Department of Energy
Washington, D.C. 20545

Docket No. 50-537
HQ:S:82:036

JUN 0 1 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION - POWER SYSTEMS

Reference: Letter, P. S. Check to J. R. Longenecker, "CRBRP Request for Additional Information," dated March 16, 1982

This letter formally responds to your request for additional information contained in the reference letter.

Enclosed are responses to Questions CS 430.1 through 3, CS 430.5 through 88, and CS 430.90 through 104. Question CS 430.4 was deleted in the reference letter and the response to CS 430.89 will be supplied in a separate letter. These responses will also be incorporated into the PSAR in a future amendment.

Sincerely,

John R. Longenecker

John R. Longenecker, Manager
Licensing & Environmental
Coordination
Office of Nuclear Energy

Enclosures

cc: Service List
Standard Distribution
Licensing Distribution

D001

Question CS430.1 (8.2)

Provide physical layout drawings and/or additional description in the PSAR of the physical independence to be provided between the offsite power circuits in proximity of the plant to the switchyards and from the switchyard to the Class 1E onsite power system. Also provide description of physical independence between Class 1E and the offsite circuits protective relaying.

Response

K-31 and Fort Loudoun-2 161kV transmission lines (both connected to the reserve switchyard of the CRBRP) provide the two physically independent offsite power sources to CRBRP; details of their routing and construction in the proximity of the plant have been described in Section 8.2.1.1 and 8.2.1.3 of the PSAR. Further, in the proximity of the CRBRP:

1. at any one location no transmission line crosses over these two transmission lines simultaneously;
2. transmission lines are spaced sufficiently apart such that failure of one line does not affect the other line. (see Figures 8.2-11 and 8.2-12 attached).

This demonstrates the physical independence of the two offsite power sources.

The 4.16kV medium voltage (MV) winding of the Reserve Station Service Transformer (RSST) 11AAX005A will be conected to the Medium Voltage Switchgear of Class 1E Division 1 through a non-segregated phase bus duct and to the Medium Voltage Switchgear of Class 1E Division 3, through the non-segregated phase bus duct and MV cables. Similarly, the 4.16kV MV winding of the RSST 11AAX005B is connected to the Class 1E Division 2 switchgear through non-segregated phase bus duct.

Non-segregated phase bus duct runs from RSSTs 11AAX005A and 5B are physically separated.

Control and protection circuits for the Reserve Switchyard have been arranged to receive 125V DC power from two independent Divisions A and B DC power distribution systems (see Figure 8.2-13).

The DC equipment of the two divisions are physically separate and electrically independent of each other. The control cables of Divisions A and B are routed in separate trays and conduits.

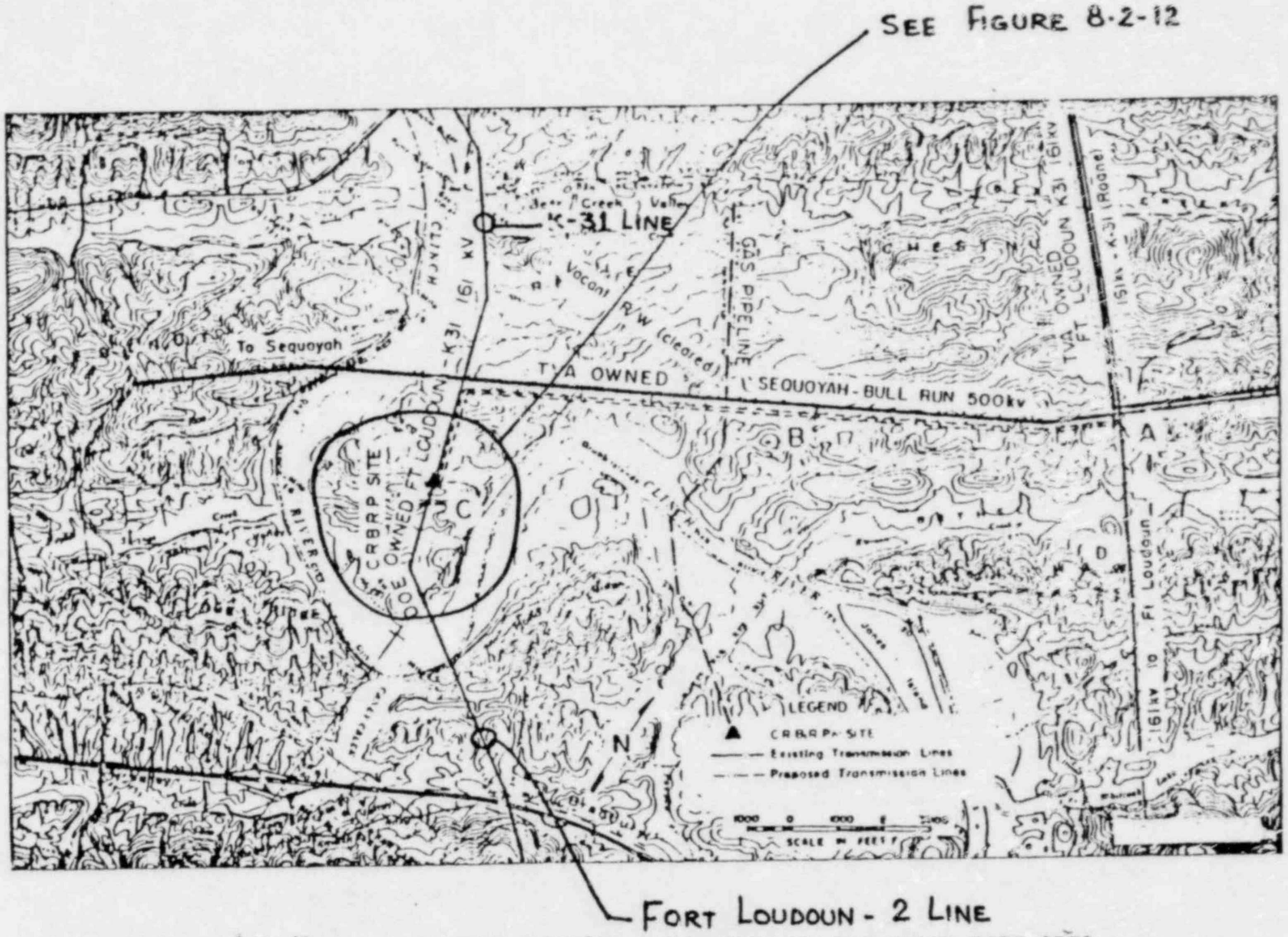


Figure 8-2-11 PROPOSED TRANSMISSION LINE ROUTE OF THE CRBRP SITE AREA

161KV LINE CONNECTIONS

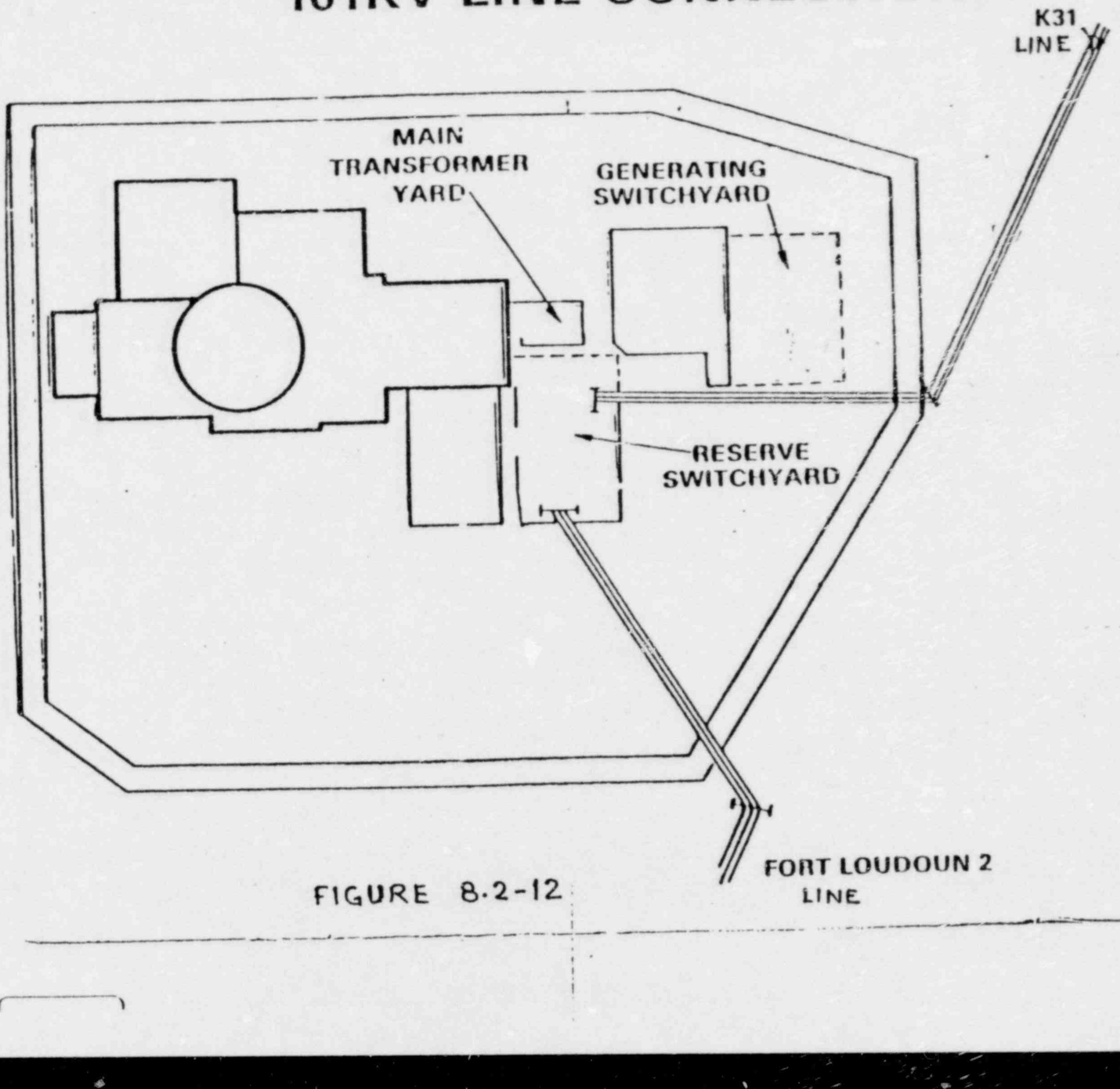
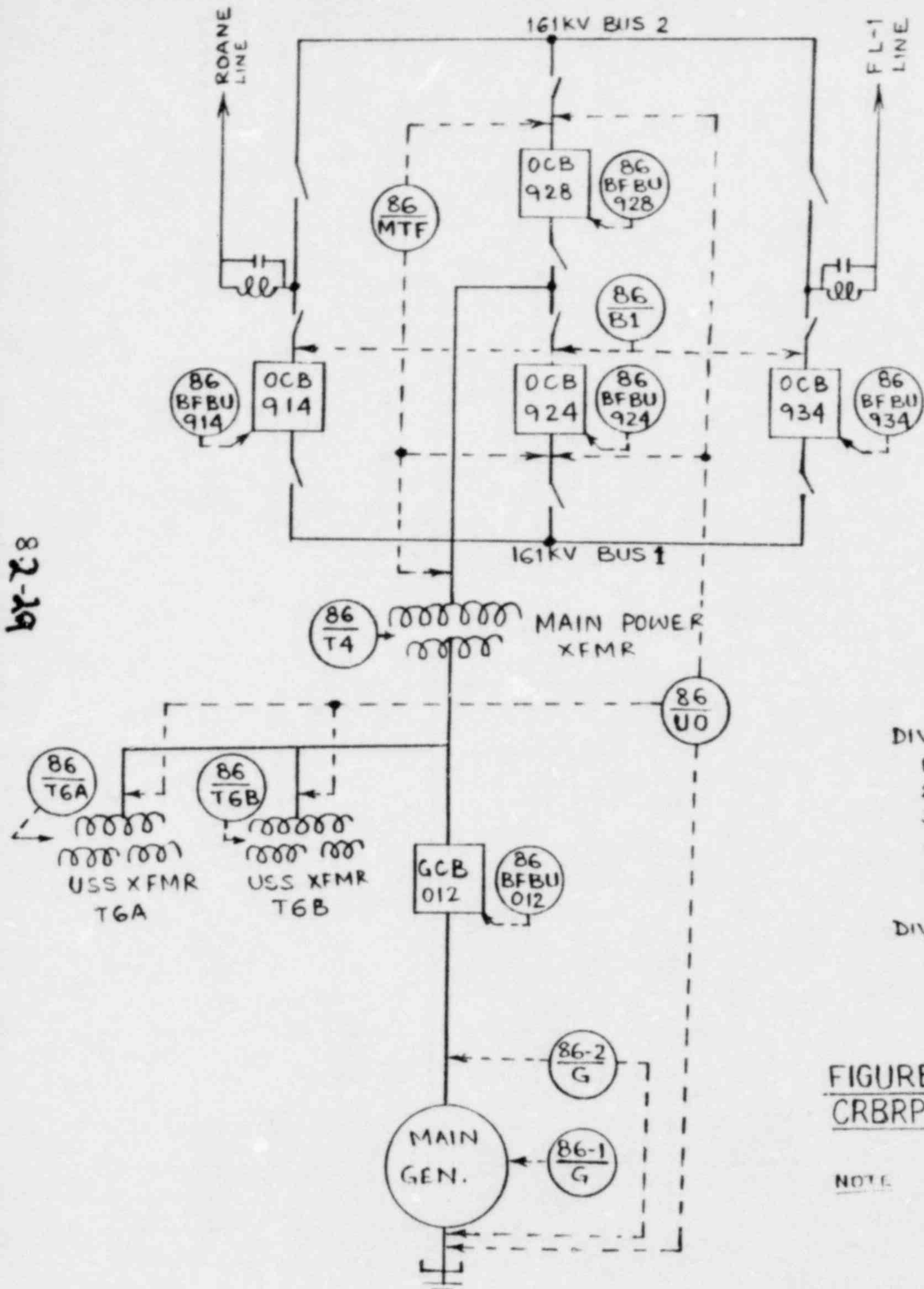
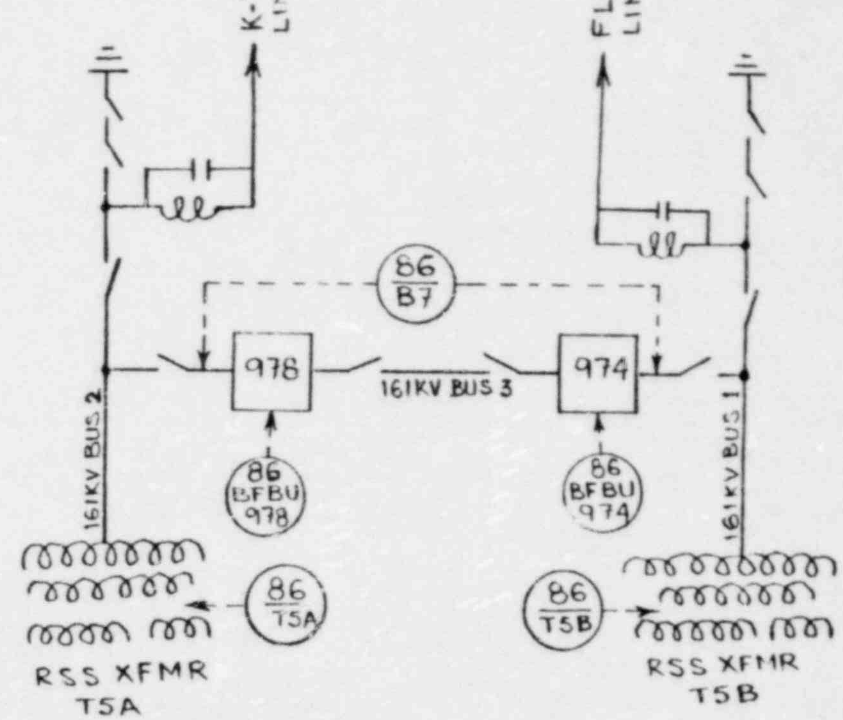


