdc motor control center bus voltage low alarm (for Division 1, 2, and 4), and

g. ground at 125-Vdc motor control center alarm (for Division 1, 2, and 4).

The following protection is provided against overcharging the battery:

a. A high-voltage shutdown device disables the charger when the d-c output voltage of the charger exceeds a pre-set voltage for a time delay.

b. A d-c voltmeter provides a visual check on battery voltage.

8.3.2.2 Analysis

The following analyses demonstrate compliance with NRC General Design Criteria 17 and 18 and conformance with NRC Regulatory Guides 1.6 and 1.32.

8.3.2.2.1 Compliance with NRC General Design Criteria

The analyses of compliance with General Design Criteria 17 and 18 in Subsection 8.3.1.2 are also applicable to the d-c power systems.

8.3.2.2.2 Conformance with NRC Regulatory Guides

8.3.2.2.2.1 Regulatory Guide 1.6, "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems"

Conformance with this regulatory guide is described as follows for the regulatory positions:

Position D.1

Each Class 1E load is assigned to one of the four divisions of load groups. Assignment is determined by the nuclear safety functional redundancy of the load such that the loss of any one division of the load group will not prevent the minimum safety functions from being performed.

Position D.2

Not applicable, since the regulatory position addresses a-c loads, while this subsection addresses d-c loads.

Position D.3

Each division d-c load group has a feed from one battery charger and one battery as shown in Drawing E02-1DC06.

The d-c load groups from different divisions cannot be connected to each other. The d-c batteries and battery chargers from different divisions cannot be connected to each other.

Position D.4

Not applicable to d-c because the regulatory position deals with standby sources, i.e. diesel generators.

Position D.5

Not applicable to d-c because the regulatory position deals with standby sources, i.e. diesel generators.

8.3.2.2.2.2 Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants"

Conformance with this regulatory guide is described as follows for each regulatory position:

Positions C.1a, C.1d, and C.1f

Not applicable because Position 1a deals with offsite power and Positions 1d and 1f deal with standby sources.

Position C.1b

The battery charger of each division is sized to carry the maximum steady-state d-c load of that division plus the charging capacity to restore the battery from the design minimum charge state to the fully charged state.

Position C.1c

The service test and the performance discharge tests will be performed in accordance with IEEE 450.

Position C.1e

See Subsection 8.1.6.1.14, conformance to Regulatory Guide 1.75.

Position C.2a

Not applicable since CPS is not a multi-unit nuclear power plant.

Position C.2b

Conformance with Regulatory Guide 1.93 is discussed in Subsection 8.1.6.1.

Clarification

Section 5.3.4(5)(c) of IEEE 308 states that circuit breaker position indication shall be provided to monitor the status of the battery charger supply. The design of the Clinton Power Station is such that sufficient information is available at the charger, d-c MCC and the main control room to determine this status without the use of breaker position indication on all breakers. (One light is furnished at the charger to indicate that the a-c breaker is closed.) Local (at the charger) voltage and current monitoring is provided in addition to a remote charger "trouble" alarm. For the d-c MCC's, local and remote voltage and current monitoring and remote main feed indication and annunciation are provided.

8.3.2.2.2.3 Regulatory Guide 1.47, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems"

A review of all approved operating, maintenance and testing* procedures indicated that the use of jumpers or other temporary forms of bypassing functions is within the requirements of Regulatory Guide 1.47. The Clinton Power Station was designed to satisfy the regulatory position of Regulatory Guide 1.47. Jumpers and other temporary bypasses are used in procedures within the constraints of regulatory position C.3 of Regulatory Guide 1.47 and testing (e.g., jumpering a redundant load cell switch while testing refueling platform interlocks). Indications of jumpers and other temporary bypasses are administratively controlled.

(See CPS-USAR Subsections 7.1.2 and 8.1.6.1.9 for additional information.)

* Testing in this context refers to testing performed during commercial operation of the plant. Testing during the Startup Test Program was controlled within the guidelines of the program.

8.3.2.2.2.4 Regulatory Guide 1.129, “Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants”

Conformance with this regulatory guide is described as follows for the regulatory positions:

Position C.1

The service test and the performance discharge tests will be performed, in accordance with IEEE 450. See Technical Specifications 5.5.14, “Battery Monitoring and Maintenance Program” and Operation Requirements Manual for details.

Position C.2

The applicability of the referenced standards is addressed in Subsection 1.8.

8.3.3 Fire Protection for Cable Systems

See Subsections 8.3.1.4.2, 8.3.1.4.5 and 9.5.1.

8.3.3.1 Cable Derating and Cable Tray Fill

See Subsections 8.3.1.4.4.1 and 8.3.1.4.3.1.

8.3.3.2 Fire Detection and Protection in Areas Where Cables are Installed

See Subsection 9.5.1.

8.3.3.3 Fire Barriers and Separation Between Redundant Cable Trays

See Subsection 8.3.1.4.2.

8.3.3.4 Fire Stops At Wall and Floor Penetrations

See Subsection 9.5.1.

TABLE 8.3-1
SUMMARY OF CLASS 1E 4160-V CIRCUITS PROTECTION FOR BUS FED FROM NON-DIESEL-GENERATOR SOURCE ONLY

EVENT	VARIABLE	DEVICE	ACTION
Service ground fault	Residual current at service ACB	Instantaneous overcurrent relay (50G)	Trip service ACB
Service ground fault (backup)	Residual current at source ACB	Time overcurrent relay (51N)	Trip and lock out all source ACB's
Service phase fault	Phase current at service ACB	Inst./time overcurrent relay (50/51)	Trip service ACB
Service phase fault (backup)	Phase current at source ACB	Time overcurrent relay (51)	Trip and lock out all source ACB's
Bus ground fault	Residual current at source ACB	Time overcurrent relay (51N)	Trip and lock out all source ACB's
Bus ground fault (backup)	Residual current at source neutral	Time overcurrent relay (51N)	Trip and lock out source
Bus phase fault	Phase current at source ACB	Time overcurrent relay (51)	Trip and lock out all source ACB’s
Bus phase fault (backup)	Phase current at source	Time overcurrent relay (51)	Trip and lock out source

TABLE 8.3-2
SUMMARY OF CLASS 1E 4160-V CIRCUITS PROTECTION FOR BUS FED FROM DIESEL-GENERATOR (DG) SOURCE ONLY

EVENT	VARIABLE	DEVICE	ACTION
Service ground fault	Residual current at the service A CB	Inst./Time overcurrent relay 251G/50G - Div I & II	Trip Service ACB and Alarm - Div I & II
		50GS - Div III	Alarm - Div III
Service ground fault (backup)	Neutral voltage at DG	Time overvoltage relay (59G/259G) - Div I & II	DG lockout and Alarm* - Div I & II
		259DG1C/59N - Div III	Alarm - Div III
Service phase fault	Phase current at service ACB	Inst./time overcurrent relay (50/51)	Trip service ACB
Service phase fault (backup)	Phase current at diesel generator	Voltage restrained time overcurrent relay (51V)	Trip DG and lock out DG source ACB*
Bus ground fault	SAME AS SERVICE GROUND FAULT (BACKUP)		
Bus ground fault (backup)	N/A	N/A	None
Bus phase fault	Phase current at diesel generator	Voltage restrained time overcurrent relay (51V)	Trip diesel generator and lock out DG source ACB*
Generator and generator connections phase fault	Phase current within diesel generator and between it and the bus side of the source breaker	Differential Relay 87	Trip diesel generator and lock out

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* Alarm only during LOCA signal.

TABLE 8.3-3
DIESEL GENERATOR INFORMATION

ITEM	DIESEL GENERATORS 1A (DIVISION 1)	DIESEL GENERATORS 1B (DIVISION 2)	DIESEL GENERATORS 1C (DIVISION 3)
Continuous rating, kW (8760-hour maintenance interval)	3869	3875	2200
2000-hour rating, kW (2000-hours maintenance interval)	4078	4082	2350
200-hour rating, kW (24-hour maintenance interval)	4180	4185	2423
30-minute rating, kW (30-minute maintenance interval)	4337	4342	2500

TABLE 8.3-4
TABULATION OF DIESEL GENERATOR (DIVISIONS 1 AND 2) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
*OVERSPEED	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	DIESEL GENERATOR (X) TRIPPED
*FAILURE TO START (OVERCRANK)	ALARM/TRIP	ALARM/TRIP	ALARM TRIP	DIESEL GENERATOR (X) TRIPPED
GENERATOR DIFFERENTIAL	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	DIESEL GENERATOR (X) TRIPPED
*LOCKOUT RELAY TRIPPED	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	DIESEL GENERATOR (X) TRIPPED
EMERGENCY STOP SWITCH ACTUATED (LOCAL OR REMOTE)	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	DIESEL GENERATOR (X) TRIPPED
*LOW STARTING AIR PRESSURE	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) OUT OF SERVICE
CONTROL POWER FAILURE	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) OUT OF SERVICE
*LOSS OF EXCITATION	ALARM/TRIP	ALARM/TRIP	ALARM	**DIESEL GENERATOR (X) OUT OF SERVICE
ENGINE MAINTENANCE SWITCH IN MAINTENANCE POSITION	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) OUT OF SERVICE

TABLE 8.3-4 (Cont'd)
TABULATION OF DIESEL GENERATOR (DIVISIONS 1 AND 2) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
FIELD CIRCUIT BREAKER TRIPPED	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) OUT OF SERVICE
TURBO-SOAKBACK, CIRC OIL AND FUEL PRIMING PUMP MOTORS POWER FAILURE (DIVISION 1 ONLY)	ALARM (DIVISION 1 ONLY)	ALARM (DIVISION 1 ONLY)	ALARM (DIVISION 1 ONLY)	DIESEL GENERATOR 1A OUT OF SERVICE
DG/DO SYSTEM DIVISION (X) OOS SWITCH IN INOP	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) OUT OF SERVICE
*LUBE OIL FILTER RESTRICTED	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
***LOW LUBE OIL PRESSURE	ALARM/TRIP	ALARM/TRIP	ALARM	**DIESEL GENERATOR (X) TROUBLE
***LOW LUBE OIL LEVEL	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
*FUEL FILTER RESTRICTED	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
*HIGH CRANKCASE PRESSURE	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
****HIGH COOLANT TEMPERATAURE	ALARM/TRIP*****	ALARM/TRIP*****	ALARM	**DIESEL GENERATOR (X) TROUBLE

TABLE 8.3-4 (Cont'd)

TABULATION OF DIESEL GENERATOR (DIVISIONS 1 AND 2) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
****LOW COOLANT LEVEL	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
*HIGH LUBE OIL TEMPERATURE	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
*LOW LUBE OIL TEMPERATURE	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
*LOW FUEL LEVEL	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
*GENERATOR REVERSE POWER	ALARM/TRIP	ALARM/TRIP	ALARM	**DIESEL GENERATOR (X) TROUBLE
*GENERATOR OVERCURRENT	ALARM/TRIP	ALARM/TRIP	ALARM	**DIESEL GENERATOR (X) TROUBLE
*GENERATOR GROUND FAULT	ALARM/TRIP	ALARM/TRIP	ALARM	**DIESEL GENERATOR (X) TROUBLE
*LOW TURBO CHARGER OIL PRESSURE	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
LOCAL ANNUNCIATOR POWER FAILURE	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) TROUBLE
LOCAL VOLTAGE REGULATOR SWITCH NOT IN AUTO POSITION	ALARM	ALARM	ALARM	DIESEL GENERATOR (X) NOT IN AUTO START MODE

TABLE 8.3-4 (Cont'd)
TABULATION OF DIESEL GENERATOR (DIVISIONS 1 AND 2)
PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
REMOTE SHUTDOWN PANEL SWITCH IN EMERGENCY POSITION (DIVISION 1 ONLY)	ALARM (DIVISION 1 ONLY)	ALARM (DIVISION 1 ONLY)	ALARM (DIVISION 1 ONLY)	DIESEL GENERATOR 1A NOT IN AUTO START MODE

* INDICATES INDIVIDUAL ALARM AT LOCAL ANNUNCIATOR PANEL

** INDICATES THAT THIS EVENT ALSO ACTUATES CONTROL ROOM ALARM "DIESEL GENERATOR (X) TRIPPED" DURING TEST MODE AND LOSS OF OFFSITE POWER, BUT IS BYPASSED DURING LOCA CONDITIONS.

