GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

May 27, 1993

Docket No. STN 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: Submittal Supporting Accelerated ABWR Review Schedule - **Chapter 8 Modifications**

Dear Chet:

Enclosed are SSAR markups to Chapter 8 material that resulted from the GE/NRC conference call on May 24, 1993. The following items are addressed:

Confirmatory items 8.3.3.1-1, 8.3.3.7-1, 8.3.3.8-1, 8.3.8.2-1, 8.3.8.4-1;

Open item 8.3.3.14-1;
and
COL Item 8.3.8.4-1

Please send copies of this transmittal to John Knox and Dale Thatcher.

Sincerely,

Jeffrey C. Buechler for JNF

Jack Fox
Advanced Reactor Programs

cc: Bob Strong (GE)
Norman Fletcher (DOE)

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Power for 480V auxiliaries is supplied from power centers consisting of 6.9-kV/480V transformers and associated metal clad switchgear, Figure 8.3-1.

Class 1E 480V power centers supplying Class 1E loads are arranged as independent radial systems, with each 480V bus fed by its own power transformer. Each 480V Class 1E bus in a division is physically and electrically independent of the other 480V buses in other divisions.

The 480V unit substation breakers supply motor control centers and motor loads up to and including 300KW. Switchgear for the 480V load centers is of indoor, metal-enclosed type with draw-out circuit breakers. Control power is from the Class 1E 125 Vdc power system of the same division.

8.3.1.1.2.2 Motor Control Centers

The 480V MCCs feed motors 100kW or smaller, control power transformers, process heaters, motor-operated valves and other small electrically operated auxiliaries, including 480-120V and 480-240V transformers. Class 1E motor control centers are isolated in separate load groups corresponding to divisions established by the 480V unit substations.

Starters for the control of 460v motors 100kW or smaller are MCC-mounted, across-the-line magnetically operated, air break type. Power circuits leading from the electrical penetration assemblies into the containment area have a fuse in series with the circuit breakers as a backup protection for a fault current in the penetration in the event of circuit breaker over-current or fault protection failure.

8.3.1.1.3 120/240V Distribution System

Individual transformers and distribution panels are located in the vicinity of the loads requiring Class 1E 120/240V power. This power is used for emergency lighting, and other 120V Class 1E loads.

8.3.1.1.4 Instrument Power Supply Systems

8.3.1.1.4.1 120V AC Class 1E Instrument Power System

Individual transformers supply 120V ac instrument power (Figure 8.3-2). Each Class 1E divisional transformer is supplied from a 430V MCC in the same division. There are three divisions, each backed up by its divisional diesel generator as the source when the offsite source is lost. Power is distributed to the individual loads from distribution panels, and to logic level circuits through the control room logic panels.

8.3.1.1.4.2 120V AC Class 1E Vital AC Power Supply System

8.3.1.1.4.2.1 CVCF Power Supply for the Safety System Logic and Control

(12 open) The power supply for the SSLC is shown in Figure 8.3-3, with each of the four buses supplying power for the independent trip systems of the SSLC system. Four constant voltage, constant frequency (CVCF) control power buses (Divisions I, II, III, and IV) have been established. They are each normally supplied

Insert "AA" →

independently from inverters which, in turn, are normally supplied power via a static switch from a rectifier which receives 480V divisional power. A 125V dc battery provides an alternate source of power through the static switch.

The capacity of each of the four redundant Class 1E CVCF power supplies is based on the largest combined demands of the various continuous loads, plus the largest combination of non-continuous loads that would likely be connected to the power supply simultaneously during normal or accident plant operation, whichever is higher. The design also provides capability for being tested for adequate capacity (see 8.3.4.34).

(72 open)

For Divisions I, II, and III, the AC supply is from a 480 V MCC for each division. The backup dc supply is via a static switch and a dc/ac inverter from the 125 Vdc central/distribution board for the division. A second static switch also is capable of transferring from the inverter to a direct feed through a voltage regulating transformer from a 480V motor control center for each of the three divisions.

Since there is no 480V ac Division IV power, Division IV is fed from a Division II motor control center. Otherwise, the ac supply for the Division IV CVCF power supply is similar to the other three divisions. The dc supply for Division IV is backed up by a separate Division IV battery.