FIGURE 8.2-12





DIVISION A 125V DC DISTRIBUTION SYSTEM SUPPLIES POWER TO:

1. CARRIER, TRANSFER TRIP AND PRIMARY LINE RELAYS OF GSY TRANS. LINE
2. GSY AND MAIN TURBINE GENERATOR LOCKOUT RELAYS & GSY XFMR PROTECTION
3. GSY BREAKERS' AND GEN. CIRCUIT BREAKER'S CLOSING & PRIMARY TRIP COILS
4. GSY SPARE BREAKER LINE RELAYING
5. SECONDARY LINE RELAYING OF RSY TRANS. LINES
6. RSY BREAKERS' SECONDARY TRIP COILS AND BREAKER FAILURE LORS.

DIVISION B 125V DC DISTRIBUTION SYSTEM SUPPLIES POWER TO:

1. CARRIER, TRANSFER TRIP AND PRIMARY LINE RELAYS OF RSY TRANS. LINES
2. RSY XFMR PROTECTION AND RSY LOCKOUT RELAYS
3. RSY BREAKERS' CLOSING AND PRIMARY TRIP COILS
4. SECONDARY LINE RELAYING FOR GSY TRANS. LINES
5 GSY BREAKERS SECONDARY TRIP COILS AND BREAKER FAILURE LORS

FIGURE 8.2-13

CRBRP POWER TRANSMISSION SYSTEM, PROTECTION & CONTROL

NOTE TRIPPING OF BOTH GSY BREAKERS 924 AND 928 BY ANY RELAY WILL TRANSFER AUXILIARY LOADS TO RSY POWER SUPPLY.

Question CS430.2 (8.2) (3.1.3.1)

Section 3.1.3.1 of the PSAR indicates that each of the reserve transformers is capable of supplying full power required for the auxiliary AC power distribution system to supply one redundant class 1E division load groups. Figure 8.3.1 of the PSAR in contradiction, shows reserve transformers supplying two Class 1E division loads as well as numerous non-Class 1E loads. Correct the contradiction and describe the capability and capacity of the offsite circuits, including the unit station service and reserve transformers, to supply all connected loads (Class 1E and Non-Class 1E) for all modes of plant operation.

Response

The two reserve station service transformers located in the reserve switchyard have been designed with the capability to provide power to all plant connected loads (Class 1E and Non-Class 1E) under all modes of plant operation including startup, normal operation, and to facilitate and maintain a safe plant shutdown. One of the two reserve station service transformers also supplies 100 percent power to Class 1E loads of Divisions 1 and 3 and the other reserve station service transformer provides 100 percent power to Class 1E loads of Division 2 as indicated in Figure 8.3.1. Section 3.1.3.1 of the PSAR will be revised to further describe the capability and capacity of reserve unit station service transformers as attached.

The CRBRP is connected to the TVA 161kV grid using two separate and physically independent switchyards - the plant generating switchyard and the plant reserve switchyard. The plant generating switchyard is connected to the TVA 161kV power grid by two 161kV transmission lines. The plant reserve switchyard is connected to the TVA 161kV grid by two physically separate and electrically independent 161kV transmission lines. Each of the four transmission lines is capable of providing power to all connected loads (Class 1E and Non-Class 1E) required for plant startup, normal operation and to facilitate and maintain a safe plant shutdown.

The two unit station service transformers have been designed with the capability to provide power to all plant connected loads (Class 1E and Non-Class 1E) under all modes of plant operation including startup, normal operation and to facilitate and maintain a safe plant shutdown. One of the two unit station service transformers also supplies 100 percent power to Class 1E loads of Division 1 and 3 and the other unit station service transformers provides 100 percent power to Class 1E loads of Division 2.

Upon loss of all 161kV power sources, the diesel generators start automatically and are capable of accepting the required safety loads. Any of these diesel generators or any of the 161kV power sources are capable of providing sufficient power to safely shutdown the plant during the anticipated operational occurrences and to power the necessary engineered safety features in the event of postulated accidents.

The three diesel generators are independent including the distribution systems which they supply as described in Section 8.3.1.1. Automatic starting and loading of each diesel generator to perform the safety function of the distribution systems they supply can be tested by simulating loss of AC power supply to each 4.16kV ESF distribution bus that is supplied by a diesel generator. Each diesel will start automatically and, if required, after 10 seconds the diesel generator on the disrupted distribution system will be automatically loaded with engineered safety features equipment in a timed sequence. The battery systems are redundant and independent including the distribution systems which they supply as described in Section 8.3.2.

In addition to the features detailed in Sections 8.2.1.1, 8.2.1.2 and 8.2.1.3, compliance with Criterion 15 is further demonstrated by the following:

a. The plant is provided with two separate and independent switchyards - the generating switchyard and the reserve switchyard. The generating switchyard is connected to the power grid by two 161kV transmission lines. The reserve switchyard is connected to the grid by two separate and physically independent 161kV transmission lines. Each of the four transmission lines and each of the two switchyards are designed to be capable of providing power to the Non-Class 1E and Class 1E auxiliary loads required for plant startup, normal operation and to facilitate and maintain a safe plant shutdown.

   The generating switchyard provides power to the plant auxiliary loads through the main power transformer and the two (2) unit station service transformers. Each unit station service transformer is sized to supply 50 percent of the plant auxiliary loads required during the plant startup and the maximum power plant generation. (When the main generator is operating the plant auxiliary loads receive power from the main generator via the generator circuit breaker and the unit station service transformers). One of two unit station service transformers also supplies 100 percent power to Class 1E loads of Divisions 1 and 3 and the other unit station service transformer provides 100 percent power to Class 1E loads of Division 2.

   The plant reserve switchyard provides power to the plant auxiliary loads through two (2) reserve station service transformers. Each reserve station service transformer is sized to supply 50 percent of the plant auxiliary loads required during the plant startup and the maximum power plant generation. One of the two reserve station service transformers also supplies 100 percent power to Class 1E loads of Division 1 and 3 and the other reserve station service transformer provides 100 percent power to Class 1E loads of Division 2.

b. The 161 kV transmission lines are protected from lightning by overhead shield lines.

c. The switchyards are provided with two independent DC supplies. Each supply system consists of a separate 125V DC battery, two battery chargers and a distribution system. A single failure caused by a malfunction of either of the two 125V DC systems will not affect the performance of the other system. The ability of the switchyard to supply offsite power to the plant will not be affected by the loss of one of the two 125V DC systems. The surveillance of battery charger operation and battery voltage for each system is provided by individual alarms monitored in the control room.

Question CS430.3 (8.1)

Section 8.3.1.1 of the PSAR indicates that three independent load groups are provided with load group 1 redundant to load group 2. No description as to redundancy of load group 3 has been provided in Chapter 8 of the PSAR. Conversely, Section 3.1.3.1 of the PSAR under criterion 26 response indicates that the power supplies servicing the heat transfer system are fully redundant. Clarify Chapter 8 of the PSAR to indicate redundancy of the 3 divisions.

Response

The Class 1E electrical distribution system consists of three Class 1E divisions (Division 1, 2 and 3). Each of these divisions is separated physically and electrically from the other two divisions as described in Section 8.3.1.4 and 8.3.1.2.1 of the PSAR. Each of these divisions is provided with an onsite (standby) diesel generator and has the capability to shutdown the plant safely. However, from the consideration of connected loads, Class 1E Divisions 1 and 2 provide power to redundant load groups and as such are described as redundant divisions in the PSAR. Class 1E Division 3 provides Class 1E power to Loop 3 of the Heat Transport System (HTS) and to certain plant Non-Class 1E loads. The Non-Class 1E loads are connected through an isolation subsystem. Since not all the loads powered from Division 3 are identical or similar to those powered by Division 1 or 2, this division has not been identified as redundant to Division 1 or 2 in the PSAR. However, as far as the HTS is concerned, the Divisions 1, 2 and 3 power supplies are fully redundant serving the Loops 1, 2 and 3 Class 1E loads, respectively.

Sections 8.1.2 and 8.3.1.1 of the PSAR has been revised to add the above clarification.