*** LOW LUBE OIL LEVEL AND LOW LUBE OIL PRESSURE ARE COMBINED INTO A SINGLE ALARM AT LOCAL ANNUNCIATOR PANEL.

**** HIGH COOLANT TEMPERATURE AND LOW COOLANT LEVEL ARE COMBINED INTO A SINGLE ALARM AT LOCAL ANNUNCIATOR PANEL.

***** HIGH COOLANT TEMPERATURE TRIP IS AT A HIGHER TEMPERATURE THAN THE ALARM.

TABLE 8.3-5
ASSIGNMENT OF CLASS 1E COMPONENTS TO DIVISIONS

DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
Low-Pressure Core Spray (LPCS)	Residual Heat Removal Subsystem B (RHR B)		
Residual Heat Removal Subsystem A (RHR A)	Residual Heat Removal Subsystem C (RHR C)		
Automatic De-pressurization Subsystem A (ADS A)	Automatic De-pressurization Subsystem B (ADS B)	High-Pressure Core Spray System (HPCS)	
Reactor Core Isolation Cooling System (RCIC)			
Standby Gas Treatment System A (SGTS A)	Standby Gas Treatment System B (SGTS B)		
Shutdown Service Water System A (SSWS A)	Shutdown Service Water System B (SSWS B)	Shutdown Service Water System C (SSWS C)	
Unit Class 1E A-C Power Subsystem A	Unit Class 1E A-C Power Subsystem B	Unit Class 1E A-C Power Subsystem C	
Unit Class 1E D-C Power Subsystem A	Unit Class 1E D-C Power Subsystem B	Unit Class 1E D-C Power Subsystem C	Unit Class 1E D-C Power Subsystem D
Combustible Gas Control Subsystem A	Combustible Gas Control Subsystem B		
Control Room HVAC System A	Control Room HVAC System B		

TABLE 8.3-5 (Cont'd)

DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
Diesel Generator Ventilation System A	Diesel Generator Ventilation System B	Diesel Generator Ventilation System C	
Essential Switchgear Heat Removal System A	Essential Switchgear Heat Removal System B	Essential Switchgear Heat Removal System C	
ECCS Equipment Area Cooling System A	ECCS Equipment Area Cooling System B	ECCS Equipment Area Cooling System C	
Shutdown Service Water Ventilation System A	Shutdown Service Water Ventilation System B	Shutdown Service Water	
Ventilation System C			
Average Power Range Monitor Subsystem Output Channels A	Average Power Range Monitor Subsystem Output Channels B	Average Power Range Monitor Subsystem Output Channels C	Average Power Range Monitor Subsystem Output Channels D
Suffix A and E Control and Instrumentation*	Suffix B and F Control and Instrumentation*	Suffix C and G Control and Instrumentation*	Suffix D and H Control and Instrumentation*
Outboard isolation valves	Inboard isolation valves		
Hydrogen Ignition System	Hydrogen Ignition System		
	Containment Atmosphere Monitoring System B		
Diesel Generator 1A Auxiliary Systems	Diesel Generator 1B Auxiliary Systems	Diesel Generator 1C Auxiliary Systems	

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* Includes reactor protection system (SRM, IRM) and GE engineered safety features systems control and instrumentation.

TABLE 8.3-6
ELECTRICAL PENETRATION SCHEDULE

PENETRATION NUMBER	SERVICE	ELEVATION (ft)	CLOCKWISE AZIMUTH	SEGREGATION CODE*
1P1B-1	Recirc Pump 1A (P)	773	42°-30'	P1B
1P2B-1	Recirc Pump 1B (P)	773	317°-30'	P2B
1P1B-2	NSR LVP (P)**	773	57°-30'	P1B
1P2B-2	NSR LVP (P)	773	302°-30'	P2B
1P1B-3	NSR LVP (P)	773	52°-30'	P1B
1P2B-3	NSR LVP (P)	773	307°-30'	P2B
1P1B-4	NSR LVP (P)	773	47°-30'	P1B
1P2B-4	NSR LVP (P)	773	312°-30'	P2B
1P1B-5	NSR LVP (P)	771	35°-0'	P1B
1P1E-1	ESF 1 (P)	796	42°-30'	P1E
1P2E-1	ESF 2 (P)	796	307°-30'	P2E
1P1E-2	ESF 1 (P)	794	50°-0'	P1E
1P2E-2	ESF 2 (P)	796	302°-30'	P2E
1P2E-3	ESF 2 (P)	796	52°-30'	P2E
1C1B-1	Control (C)	771	50°-0'	C1B
1C2B-1	Control (C)	771	310°-0'	C2B
1C1B-2	Control (C)	771	40°-0'	C1B
1C2B-2	Control (C)	771	320°-0'	C2B
1C1B-3	Control (C)	771	55°-0'	C1B

TABLE 8.3-6
ELECTRICAL PENETRATION SCHEDULE.(Continued)

PENETRATION NUMBER	SERVICE	ELEVATION (ft)	CLOCKWISE AZIMUTH	SEGREGATION CODE*
1C2B-3	Control (C)	771	305°-0'	C2B
1C1E	RPS 1, ESF 1 (C)	794	40°-0'	C1E
1C2E-1	RPS 2, ESF 2 (C)	794	305°-0'	C2E
1C2E-2	ESF 2 (C)	794	310°-0'	C2E
1C3E	RPS 3 (C)	794	55°-0'	C3E
1C4E	RPS 4 (C)	794	317°-30	C4E
1K1B-1	Instr (K)	769	52°-30'	K1B
1K2B-1	INST. (K)	769	302°-30'	K2B
1K1B-2	INST. (K)	769	57°-30'	K1B
1K2B-2	Instr (K)	769	322°-30'	K2B
1K1B-3	Instr (K)	775'-9"	192°-0'	K1B
1K1B-4	Instr (K)	775'-9"	205°-0'	K1B
1K2B-3	Instr (K)	769	307°-30'	K2B
1K1N	NMS 1 (K)	792	42°-30'	K1N
1K2N	NMS 2 (K)	794'-6"	240°-0'	K2N
1K3N	NMS 3 (K)	794'-6"	140°-0'	K3N
1K4N	NMS 4 (K)	792	315°-0'	K4N
1K1E-1	CRD 1 (K)	792	37°-30'	K1E
1K2E-2	CRD 2 (K)	792	302°-30'	K2E

TABLE 8.3-6
ELECTRICAL PENETRATION SCHEDULE.(Continued)

PENETRATION NUMBER	SERVICE	ELEVATION (ft)	CLOCKWISE AZIMUTH	SEGREGATION CODE*
1K1E-2	INST. 1 (K)	769	37°-30'	K1E
1K2E-1	INST. 2 (K)	792	307°-30'	K2E
1K3E	INST. 3 (K)	792	57°-30'	K3E
1K4E	INST. 4 (K)	792	320°-0'	K4E
SPARE-1	---	794	45°-0'	
1K1E	INST. 1 (K)	792	52°-30'	K1E
SPARE-3	---	771	325°-0'	

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* See Table 8.3-7 for segregation codes.

** Non-safety related low voltage power.

TABLE 8.3-7
SEGREGATION CODES AND COLORS

PENETRATION OR RACEWAY COLOR	PENETRATION OR RACEWAY CODES	CABLE CABLE COLOR PERMITTED	CABLE CODES PERMITTED
Yellow	P1E, C1E, K1E	Yellow	P1E, C1E, K1E
	P1N, C1N, K1N		P1N, C1N, K1N
	P1R, C1R, K1R		P1R, C1R, K1R
		Yellow-White	P1A, C1A, K1A
Yellow-White	P1A, C1A, K1A	Yellow-White	P1A, C1A, K1A
Blue	P2E, C2E, K2E	Blue	P2E, C2E, K2E,
	P2N, C2N, K2N		P2N, C2N, K2N
	P2R, C2R, K2R		P2R, C2R, K2R
		Blue-White	P2A, C2A, K2A
Blue-White	P2A, C2A, K2A	Blue-White	P2A, C2A, K2A
Green	P3E, C3E, K3E,	Green	P3E, C3E, K3E,
	P3N, C3N, K3N		P3N, C3N, K3N
	P3R, C3R, K3R		P3R, C3R, K3R
			C3R, K3N
		Green-White	P3A, C3A, K3A
Green-White	P3A, C3A, K3A	Green-White	P3A, C3A, K3A
Orange	P4E, C4E, K4E	Orange	P4E, C4E, K4E
	P4N, C4N, K4N		P4N, C4N, K4N
	P4R, C4R, K4R		P4R, C4R, K4R
		Orange-White	P4A, C4A, K4A
Orange-White	P4A, C4A, K4A	Orange-White	P4A, C4A, K4A
Black	P1B, C1B, K1B	Black or Gray	P1B, C1B, K1B
Black	P2B, C2B, K2B	Black or Gray	P2B, C2B, K2B
Black	PXB, CXB, KXB	Black or Gray	PXB, CXB, KXB

TABLE 8.3-7 (Cont'd)

NOTES FOR TABLE 8.3-7:

1. Segregation code makeup:

The first character is the voltage classification (see Subsection 8.3.1.4.4.3) - P, C, or K.

The second character indicates the Division - 1, 2, 3, or 4.

The third character is chosen according to the following tabulation:

CHARACTER	CABLES	RACEWAYS
R	Class 1E RPS cables	RPS Division raceways
N	Class 1E SRM, IRM, LPRM, and preamplifier cables	SRM, IRM, LPRM, and preamplifier Division raceways
E	Other Class 1E cables	Other Division raceways
A	Class 1E Division-associated cables	Conduit only
B	Non-safety-related Division cables (all station cables not categorized as R, N, E, or A)	Non-safety-related Division raceways
X	Non-safety-Related Division cables not in the main power station	Non-safety-related Division raceways

Tables 8.3-8 through 8.3-11
have been intentionally deleted.