The CVCF power supply buses are designed to provide logic and control power to the four division SSLC system that operates the RPS. [The SSLC for the ECCS derives its power from the 125 Vdc power system (Figure 8.3-4)]. The ac buses also supply power to the neutron monitoring system and parts of the process radiation monitoring system and MSIV function in the leak detection system. Power distribution is arranged to prevent inadvertent operation of the reactor scram initiation or MSIV isolation upon loss of any single power supply.

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Routine maintenance can be conducted on equipment associated with the CVCF power supply. Inverters and solid-state switches can be inspected, serviced and tested channel by channel without tripping the RPS logic.

8.3.1.1.4.2.2 Components

Each of the four Class 1E CVCF power supplies includes the following components:

(1) a power distribution cabinet, including the CVCF 120 Vac bus and circuit breakers for the SSLC loads;

(2) a solid-state inverter, to convert 125 Vdc power to 120 Vac uninterruptible power supply;

(3) a solid-state transfer switch to sense inverter failure and automatically switch to alternate 120 Vac power;

(4) a 480V/120V bypass transformer for the alternate power supply;

(5) a solid-state transfer switch to sense ac input power failure and automatically switch to alternate 125 Vdc power.

(6) a manual transfer switch for maintenance.

MARK-UP TEXT INSERTS

INSERT X (Needed to backup tech specs)**

The signals generated from high drywell pressure and low reactor vessel level are arranged in two-out-of-four logic combinations, and are utilized to sense the presence of a LOCA condition and subsequently start the diesel. These signals also initiate the emergency core cooling systems.

The loss of voltage condition and the degraded voltage condition are sensed by independent sets of three undervoltage relays (one on each phase of the 6.9 kV bus) which are configured such that two-out-of-three trip states will start the diesel generator. The primary side of each of the instrument potential transformers (PTs) is connected phase-to-phase (i.e., a "delta" configuration) such that a loss of a single phase will cause two of the three undervoltage relays to trip, thus satisfying the two-out-of-three logic. (For more information on the degraded voltage condition and associated time delays, etc., see Subsection (8) of 8.3.1.1.7.)

INSERT Y (NRC request to close new item 8.2.3.8-1 per 5-7-93 phone call)

Switching and lightning surge protection is provided by the station grounding and surge protection systems described in Appendix 8A, and by the independent feeds (i.e., normal and alternate preferred power circuits described in 8.2.1.2). Maximum and minimum voltage ranges are specified in 8.2.3(2) and transformers are designed per 8.2.1.2. Allowable frequency variation or stability limitations are addressed in 8.2.3. Surge and EMI protection for Class 1E systems, equipment and components is described in Appendix 7A. Protection for degraded voltage conditions is discussed in 8.3.1.1.7(8).

INSERT Z (NRC request to close item 8.3.4.4-2 per 5-18-93 phone call)

Each FMCRD power train has current limiting features to limit the FMCRD motor fault current. Continuous operation of the FMCRD motors at the limiting fault current will not degrade operation of any Class 1E loads. Also, the Division I diesel generator has sufficient capacity margin to supply overload currents up to the trip setpoint of the Class 1E feeder breaker to the FMCRDs.

INSERT AA (NRC request to close item 8.3.3.14-1 per 5-24-93 phone call)

The function of the Class 1E Vital ac Power Supply System is to provide reliable 120V uninterruptible power to the individual trip systems of the SSLC system. The system consists of four 120V ac uninterruptible constant voltage, constant frequency (CVCF) power supplies (Divisions I, II, III, IV), each including a static inverter, ac and dc static transfer switches, a regulating step-down transformer (as an alternate ac power supply), and a distribution panel (see Figure 8.3-3). The primary source of power comes from the Class 1E 480 Vac motor control centers in the same Class 1E division, except for Division IV, which is powered from Division II.. The secondary source is the Class 1E 125 Vdc battery in the same division.

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INSERT AB (NRC request to close item 8.3.3.14-1 per 5-24-93 phone call)

There are three automatic switching modes for the CVCF power supplies, any of which may be initiated manually. First, the frequency of the output of the inverter is normally synchronized with the input ac power. If the frequency of the input power goes out of range, the power supply switches over to internal synchronization to restore the frequency of its output. Switching back to external synchronization is automatic and occurs if the frequency of the ac power has been restored and maintained for approximately 60 seconds.