8.3 ON-SITE POWER SYSTEMS

8.3.1 AC Power Systems

8.3.1.1 Description

The on-site power system consists of the following:

a) Non-Class 1E power distribution system which consists of two generally independent load groups (Divisions A and B). Each division is provided with its own:

- power supplies (13.8KV, 4.16KV, 480 volts, 277 volts, 208 volts and 120 volts AC)
- transformers
- cables and raceways
- 125 volts DC control and instrumentation power
- multiplexer system for control, alarm and indication
- 120/208 volts uninterruptible power supplies (UPS) for essential Non-Class 1E loads

b) Class 1E power distribution system which consists of three independent load groups (Division 1, 2 and 3). Class 1E Divisions 1 and 2 provide the two redundant safety related load groups. Each of the three load groups consists of its own:

- power supplies (4.16KB, 480 volts, 277 volts, 208 volts and 120 volts AC)
- standby (on-site) diesel generator
- transformers
- cables and raceways
- 125 volts DC control and instrumentation power
- solid state programmable logic system for control, diesel generator load sequencing, periodic testing, and alarm indications

Each of these divisions is separated physically and electrically from the other two division as described in Section 8.3.1.4, and has the capability to shutdown the plant safely. However, from the consideration of connected loads, Class 1E Divisions 1 and 2 provide power to redundant load groups and as such are referred to as redundant divisions, Class 1E Division 3 provides Class 1E power to Loop 3 of the Heat Transport System (HTS) and to certain plant Non-Class 1E loads. (The Non-Class 1E loads are connected through an isolation subsystem). Since not all loads powered from Division 3 are identical or similar to those powered by Divisions 1 or 2, this division is

not identified as redundant to Division 1 or 2. However, as far as the HTS is concerned, the Divisions 1, 2 and 3 power supplies are fully redundant serving the Loops 1, 2 and 3 Class 1E loads, respectively.

13.8KV and 4.16KV Distribution System

During normal operation, plant auxiliary power is provided by two (2) 50 percent capacity (50 percent capacity of total plant electrical loads, but 100 percent of loads for one safety division) unit station service transformers (USSTs) fed from the main generator through the 22KV isolated phase bus and the generator circuit breaker.

4) The Standby (on-site) AC Power Supply* which consists of three physically separate and electrically independent diesel generators. Two of these diesel generators supply power to safety-related (Class 1E) Division 1 and 2 loads redundant to each other. Either one of these three standby diesel generators can provide sufficient power to facilitate and maintain a safe plant shutdown. However, from the consideration of connected loads, Class 1E Divisions 1 and 2 provide power to redundant load groups and as such are referred to as redundant divisions. Class 1E Division 3 provides Class 1E power to Loop 3 of the Heat Transport System (HTS) and to certain plant Non-Class 1E loads. (The Non-Class 1E loads are connected through an isolation subsystem). Since not all the loads powered from Division 3 are identical or similar to those powered by Divisions 1 or 2, this division is not identified as redundant to Division 1 or 2. However, as far as the HTS is concerned, the Divisions 1, 2 and 3 power supplies are fully redundant serving the Loops 1, 2 and 3 Class 1E loads, respectively.

5) The DC Power Supply* which, for Division 1, 2 or 3, consists of one independent 125 volt DC battery with its associated active and spare battery chargers and an inverter for 120/208 volt AC uninterruptible power supply (UPS). Each battery is capable of supplying power to DC loads and UPS loads of its associated safety division. Clas 1E UPS is also referred to as vital AC power supply.

6) The 120/208 volt vital AC Power Supply* which, for each Division 1, 2 or 3, consists of one independent inverter supplied by an independent DC system. Each inverter will supply power to vital AC loads of its associated safety Division. Division 1 and 2 vital AC loads are redundant to each other.

7) The Non-Class 1E DC Power Supply consists of two systems (Divisions A and B) each having one 125 volt DC battery dedicated for plant instrumentation and control. Two separate 125 volt DC batteries are dedicated for switchyard control and instrumentation and two 48 volt DC batteries are provided for the plant communication systems. Division A also has one 250 volt battery to provide power for DC motor loads. Each battery system is equipped with its own active and spare battery chargers, switchgear and distribution panels. 125 bolt DC and 250 volt DC battery systems have inverters for 120/208 volt uninterruptible power supply (UPS). Non-Class 1E UPS is also referred to as Non-Class 1E essential power supply.

8) Two Non-Class 1E 125 volt DC Power Supplies (one for Division A and the other for Division B) will be provided complete with associated active and spare battery chargers for security systems, and the associated inverters for 480 volt AC UPS for security and lighting loads.

Distribution Systems

The Plant electrical power distribution system can be fed by the Plant, the CRBRP Preferred and the Reserve Power supplies and provides power to all Non-Class 1E and Class 1E loads. The Plant distribution system has been divided into two systems; the normal distribution (Non-Class 1E) system and the safety-related distribution (Class 1E) system. The safety-related distribution system can be fed by the Plant,

*This equipment is Class 1E as defined by IEEE Standard 308.

Question CS430.5 (8.3.1)

You state in Section 8.3.1.2.1 that "the standby onsite power supply network has provisions to manually cross-connect the 4.16kV buses of the Division 1 and 2 power supplies in case of extreme emergency." Enumerate and define each case of extreme emergency that would necessitate the use of the interconnections. For each case listed justify its noncompliance with the independence requirement of criterion 15 listed in Section 3.1 of the PSAR.

Response

Manual cross-connection of 4.15kV Class 1E Division 1 and Division 2 Standby Onsite Power Supplies will be initiated if all of the following extreme emergency conditions occur:

a) Loss of Plant, Preferred, and Reserve Power to 4.16kV Class 1E buses 12NIE003A and 12N1E003B;

b) Diesel 12N1E022A or 12N1E022B failed to start and is determined to be inoperable, and

c) Critical safety-related loads associated with the operative diesel generator have failed and become unavailable.

The manual cross-connection will be disconnected as soon as one of the above conditions cease to exist.

PSAR Section 3.1, Criterion 15, Electric Power Systems, states that "the two diesel generator units will be physically and electrically independent of each other and the offsite AC power supplies".

The Class 1E Division 1 and Division 2 Standby Onsite AC Power Supplies, with a provision for manual cross-connection, meet the criteria for independence of Regulatory Guide 1.6 as follows:

1) No provisions exist for automatically connecting one Class 1E load group to another Class 1E load group;

2) No provisions exist for automatically transferrring loads between redundant Class 1E power sources;

3) Mechanical and electrical interlocks have been provided to prevent an operator error that would result in paralleling of standby power sources;

4) The circuit breakers used for the cross-connection will normally be stored in separate locked dummy compartments. Opening of the doors of these compartments shall be alarmed in the Control Room.

Therefore, there is no non-compliance with the Regulatory Requirements. PSAR Section 3.1 will be revised to include the following paragraph:

Provision has been made in the safety-related AC distribution system design, for manual cross-connection between the 4.16kV switchgear buses of Class 1E Divisions 1 and 2. Manual cross-connection details are as described in Section 8.2.1.2.1 of the PSAR.

Question CS430.6 (8.2) (8.3.1) (8.3.2)

The response to Criterion 16 in Section 3.1 of the PSAR indicates that periodic tests of the transfer of power between onsite and offsite sources and between the normal offsite supply and the preferred (reserve) supply are performed only during prolonged plant shutdown periods. The response to Criterion 16 implies that the power transfer has not been designed to be testable during operation of the nuclear plant as recommended by IEEE Standard 338-1977 and Regulatory Guide 1.118. In addition it has been implied that the onsite AC and DC systems have all not been designed to be testable during operation of the nuclear plant. Describe compliance with IEEE Standard 338-1977 and Regulatory Guide 1.118 and justify areas of noncompliance.

Response

The design of the power transfer schemes of CRBRP for transfer of power between the normal offsite supply and the preferred (reserve) supply and the onsite AC and DC systems are in full compliance with Criterion 16, IEEE Standard 338-1977 and Regulatory Guide 1.118.

Section 3.1 of the PSAR has been revised to further clarify the conformance of CRBRP design with Criterion 16, IEEE Standard 338-1977 and Regulatory Guide 1.118.

Criterion 16 INSPECTION AND TESTING OF ELECTRIC POWER SYSTEMS

Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems shall be designed with a capability to test periodically (1) the operabiltiy and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system.

RESPONSE

The following transfers are testable during operation of the nuclear plant.

1. Automatic transfer from normal power source (nuclear power unit) to the reserve power source (preferred onsite power system) initiated by fault sensing relays in normal power supply. Testing is by inserting simulated signals in relay inputs which accomplishes the transfer.

2. Manual transfer from normal to reserve power source and vice versa.

3. Automatic transfer of Class 1E Bus from normal or reserve power source to diesel generator (onsite power supply) on degraded voltage at the Class 1E Bus.

   3.1 Prolonged degraded voltage between 85% and 70% of nominal voltages is simulated at input to undervoltage relays.

   3.2 Instantaneous degraded voltage below 70% of nominal voltage is perturbed by tripping of normal incoming breaker.

   Operation of the sequencer logic is also tested by simulating inputs and monitoring the sequencer outputs to actuators (such as breakers) without actuating them. The load sequencer has intrinsic automatic testing of its circuitry which works continuously when the sequencer is not actuated by protective or testing input signals.

4. Manual transfer of Class 1E Bus from normal or reserve power source to diesel generator.

   4.1 Testing of diesel with Class 1E Bus disconnected from offsite source is performed by starting the diesel, paralleling the diesel generator with the Class 1E medium voltage bus, and tripping the incoming breaker of the offsite power source.

4.2 Testing of diesel with Class 1E Bus energized by offsite source is performed by starting the diesel, synchronizing it with Class 1E Bus and loading it in steps consistent with actual loading requirements.

The AC and DC systems will be designed to be testable during operating of the plant in accordance with IEEE Standard 338-1977 and Regulatory Guide 1.118.

Periodic inspections and testing of important features, such as wiring, insulation, and connections, to assess the continuity of systems and the condition of their components will be performed during equipment shutdown.

Initial operational system tests will be performed with components installed and connected to demonstrate that the system operates within design limits and meets the performance specification, and to verify the independence between redundant AC power sources and load groups.

After being placed in service, the standby diesel generators and their respective associated supply systems will be inspected and tested periodically to detect any degradation of the system. (See Section 8.3.1.1.1)

Initial pre-operational tests will be performed with equipment and components installed and connected to demonstrate that the equipment is within design limits and the system meets performance specifications. This test will also demonstrate that loss of the Plant Power Supply and offsite AC power supplies can be detected.

Periodic equipment tests will be performed to detect any degradation of the system and to demonstrate the capability of equipment which is normally de-energized. The test methods utilized are detailed in Section 8.3.1.1.2.

Periodic tests of the transfer of power between the Plant Power Supply and offsite AC power supplies will be performed to demonstrate that:

a. Sensors can properly detect loss of the Plant Power Supply and the offsite AC power supplies.

b. Components required to accomplish the transfer from the Plant Power Supply to the Preferred AC Power Supply are operable.

c. Components required to accomplish the transfer from the Normal AC Power Supply to the Reserve AC Power Supply are operable.

d. Components required to accomplish the transfer from the Reserve AC Power Supply to the Standby AC Power Supply are operable.

e. Components required to accomplish the transfer from the Plant Power Supply (simulating the unavailability of the offsite AC power supplies) to the Standby AC Power Supply are operable.

f. Instruments and protective relays are properly set and operating correctly.

The 161kV circuit breakers connecting the generating and reserve switchyard to the power grid will be inspected and tested as follows:

On a routine basis with the generators in service since the two breakers, each fully rated, are provided to connect the generator to the two buses of the generating switchyard.

Question CS430.7 (8.3.1) (8.3.2)

You state in Section 8.3.1.1.2 of the PSAR under the subheading "Testing and Inspection", that "in the case an emergency signal is generated during the testing, the circuit breaker cannot be closed immediately." Describe how the design implied by this statement meets the recommendations of IEEE Standard 338-1977.

Response

The periodic testing procedure for the safety-related electrical distribution system meets the recommendations of IEEE Standard 338-1977. The PSAR Section 8.3.1.1.2 subheading "Testing and Inspection" will be revised as per attached.

Installation is complete, pre-operational equipment tests and inspections will be performed.

Initial pre-operational tests will be performed with equipment and components installed and connected to demonstrate that the equipment is within the design limits and the system meets performance specifications. This test will also demonstrate that loss of the Plant Power Supply and Offsite (CRBRP Preferred and Reserve Power) AC power supplies can be detected.

Periodic equipment tests will be performed to detect any degradation of the system and to demonstrate the capability of equipment which is normally de-energized.