TABLE 8.3-12

AMPACITIES OF 1-kV, 5-kV, 8-kV POWER CABLES, IN 50° C AMBIENT

	1-kV CABLES		5-kV CABLES		8-kV CABLES	
CABLE SIZE	CABLE TRAYS	CONDUIT	CABLE TRAYS	CONDUIT	CABLE TRAYS	CONDUIT
3/C # 19/22	16	30				
3/C # 6	32	62				
4/C # 4	44	82				
3/C # 2	64	111				
3/C # 1/0	97	149	133	151	121	167
4/C # 2/0	117	171				
3/C # 4/0	175	230				
3/C # 350	269	313	286	305	274	338
3/C # 500	333	383	366	371	367	412
3/C # 750			457	463	483	514

Table 8.3-13
PLANT LOADS

	LOAD NAME	EIN'S	DELAY TIME (SEC NOMINAL) AFTER DIESEL GENERATOR CIRCUIT BREAKER IS CLOSED	NUMBER INSTALLED	MAXIMUM BHP EACH (I)	MINIMUM IMMEDIATE REQUIREMENTS	ESF DIV.1 TOTAL BHP (I)	ESF DIV.2 TOTAL BHP (I)	PERCENT EFF.
A.	4160-V Loads (a)								
	1. Residual Heat Removal Pump	1E12-C002A/B/C	5(2A,2B), 0(2C)	3	590.8	1	590.8	1180	92.5
	2. LPCS Pump	1E21-C001	0	1	1200	1	1200	--	93.5
	3. Shutdown Service Wtr. Pump	1SX01PA/PB	10	2	1333	1	1333	1333	94.5
	4. Fuel Pool Cooling Pump	1FC02PA/PB	82 min.manual	2	340	0	340	340	95.4
B.	480-Vac Swgr. Loads (d)								
	1. HVAC Cont. Room Chiller Unit	0VC13CA/CB	20 min. Man. Start	2	271.1 (Div 1) 274.0 (Div 2)	0	271.1	274	96
	2. Cont. Rm. HVAC Supply Fan	0VC03CA	43	1	148	(Note n)	148	148	90
	3. Cont. Rm. HVAC Return Fan	0VC04CA	43	1	102	(Note n)	102	102	90
	4. Cont. Rm. HVAC Supply Fan	0VC03CB	40	1	148	(Note n)	148	148	90
	5. Cont. Rm. HVAC Return Fan	0VC04CB	40	1	102	(Note n)	102	102	90
	6. Swgr. Heat Removal Cond. Unit	1VX06CA/CB	2 min.	2	51.5 kW	1	51.5 kW	51.5 kW	90
	7. Diesel Gen. Rm. Vent Fan	1VD01CA/CB	10	2	114	1	114	114	90
C.	480-Vac MCC Loads (b)								
	1. Diesel Gen Rm Vent Sys Dmpr.	1VD01YA/YB, 1VD02YA/YB 1VD03YA/YB		6	0.2	3	0.6	0.6	75
	2. Diesel Gen Oil Transfer Pump	1D001PA/PB		2	0.5	1	0.5	0.5	75
	3. Diesel Gen Oil Rm Vent Exh Fan	1VD02CA/CB		2	2.9	1	2.9	2.9	80
	4. Diesel Gen Oil Recir & Turbo Pmp	1DG01KA/KB [B7/1B7][B7A/1B7A]	(See Note j)	8	1.8	4	3.6	3.6	75
	5. Swgr Heat Removal Fan	1VX03CA/CB		2	28.4	1	28.4	28.4	85
	6. Swgr Heat Removal Rtn Air Fan	1VX12CA/CB		2	4.0	1	4.0	4.0	80
	7. Swgr Rm Heat Rmvl Dmpr	1VX03YA/YB		2	0.2	1	0.2	0.2	75
	8. Battery Rm Exhaust Fan	1VX11CA/CB		2	1.9	1	1.9	1.9	80
	9. Battery Rm Exhaust Fan Dmpr	1VX59YA/YB		2	0.2	1	0.2	0.2	75
	10. Battery Charger	1DC06E/ 1DC07E		2	44.8 kW rated	1	34.9 kW	16.1 kW	87
	11. Batter Charger (Div. 4)	1DC08E		1	44.8 kW rated	1	--	16.9 kW	87
	12. Deleted								

TABLE 8.3-13 (Cont'd)
PLANT LOADS

LOAD NAME	EIN'S	DELAY TIME (SEC NOMINAL) AFTER DIESEL GENERATOR CIRCUIT BREAKER IS CLOSED	NUMBER INSTALLED	MAXIMUM BHP EACH (I)	MINIMUM IMMEDIATE REQUIREMENTS	ESF DIV.1 TOTAL BHP (I)	ESF DIV.2 TOTAL BHP (I)	PERCENT EFF.
13. NSPS 480-Vac-120-Vac Transformer	1RP01E/02E/04E		3	7.5 kVA	0	See Note f	--	--
14. Inverter Rm Cub Cooling Fan	1VX13CA/CB		2	.1	1	.1	.1	75
15. 480-Vac-208/120-Vac Dist Transf	0AP54EB/55EB 0AP56E/57E 1AP72E/75E/93E/94E		8	7.5 kVA	4	22.5 kW	22.5 kW	100
16. Regulation Transformer	0IP54EB/55EB		2	7.5 kVA	1	5.6 kW	5.6 kW	100
17. 480-Vac-208/120-Vac Dist Transf	1AP29E/30E		2	3 kVA	1	2.3 kW	2.3 kW	100
18. Standby Lighting Cabinet	1LL58EA/59EA/60EA 1LL61EA/69EA/70EA		6	48.4 kW	6	102.2 kW	95.0 kW	100
19. Hydrogen (H_2) Recombiner Rm Clg Fan	OVG01CA/CB	4 hr manual	2	5	0	5	5	80
20. Hydrogen Ignitor Dist Pnl	1HG03JA/JB		2	15 kW rated	1	6.1 kW	6.8 kW	100
21. Hyd/Oxy (H_2) Monitg Sample Pump	1CM01SB (1CMO1SA)		1	1.5 (0.5)	0	0.5	1.5	75
22. Hyd/Oxy Monitg Air Compressor	1CM01SB		1	1.5	0	--	1.5	75
23. ECCS RHR Pmp Rm & HX Rm Supply Fan	1VY02C/03C 1VY05C/06C/07C	5 (2C; 6C) 0 (3C; 5C; 7C)	5	5	2/3	10	15	80
24. ECCS LPCS Pump Rm Supply Fan	1VY01C		1	7	1	7	--	80
25. ECCS Rm Outlet SGT Set Dmpr.	1VG06YA/YB		2	0.2	1	0.2	0.2	75
26. ECCS RCIC Pmp Rm Supp Fan	1VY04C		1	2.0	1	2.0	--	80
27. CGCS Cub Sys Supply Fan	1VR08C/11C		2	3.0	1	3.0	3.0	80
28. CGCS Hydrogen Compressor	1HG02CA/CB	2 hr manual	2	60	0	60	60	82
29. CGCS Hydrogen Recombiner	0HG01SA/SB	4 hr manual	2	56.8 kW	0	56.8 kW	56.8 kW	100
30. Low Press Core Spray Wtr Leg Pump	1E21-C002		1	5.1	1	5.1	--	81
31. RHR Water Leg Pump	1E12-C003		1	5.1	1	--	5.1	81
32. SSW Pump Rm Supply Fan	1VH01CA/CB	10	2	16.0	1	16.0	16.0	85
33. RWCU Room Damper	1VG04YA/YB		2	0.2	1	0.2	0.2	75
34. Fuel Building Damper	1VG05YA/YB		2	0.2	1	0.2	0.2	75

TABLE 8.3-13 (Cont'd)
PLANT LOADS

LOAD NAME	EIN'S	DELAY TIME (SEC NOMINAL) AFTER DIESEL GENERATOR CIRCUIT BREAKER IS CLOSED	NUMBER INSTALLED	MAXIMUM BHP EACH (I)	MINIMUM IMMEDIATE REQUIREMENTS	ESF DIV.1 TOTAL BHP (I)	ESF DIV.2 TOTAL BHP (I)	PERCENT EFF.
35. RCIC Water Leg Pump	1E51-C003		1	4.0	1	4.0	--	80
36. Cont Rm Supply Air Mod Dmpr	0VC12YA/YB thru 0VC18YA/YB		14	0.2	7	1.4	1.4	75
37 Cont Rm Filt Trn Dmpr	0VC09YAA/YAB 0VC09YBA/YBB 0VC10YA/YB 0VC11YAA/YAB 0VC11YBA/YBB		10	0.2	4	1.0	1.0	75
38. Cont Rm Max Intake & Pge Dmpr	0VC05YA/YB 0VC48YA/YB 0VC49YA/YB 0VC81YA/YB		8	0.2	0	0.8	0.8	75
39. Cont Rm HVAC Chilled Wtr Pump	0VC08PA/PB	40	2	18.4	1	18.4	18.4	65
40. Cont Rm HVAC M-U Air El Htg Coil	0VC02AA/AB	24	2	15.2 kW	1	15.2 kW	15.2 kW	100
41. Cont Rm HVAC M-U Air Fan	0VC05CA/CB	24	2	24	1	24	24	86.5
42. Cont Rm HVAC M-U Equip Fan	0VC18CA/CB		2	2	1	2	2	80
43. Deleted								
44. Chiller Oil Pump	0VC13CA/CB		2	1.5	1	1.5	1.5	75
45. MSIV Inbd Outb Room Fan	1VY09C/1VY10C		2	0.8	1	0.8	0.5	75
46. Deleted								
47. Deleted								
48. SBGT Exh Fan	0VG02CA/CB		2	20	1	20	20	85
49. SBGT Room Fan	0VG05CA/CB		2	5	1	5	5	80
50. SBGT Electric Heater	0VG04AA/AB		2	20 kW rated	1	20 kW	20 kW	100
51. SGT Set Sec Ctl Inlet Dmpr	1VG02YA/YB		2	0.2	1	0.2	0.2	75

TABLE 8.3-13 (Cont'd)
PLANT LOADS

LOAD NAME	EIN'S	DELAY TIME (SEC NOMINAL) AFTER DIESEL GENERATOR CIRCUIT BREAKER IS CLOSED	NUMBER INSTALLED	MAXIMUM BHP EACH (I)	MINIMUM IMMEDIATE REQUIREMENTS	ESF DIV.1 TOTAL BHP (I)	ESF DIV.2 TOTAL BHP (I)	PERCENT EFF.
52. SGTS Trn Dmpr	0VG01YA/YB thru 0VG05YA/YB 1VG01YA/YB		12	0.2	3	1.2	1.2	75
53. Deleted								
54. CRA Zn + Isol Dmpr	0VC04YA/YB, 08YA/YB 0VC21YA/YB, 24YA/YB 0VC27YA/YB, 30YA/YB 0VC33YA/YB, 0VC36YA/YB, 39YA/YB		18	0.2	9	1.8	1.8	75
55. Cont Rm M-U Air Dmpr	0VC02YA/B, 0VC03YA/YB 0VC06YA/YB, 0VC114YA/YB 0VC115YA/YB	0 0 0 24 0	10	0.2	3	1.0	1	75
56. Deleted								
57. Deleted								
58. Battery Room Exh Fan	1VX05CA/CB		2	0.2	1	0.2	0.2	75
59. Inverter Rm Cb Cool Fan Div 4	1VX14C		1	1.9	1	--	1.9	80
60. Fire Protection Dist. Pnl.			1	7.5kVA rated	1	3.8 kVA	--	100
61. MSIV Inboard Air Blower	1E32-C001		1	5	0	5	--	80
62. MSIV Leak Cont. Pipe Heater	1E32-B001A/E 1E32-B001J/N		4	6.6kW rated	0	25.1 kW	--	100
63. Standby Liquid Cont. Pump	1C41-C001A/B		2	35	0	0	35	90.6
64. Deleted								
65. Deleted								
66. SSW Strainer Basket	1SX01FA/FB		2	1.3	2	1.3	1.3	75
67. Deleted								
68. Telephone System Emerg. Feed	0CQ07EB		1	15 kVA rated	0	7.5 KVA	--	100