The second switching mode is from ac to dc for the power source. If the voltage of the input ac power is less than 88% of the rated voltage, the input is switched to the dc power supply. The input is switched back to the ac power after a confirmation period of approximately 60 seconds.

The third switching mode is between the inverter and the voltage regulating transformer, which receives power from the same bus as the primary source. If any of the conditions listed below occur, the power supply is switched to the voltage regulating transformer.

(a) Output voltage out of rating by more than plus or minus 10 per cent (72 pm)

(b) Output frequency out of rating by more than plus or minus 3 per cent

(c) High temperature inside of panel

(d) Loss of control power supply

(e) Commutation failure

(f) Over-current of smoothing condenser

(g) Loss of control power for gate circuit

(h) Incoming MCCB trip

(i) Cooling fan trip

(9) an output power monitor which monitors the 120 Vac power from the CVCF power supply to its output power distribution cabinet. If the voltage or frequency of the ac power gets out of its design range, the power monitor trips and interrupts the power supply to the distribution cabinet. The purpose of the power monitor is to protect the scram solenoids from voltage levels and frequencies which could result in their damage.

(7) In addition, an external electrical protection assembly (EPA) is provided as ~~which performs similar function as the monitor described in (7) above~~ (see Figure 8.3-3, ~~sheet 1~~). (72 rpm)

8.3.1.1.4.2.3 Operating Configuration

The four 120 Vac Class 1E power supplies operate independently, providing four divisions of CVCF power supplies for the SSLC which facilitate the two-out-of-four logic. The normal lineup for each division is through an Class 1E 480 Vac power supply, the ac/dc rectifier, the inverter and the static transfer switch. The bus for the RPS A solenoids is supplied by the Division II CVCF power supply. The RPS B solenoids bus is supplied from the Division III CVCF power supply. The #3 solenoids for the MSIVs are powered from the Division I CVCF: and the #2 solenoids, from the Division II CVCF power supply.

8.3.1.1.5 Class 1E Electric Equipment Considerations

The following guidelines are utilized for Class 1E equipment.

(1) Motors are sized in accordance with NEMA standards. The manufacturers' ratings are at least large enough to produce the starting, pull-in and driving torque needed for the particular application, with due consideration for capabilities of the power sources. Plant design specifications for electrical equipment require such equipment be capable of continuous operation for voltage fluctuations of +/- 10%. In addition, Class 1E motors must be able to withstand voltage drops to 70% rated during starting transients. See Subsection 8.3.4.12 for COL license information.

(2) Power sources, distribution systems and branch circuits are designed to maintain voltage and frequency within acceptable limits. A capacity and voltage drop analysis will be performed in accordance with IEEE 141 to assure that power sources and distribution equipment will be capable of transmitting sufficient energy to start and operate all required loads for all plant conditions.

(3) The selection of motor insulation such as Class F, H or B is a design consideration based on service requirements and environment. The Class 1E motors are qualified by tests in accordance with IEEE Std 334.

(4) Interrupting capacity of switchgear, power centers, motor control centers, and distribution panels is equal to or greater than the maximum available fault current to which it is exposed under all modes of operation.

Interrupting capacity requirements of the medium voltage Class 1E switchgear is selected to accommodate the available short-circuit current at the switchgear terminals. Circuit breaker and applications are in conditions, the only protective devices which shut down the diesel are the generator differential relays, and the engine over-speed trip. These protection devices are retained under accident conditions to protect against possible, significant damage. Other protective relays, such as loss of excitation, anti-motoring (reverse power), over-current voltage restraint, low jacket water pressure, high jacket water temperature, and low-lube oil pressure, are used to protect the machine when operating in parallel with the normal power system, and during periodic tests. The relays are automatically isolated from the tripping circuits during LOCA conditions. However, all of these bypassed parameters are annunciated in the main control room (see Subsection 8.3.1.1.8.5). The bypasses and protective relaying are testable, meet all IEEE 603 requirements, and are manually reset as required by Position 7 of Reg. Guide 1.9. No trips are bypassed during LOPP or testing. See Subsection 8.3.4.22 for COL license information. (70)

Synchronizing interlocks are provided to prevent incorrect synchronization whenever the diesel generator is required to operate in parallel with the preferred power supply (see Section 5.1.4.2 of IEEE 741). Such interlocks are capable of being tested, and shall be periodically tested per 8.3.4.23).