Periodic tests on the Class 1e 4.16KV switchgear and 480 volt switchgear circuit breakers will be performed by utilizing the following test methods:

a. The operability of circuit breakers carrying current under normal plant operation will be demonstrated by their performance in supplying power. In addition, the circuit breakers will be tested in "Test" position at regular intervals. During this test, the proper operation of the circuit breakers and the control circuits will be verified.

b. Testing of circuit breakers of the standby equipment will be performed by racking the circuit breakers in the "Test" position. In the "Test" position, the main contact of the circuit breaker are disconnected, but the auxiliary and the control circuits are maintained. This facilitates functional tests of the circuit breaker and its control circuit.

c. The operability of safety related circuit breakers will be demonstrated by their performance in supplying power to safety related loads during scheduled load performance tests. In addition functional tests of the circuit breaker and its control circuit will be performed during plant refueling or prolonged plant shutdown.

Periodic tests of the transfer of power between the CRBRP Preferred Power Supply and Reserve AC Power Supplies will be performed during prolonged plant shutdown or during refueling to demonstrate that:

a. Sensors can properly detect loss of the CRBRP Preferred Power Supply and the Reserve AC Power Supplies.

b. Components required to accomplish the transfer from the CRBRP Preferred Power Supply to the Reserve AC Power Supply are operable.

Question CS430.8 (8.3.1) (8.3.2)

Section 8.3.1.2.11 of the PSAR indicates that conductors of the penetration are designed to withstand the maximum short-circuit currents based on the interrupting capability of the protection device associated with the penetration assembly conductors. Position C.1 of Regulatory Guide 1.63, on the other hand, states that the electric penetration asembly versus the conductor should be designed to withstand the maximum short-circuit condition. Justify noncompliance to Position C.1 of Regulatory Guide 1.63.

Response

The electrical penetration conductors and the assembly will be designed to withstand the maximum short-circuit current versus time conditions that could occur given single random failures of circuit overload protection devices in accordance with Position C.1 of Regulatory Guide 1.63. PSAR Section 8.3.1.2.11 will be revised as attached.

c. Sections 6.3 and 6.4 of IEEE Std. 379-1972 are interpreted as not permitting separate failure mode analyses for the protection system logic and the actuator system. The collective protection system logic-actuator system as applicable for the Class 1E electrical power systems is analyzed for single-failure modes which, though not negating the functional capability of either portion, act to disable the complete protective function.

8.3.1.2.11 NRC Regulatory Guide 1.63, Rev. 2 (7/78)

The electrical penetration assemblies in the containment vessel will be designed, constructed, qualified, installed and tested in accordance with IEEE Std. 317-1976, supplemented by Regulatory guide 1.63 positions as discussed herein.

The conductors and the electrical penetration assembly will be designed to withstand the maximum short-circuit currents versus time conditions that could occur given single random failures of circuit overload protective devices. The duration of rated short circuit current is based on the operating time of the secondary (backup) protective device or apparatus. The electrical penetration assemblies will be designed to maintain their mechanical and electrical integrity in accordance with IEEE Std. 317-1976, IEEE Std. 279-1971 and Regulatory Guide 1.63.

The dielectric-strength test qualification for medium voltage power conductors is in accordance with IEEE Std. 317-1976 supplemented by the impulse voltage test as described in Regulatory Guide 1.63.

Regulatory positions, C1, C2, C3, and C4 place additional restrictions on maximum short-circuit current, x/r ratios, maximum short-circuit current duration and impulse voltage qualification testing on the electrical penetration assemblies in addition to the requirements of IEEE Std. 317-1976. The project will comply fully with the requirements as set forth in IEEE Std. 317-1976 and as modified by Regulatory Guide 1.63.

8.3.1.2.12 NRC Regulatory guide 1.68, Rev. 2 (8/78)

Written procedures for preoperational and startup testing for the Plant AC Power Distribution System, Class 1E AC Power Distribution System, Standby AC Power Supplies and DC System will be developed. Format and content of these procedures will conform to the guidance given in Regulatory Guide 1.68. for test program description, see Chapter 14.

8.3.1.2.13 NRC Regulatory Guide 1.73, Rev. 0 (1/74)

All Class 1E electric valve operator assemblies, for installation inside the containment vessel, will be designed, constructed, qualified, installed and tested in accordance with IEEE Std. 382-1972 supplemented by Regulatory guide 1.73 requirements.

Each electric valve operator assembly will be designed and constructed to withstand the worst local environmental requirements (during normal or accident conditions) such as temperature, humidity, radiation, and sodium aerosol condition.

Question CS430.9 (8.3.1) (8.3.2)

You state in Section 8.3.1.4 of the PSAR that environmental type test will be performed on cables and terminations that are required to function in a hostile environment. This statement implies that cables or terminations that are not required to function in a hostile environment, will not be environmentally qualified and may not be in compliance with IEEE Standard 323-1974. Justify noncompliance..

Response

All cabling and terminations will be designed, qualified and tested in accordance wtih IEEE Standard 323-1974 supplemented by Regulatory Guide 1.131.

PSAR Section 8.3.1.4, Part B, will be revised as attached.

8.3.1.2.28 IEEE Standard 387 - 1977

The Standby AC Power Supply conforms to IEEE Standard 387-1977 which includes requirements for capability rating, independence, redundancy, testing, analyses, quality assurance, and identification.

8.3.1.3 Conformance with Appropriate Quality Assurance Standards

Assurance that equipment and workmanship quality is maintained throughout the construction process is provided by conformance to IEEE Standard 336 - 1971, "Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment during the Construction of Nuclear Power Generating Stations". The methods used to accomplish cnformance are described by construction procedures and instructions and in Chapter 17.0 of this PSAR.

8.3.1.4 Indepencence of Class 1E Systems

The following criteria is used to preserve the independence of Class 1E system.

A. General Separation of Cables by Voltage Class

A raceway contains cables of ony one class. Classes are based on the nominal utilization voltage of the cable and/or vulnerability to spurious signals.

Voltage Classes are:

15KV Class - 13.8KV AC nominal power
5KV Class - 4.16KV AC nominal power
600V Class - 480-277 volt AC and 250 volt DC nominal power
Control - 120V/208V AC, 125V DC, 120V AC nominal power and control
Low level instrumentation including digital and analog signals

When cable trays are arranged in a vertical stack, the preferable arrangement is in order of voltage class, with the highest voltage at the top.

B. Cable Derating

Ampacity rating and group derating factors of cables are in accordance with the Insulated Power Cable Engineers Association Publication IPCEA-P54-440 and IPCEA-P46-426. Cables are selected to minimize deterioriation due to temperature, humidity, and radiation during design life of the plant. Environmental type test will be performed on all cables and terminations for their expected environment. The tests will include radiation exposure, heat aging, and electrical measurements to assure that the cable will function in the design environment for the required time. Cable derating as a result of fire stops/seals are included in the design.

Question CS430.10 (8.3.1)(8.3.2)

Section 8.3.1.2.14 of the PSAR indicates that physical separation of circuits and equipment comprising or associated with the Class 1E power system, Class 1E protection systems and Class 1E equipment, will be in accordance with criteria set forth in paragraph 8.3.1.4 of the PSAR. Separation criteria described in Sections 8.3.1.2.14 and 8.3.1.4 of the PSAR is not clear and does not meet the guidelines of IEEE Standard 384 and Regulatory Guide 1.75. For example, the PSAR indicates that non-Class 1E cables in panels will be separated from Class 1E cables so that they will not provide a combustion path between different divisions. Section 5.6.5 of IEEE Standard 384-1974 states that non-Class 1E cables shall be separated by six inches or a barrier. In general no cirteria has been described for separation of Class 1E and non-Class 1E cables. Other examples include: (1) no criteria for separation between cables trays and conduits of another division, (2) confusing criteria for the separation of the third division (the design indicates there are three divisions but ony two redundant divisions. Separation criteria refers to only two redundant divisions in many cases versus the three divisions), (3) confusing definition for associated cables, (4) no criteria for separation between associated cables and non-Class 1E cables, and (5) no criteria before and after an isolatoin device. Revise your PSAR description of physical separation of circuits to comply with the recommendations of IEEE Standard 384-1974 and guidance of R.G. 1.75 or justify noncompliance.

Response:

The CRBRP physical separation design criteria is fully consistent with the guidelines set forth in IEEE Standard 384-1974 and Regulatory Guide 1.75.

The PSAR Section 8.3.1.4 will be revised to further clarify consistency with IEEE Standard 384-1974 and Regulatory Guide 1.75 for the following items:

1. Separation of Class 1E and non-Class 1E cables within control board and other panels.

2. Separation of Class 1E and non-Class 1E cables.

3. Separation between cable trays and conduits of another division.

4. Criteria for the separation of third division.

5. Criteria for separation between associated cables and non-Class 1E cables.

6. Separation criteria before and after an isolation device.

8.3.1.2.28 IEEE Standard 387 - 1977

The Standby AC Power Supply conforms to IEEE Standard 387-1977 which includes requirements for capability rating, independence, redundancy, testing, analyses, quality assurance, and identification.

8.3.1.3 Conformance with Appropriate Quality Assurance Standards

Assurance that equipment and workmanship quality is maintained throughout the construction process is provided by conformance to IEEE Standard 336-1971, "Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment during the Construction of Nuclear Power Generating Stations". The methods used to accomplish conformance are described by construction procedures and instructions and in Chapter 17.0 of this PSAR.

8.3.1.4 Independence of Class 1E and Non-Class 1E Systems

The following criteria is used to preserve the independence of Class 1E and non-Class 1E systems.

A. General Separation of Cables by Voltage Class

A raceway contains cables of only one voltage class. Classes are based on the nominal utilization voltage of the cable and/or vulnerability to spurious signals.

Voltage Classes are:

15KV Class - 13.8KV AC nominal power
5KV Class - 4.16KV AC nominal power
600V Class - 480-277 volt AC and 250 volt DC nominal power
Control - 120V/208V AC, 125V DC, 120V AC nominal power and control
Low level instrumentation including digitial and analog signals

When cable trays are arranged in a vertical stack, the preferable arrangement is in order of voltage class, with the highest voltage at the top. Each raceway (cable tray, conduit, raceway or duct) provides a cable routing path for only one service class.

B. Cable Derating

Ampacity rating and group derating factors of cables are in accordance with the Insulated Power Cable Engineers Association Publications IPCEA-P54-440 and IPCEA-P46-426. Cables are selected to minimize deterioration due to temperature, humidity, and radiation during the design life of the plant. Environmental type tests will be performed on cables and terminations that are required to function in a hostile environment. The tests will include radiation exposure, heat aging, and electrical measurments to assure that the cable will function in the design environment for the required time. Cable derating as a result of fire stops/seals are included in the design.

C. Raceway Fill

Cable tray fill will be limited such that the summation of the cross-sectional areas of cables in a tray section will in general be not more than 40% of the usable cross-sectional area of that tray section.

Conduits will be sized for a maximum percent fill of the inside area of the conduit in accordance with NFPA 70 "National Electrical Code" Art. 346.

D. Sealing Raceway Blockouts and Wall and Floor Penetrations

Fire stops will be installed for cable trays wherever the cables pass through fire walls and floors other than the Reactor Containment vessel. Cable and cable tray penetrations of fire baarriers are sealed to provide protection at least equivalent to that required of the fire barrier. Penetrations are qualified to meet the requirements of ASTM E-119, and IEEE Std. 634-1978. The actual fire ratings of stops and penetrations are determined by fire hazards analysis.

Fire stops, fire barriers, and air seals will be constructed of mastic type materials or elastomer modular construction materials qualified in accordance with IEEE Std. 623 and ASTM E-119. Fire stop/seal material will be compatible with insulation and conductor materials and will be shock, vibration, seismic, and radiation resistant in accordance with the area(s) penetrated.

E. Physical Separation by Class 1E Cables

The separation design description for raceways, Class 1E circuitry and associated cabling given below incorporates the requirements of IEEE Std. 384-1974, Regulatory Guide 1.6 and NRC Regulatory Guide 1.75.

Load groups, cables and raceways of a safety-related system will be separated from load groups, cables, or raceways of other safety-related groups in accordance with the separation criteria described herein. This separation criteria will preclude a single failure withinthe safety-related system from preventing proper protective action at the system level when required. Raceways and cables will be classified by separation groups, namely Class 1E Division 1, Class 1E Division 2, Class 1E Division 3, and Plant Protection System. For the purpose of physical separation criteria Class 1E Division 1, 2, and 3 are treated as redundant divisions.