TABLE 8.3-13 (Cont'd)
PLANT LOADS

LOAD NAME	EIN'S	DELAY TIME (SEC NOMINAL) AFTER DIESEL GENERATOR CIRCUIT BREAKER IS CLOSED	NUMBER INSTALLED	MAXIMUM BHP EACH (I)	MINIMUM IMMEDIATE REQUIREMENTS	ESF DIV.1 TOTAL BHP (I)	ESF DIV.2 TOTAL BHP (I)	PERCENT EFF.
69. SGBT Sys. Cool Fan	0VG03CA/CB		2	1.0	0	1.0	1.0	75
70. Control Room Min. O.A. Dmprs.	0VC01YA/YB		2	0.2	2	0.2	0.2	75
71. Control Room Locker Rm. Dmpr.	0VC69Y/70Y		2	0.2	0	0.2	0.2	75
72. Deleted								
73. Deleted								
74. Deleted								
75. Deleted								
76. Deleted								
77. Deleted								
78. Swgr Ht Rmvl Cont Vlv	1SX025A/B	2 min.	2	0.2	1	0.2	--	75
79. MSIV Outboard Air Blower	1E32-C002B/2F		2	5	0	--	10	80
80. HVAC Ht Exch Outlet Cont Vlv	1SX019A/B		2	1.0	1	--	1.0	75
81. Valves (c)			--	--	--	--	--	--
82. Deleted								
83. Chem Lab Standby Ltg Cab	1LL89EB		1	8.3 kVA rated	1	--	3.5 kW	100
84. Swgr Rm Heat Rmvl Sply	1VXO4YA/YB		1	0.2	1	0.2	0.2	75
TOTAL INPUT KW @ EFF (m)						3849	3365	
TOTAL INPUT KVA						4419	3848	

TABLE 8.3-13 (Cont'd)
PLANT LOADS

	LOAD NAME	EIN'S	DELAY TIME (SEC NOMINAL) AFTER DIESEL GENERATOR CIRCUIT BREAKER IS CLOSED	NUMBER INSTALLED	MAXIMUM BHP EACH (I)	MINIMUM IMMEDIATE REQUIREMENTS	ESF DIV.3 TOTAL BHP (I)	PERCENT EFF.
A.	4160-V Loads							
	1. HPCS Pump	1E22-C001		1	2316.20	1	2316.20	94
B.	480-Vac MCC Loads (b)							
	1. DG IC Circ. Oil Pump	1E22-S001F		1	1.8	1	1.8	75
	2. HPCS Water Leg Pump	1E22-C003		1	4	1	4	80
	3. HPCS Battery Charger 1C	1E22-S001E		1	13.0 kW rated	1	6.4 kW	83
	4. 480-Vac/120-Vac NSPS Div3 Sply Trnsf	C71P001C		1	10 kVA	0	See Note f	--
	5. 480-Vac/208-Vac/120-Vac 15 kVA Reg. Transf.	1AP78ERT		1	2.7 kVA	1	2.7 kVA	90
	6. DG Fuel Oil Transfer Pump 1C	1DO01PC		1	0.5	1	0.5	75
	7. Regulation Transformer	1IP78E		1	7.5 kVA	1	7.5 kVA	100
	8. DG Room 1C Vent Fan	1VD01CC		1	75 rated	1	71	90
	9. DG 1C Oil Room Exhaust Fan	1VD02CC		1	2.9	1	2.9	80
	10. DG Room 1C Vent Sys. Damper	1VD01YC/2YC/3YC		3	0.2	3	0.6	75
	11. SWGR 1C1 Ht. Removal Fan 1A	1VX03CC		1	3.7	1	3.7	80
	12. Battery Room 1C1 Exhaust Fan	1VX05CC		1	0.2	1	0.2	75
	13. SWGR 1C1 Ht. Removal Cond. Unit	1VX06CC		1	13.2 kW	1	13.2 kW	85
	14. SWGR Room 1C1 Ht. Rm. Vl. Dmpr.	1VX03YC/4YC		2	0.2	1	0.4	75
	15. ECCS HPCS Pump Room Supply Fan	1VY08CA/CB		2	5.0	2	10.0	80
	16. 480-Vac/208-Vac/120-Vac Dist. Transformer	1AP31E		1	3 kVA	1	3 kVA	100
	17. SSW Pump 1C	1SX01PC		1	68	1	68	90
	18. SSW Pump Rm. 1C Supply Fan	1VH01CC		1	3.0	1	3.0	80
	19. Deleted							
	20. Deleted							
	21. 480-Vac/208-Vac/120-Vac Dist XFMR (HPCS Area Dist Pnl)			1	5 kVA rated	1	2.7 kVA	100
	22. SSW Bskt Strainer Mtr	1SX01FC		1	0.3	1	0.3	75
	23. Swgr Ht Rmvl Cont Vlv	1SX025C		1	0.2	1	0.2	75
	24. Valves (c)			--	--	--	--	--
	25. Deleted							

TABLE 8.3-13 (Cont'd)

PLANT LOADS

LOAD NAME	EIN'S	DELAY TIME (SEC NOMINAL) AFTER DIESEL GENERATOR CIRCUIT BREAKER IS CLOSED	NUMBER INSTALLED	MAXIMUM BHP EACH (l)	MINIMUM IMMEDIATE REQUIREMENTS	ESF DIV.3 TOTAL BHP (l)	PERCENT EFF.
TOTAL INPUT KW @ EFF. (m)						2020	
TOTAL INPUT KVA						2215	

NOTES:

a) Loads are applied automatically in sequence as indicated.
b) Loads are energized automatically upon restoration of bus voltage.
c) Loads are considered intermittent.
d) 4160-V/480-Vac unit substations will be energized as soon as the bus feed breaker to the diesel generator is closed.
e) Total input KVA calculated based on given power factor and efficiency given in auxiliary system bus loading calculation. Total input kW and kVA includes system losses.
f) The NSPS load is included in the battery charger load. Transformer is secondary source.
g) The total load is the maximum on a per diesel generator basis. The actual load on Div. 1 and Div. 2 when both diesel generators are available will be less.
h) Deleted.
i) Individual load KW may be found using:
    1. DG load [KW] = BHP X 0.746/EFF,
    OR
    2. DG load [KW] = KW/EFF
j) Each diesel generator consists of four pump motors: B7 = 1 HP, 1B7 = 0.75 HP, B7A = 1 HP and 1B7A = 0.75 HP.
k) Dist. xmfr are conservatively assumed to be loaded at 50% of rating.
l) BHP values are rounded to the nearest tenth BHP. BHP values are based on rated voltage and frequency.
m) Calculations evaluate the effects of voltage and frequency variations in confirming that there is margin between the loading (as listed above) and the 2000-hour rating of the Diesel Generators (DGs). The sequence and time of manually started loads as shown in the table above is one possible scenario, other sequences and times are possible. The total loading shown above on the DGs is a conservative estimate of the anticipated loading. For detailed evaluation of DG loading, refer to the most recent revision of the site load flow analysis calculation.
n) One VC supply fan and one VC return fan from the same division (A or B) is required.

Tables 8.3-14 through 8.3-16
have been intentionally deleted.

TABLE 8.3-17
ELECTRICAL SEPARATION REQUIREMENTS

	RACEWAY CONFIGURATION	MINIMUM CLEARANCE REQUIRED		REFERENCE FIGURE
A)	Safety-related open cable tray above or to the side of redundant safety-related/or non-safety-related open cable tray.	Horizontal………………………	> 0"	8.3-8 (1)
		Vertical…………………………	24"	
B	Safety-related/cable tray above or to the side of redundant safety-related or non-safety-related cable tray with cover	Horizontal………………………	> 0"	8.3-8 (2)
		Vertical…………………………	1"	
C)	Safety-related cable tray crossing above redundant safety-related or non-safety-related cable tray with cover	Vertical…………………………	1"	8.3-8 (3)
D)	Safety-related cable tray below non-safety-related open cable tray.	Vertical…………………………	1"	8.3-8 (4)
E)	Safety-related/and redundant safety-related/or non-safety-related open tray/riser combinations.	Horizontal………………………	6"	8.3-8 (5)
F)	Safety-related and redundant safety-related or non-safety-related tray/riser combinations with cover on either tray.	Horizontal………………………	> 0"	8.3-8 (5)

TABLE 8.3-17 (Cont'd)

	RACEWAY CONFIGURATION	CLEARANCE REQUIRED		FIGURE
G)	Non-safety-related conduit crossing, above, below, or to the side of safety-related open cable tray	Horizontal (raceway)…………..	0" (1")	8.3-8 (6)
		Horizontal (cable in open tray)………….....	> 0"	
		Vertical................………………	0" (1")	
H)	Safety-related/associated conduit crossing above a redundant safety-related/ or non-safety-related open tray.	Vertical (EPR/HYP)...……….....	1" (12")	8.3-8 (7)
		Vertical (TEFZEL)......…………	12"	
I)	Safety-related/associated conduit above redundant safety-related or non-safety-related cable tray with cover or barrier.	Vertical (TEFZEL)..……….….....	1"	8.3-8 (8)
		Vertical (EPR/HYP)..……….....	> 0"	
J)	Safety-related/associated conduit below or to the side of redundant safety-related or non-safety-related open cable tray.	Horizontal............……………...	> 0"	8.3-8 (9)
		Vertical (EPR/HYP).....………...	> 0"	
		Vertical (TEFZEL)......……….....	1"	
K)	Safety-related/associated and redundant safety-relate/ associated or non-safety-related conduit crossings.	Horizontal............……………...	0" (1")	8.3-8 (10)
		Vertical.........………………….....	0" (1")	

TABLE 8.3-17 (Cont'd)

	RACEWAY CONFIGURATION	CLEARANCE REQUIRED		FIGURE
L)	Safety-related/associated conduit (containing cables with only EPR/Hypalon insulation /jacket) and redundant safety-related/associated conduit (containing cables with only EPR/Hypalon insulation /jacket) or non-safety-related conduit in parallel runs of 24" or less.	Horizontal (EPR/HYP)....……..	0" (1")	8.3-8 (11)
		Vertical (EPR/HYP)....………..	0" (1")	
M)	All other safety-related/ associated conduit redundant safety-related/associated conduit or non-safety-related conduit parallel runs not covered by configuration L above.	Horizontal...……………….........	1"	8.3-8 (12)
		Vertical.......………………........	1"	
N)	Safety-related/associated conduit and redundant safety-related/associated or non-safety-related conduit/box combinations.	Horizontal.......………………......	0" (1")	8.3-8 (13)
		Vertical............……………......	0" (1")	
O)	Safety-related/associated or non-safety cable in free air and redundant safety-related/associated or non-safety-related conduit combinations.	Horizontal (crossing)……….....	> 0" (1")	8.3-8 (14)
		Horizontal (parallel)..…………..	1"	
		Vertical………………................	1"	

TABLE 8.3-17 (CONT'D)

	RACEWAY CONFIGURATION	CLEARANCE REQUIRED		FIGURE
P)	Safety-related/associated cable and redundant safety-related/associated or non-safety-related cable in free air.	Horizontal..............................	6"	8.3-8 (15)
		Vertical.................................	6"	

NOTE: For those dimensions noted in parentheses, the following is applicable:

1) Separation between redundant safety-related raceways when either raceway contains a cable larger than 500 MC.