8.3.1.1.7 Load Shedding and Sequencing on Class 1E Buses

This subsection addresses Class 1E Divisions I, II, and III. Load shedding, bus transfer and sequencing on a 6.9kV Class 1E bus is initiated on loss of bus voltage. Only LOPP (≤70% bus voltage) or degraded voltage signals are used to trip the loads. However, the presence of a LOCA during LOPP reduces the time delay for initiation of bus transfer from 3 seconds to 0.4 seconds. The Class 1E equipment is designed to sustain operation for this 3-second period without damage to the equipment. The load sequencing for the diesels is given on Table 8.3-4.

Load shedding and buses ready to load signals are generated by the control system for the electrical power distribution system. Individual timers for each major load are reset and started by their electrical power distribution systems signals.

(1) **Loss of Preferred Power (LOPP)** : The 6.9kV Class 1E buses are normally energized from the normal or alternate preferred power supplies. Should the bus voltage decay to ~~below~~ ≤ 70% of its nominal rated value, a bus transfer is initiated and the signal will trip the supply breaker, and , start the diesel generator. When the bus voltage decays to 30%, large pump motor breakers are tripped. The transfer then proceeds to the diesel generator. If the standby diesel generator is ready to accept load (i.e., voltage and frequency are within normal limits and no lockout exists, and the normal and alternate preferred supply breakers are open), then the diesel-generator breaker is signalled to close, following the tripping of the large motors ~~(i.e., when voltage decays to 30%)~~. This accomplishes automatic transfer of the Class 1E bus to the diesel generator. Large motor loads will be sequence started as required and shown on Table 8.3-4.

(2) **Loss of Coolant Accident (LOCA)**: When a LOCA occurs, with or without a LOPP, the load sequence timers are started if the 6.9 KV emergency bus voltage is greater than 70% and loads are applied to the bus at the end of preset times.

(14) During diesel generator load sequencing, the frequency will be restored to within 2% of nominal, and voltage will be restored to within 10% of nominal within 60% of each load sequence time interval (see C.4 of Regulatory Guide 1.9).

(15) 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 unit will not exceed the nominal speed plus 75% of the difference between nominal speed and the over-speed trip setpoint or 115% of nominal, whichever is lower (see C.4 of Regulatory Guide 1.9).

(16) The transient following the complete loss of load will not cause the speed of the diesel generator unit to attain the over-speed trip setpoint (see C.4 of Regulatory Guide 1.9).

(17) Bus voltage and frequency will recover to 6.9 kv±10% at 60±2% Hz within 10 seconds following trip and restart of the largest load.

(18) Each of the above design criteria has the capability of being periodically verified (see 8.3.4.36). However, note exception for Item (10).

8.3.1.1.8.3 Starting Circuits and Systems

(and shall be periodically verified (see 8.3.4.36).)

Diesel generators I, II and III start automatically on loss of bus voltage. Under-voltage relays are used to start each diesel engine in the event of a drop in bus voltage below preset values for a predetermined period of time. Low-water-level switches and drywell high-pressure switches in each division are used to initiate diesel start under accident conditions. Manual start capability is also provided. The Class 1E batteries provide power for the diesel control and protection circuits. The transfer of the Class 1E buses to standby power supply is automatic should this become necessary on loss of preferred power. After the breakers connecting the buses to the preferred power supplies are open the diesel-generator breaker is closed when required generator voltage and frequency are established. (82

Diesel generators I, II and III are designed to start and attain rated voltage and frequency within 20 seconds. The generator, and voltage regulator are designed to permit the set to accept the load and to accelerate the motors in the sequence within the time requirements. The voltage drop caused by starting the large motors does not exceed the requirements set forth in Regulatory Guide 1.9, and proper acceleration of these motors is ensured. Control and timing circuits are provided, as appropriate, to ensure that each load is applied automatically at the correct time. Each diesel generator set is provided with two independent starting air systems. (182

(The design provides capability for periodic verification of these criteria, as indicated in 8.3.1.1.8.2 (18).)

8.3.1.1.8.4 Automatic Shedding, Loading and Isolation

The diesel generator is connected to its Class 1E bus only when the incoming preferred source breakers have been tripped (Subsection 8.3.1.1.7). Under this condition, major loads are tripped from the Class 1E bus, except for the Class 1E 480V unit substation feeders, before closing the diesel generator breaker.