Cables designated in each division will be run in raceways separated from cables designated in other divisions and from Non-Class 1E cables. Associated cables will be separated as if they were Class 1E pursuant to the Class 1E division associated with these cables.

F. Separation Criteria between Class 1E and Non-Class 1E and Associated Circuits

1. Separation of Class 1E and Non-Class 1E Cables Within Control Board and Other Panels

Within control boards and other panels, harnesses of different divisions will be provided with a minimum of 6 inches free air separation, otherwise barriers will be installed. Metal conduit, fire barriers, or steel wire ducts are acceptable barriers to maintain independence without additional spatial separation over that required by Regulatory Guide 1.75. Non-Class 1E wiring will not be harnessed together with Class 1E cable. Non-Class 1E wiring will be separated from Class 1E or associated wiring with a minimum of 6 inches free air or by a barrier.

2. Separation of Class 1E and Non-Class 1E Cables

All Class 1E and non-Class 1E cables will be routed in raceways consisting of cable trays and conduits. Each raceway will contain cable(s) of one Class 1E safety division or a Non-class 1E system only. For the purpose of cable and raceway, the plant areas have been divided into six (6) separation zones as described in Section 8.3.1.4 of the PSAR. This paragraph will be revised to further clarify the separation criteria between Class 1E and non-Class 1E raceways in all separation zones.

3. Separation Between Cable Trays and Conduits of Another Division.

A Class 1E conduit will contain circuits of only one load division. In Non-hazard zones exposed Class 1E conduits are separated from trays of another division as described in Attachment I. In all other separation zones the Class 1E conduits are not routed with trays of another division.

4. Criteria for the Separation of Third Division

The Class 1E electrical distribution system consists of three Class 1E divisions (Division 1, 2 and 3). Each of these division is designed to have physical and electrical independence from the other two divisions as described in Paragraph 8.3.1.4 of the PSAR and further clarified in Item 2 above. Each of these divisions is provided with an onsite (standby) diesel generator and has the capability to shutdown the plant safely. However, from the consideration of connected loads, Class 1E Divisions 1 and 2 provide power to redundant load groups and as such are described as redundant divisions in the PSAR. Class 1E Division 3 provides power to heat removal system of Loop 3 and other important Non-Class 1E loads through an isolation subsystem. Class 1E Division 3 as stated above has the capability to shutdown the plant safely; however, since all the loads powered from this division are not similar or identical to those powered by Division 1 or 2, this division has not been identified as redundant to Division 1 or 2 in the PSAR.

5. Criteria for Separation Between Associated Cables and Non-Class 1E Cables

The associated circuits as defined in paragraph 4.5 of the IEEE Standard 384-1974 will be considered as Class 1E cables for the purpose of their routing and installation. The separation criteria between associated cables and Non-Class 1E cables is the same as described in Item 2 above for the separation between Class 1E and Non-Class 1E cables. These cables, once identified as associated with a safety division, will be routed and installed in a raceway of that division. Each associated cable will be uniquely identified as described in Section 8.3.1.5 of the PSAR.

6. Separation Criteria Before and After an Isolation Device

The cables before an isolation device are Class 1E circuits and are routed in Class 1E raceway system in accordance with criteria described in Item 2 above for physical separation of Class 1E cables. The cables after the isolation device are considered Non-Class 1E cables and are routed in Non-Class 1E raceway system. Section 8.3.1 of PSAR will be revised to include separation criteria before and after an isolation device.

The minimum separation maintained between cables of each division varies according to cable location with respect to potential hazards. The design intent is to provide separation greater than the minimum listed where consistent with a practical plant layout. Six general classifications of hazard zones or areas are defined for electrical separation considerations:

I. Non-Hazard Zones

Areas in which the only potential hazard is a fire of an electrical nature.

II. Fire Hazard Zone

Areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible materials as defined in PSAR Section 9.13.1.

III. Equipment Hazard Zone (Pipe Break Hazard Zone)

Areas in which a potential hazard could exist as a consequence of postulated pipe break events in high energy lines.

IV. Cable Spreading Rooms

Areas just above and below the main control room where control and instrumentation cables converge prior to entering the control room.

V. Containment Electrical Penetration Areas

The areas and assemblies that allow cable passage through the Containment Building pressure boundary.

VI. Control Room

Continuously manned utilized by plant operators to monitor and control the plant.

Non-Hazard Zones

Redundant cables entering panels, cabinets or other equipment enter through separate openings.

In Non-Hazard Zones, no minimum vertical or horizontal physical separation is provided between conduits of the same division beyond that required for construction, installation or access clearances between conduits and/or metal enclosed ducts.

In Non-Hazard Zones, exposed conduits of different Class 1E divisions are routed as far as possible apart, preferably on opposite sides of the walls. Parallel routing of conduits of different divisions is avoided. If the design makes it unavoidable a minimum of one (1) inch spatial separation is provided between conduits of different Class 1E divisions as shown in Figure 8.3-6. When the safety related conduit cross or run parallel to another safety related tray the minimum horizontal and vertical clearance is the same as provided for cable trays of different Class 1E divisions. If this clearance is unavoidable, a barrier is provided between the safety-related conduit and cable trays of other Class 1E divisions as shown in Figure 8.3-6.

In Non-Hazard Zones, a minimum horizontal clear space of three feet is maintained between cable trays of different divisions as shown in Figure 8.3-6 If a horizontal clearance of less than three feet is unavoidable, a fire barrier is provided between the divisions as shown in Figure 8.3-6.

Vertical stacking of cable trays of different divisions is avoided wherever possible. Where cable trays of different divisions are stacked vertically, a minimum clear space of five feet is provided between the divisions as shown in Figure 8.3-6. If a vertical clearance of less than five feet is unavoidable, a fire barrier is provided between the divisions as shown in Figure 8.3-6.

Fire Hazard Zones

In fire hazard zones, Class 1E conduits, trays, wireways or raceways of only one safety division are routed. This division is suitably protected by fire barriers and fire protections systems to mitigate the effects of fire in this zone on the safety function of the other safety groups.

Equipment Hazard Zone (Pipe Break Hazard Zone)

To the extent practical, Class 1E cables are routed in areas remote from high energy piping or areas of potential sodium fires; if unavoidable, the following precautions are taken:

a) Raceways (trays and conduit) are not less than fifteen feet from a high-energy pipeline unless the pipeline is suitably restrained so as not to whip and strike the raceway. This spacing applies regardless of whether the high energy pipeline is a safety system or non-safety system pipeline. The exception to this consideration is the acceptability of the mechanical failure of one safety system damaging the cable that provides service to components/systems of the mechanical system that has failed.

   Under no circumstances do safety-related raceways run less than fifteen feet from high-energy pipelines of the opposite safety system.

b) Redundant Class 1E circuits are routed or protected such that a postulated event in one system and division cannot preclude the operation of the other redundant system or division.

c) In all areas of the plant, the separation between redundant Calss 1E cable raceways takes into consideration the presence of rotating equipment, monorails, equipment removal paths and dropped equipment such that failure of rotating equipment will not cause failure of more than one safety division and any dropped equipment will not cause failure of any safety-related raceways.

d) In general, Class 1E electrical distribution equipment (e.g., switchgear, motor control centers, etc.) is not located in areas where high energy piping or other similar hazards are located.

prevent a protective action. Separation of Class 1E circuits is maintained through penetrations. No Class 1E cables share penetrations with Non-Class 1E systems, other than associated Class 1E cable systems.

Control Room

Cables in the Control Room are kept to the minimum necessary for operation of the Control Room. All cables entering the Control Room terminate there. Cables are not installed in culverts or floor trenches.

Cables are not routed in concealed ceiling or under floor spaces unless installed in a solid enclosed steel raceway.

Separation of Non-Class 1E Cables (Non-Safety-Related)

The separation design description for Non-Class 1E circuitry from Class 1E and associated circuits given below incorporates the requirements of IEEE Standard 384-1974 and NRC Regulatory Guide 1.75.

The trays carrying Non-Class 1E circuits are separated form the trays carrying Class 1E and associated circuits by a minimum horizontal clear space of three (3) feet and a minimum vertical clear space of five (5) feet between the trays. If a horizontal clearance of less than three (3) feet is unavoidable, a fire barrier is provided between the safety and non-safety related trays.

Vertical stacking of safety and non-safety related trays is avoided wherever possible. Where safety and non-safety related cable trays are stacked vertically and a vertical clearance of less than five (5) feet is unavoidable, a fire barrier is provided between non-safety and safety related trays.

In Cable Spreading Rooms a minimum clear separation of one (1) foot horizontal and three (3) feet vertical is maintained between trays carrying Non-class 1E cables and trays carrying Class 1E and associated cables. If the minimum horizontal or vertical separation does not exist, a fire barrier is provided.

Non-Class 1E and Class 1E exposed conduits are routed as far as possible, preferably on opposite sides of the walls. Parallel routing of safety related and non-safety related conduits is avoided. If the design makes it unavoidable a minimum of one (1) inch spatial separation is provided between non-safety related and safety related conduits.

Separation of Associated Cables

The associated circuits as defined in paragraph 4.5 of the IEEE Std. 384-1974, which become associated with Class 1E cabling remain with or separated in accordance with the above given requirements for physical separation of Class 1E cables. The associated cables are uniquely identified in accordance with Section 8.3.1.5 of the PSAR.

Separation Criteria Before and After an Isolation Device

The cables before an isolation device are Class 1E circuits and are routed in Class 1E raceway system in accordance with criteria given above for physical separation of Class 1E cables. The cables after the isolation device are non-Class 1E cables and are routed in non-Class 1E raceway system in accordance with criteria given above for separation of Class 1E and non-Class 1E cables.

Plant Protection System (PPS) Separation

The PPS will meet the separation requirements of IEEE Std. 384-1974 and Regulatory Guide 1.75 and the following:

a) All PPS wiring external to control panels is run in conduit, with wiring for redundant channels run in spearate conduits. Only PPS wiring is included in these conduits. Primary shutdown system wiring is not run in the same conduit as the secondary shutdown system wiring.

b) Wiring for each Primary PPS instrument channel (R1A, R1B, R1C) is routed in separate conduits.

c) Wiring for each Secondary PPS instrument channel (S2A, S2B, S2C) is routed in separate conduits.

d) There are dedicated containment penetrations for each of the three Primary PPS instrument channels and each of the three Secondary PPS instrument channels which pass through containment. All requirements for separation of PPS wiring in raceways are utilized for separation of PPS wiring through containment penetrations.

e) All wiring for the three Containment Isolation System instrument channels is routed exclusively with the three Primary PPS instrument channels, or exclusively with the Secondary PPS instrument channels or through three independent conduits.

f) The Primary PPS Logic Train Actuation wiring is routed through at least three separate conduits from three separate Primary PPS Logic Train Panels to the Primary PPS Scram Breakers. One conduit contains wiring from only one Primary PPS logic train.

g) The Secondary PPS Logic Train Actuation wiring is routed through at least three separate conduits from the Secondary PPS Logic Panels to the Secondary Control Rod Solenoid Valve Actuation wiring in the Head Access Area.

h) Containment Isolation System (CIS Logic Train Actuation wiring is routed through two independent conduits. One conduit contains wiring from only one CIS Logic Train. No intermixing of CIS Logic Trains within a conduit is permitted. CIS Logic Train 1 wiring is routed from CIS Logic Panel 1 to CIS Breaker 1 in the Intermediate Building. CIS Logic Trian 2 is routed from CIS Logic Panel 2 to CIS Breaker 2 in the Intermediate Building.

i) The -iring from a PPS buffered output which is used for a non-PPS purpose may be included in a PPS rack. The PPS wiring is separated from the non-PPS wiring. The amount of separation is defined on an individual case basis; however, it is designed to meet the requirements of IEEE Std. 384-1974 and Regulatory Guide 1.75.

j) Containment Isolation Valve actuation wiring (for either manually or automatically initiated actuation) to athe Inside Containment and the Otside Containment Isolation Valves are separated as Division 1 and Division 2 cabling, respectively.

k) Rigid, metallic, completely enclosed and unvented raceways are considered acceptable for any of the above applications as they are equivalent to rigid metal conduit, as defined in IEEE Std. 100 and NFPA 70.