2) Separation between safety-related and non-safety-related raceways when the non-safety-related raceway contains a cable larger than 500 MCM.

TABLE 8.3-18

TABULATION OF DIESEL GENERATOR (DIVISION 3) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
GENERATOR OVERCURRENT	ALARM	ALARM	ALARM	OVERCURRENT DIESEL GENERATOR 1C
***GENERATOR VOLTAGE RESTRAINT OVERCURRENT	ALARM/TRIP	ALARM/TRIP	NONE	OVERCURRENT DIESEL GENERATOR 1C AND TRIP/LOCKOUT DIESEL GENERATOR 1C
***GENERATOR REVERSE POWER	ALARM/TRIP	ALARM/TRIP	NONE	TRIP/LOCKOUT DIESEL GENERATOR 1C
***LOSS OF EXCITATION	ALARM/TRIP	ALARM/TRIP	NONE	TRIP/LOCKOUT DIESEL GENERATOR 1C
***GENERATOR DIFFERENTIAL	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	TRIP/LOCKOUT DIESEL GENERATOR 1C
ENGINE CONTROL SWITCH NOT IN AUTO	ALARM	ALARM	ALARM	HPCS SYSTEM NOT READY FOR AUTO START OR BREAKER IN LOWER POSITION
LOCAL VOLTAGE REGULATOR SWITCH NOT IN AUTO POSITION	ALARM	ALARM	ALARM	HPCS SYSTEM NOT READY FOR AUTO START OR BREAKER IN LOWER POSITION

TABLE 8.3-18 (Cont'd)

TABULATION OF DIESEL GENERATOR (DIVISION 3) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
*ENGINE OVERSPEED	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	OVERSPEED DIESEL GENERATOR 1C AND TRIPPED DIESEL GENERATOR 1C ENGINE AND TROUBLE DIESEL GENERATOR 1C
DIESEL GENERATOR ABOVE 150 RPM	ALARM	ALARM	ALARM	RUNNING DIESEL GENERATOR 1C
DIESEL GENERATOR TROUBLE LOCKOUT	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	TRIPPED DIESEL GENERATOR 1C ENGINE AND HPCS SYSTEM NOT READY FOR AUTO START OR BREAKER IN LOWER POSITION
ENGINE CONTROL SWITCH IN MAINTENANCE POSITION	ALARM	ALARM	ALARM	DIESEL ENGINE IN MAINTENANCE POSITION
GENERATOR GROUND FAULT	ALARM	ALARM	ALARM	GROUND HPCS SYSTEM

TABLE 8.3-18 (Cont'd)

TABULATION OF DIESEL GENERATOR (DIVISION 3) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
LOCAL ANNUNCIATOR POWER FAILURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*FAIL TO START/RUN (OVERCRANK)	ALARM/TRIP	ALARM/TRIP	ALARM	**TROUBLE DIESEL GENERATOR 1C
*LOW FUEL LEVEL	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*CRANKCASE PRESSURE HIGH	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*HIGH LUBE OIL TEMPERATURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*HIGH WATER TEMPERATURE	ALARM/TRIP	ALARM/TRIP	ALARM	**TROUBLE DIESEL GENERATOR 1C
*CHARGER FAILURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*LOW START AIR PRESSURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*ENGINE TRIPPED	ALARM/TRIP	ALARM/TRIP	ALARM/TRIP	TROUBLE DIESEL GENERATOR 1C
*MAIN FUEL PUMP FAILURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C

TABLE 8.3-18 (Cont'd)

TABULATION OF DIESEL GENERATOR (DIVISION 3) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
*LOW LUBE OIL TEMPERATURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*LOW EXPANSION TANK WATER LEVEL	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*CONTROL POWER FAILURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*LOW LUBE OIL LEVEL	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*RESERVE FUEL PUMP FAILURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*LOW LUBE OIL PRESSURE	ALARM/TRIP	ALARM/TRIP	ALARM	**TROUBLE DIESEL GENERATOR 1C
*LOW COOLING WATER PRESSURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*125V DC GROUND	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*LOW CIRCULATING OIL PUMP PRESSURE	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C
*RESTRICTED FUEL OIL FILTER	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C

TABLE 8.3-18 (Cont'd)
TABULATION OF DIESEL GENERATOR (DIVISION 3) PROTECTIVE AND SUPERVISORY FUNCTIONS

EVENT	FUNCTION FOR TESTING (MANUAL START)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO LOSS OF ALL OFFSITE POWER (LOOP)	FUNCTION FOR EMERGENCY (AUTOMATIC START) OPERATION DUE TO ACCIDENT (LOCA)	CORRESPONDING CONTROL ROOM ALARM DESIGNATION
*RESTRICTED LUBE OIL FILTER	ALARM	ALARM	ALARM	TROUBLE DIESEL GENERATOR 1C

* INDICATES INDIVIDUAL ALARM AT LOCAL ANNUNCIATOR

** INDICATES THAT THIS EVENT ALSO ACTUATES CONTROL ROOM ALARM "TRIPPED DIESEL GENERATOR 1C ENGINE" DURING TEST MODE AND LOSS OF OFFSITE POWER BUT IS BYPASSED DURING LOCA CONDITIONS.

*** INDICATES THAT THIS EVENT ALSO ACUTATES CONTROL ROOM ALARM "HPCS SYSTEM NOT READY FOR AUTO START OR BREAKER IN LOWER POSITION."

TABLE 8.3-19 Q&R 430.108

WORST CASE FAULT CURRENTS AND CORRESPONDING INTERRUPTING CAPABILITIES FOR CLASS 1E EQUIPMENT

(HISTORICAL)

Class 1E Equipment	Maximum Fault Level (% of Rating)	Voltage Level	Interrupting Rating
6900-V Switchgear	< 90%	7093V	40708A
4160-V Switchgear	< 96%	4300V	46935A
480-Vac Switchgear	< 90%	479V	22000A
480-Vac MCCs	< 90%	488V	22000A
120-Vac/208-Vac Dist. Panels:	< 95%	---	18000A
	< 95%	---	10000A
Phase to Phase (208-Vac)	< 50%	---	10000A
Phase to Ground (120-Vac)	< 50%	---	10000A

Present fault current values are determined in site calculations,.(19-AK-13 and 19-AJ-03.)

TABLE 8.3-20
WORST-CASE FULL-LOAD AND FAULT CURRENTS FOR 4160-V AND 6900-V MANUALLY-OPERATED DISCONNECT SWITCHES

(HISTORICAL)

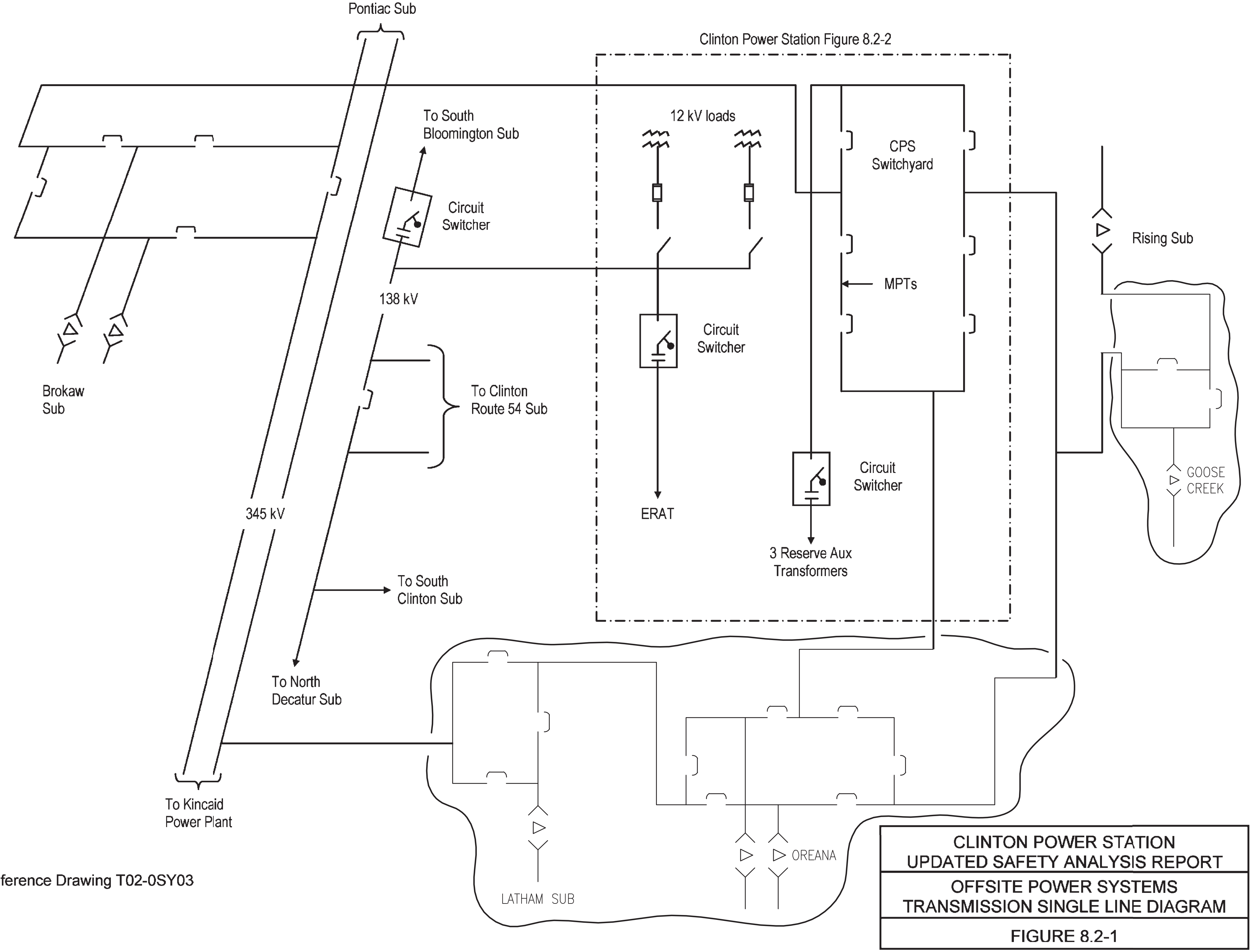
Switch	Rating (amps)	Full-Load Current (amps)	Momentary RMS Asymmetrical Capability (amps)	Instantaneous Peak Current Capability (amp)	Momentary Fault (% of Rating)
ET4	4000	1430	60,000	84,000	< 80%
ET14	4000	1430	60,000	84,000	< 95%
RT16	3000	2340	80,000	112,000	< 50%
RT14	4000	4180	60,000	84,000	< 95%

Present full load and fault current values are determined in site calculation 19-AK-13.