The large motor loads are later re-applied sequentially and automatically to the bus after closing of the diesel-generator breaker.

8.3.1.1.8.5 Protection Systems

The diesel generator is shut down and the generator breaker tripped under the following conditions during all modes of operation and testing operation:

(1) engine over-speed trip; and

(2) generator differential relay trip.

These and other protective functions (alarms and trips) of the engine or the generator breaker and other off-normal conditions are annunciated in the main control room and/or locally as shown in Table 8.3-5. Local alarm/annunciation points have auxiliary isolated switch outputs which provide inputs to alarm/annunciator refresh units in the main control room which identifies the diesel generator and general anomaly concerned. Those anomalies which cause the respective D/G to become inoperative are so indicated in accordance with Regulatory Guide 1.47 and BTP PSB-2.

8.3.1.1.8.6 Local and Remote Control and Indication

Each diesel generator is capable of being started or stopped manually from the main control room. Start/stop control and bus transfer control may be transferred to a local control station in the diesel generator area by operating key switches at that station. When the diesel is started from the local control station, the engine will attain rated voltage and frequency, then remain on standby without load sequencing (i.e., the generator breaker will remain open). (This function is capable of being periodically tested (see 8.3.4-36)

Control room indications are provided for system output, i.e., volts, amps, watts, vars, frequency, synchronization, field volts, field amps, engine speed, and watt-hours. Diesel generator status (i.e., "RUN", "STOP") indication is provided for the Remote Shutdown System. (82 add

8.3.1.1.8.7 Engine Mechanical Systems and Accessories

Descriptions of these systems and accessories are given in Section 9.5.

8.3.1.1.8.8 Interlocks and Testability

Each diesel generator, when operating other than in test mode, is totally independent of the preferred power supply. Additional interlocks to the LOCA and LOPP sensing circuits terminate parallel operation test and cause the diesel generator to automatically revert and reset to its standby mode if either signal appears during a test. These interlocks are designed to be testable, and are periodically tested per 8.3.4.21. A lockout or maintenance mode removes the diesel generator from service. The inoperable status is indicated in the control room.

criteria as defined in IEEE 603 for: operating bypass, maintenance bypass, and bypass indication.

(d) RG 1.47 - Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems

(e) RG 1.63 - Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants

(f) RG 1.75 - Physical Independence of Electric Systems

Regarding Position C-1 of Regulatory Guide 1.75 (see Section 8.3.1.1.1), the non-Class 1E FMCRD motors and brakes are supplied power from the Division 1 Class 1E bus through three dedicated power center transformers. The Class 1E load breaker for the bus is tripped by fault current for faults in the non-Class 1E load. There is also a zone selective interlock provided from the load breaker to the Class 1E bus supply breaker so that the supply breaker is delayed from tripping while fault current is flowing in the non-Class 1E load feeder. This meets the intent of the Regulatory Guide position in that the main supply breaker is prevented from tripping on faults in the non-safety-related loads. The transfer switch downstream of the load feeder is Class 1E associated, and meets Class 1E requirements.

There are three 6.9 KV electrical divisions which are independent load groups backed by individual diesel-generator sets. The low voltage ac systems consists of four divisions which are backed by independent dc battery, charger and inverter systems.

There is no sharing of standby power system components between divisions, and there is no sharing of diesel-generator power sources between units, since the ABWR is a single unit-plant design.

Each standby power supply for each of the three divisions is composed of a single generator driven by a diesel engine having fast start characteristics and sized in accordance with Regulatory Guide 1.9.

Table 8.3-1 and 8.3-2 show the rating of each of the Divisions I, II and III diesel generators, respectively, and the maximum coincidental load for each.

(g) RG 1.106 - Thermal Overload Protection for Electric Motors on Motor-Operated Valves

Safety functions which are required to go to completion for safety have their thermal overload protection devices in force during normal plant operation but the overloads are bypassed under accident conditions per Regulatory Position 1.(b) of the guide. These overload bypasses meet the requirements of IEEE 603, and are capable of being periodically tested (see 8.3.4.24).