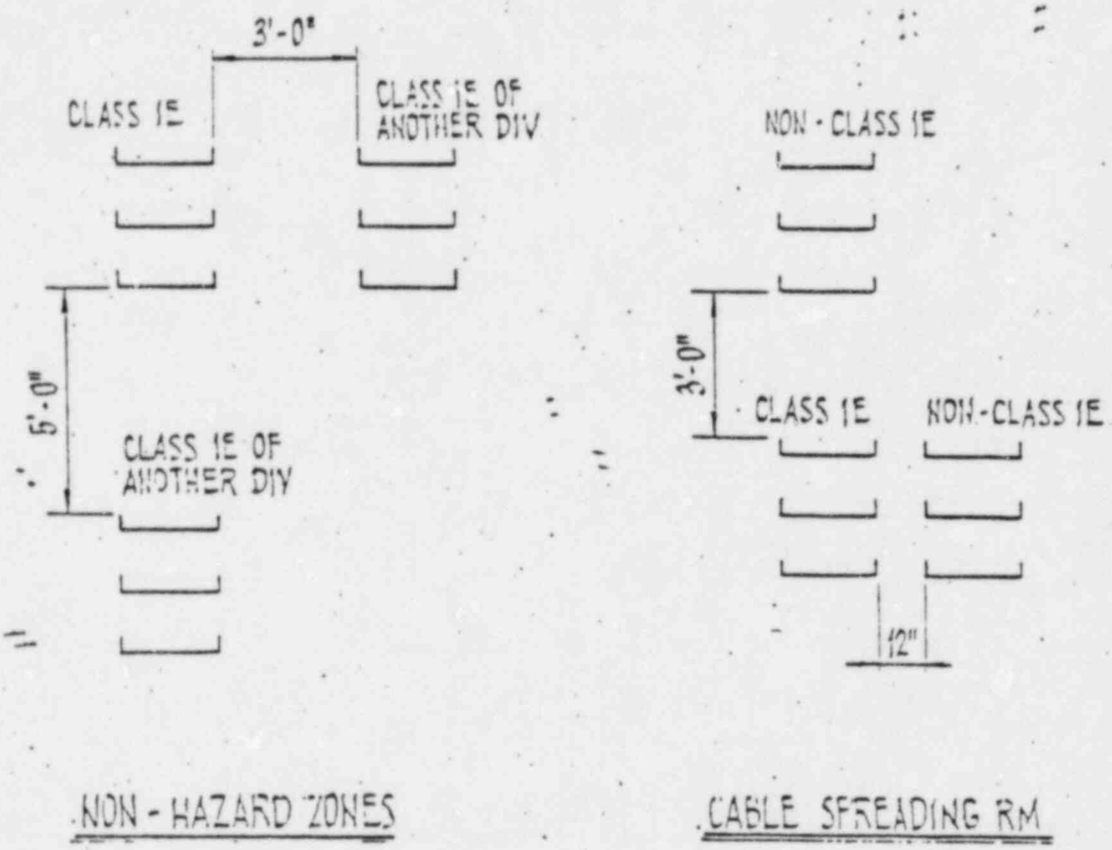
l) The physical separation between PPS conduits, containment penetrations, or panels is in accordance with IEEE Std. 384-1974 and Regulatory Guide 1.75 to provide assurance that a credible single event cannot simultaneously degrade redundant protection channels or shutdown systems.

m) The Primary Steam Generator Auxiliary Heat Removal System (SGAHRS) channels and logic outputs are treated and separated as Primary PPS signals. The primary SGAHRS logic output is kept separated from the Secondary SGAHRS logic output channels. The Secondary SGAHRS channels and logic outputs are treated and separated as Secondary PPS signals. The Secondary SGAHRS logic output is kept separated from Primary PPS, CIS and non-PPS outputs. Redundant SGAHRS logic train outputs are separated torm each other. The manual trip and reset inputs to each SGAHRS divisional latch logic are routed and separated as redundant PPS signals separated form the automatic SGAHRS logic outputs and all other PPS and non-PPS channels.

F. Cables Within Control Board and Other Panels

Within control boards and other panels, harnesses of different divisions are provided with a minimum of 6 inches free air separation. Otherwise barriers are to be installed. Metal conduit, fire barriers, or steel wire ducts are acceptable barriers to maintain independence without additional spatial separation over that required by Regulatory Guide 1.75. Non-Class 1E wiring are not harnessed together with Class 1E cable. Non-class 1E wiring are separated from Class 1E or associated wiring with a minimum of 6 inches free air or by a barrier.

note (there is no page 12 of 19)



NOTE
THIS SEPARATION APPLIES FOR ALL DIVISIONS CLASS 1E CABLE TRAYS FROM EACH OTHER AND FROM NON-CLASS 1E CABLE TRAYS.

FIGURE 8.3-6 CABLE TRAY SEPARATION

SHEET 1 OF 7

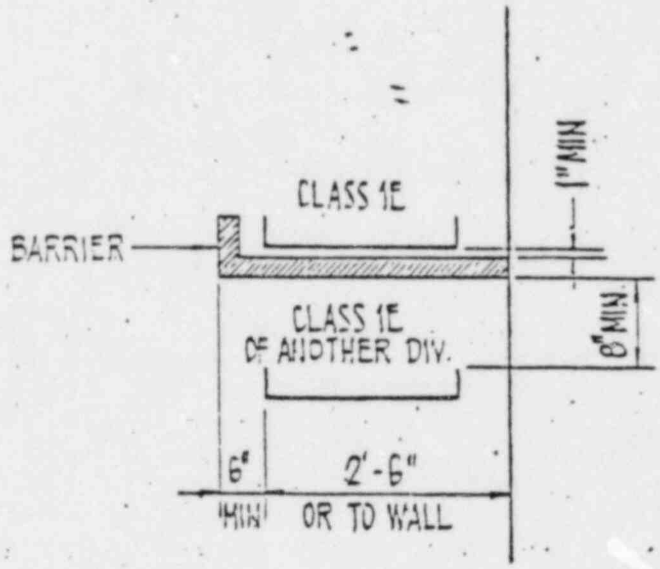


FIGURE 8.3-6 ARRANGEMENT WHEN VERTICAL SPATIAL SEPARATION IS NOT MAINTAINED NON-HAZARD ZONES.

SHEET 2 OF 7

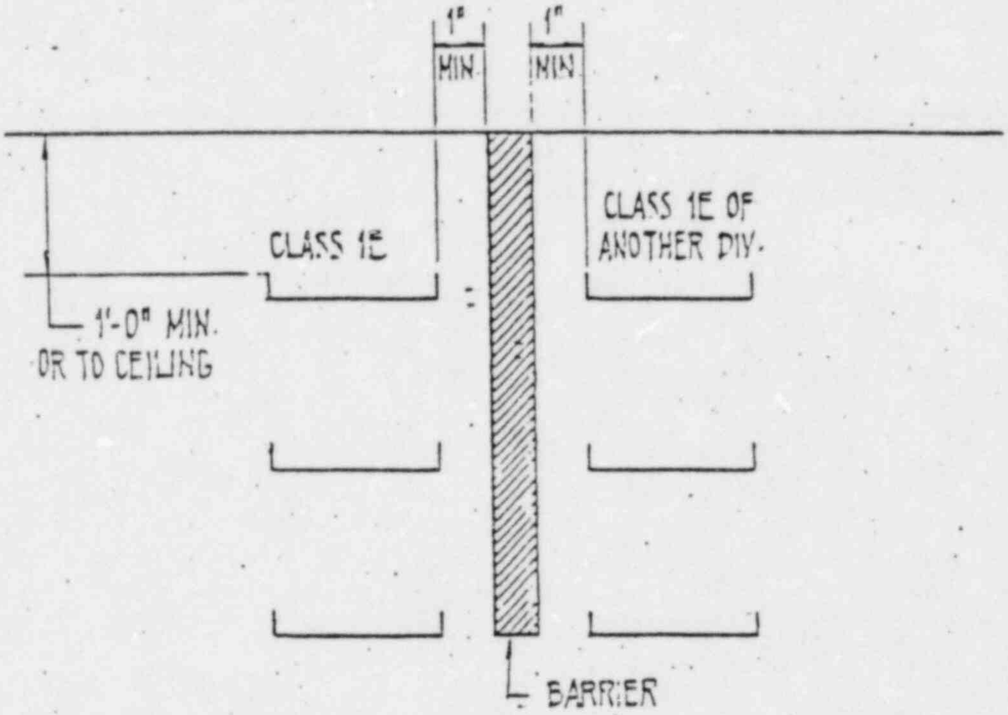


FIGURE 8.3-6 ARRANGEMENT WHEN HORIZONTAL SPATIAL SEPARATION IS NOT MAINTAINED NON-HAZARD ZONES.

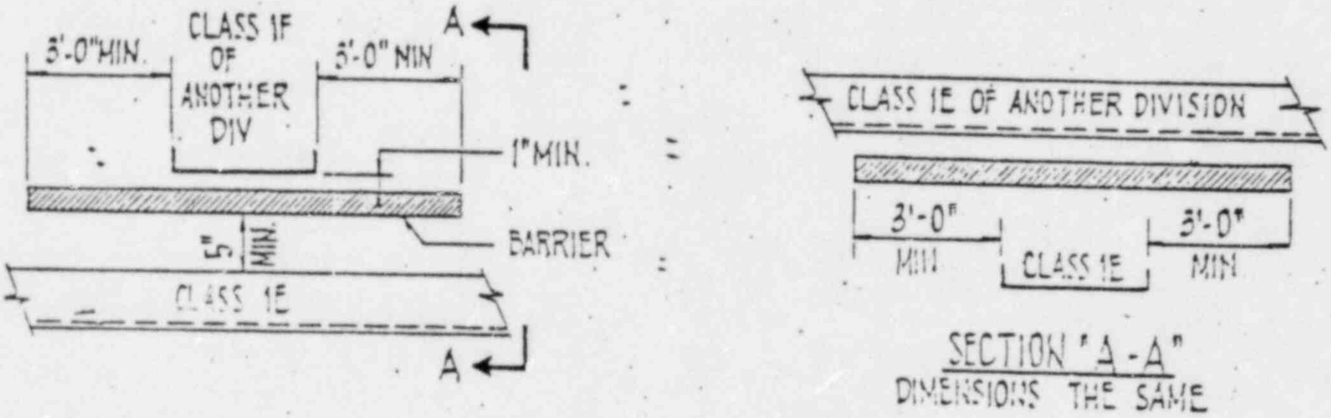


FIGURE 8.3-6 ARRANGEMENT FOR CLASS 1E CABLE TRAY CROSSINGS WHERE VERTICAL SEPARATION IS NOT MAINTAINED NON-HAZARD ZONES

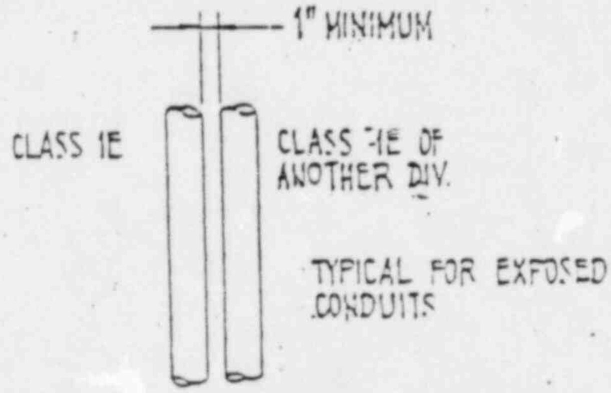


FIGURE 8.3-6 CONDUIT SPATIAL SEPARATION
NON - HAZARD ZONES

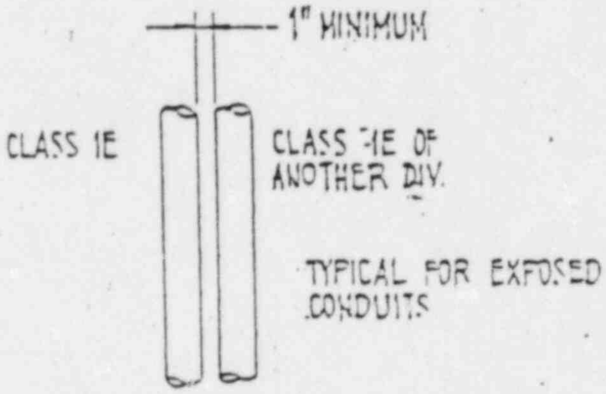
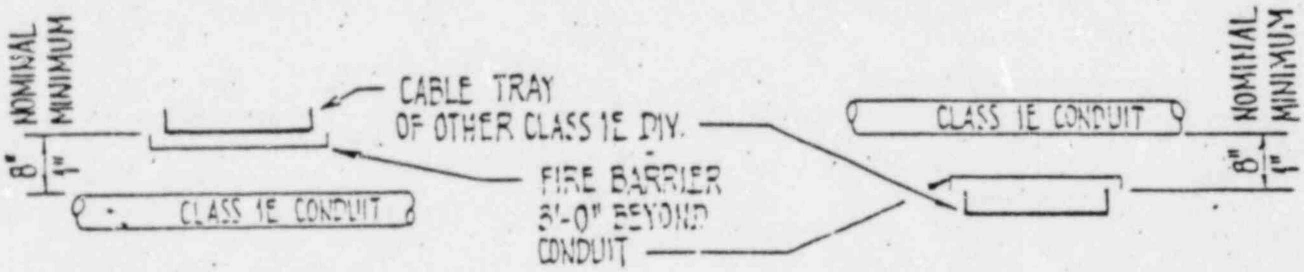