(Q&R 430.109)

Ratings shown are based on the non-segregated buswork in which these switches are installed. The vendor drawings for the switches show an 80,000A momentary ratings for all the switches. Accordingly the momentary fault current available would be a smaller % of the actual switch rating.

The full load current shown for switch RT14 is a maximum value that would only be present for a short period immediately after a LOCA accident requiring operation of all ECCS and safety pumps. As the plant response continued, non-essential loads would be shutdown and the full load current would be reduced to within the 4000A rating of the bus and switch.

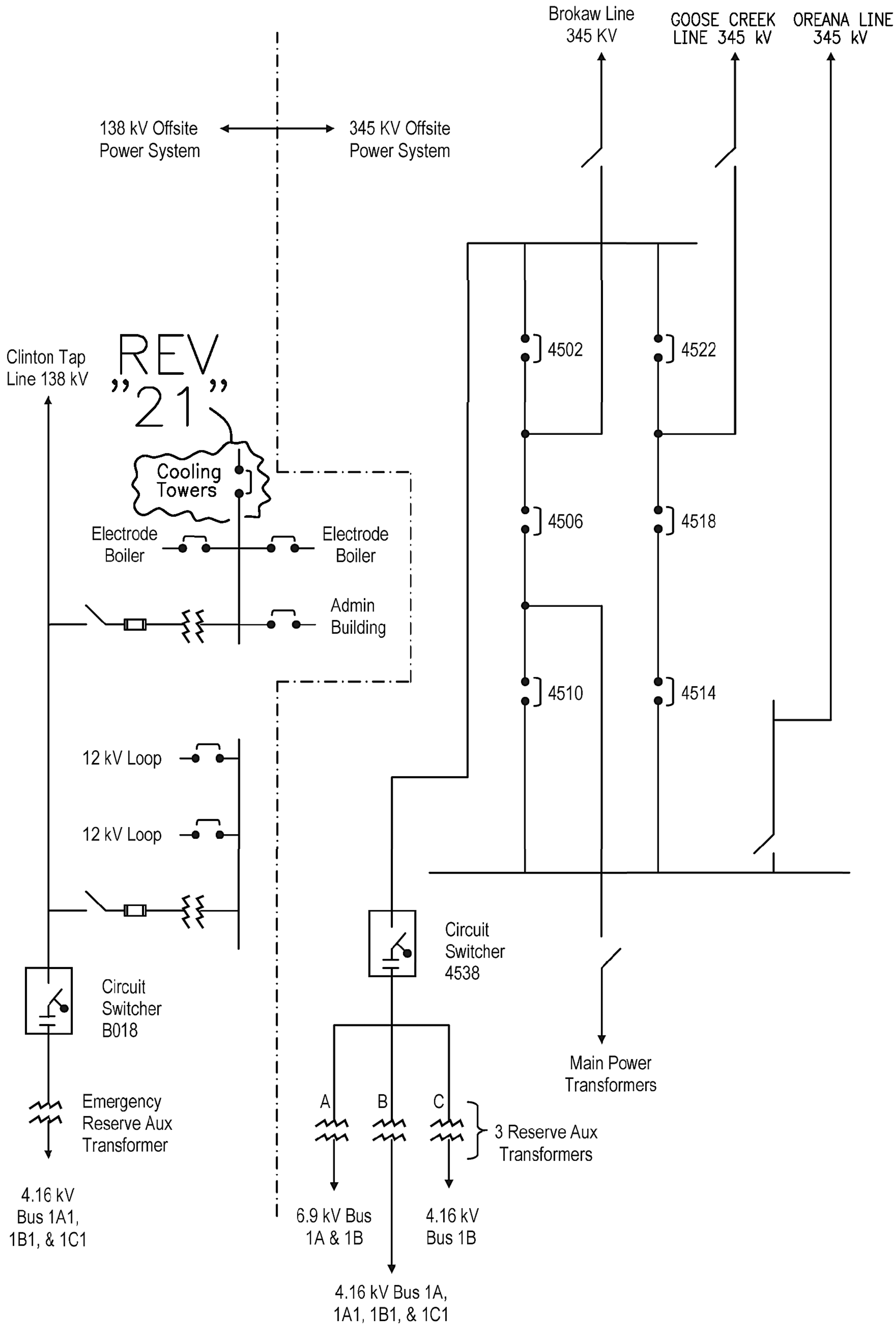


Reference Drawing T02-0SY03

CLINTON POWER STATION
UPDATED SAFETY ANALYSIS REPORT

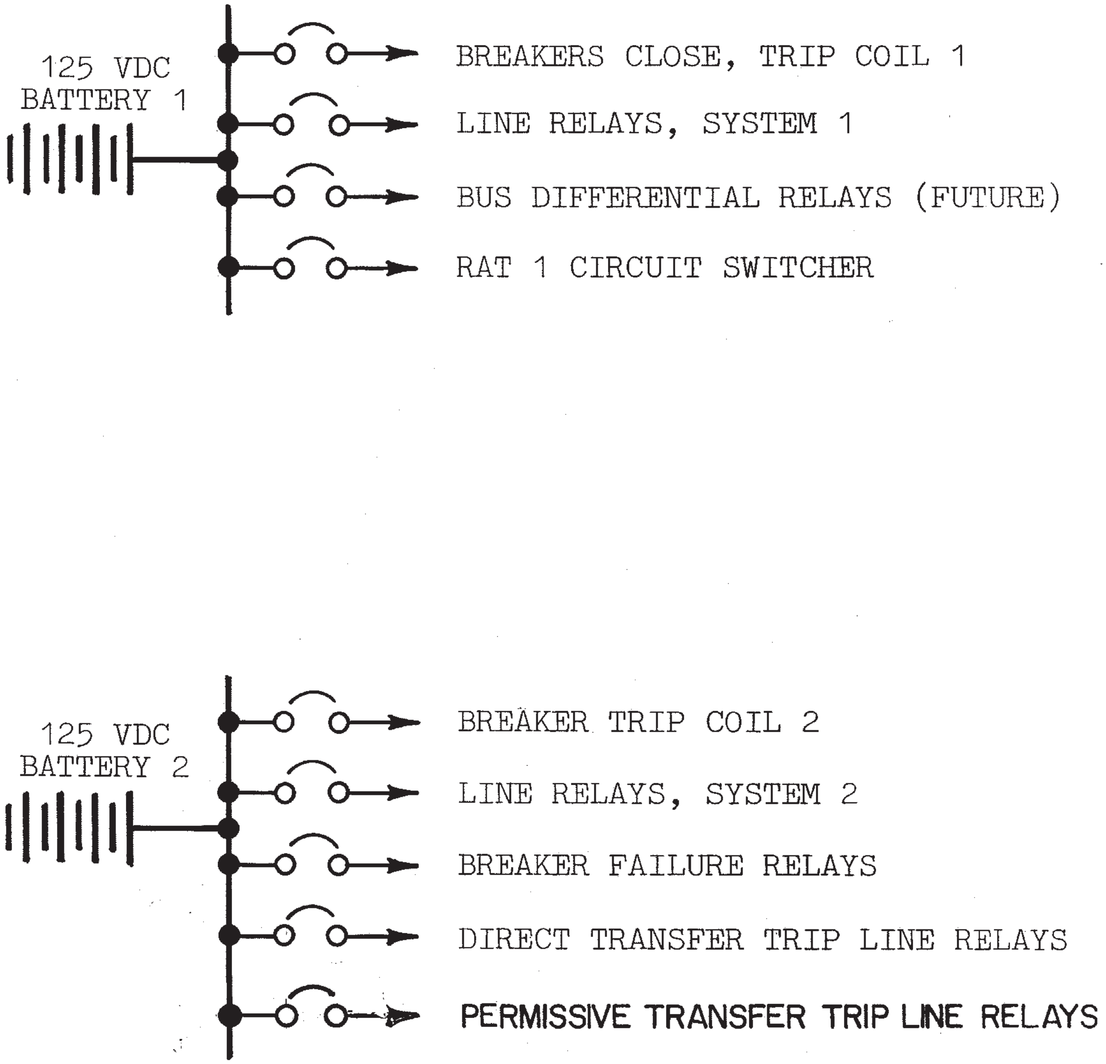
OFFSITE POWER SYSTEMS
TRANSMISSION SINGLE LINE DIAGRAM

FIGURE 8.2-1



CLINTON POWER STATION
UPDATED SAFETY ANALYSIS REPORT

OFFSITE POWER SYSTEMS
SWITCHYARD SINGLE LINE DIAGRAM
FIGURE 8.2-2



CLINTON POWER STATION
UPDATED SAFETY ANALYSIS REPORT

FIGURE 8.2-3

D-C POWER SYSTEM -
SWITCHYARD SINGLE-LINE

Figure 8.2-4

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Figure 8.2-5

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Figures 8.3-1 through 8.3-5
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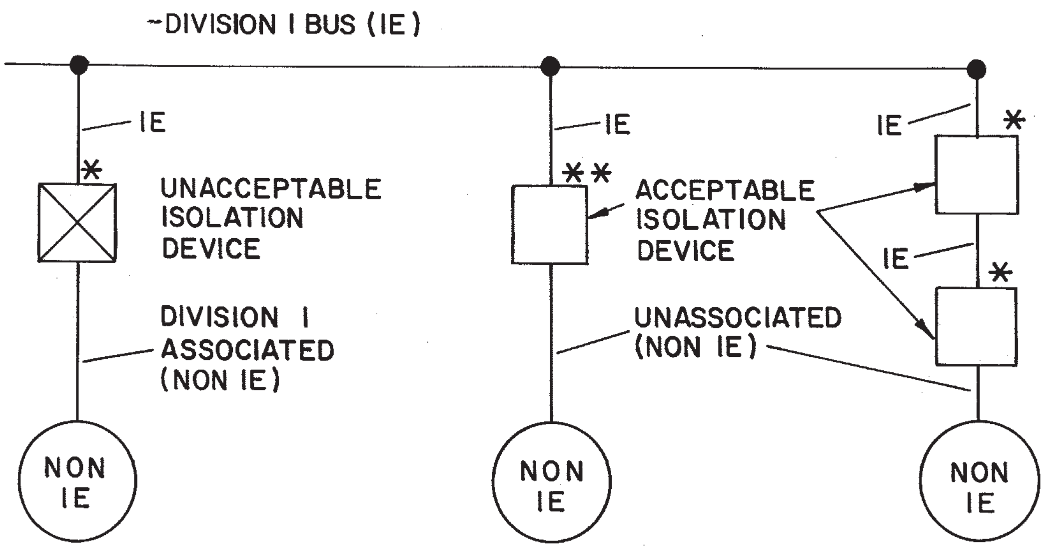
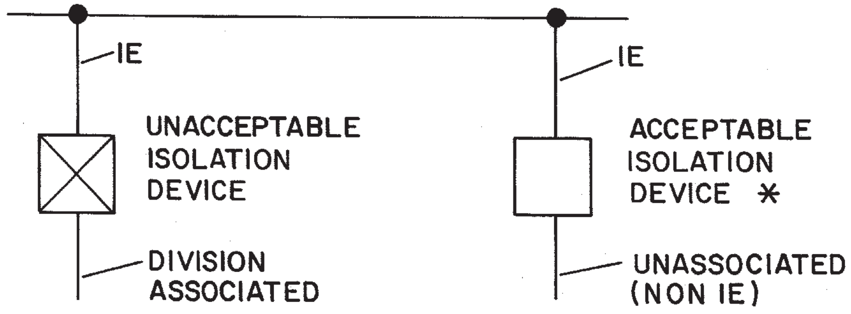
POWER CIRCUITS