(h) RG 1.108 - Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants

2) is immediately available during both normal operations and following loss of power from the alternating current systems,

3) has sufficient stored energy to provide an adequate source of power for starting and operating all required LOCA and/or LOPP loads and circuit breakers for two hours with no ac power,

4) has sufficient stored energy to provide power in excess of the capacity of the battery charger when needed for transients,

5) has a capacity design margin of 5 to 15 percent to allow for less than optimum operating conditions,

6) has a 25-percent capacity design margin to compensate for battery aging,

7) has a ~~4~~ 19-percent capacity design margin to allow for the lowest expected electrolyte temperature of ~~21C (70F)~~, 10C (50F). (81)

8) has a number of battery cells that correctly matches the battery-to-system voltage limitations.

9) bases the first minute of the batteries' duty cycle on the sum of all momentary, continuous, and non-continuous loads that can be expected to operate during the one minute following a LOCA and/or LOPP,

10) is designed so that each battery's capacity can periodically be verified.

8.3.2.1.2 Class 1E DC Loads

The 125 Vdc Class 1E power is required for emergency lighting, diesel-generator field flashing, control and switching functions such as the control of 6.9-kv and 480V switchgear, control relays, meters and indicators, multiplexers, vital ac power supplies, as well as dc components used in the reactor core isolation cooling system.

The four divisions that are essential to the safe shutdown of the reactor are supplied from four independent Class 1E 125 Vdc buses.

8.3.2.1.3 Station Batteries and Battery Chargers, General Considerations

The four ESF divisions are supplied from four independent Class 1E 125 Vdc systems (See Figure 8.3-4). Each of the Class 1E 125 Vdc systems has a 125 Vdc battery, a battery charger and a distribution panel. One standby battery charger can be connected to either of two divisions and another standby battery charger can be connected to either of two other divisions. Kirk key interlocks prevent cross connection between divisions. The main dc distribution buses include distribution panels, drawout-type breakers and molded case circuit breakers.

The Class 1E 125 Vdc systems supply dc power to Divisions I, II, III and IV, respectively, and are designed as Class 1E equipment in accordance with IEEE Std 308. They are designed so that no single failure in any 125 Vdc system will result in conditions that prevent safe shutdown of the plant with the remaining ac power divisions. The plant design and circuit layout from these dc systems provide physical separation of the equipment, cabling and instrumentation essential to plant safety.

Each division of the system is located in an area separated physically from other divisions. All the components of Class 1E 125 Vdc systems are housed in Seismic Category I structures.

8.3.2.1.3.1 125 Vdc Systems Configuration

Figure 8.3-4 shows the overall 125 Vdc system provided for Class 1E Divisions I, II, III and IV. One divisional battery charger is used to supply each divisional dc distribution panel bus and its associated battery. The divisional battery charger is normally fed from its divisional 480V MCC bus, with no automatic interconnection or transfer between buses. Also, there are no manual interconnections between dc divisions except those involving the standby battery chargers, as described below.

Each Class 1E 125 Vdc battery is provided with a charger, and a standby charger shared by two divisions, each of which is capable of recharging its battery from a discharged state to a fully charged state while handling the normal, steady-state dc load. Cross connection between two divisions through a standby charger is prevented by at least two interlocked breakers, kept normally open, in series in each potential cross-connect path. (See Figure 8.3-4 and Subsection 8.3.4.18.)

The maximum equalizing charge voltage for Class 1E batteries is 140 Vdc. The dc system minimum discharge voltage at the end of the discharge period is 1.75 Vdc per cell (105 volts for the battery). The operating voltage range of Class 1E dc loads is 100 to 140V.

~~As a general requirement,~~ The batteries have sufficient stored energy to operate connected Class 1E loads continuously for at least two hours without recharging. ~~The Division I battery, which controls the RCIC system, is sufficient for eight hours during station blackout.~~ During ~~this~~ the station blackout event ~~scenario~~, the load reductions ~~on Divisions II, III, and IV~~ also extend the times these batteries are available (See Subsection 19E.2.1.2.2). Each distribution circuit is capable of transmitting sufficient energy to start and operate all required loads in that circuit. (81)

A load capacity analysis has been performed based on IEEE 485-1978, and submitted on the docket for estimated Class 1E dc battery loads as of September, 1989. A final analysis will be performed when specific battery parameters are known (see 8.3.4.6).