FIGURE 8.3-6 CONDUIT SPATIAL SEPARATION NON - HAZARD ZONES



SAFETY CONDUITS CROSSING
OTHER CLASS 1E DIVISION
CABLE TRAYS FROM BELOW
NON-HAZARD ZONES

SAFETY CONDUITS CROSSING
OTHER CLASS 1E DIVISION
CABLE TRAYS FROM ABOVE.
NON-HAZARD ZONES

FIGURE 8.3-6

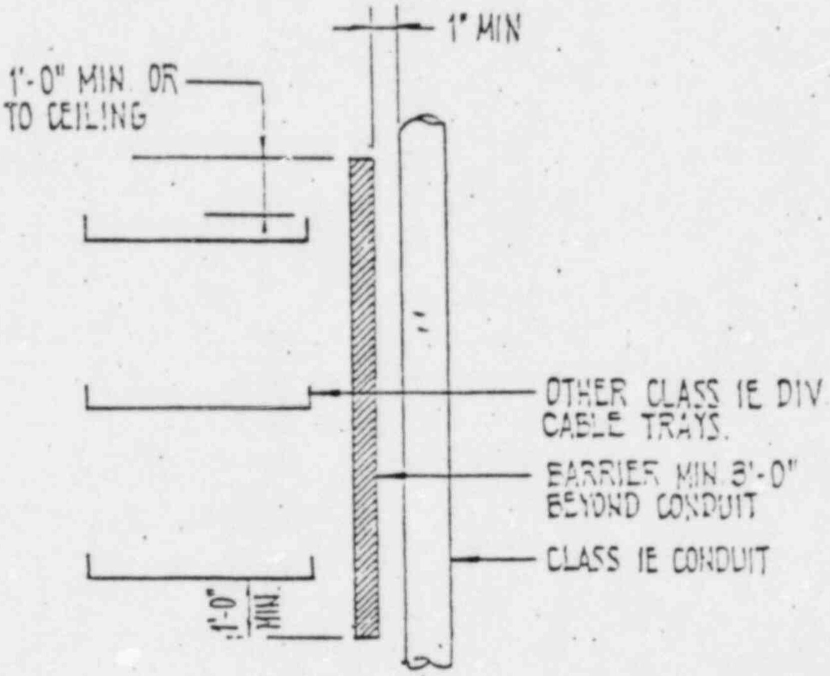


FIGURE 8.3-6 ARRANGEMENT FOR VERTICAL SAFETY CONDUITS CROSSING OTHER CLASS 1E DIVISION CABLE TRAYS NON-HAZARD ZONES.

Question CS430.11 (8.3.1) (8.3.2)

You state in section 8.3.1.4.E of the PSAR that only one safety division is routed in a fire hazard zone and that this one division is suitably protected so that a fire in the zone will not effect the safety functions of the other safety groups. This statement does not meet current regulatory guidelines. Current guidelines require that the one division be suitably protected so that fire in the zone will not affect the safety function of the one division located in the zone. The other safety groups must be separated by a three-hour fire rated barrier from the zone.

In addition to current guidelines, it is proposed that if the one division cannot be protected from the effects of fire in the zone (such as in areas of potential sodium fires) there must be a minimum of two remaining safety divisions outside the fire zone and separated by a barrier sufficient to contain the fire. The remaining safety divisions must be capable of safely shutting down the reactor in compliance with the single failure criteria. Indicate compliance with the above current and proposed guidelines in the PSAR or describe and justify an acceptable alternative.

Response

CRBRP equipment arrangements and fire suppression system design has been developed in a manner as to preclude the likelihood of a fire in an area reaching safety related equipment. Spacial separation and/or walls are provided between fire hazard and safety-related equipment, and general area sprinkler coverage has been provided wherever feasible to protect safety related equipment from potential exposure to fires.

In the event of a fire in a fire zone containing a safety division, which affects that division, there will be two remaining safety divisions outside the fire zone, separated by three-hour fire rated barriers and capable of safely shutting down the reactor. This will be in compliance with the proposed NRC guidelines. Furthermore, the CRBRP design will comply with BTP CMEB 9.5-1 position C.5.d governing the control of combustibles.

Question QCS430.12 (8.3.1) (8.3.2)

Fire hazard zones have been defined in the PSAR as areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of flammable material. Current regulatory guidelines define areas of credible accumulation as any open areas of the plant where transient combustables can be placed. This definition encompasses most areas of the plant including switchgear and cable spreading rooms. Revise the PSAR to incorporate the above definition or describe an alternative definition with justifications.

Response

Those areas of the plant where transient combustibles can be placed; will be considered in the fire hazard analysis and will be considered in the selection of fire suppression systems and arrangement of the fire barriers. The definition of Fire Hazard Zones will be deleted from Section 8.3 and will be provided in Section 9.13.1 as follows:

> "Areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible material."

The specific areas where transient combustibles are considered will be identified in the Fire Hazard Analysis. Our review of the plant layout indicated that neither the cable spreading room nor the Class 1E switchgear rooms need to be considered for placement of transient combustibles since they are not part of a pathway of any combustible traffic.

Furthermore, administrative controls governing the handling of transient fire loads will be implemented in accordance with BTP CMEB 9.5-1 position C.2c.

The minimum separation maintained between cables of each division varies according to cable location with respect to potential hazards. The design intent is to provide separation greater than the minimum listed where consistent with a practical plant layout. Six general classifications of hazard zones or areas are defined for electrical separation consideration:

I. Non-Hazard Zones

Areas in which the only potential hazard is a fire of an electrical nature.

II. Fire Hazard Zones

Areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible material as defined in PSAR Section 9.13.1.

III. Equipment Hazard Zone (Pipe Break Hazard Zone)

Areas in which a potential hazard could exist as a consequence of postulated pipe break events in high energy lines.

IV. Cable Spreading Rooms

Areas just above and below the main control room where control and instrumentation cables converge prior to entering the control room.

V. Containment Electrical Penetration Areas

The areas and assemblies that allow cable passage through the Containment Building pressure boundary.

VI. Control Room

Continuously manned room utilized by plant operators to monitor and control the plant.

Non-Hazard Zones

Redundant cables entering panels, cabinets or other equipment enter through separate openings.

In Non-Hazard Zones, no minimum vertical or horizontal physical separation is provided between conduits of the same division beyond that required for construction, installation or access clearances between conduits and/or metal enclosed ducts.

9.13 PLANT FIRE PROTECTION SYSTEM

9.13.1 Non-Sodium Fire Protection System

The Non-Sodium Fire Protection System (NSFPS) provides the plant with equipment, piping, valves, detectors, instrumentation and controls to prevent or mitigate the consequences of a non-sodium fire. Table 9.13-1 shows the areas covered by the Non-Sodium Fire Protection System. Fire Hazard Zones are areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible material.

9.13.1.1 Design Bases

a. Fires that could indirectly or directly affect Seismic Category I safety-related structures, systems and components are identified in Table 9.13-2. Potential fire hazards which provide the base for the design of the fire protection system in areas containing engineered safety-related structures, systems or components, are self-contained lube oil systems, diesel generator fuel oil system, electrical cable insulation, and activated carbon filters. The intensities of the maximum fires involving the above combustible materials are listed in Table 9.13-2 and described below.

   These maximum fires, together with lesser intensity design-basis fires, have served, via a preliminary fire hazards analysis, as the bases for the selection of fire protection measures taken will be confirmed in conjunction with a more detailed fire hazards analysis which will be provided in the PSAR.

   Lubricating Oil

   The maximum fire involving lubricating oil would develop in the turbine lubricating oil equipment located in the Turbine Generator Building and would have an intensity of 20,000 BTU/lb. Fire from this source does not involve safety-related areas and safe shutdown of the plant will not be jeopardized.

   Diesel Generator Fuel Oil

   The largest potential source of fire from fuel oil is in the vicinity of the standby diesel generator fuel oil storage tanks, located below grade adjacent to the Diesel Generator Building. As these tanks are located below grade, the chance of an accident is reduced. Physical separation provided between the two tanks limits

Question CS430.13

Separation of Class 1E raceways from high energy pipelines as defined in the PSAR is to be greater than 15 feet or less than 15 feet if the pipe is suitably restrained so as not to whip and strike the raceway. Current regulatory guidelines require that the Class 1E raceway be protected by a barrier so that pipe whip missiles, jet impingement or environmental effects of the pipe break will not cause failure of the Class 1E raceway. Fifteen feet of space is not considered adequate protection. Indicate compliance with the above guidelines in the PSAR or propose, describe, and justify an acceptable alternative.

Response

CRBRP has three (3) Class 1E Divisions with complete physical separation between divisions. Any damage to cable trays caused by pipe whip missiles, jet impingement, or environmental effect will be limited to the same safety division to which the pipe belongs, and the two other divisions capable of safely shutting down the plant will remain unaffected.

Additional protection will be provided against any single Class 1E Division cable tray damage due to high energy pipe whip missiles by restraint of high energy pipe lines in the vicinity of Class 1E raceways. The design of restraints and/or barriers will be determined by analysis to meet BTP APCSB 3-1, rather than the arbitrary 15 foot distance.

Protection against single Division damage due to high energy jet impingement or environmental effect is considered impractical and unnecessary since two additional safe shutdown Divisions will be available as noted above.

Question CS430.14

Separation between redundant raceways as defined in the PSAR takes into consideration the presence of rotating equipment, monorails, and equipment removal paths and the possibility that heavy equipment could be lifted and dropped and possibly cause failure of two raceway channels. Minimum separation between the two raceway channels is to be such as to preclude failure of both channels. Current regulatory guidelines, however, requires protection of each raceway as well as separation so that the dropped equipment will not cause failure of either raceway. An alternative to protection would be a design that provides an additional two independent systems each capable of shutting down the reactor and separated such that neither will be affected by the "dropped equipment" or failure of rotating equipment. Indicate compliance with the above guidelines in the PSAR or describe and justify an acceptable alternative.

Response

The routing of the safety-related raceways of CRBRP is such that any "dropped equipment" will not result in a failure of any of these raceways.

The CRBRP raceway design is in full compliance with IEEE Standard 384-1974 as supplemented by Regulatory Guide 1.75.

In addition, the safety systems design for CRBRP includes three physically and electrically independent divisions, each capable of shutting down the reactor. Equipment of each of these divisions are located and cables are routed in separate plant areas such that failure of rotating equipment will not cause failure of more than one safety division.

The PSAR Section 8.3.1.4 will be revised as attached.

In Non-Hazard Zones, a minimum horizontal clear space of three feet is maintained between cable trays of differenc divisions. If a horizontal clearance of less than three feet is unavoidable, a fire barrier or a cover (top and bottom) on the trays is provided between the divisions.

Vertical stacking of cable trays of different divisions is avoided wherever possible. Where cable trays of different divisions are stacked vertically, a minimum clear space of five feet is provided between the divisions.

Fire Hazard Zones

In fire hazard zones, Class 1E conduits, trays, wireways or raceways of only one safety division are routed. This division is suitably protected by fire barriers and fire protection systems to mitigate the effects of fire in this zone on the safety function of the other safety groups.

Equipment Hazard Zone (Pipe Break Hazard Zone)

To the extent practical, Class 1E cables are routed in areas remote from high energy piping or areas of potential sodium fires; if unavoidable, the following precautions are taken:

a) Raceways are not less than fifteen feet from a high-energy pipeline unless the pipeline is suitably restrained so as not to whip and strike the raceway. This spacing applies regardless of whether the high energy pipeline is a safety system or non-safety system pipeline. The exception to this consideration is the acceptability of the mechanical failure of one safety system damaging the cable that provides service to components/systems of the mechanical system that has failed.