* CIRCUIT BREAKER NOT TRIPPED ON LOCA OR FUSE
** LOCA TRIPPED CIRCUIT BREAKER

INFORMATION CIRCUITS



* RELAY (EXAMPLE)

NOTES:

1) AN UNACCEPTABLE ISOLATION DEVICE CAN BE USED ONLY IF AN ANALYSIS HAS DEMONSTRATED THAT THE NON IE LOAD WILL NOT DEGRADE THE IE POWER SOURCE.
2) AN UNACCEPTABLE ISOLATION DEVICE CAN BE USED IF THE NON IE LOAD HAS THE SAME QUALIFICATION AS THE IE POWER CIRCUIT.
3) THE LABELS "ACCEPTABLE" OR "UNACCEPTABLE" ARE PER THE REQUIREMENTS OF IEEE 384 AND REGULATORY GUIDE 1.75 FOR ISOLATION DEVICES.
4) THE LABEL "LOCA TRIPPED CIRCUIT BREAKER" AGREES WITH THE DEFINITION OF ACCIDENT TRIPPED CIRCUIT BREAKER PER NRC REGULATORY GUIDE 1.75.

CLINTON POWER STATION
UPDATED SAFETY ANALYSIS REPORT

FIGURE 8.3-6

ELECTRICAL ISOLATION

Figure 8.3-7
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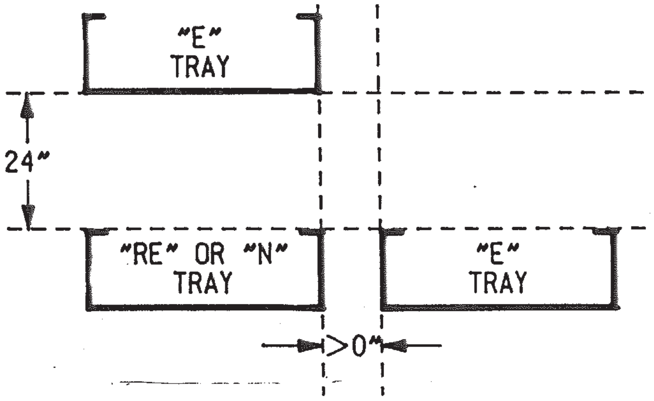
(1) SAFETY TRAY ABOVE OR TO THE SIDE OF REDUNDANT SAFETY OR NON-SAFETY TRAY

CLEARANCE REQUIRED:

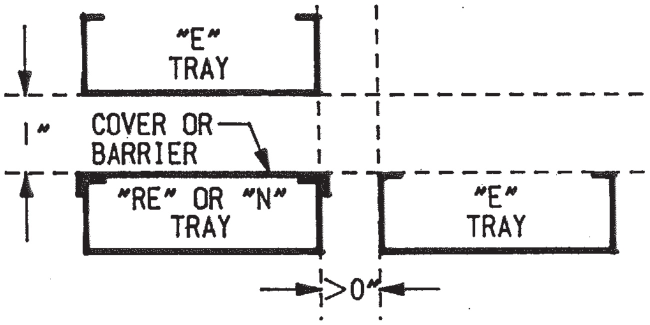
HORIZONTAL.......> 0"
OR
VERTICAL.........24"



(2) SAFETY TRAY ABOVE OR TO THE SIDE OF REDUNDANT SAFETY OR NON-SAFETY TRAY WITH COVER OR BARRIER

CLEARANCE REQUIRED:

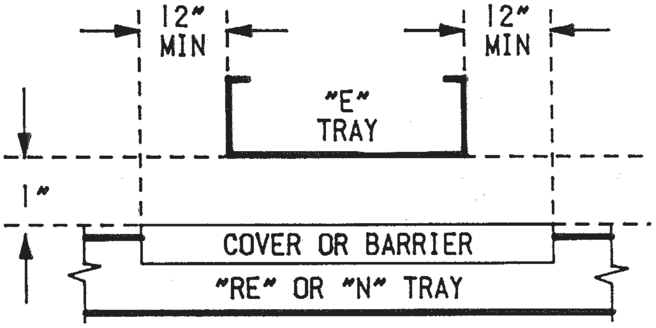
HORIZONTAL.......> 0"
OR
VERTICAL.........1"



(3) SAFETY TRAY CROSSING ABOVE REDUNDANT SAFETY OR NON-SAFETY TRAY WITH COVER OR BARRIER

CLEARANCE REQUIRED:

VERTICAL.........1"



CLINTON POWER STATION
UPDATED SAFETY ANALYSIS REPORT

FIGURE 8.3-8

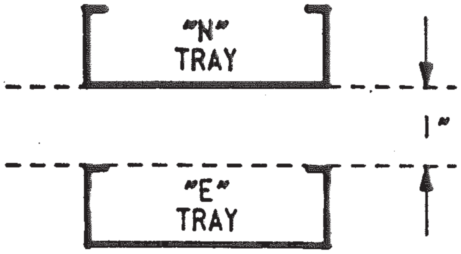
CABLE/RACEWAY
SEPARATION REQUIREMENTS

(SHEET 1 OF 6)

(4) NON-SAFETY TRAY ABOVE OR TO THE SIDE OF SAFETY TRAY

CLEARANCE REQUIRED:

VERTICAL.........1"

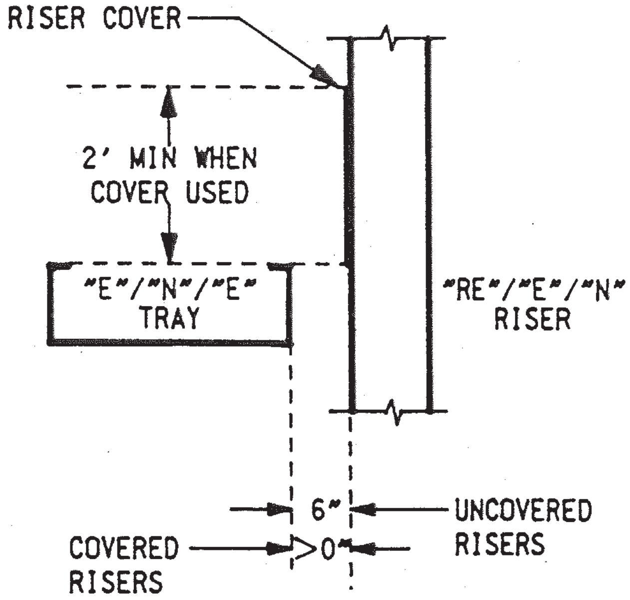


(5) SAFETY TO REDUNDANT SAFETY OR NON-SAFETY TRAY/RISER COMBINATIONS

CLEARANCE REQUIRED:

HORIZONTAL.......>0"
(COVERED RISER)

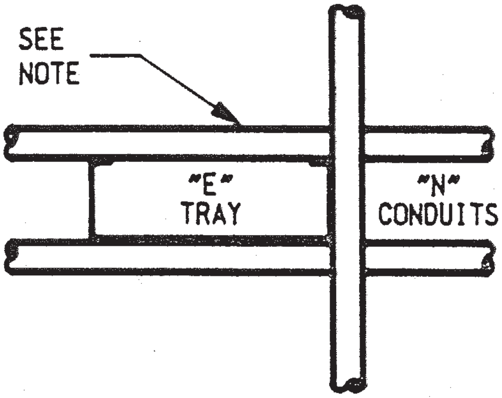
HORIZONTAL........ 6"
(UNCOVERED RISER)



(6) NON-SAFETY CONDUIT CROSSING, ABOVE, BELOW OR TO THE SIDE OF SAFETY TRAY

CLEARANCE REQUIRED:

HORIZONTAL.......0" (1")
OR
VERTICAL.........0" (1")



NOTE: SEPARATION BETWEEN CONDUIT ABOVE TRAY AND CABLES IN TRAY SHALL BE >0"

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FIGURE 8.3-8

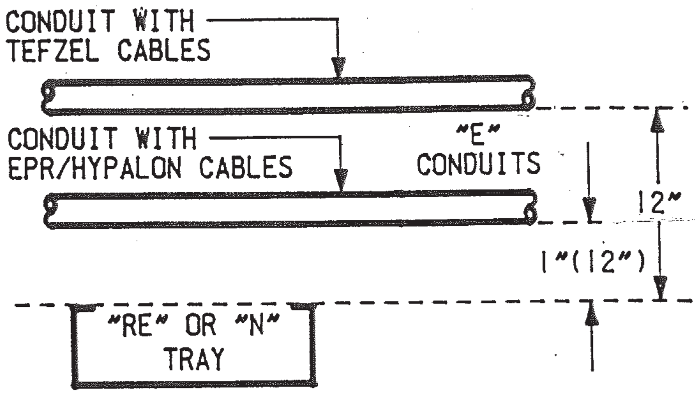
CABLE/RACEWAY
SEPARATION REQUIREMENTS

(SHEET 2 OF 6)

(7) SAFETY CONDUIT CROSSING ABOVE SAFETY OR NON-SAFETY TRAY

CLEARANCE REQUIRED:

VERTICAL (EPR/HYPALON) 1" (12")
VERTICAL (TEFZEL)..... 12"

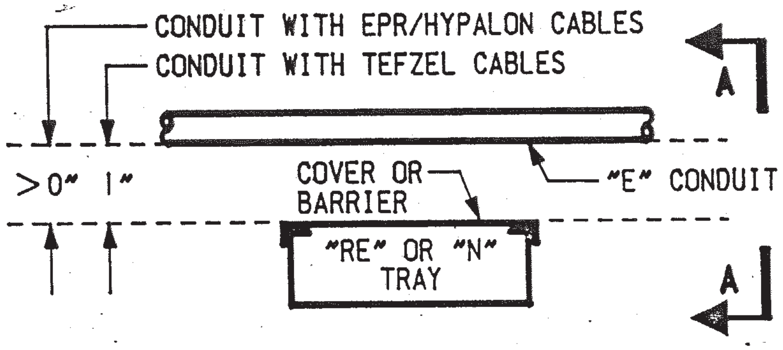


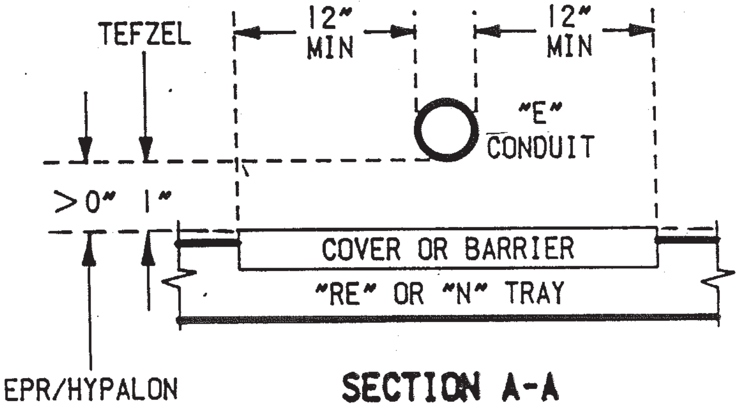
(8) SAFETY CONDUIT WITH TEFZEL CABLES ABOVE REDUNDANT SAFETY OR NON-SAFETY TRAY WITH COVER OR BARRIER