An initial composite test of onsite ac and dc power systems is called for as a prerequisite to initial fuel loading. This test will verify that each battery capacity is sufficient to satisfy a safety load demand profile under the conditions of a LOCA and loss of preferred power.

Thereafter, periodic capacity tests may be conducted in accordance with IEEE Std 450. These tests will ensure that the battery has the capacity to continue to meet safety load demands.

plant operation but the overloads are bypassed under accident conditions per Regulatory Position 1.(b) of the guide. These overloads and the overload bypasses meet the requirements of IEEE 603, and are capable of being periodically tested (see 8.3.4.24). (43)

(g) RG 1.118 - Periodic Testing of Electric Power and Protection Systems

(h) RG 1.128 - Installation Designs and Installation of Large Lead Storage Batteries for Nuclear Power Plants

(i) RG 1.129 - Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants

(j) RG 1.153 - Criteria for Power, ~~Instrumentation, and~~ Control Portions of Safety Systems

Fuses cannot be periodically tested to verified setpoints, and are exempt from such requirements per Section 4.1.7 of IEEE 741.

(k) RG 1.155 - Station Blackout

(See Appendix 1C)

The Class 1E DC power system is designed in accordance with the listed Regulatory Guides. It is designed with sufficient capacity, independence and redundancy to assure that the required power support for core cooling, containment integrity and other vital functions is maintained in the event of a postulated accident, assuming a single failure.

The batteries consist of industrial-type storage cells, designed for the type of service in which they are used. Ample capacity is available to serve the loads connected to the system for the duration of the time that alternating current is not available to the battery charger. Each division of Class 1E equipment is provided with a separate and independent 125 Vdc system.

The DC power system is designed to permit inspection and testing of all important areas and features, especially those which have a standby function and whose operation is not normally demonstrated.

(3) Branch Technical Positions (BTPs):

BTP ICSB 21 - Guidance for Application of Regulatory Guide 1.47.

The dc power system is designed consistent with this criteria.

(4) Other SRP Criteria:

According to Table 8-1 of the SRP, there are no other criteria applicable to dc power systems.

(5) Other Criteria

~~(a)~~ IEEE 946 "Recommended Practice for the Design of Safety-Related DC ~~Auxiliary~~ Power Systems for ~~Nuclear Power Generating Stations~~" add

(b) IEEE 741 "Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations"

(c) IEEE 485 "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations"

(7) Containment penetrations are so arranged that no design basis event can disable cabling in more than one division. Penetrations do not contain cables of more than one divisional assignment.

(8) Annunciator and computer inputs from Class 1E equipment or circuits are treated as Class 1E and retain their divisional identification up to a Class 1E isolation device. The output circuit from this isolation device is classified as non-divisional.

Annunciator and computer inputs from non-Class 1E equipment or circuits do not require isolation devices.

8.3.3.7 Electrical Penetration Assemblies

When the vendor-unique characteristics of the penetrations are known, the following will be provided:

1) fault current clearing-time curves of the electrical penetrations' primary and secondary current interrupting devices plotted against the thermal capability (I^2t) curve of the penetration, along with an analysis showing proper coordination of these curves;

2) a simplified one-line diagram showing the location of the protective devices in the penetration circuit, with indication of the maximum available fault current of the circuit;

3) specific identification and location of power supplies used to provide external control power for tripping primary and backup electrical penetration breakers (if utilized);

4) an analysis demonstrating the thermal capability of all ~~electrical conductors within~~ penetrations is preserved and protected by one of the following:

a) The maximum available fault current (including single-failure of an upstream device) is less than the maximum continuous current capacity [of the] ~~(based on no damage to the penetration) of the conductor within the~~ penetration; or

b) Redundant circuit protection devices are provided, and are adequately designed and set to interrupt current, in spite of single-failure, at a value below the maximum continuous current capacity ~~(based on no damage to the penetration)~~ of the ~~conductor within the~~ penetration. Such devices must be located in separate panels or be separated by barriers and must be independent such that failure of one will not adversely affect the other. Furthermore, they must not be dependent on the same power supply.

~~The functional operation of~~ [Protective] ~~Current-limiting~~ devices designed to protect the penetrations [are capable of being tested, and] shall be periodically ~~tested~~ ~~verified~~ [tested] (see 8.3.4.4). (64)

8.3.3.8 Fire Protection of Cable Systems

systems provided should assure that a fire of this magnitude does not occur, however.