CLEARANCE REQUIRED:

VERTICAL (TEFZEL)...1"

VERTICAL (EPR/HYP)..>0"





SECTION A-A

CLINTON POWER STATION
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FIGURE 8.3-8

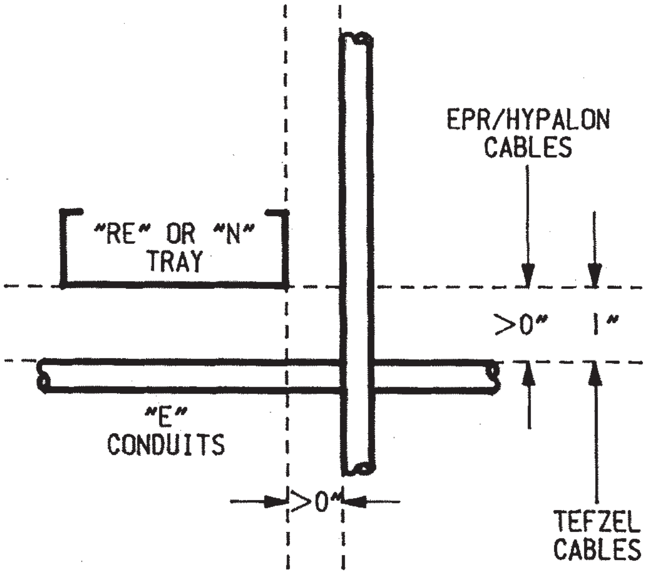
CABLE/RACEWAY
SEPARATION REQUIREMENTS

(SHEET 3 OF 6)

(9) SAFETY CONDUIT BELOW OR TO THE SIDE OF REDUNDANT SAFETY OR NON-SAFETY TRAY

CLEARANCE REQUIRED:

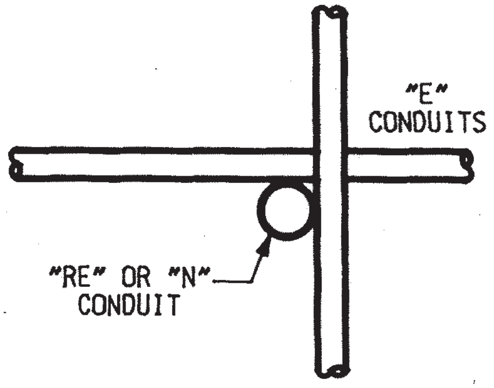
HORIZONTAL.......>0"
OR
VERTICAL(EPR/HYP)...>0"
VERTICAL(TEFZEL)..... 1"



(10) SAFETY CONDUIT TO REDUNDANT SAFETY OR NON-SAFETY CONDUIT CROSSINGS

CLEARANCE REQUIRED:

HORIZONTAL.......0" (1")
OR
VERTICAL.........0" (1")



(11) SAFETY CONDUIT WITH EPR/HYPALON CABLES PARALLEL TO REDUNDANT SAFETY OR NON-SAFETY CONDUITS

CLEARANCE REQUIRED:

HORIZONTAL.......0" (1")
OR
VERTICAL.........0" (1")

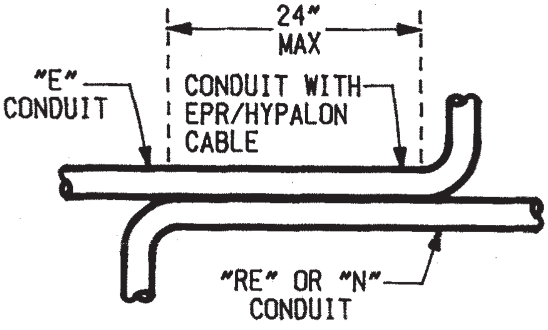


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FIGURE 8.3-8

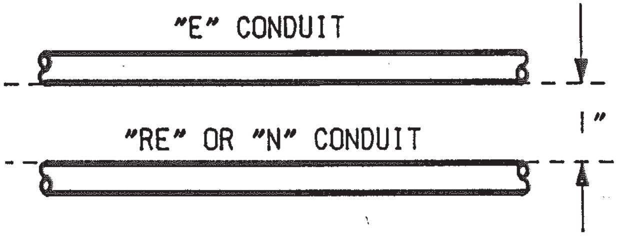
CABLE/RACEWAY
SEPARATION REQUIREMENTS

(SHEET 4 OF 6)

(12) SAFETY CONDUIT TO REDUNDANT SAFETY OR NON-SAFETY CONDUIT IN PARALLEL RUNS GREATER THAN 24" OR WHICH INVOLVED PARALLEL TEFZEL CABLE IN CONDUIT

CLEARANCE REQUIRED:

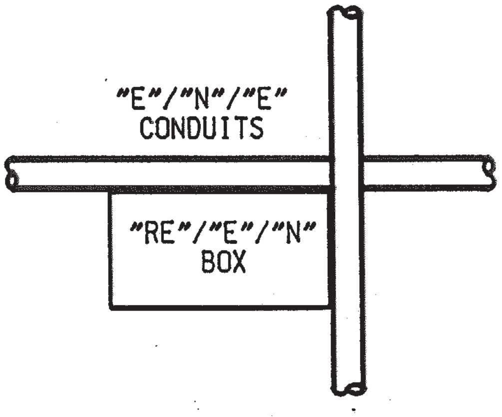
HORIZONTAL.......1"
OR
VERTICAL.........1"



(13) SAFETY TO REDUNDANT SAFETY OR NON-SAFETY CONDUIT TO BOX COMBINATIONS

CLEARANCE REQUIRED:

HORIZONTAL.......0"(1")
OR
VERTICAL.........0"(1")



(14) SAFETY TO REDUNDANT SAFETY OR NON-SAFETY CABLE IN FREE AIR TO CONDUIT COMBINATIONS

CLEARANCE REQUIRED:

HORIZONTAL(CROSSING)...>0" (1")
HORIZONTAL(PARALLEL).....1"
OR
VERTICAL.................1"

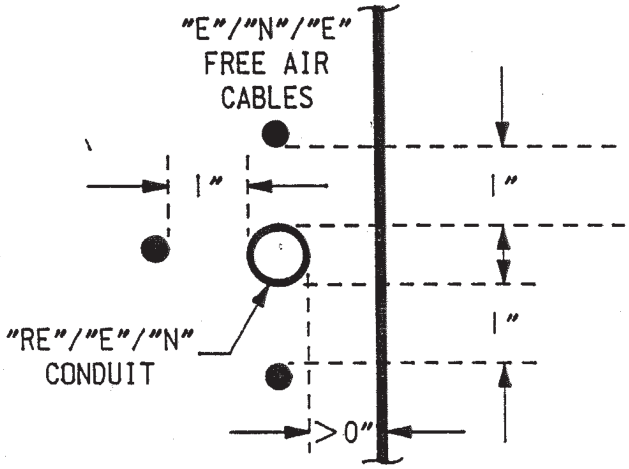


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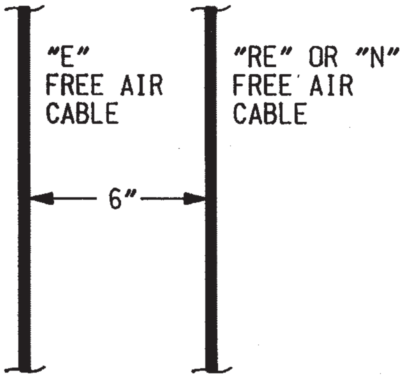
FIGURE 8.3-8
CABLE/RACEWAY
SEPARATION REQUIREMENTS

(SHEET 5 OF 6)

(15) SAFETY TO REDUNDANT SAFETY OR NON-SAFETY CABLE TO CABLE IN FREE AIR

CLEARANCE REQUIRED:

HORIZONTAL.......6"
OR
VERTICAL.........6"



CONFIGURATION KEY

ALL CABLE TRAYS IDENTIFIED IN THIS FIGURE ARE OPEN SOLID BOTTOM TYPE UNLESS OTHERWISE NOTED.

CONDUIT SEPARATION IDENTIFIED IN THIS FIGURE IS APPLICABLE TO EITHER RIGID STEEL,FLEXIBLE OR EMT.

RACEWAY SEGREGATION IDENTIFICATION IS AS FOLLOWS:

"E"	SAFETY RELATED OR ASSOCIATED
"RE"	REDUNDANT SAFETY RELATED OR ASSOCIATED
"N"	NON-SAFETY RELATED

SEPARATION DISTANCES ABOVE OPEN CABLE TRAYS SHALL BE TAKEN FROM THE TOP OF THE TOPMOST CABLE IN THE TRAY OR FROM TOP OF THE TRAY SIDE RAILS (WHICHEVER IS HIGHER).

BARRIERS MAY BE UTILIZED IN LIEU OF THE SOLID TRAY COVERS ILLUSTRATED IN CONFIGURATIONS (2), (3) AND (8). WHEN UTILIZED, BARRIERS SHALL CONFORM TO THE REQUIREMENTS OF IEEE 384-1974, FIGURES 2, 3 AND 4.

SEPARATION DISTANCES FOR JUNCTION BOXES AND PULL BOXES NOT COVERED BY CONFIGURATION (13) SHALL BE THOSE SHOWN IN CONFIGURATIONS (6), (7), (8), (9) AND (14) BY ASSUMING THAT A BOX IS EQUIVALENT TO CONDUIT.

FOR THOSE DIMENSIONS NOTED IN PARENTHESIS THE FOLLOWING IS APPLICABLE:

1) SEPARATION BETWEEN REDUNDANT SAFETY RACEWAYS WHEN EITHER RACEWAY CONTAINS A CABLE LARGER THAN 500MCM.

2) SEPARATION BETWEEN SAFETY AND NON-SAFETY RACEWAYS WHEN THE NON-SAFETY RACEWAY CONTAINS A CABLE LARGER THAN 500MCM.

THE VERTICAL CLEARANCE REQUIREMENTS PROVIDED IN CONFIGURATIONS (1) AND (4) ARE ALSO APPLICABLE FOR CONDUITS IN PARALLEL OVER TRAY.

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FIGURE 8.3-8
CABLE/RACEWAY
SEPARATION REQUIREMENTS
(SHEET 6 OF 6)