Maximum separation of equipment is provided through location of redundant equipment in separate fire areas. The Class 1E divisional AC unit substations, motor control centers, and DC distribution panels are located to provide separation and electrical isolation between the divisions. Clear access to and from the main switchgear rooms is also provided. Cable chases are ventilated and smoke removal capability is provided. Local instrument panels and racks are separated by safety division and located to facilitate required separation of cabling.

8.3.3.8.3 Fire Detection and Protection Systems

All areas of the plant are covered by a fire detection and alarm system. Double manual hose coverage is provided throughout the buildings. Sprinkler systems are provided as listed on Table 9.5.1-1. The diesel generator rooms and day tank rooms are protected by foam sprinkler systems. The foam sprinkler systems are dry pipe systems with pre-action valves which are actuated by compensated rate of heat rise and ultraviolet flame detectors. Individual sprinkler heads are opened by their thermal links.

8.3.4 COL License Information

8.3.4.1 Interrupting Capacity of Electrical Distribution Equipment

The interrupting capacity of the switchgear and circuit interrupting devices must be shown by the COL applicant to be compatible with the magnitude of the available fault current based on final selection of the transformer impedance, etc. (See Subsection 8.3.1.1.5(4)).

8.3.4.2 Diesel Generator Design Details

Subsection 8.3.1.1.8.2 (4) requires the diesel generators be capable of reaching full speed and voltage within 20 seconds after the signal to start. The COL applicant will demonstrate the reliability of the diesel generator start-up circuitry designed to accomplish this.

8.3.4.3 Certified Proof Tests on Cable Samples

Subsection 8.3.3.8.1 requires certified proof tests on cables to demonstrate 60-year life, and resistance to radiation, flame and the environment. The COL applicant will demonstrate the testing methodology to assure such attributes are acceptable for the 60-year life.

8.3.4.4 Current-Limiting Devices for Electrical Penetration Assemblies

Appropriate plant procedures shall include periodic testing of protective and/or current limiting devices (except fuses) to demonstrate their functional capability to perform their required safety functions.

8.3.4.5 (Deleted)

Appropriate plant procedures shall include periodic calibration and functional testing of the fault interrupt capability of all Class 1E breakers, fault interrupt coordination between the supply and load breakers for each Class 1E load and the Division I non-Class 1E load, and the zone selective interlock feature of the breaker for the non-Class 1E load.

8.3.4.30 Periodic Testing of Electrical Systems & Equipment

Appropriate plant procedures shall include periodic testing of all Class 1E electrical systems and equipment in accordance with Section 7 of IEEE 308.

8.3.4.31 (Deleted)

8.3.4.32 Class 1E Battery Installation and Maintenance Requirements

The installation, maintenance, testing, and replacement of the Class 1E station batteries shall meet the requirements of IEEE 484 and Section 5 of IEEE 946.

8.3.4.33 Periodic Testing of Class 1E Batteries

Appropriate plant procedures shall include periodic testing of Class 1E batteries, in accordance with Section 7 of IEEE 308, to assure they have sufficient capacity and capability to supply power to their connected loads.

8.3.4.34 Periodic Testing of Class 1E CVCF Power Supplies

Appropriate plant procedures shall include periodic testing of Class 1E constant voltage constant frequency (CVCF) power supplies to assure they have sufficient capacity to supply power to their connected loads (see 8.3.1.1.4.2.1).

8.3.4.35 Periodic Testing of Class 1E Battery Chargers

Appropriate plant procedures shall include periodic testing of Class 1E battery chargers to assure they have sufficient capacity to supply power to their connected loads (see 8.3.2.1.1). Such periodic tests shall be in conformance with Section 7.5.1 of IEEE 308 (i.e., IEEE 338).

8.3.4.36 Periodic Testing of Class 1E Diesel Generators

Appropriate plant procedures shall include periodic testing and/or analysis of Class 1E diesel generators (see 8.3.1.1.8.2), including demonstration of their capability to supply the actual full design basis load current for each sequenced load step.

8.3.1.1.8.3 and 8.3.1.1.8.6 (82) COL

8.3.5 References

In addition to those codes and standards required by the SRP the following codes and standards will be used and have been referenced in the text of this chapter of the SSAR.

IEEE Std 141 Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book)