   Under no circumstances do safety-related raceways run less than fifteen feet from high-energy pipelines of the opposite safety system.

b) Redundant Class 1E circuits are routed or protected such that a postulated event in one system and division cannot preclude the operation of the other redundant systems or divisions.

c) In all areas of the plant, the separation between redundant Class 1E cable raceways takes into consideration the presence of rotating equipment, monorails, equipment removal paths and dropped equipment such that failure of rotating equipment will not cause failure of more than one safety division and any dropped equipment will not cause failure of any safety-related raceways.

d) In general, Class 1E electrical distribution equipment (e.g., switchgear, motor control centers, etc.) is not located in areas where high energy piping or other similar hazards are located.

Question CS430.15 (8.3.1) (8.3.2)

Section 8.3.1.2.14 of the PSAR indicates that Non-Class 1E loads will be connected to one division of the Class 1E system through an isolation device.

a) The proposed design for the isolation device addresses primarily protection of the Class 1E system due to worst case faults in the Non-Class 1E system. Justify why other failures of the Non-Class 1E system such as hot shorts are not considered in the design of the isolation devices.

b) The isolation device is to be designed as indicated in the PSAR so that voltage on the Class 1E system buses will not drop below 70 or 80 percent of nominal given a worst case fault in the Non-Class 1E system. With most Class 1E equipment designed to operate at not less than 90 percent of nominal, justify your design that allows lower voltage.

c) Describe the methods to be used to demonstrate the design capability of the isolation device.

Response

Faults and failure modes other than the worst case three phase fault have also been addressed in the design of the isolation system. However, the analysis provided in the PSAR includes the worst case condition only in order to demonstrate that even under this extreme condition the degradation of the Class 1E system will be within the acceptable limits. Protective devices have been provided in the design to clear any fault on the Non-Class 1E system such as phase to ground, phase to phase, and three phase faults, within a reasonable time such that there is no degradation to the Class 1E system.

a) A phase to ground fault (which is the most likely mode of failure) on a Non-Class 1E circuit will have no effect on the Class 1E system since the isolation system includes a 4.16kV/480V delta-wye connected transformer with the high resistance grounded neutral. The neutral is grounded through a 55.4 ohm resistor which will limit the phase to ground fault current to approximately 5 amperes. The Class 1E 480V and 4.16kV circuit breakers will be tripped to clear a ground fault in the case that the affected Non-Class 1E breaker fails to trip.

Any phase to phase or three phase fault on the Non-Class 1E circuits will be isolated by instantaneous operation of the affected branch feeder circuit breaker. Back-up protection is provided by fast operation of the 480V supply circuit breaker (0.2-0.3 sec clearing time) or by the 4.16kV unit substation transformer feeder circuit breaker (0.6-0.7 sec clearing time). In addition undervoltage sensors are provided at the input terminals of the 480V supply circuit breaker. These undervoltage sensors will initiate tripping of the 480V and 4.16kV circuit breakers within five (5) seconds upon sensing the undervoltage caused by loss of power or failure of the circuit breakers to clear a fault.

b) The isolation system is designed so that impedance of the system is high enough that the worst possible fault (three phase bolted fault) on the 480V Non-Class 1E bus will not degrade the voltage at 4.16kV Class 1E bus below the following levels:

(1) When the 4.16kV Class 1E bus is being supplied from offsite power supply, the voltage at the bus will not drop below 80 percent of nominal.

(2) When the 4.16kV Class 1E bus is being supplied from onsite (standby) power supply the voltage at the bus will not drop below 75 percent.

The minimum voltage levels of 80 and 75 percent of nominal are chosen to be the same as the allowable minimum voltage levels during the sequential loading of the 4.16kV Class 1E bus or during starting of the largest motor after the bus has been fully loaded.

As discussed in a) above, any fault on 480V Non-Class 1E system will be cleared within five (5) seconds. After the fault has been cleared the voltage at the 4.16kV bus will be restored to a minimum of 90 percent of nominal within two (2) seconds, which will allow all connected loads to operated continuously.

c) The high impedance transformer used as an isolation device will be subjected to a short-circuit withstand test as part of the shop testing program at the manufacturer's facility. After the transformer has been energized a three phase fault will be applied at the secondwary windings for the maximum duration of the fault. The purpose of this test is to demonstrate the mechanical and thermal capability of the transformer to withstand short-circuit stresses which the transformer could experience and to verify the transformer current limiting capability.

Section 8.3.1.2.14 of the PSAR will be revised to add the above discussion.

8.3.1.2.14 NRC Regulatory Guide 1.75, Rev. 2 (9/78)

The electrical equipment and circuits comprising or associated with the Class 1E power system, Class 1E protection systems and Class 1E equipment will be designed, qualified and tested in accordance with IEEE Std. 384-1975, supplemented by Regulatory Guide 1.75, "Physical Independence of Electric Systems," positions as discussed herein.

The system will be designed so that the redundant equipment and circuits are separated in accordance with the criteria set forth in paragraph 8.3.1.4.

The AC loads which are not Class 1E but are required for plant availability will not be connected to the redundant Class 1E, Divisions 1 and 2.4.16KV buses, but will be connected to Division 3 switchgear through an isolation device, which is designed as follows:

a. The isolation system will consist of a 41.6KV cirult breaker, a 4.16KV/480V high impedance transformer and a 480V circuit breaker as shown in Figure 8.3-5. The isolation system will be qualified as Class 1E up to the load terminals of 480V circuit breaker.

b. The impedance of the isolation system will be high enough so that for the worst possible fault (three phase bolted fault) on the Non-Class 1E 480V bus, the following conditions will be met:

   (1) The pick-up value of the overcurrent relays protecting the Class 1E 4.16KV main supply circuit breaker will exceed the maximum current (combined maximum load current and maximum fault current contribution) flowing through the supply circuit breaker by a 2:1 margin.

   (2) When the 4.16 KV Class 1E bus is being supplied from offsite power, the voltage at the bus will not drop below 80% of nominal. When the Class 1E bus is being supplied from on-site (standby) power supply, the voltage at the bus will not drop below 75% of nominal. The voltage levels of 80 and 75 percent of nominal are chosen to be the same as the allowable minimum voltage levels during the sequential loading of the 4.16kV Class 1E bus or during starting of the largest motor after the bus has been fully loaded.

c. The isolation system 480 volt and 4.16KV circuit breakers will perform redundant isolation functions. They will be stored energy devices and will be physically separated.

d. Diverse means (electro-mechanical and solid state) will be used for fault sensing and tripping of the isolation system.

e. The isolation system will be able to accept any single component failure concurrent with the worst fault on the Non-Class 1E 480V bus without unacceptable consequences. (This does not include short circuits on the 4.16KV portion of the isolation system since this is considered an extension of the Class 1E bus).

f. Protective devices have been provided in the design to clear any fault on the Non-Class 1E system such as phase to ground, phase to phase and three phase faults within a reasonable time such that there is no degradation to the Class 1E system.

   1) A phase to ground fault (which is the most likely mode of failure) on a Non-Class 1E circuit will have no effect on the Class 1E system since the isolation system includes a 4.16kV/480V delta-wye connected transformer with the high resistance grounded neutral. The neutral is grounded through a 55.4 ohm resistor which will limit the line to ground current to approximately 5 amperes. The Class 1E 480 volt and 4.16kV circuit breakers will be tripped to clear a ground fault in the case that the affected Non-Class 1E feeder circuit breaker fails to trip.

   2) Any phase to phase or three phase fault on the Non-Class 1E circuits will be isolated by instantaneous operation of the affected branch feeder circuit breaker. Back-up protection is provided by fast operation of the Class 1E 480 Volt circuit breaker (0.2-0.3 sec clearing time) or by the 4.16kV circuit breaker (0.6-0.7 sec clearing time). In addition undervoltage sensors are provided at the input terminals of the Class 1E 480 Volt circuit breaker. These undervoltage sensors will initiate tripping of the Class 1E 480 Volt and 4.16kV circuit breakers within five (5) seconds upon sensing the undervoltage caused by loss of power or failure of the circuit breakers to clear a fault.

   3) After the fault has been cleared the voltage at the 4.16kV bus will be restored to a minimum of 90 percent of nominal within (2) seconds, which will allow all connected loads to operate continuously.

g. The high impedance transformer used as an isolation device will be subjected to a short-circuit withstand test as part of the shop testing program at the manufacturer's facility. After the transformer has been energized a three phase fault will be applied at the secondary windings for the maximum duration of the fault. The purpose of this test is to demonstrate the mechanical and thermal capability of the transformer to withstand short-circuit stresses which the transformer could experience and to verify the transformer current limiting capability.

The system is designed to keep the number of associated circuits to a bare minimum. The associated circuits as defined in paragraph 4.5 of IEEE Std. 384-9174 are installed in accordance with the requirements placed on Class 1E circuits such as cable derating, environmental qualification, flame retardance, splicing restrictions and raceway fill limitations described in paragraph 8.3.1.4. The analyses and testing of associated circuits will be

performed in accordance with paragraphs 4.5(3), 4.6.2 and 5.1.1.2 of IEEE Std. 384-9174. The cable installation design prohibits the use of cable spicing inside the cable tray or conduit raceway system.

The physical identification of Class 1E equipment, cables and raceway systems are described in Section 8.3.1.5.

The design provides two separate cable spreading rooms, one above the Control Room and one below it. The design does not permit location of any high energy equipment in the cable spreading rooms as required by IEEE Std. 384-1974. The criteria for routing of circuits in the cable spreading rooms is given in Section 8.3.1.4.

The Divisions 1, 2 and 3 Class 1E Standby Diesel Generator units are described in Section 8.3.1.1.1. The diesel generator units and associated auxiliaries and control equipment are located in separate Seismic Category I structures having independent ventilating systems. The physical separation of circuits related to redundant Standby Diesel Generators are routed in accordance with the criteria specified in Section 8.3.1.4.

The Non-Class 1E and Class 1E DC batteries and related uninterruptible power supply (UPS) equipment are described in Section 8.3.2. DC battery and associated UPS equipment of each safety division is separated from equipment of the other safety division by reinforced concrete walls. The Class 1E batteries and UPS equipment are located in Seismic Category I structures. The physical separation of circuits ralated to each separate division of batteries and UPS system is in accordance with the criteria described in Section 8.3.1.4.

Question CS430.16 (8.3.1) (8.3.2)

Section 8.3.1.2.14 of the PSAR indicates that analyses and testing of associated circuits will be performed in accordance with paragraphs 4.5(3), 4.6.2 and 5.1.1.2 of IEEE Standard 384-1974. Describe in the PSAR and in detail the analyses and testing that will be performed. The description should include the minimum separation distance between associated and Non-Class 1E cables that will be demonstrated by the proposed analyses and testing.

Response

All associated circuits as defined in IEEE Standard 384-1974, paragraph 3, will be treated and routed as Class 1E circuits of the same division. The criteria governing routing of Class 1E circuits are given in Section 8.3.1.4 as supplemented by the response to NRC Question CS430.10.

Based upon the above considerations, analysis and testing of associated circuits will not be required, per paragraph 4.5(1) of IEEE Standard 384-1974.

PSAR Section 8.3.1.2.14 will be revised, as attached.

e. The Isolation system will be able to accept any single component failure concurrent with the worst fault on the Non-Class 1E 480V bus without unacceptable consequences. (This does not include short circuits on the 4.16KV portion of the Isolation system since this is considered an extension of the Class 1E bus).

f. Protective devices have been provided in the design to clear any fault on the Non-Class 1E system such as phase to ground, phase to phase and three phase faults within a reasonable time such that there is no degradation to the Class 1E system.

1) A phase to ground fault (which is the most likely mode of failure) on a Non-Class 1E circuit will have no effect on the Class 1E system since the isolation system includes a 4.16kV/480V delta-wye connected transformer with the high resistance grounded neutral. The neutral is grounded through a 55.4 ohm resistor which will limit the line to ground current to approximately 5 amperes. The Class 1E 480 volt and 4.16kV circuit breakers will be tripped to clear a ground fault in the case that the affected Non-Class 1E feeder circuit breaker fails to trip.

2) Any phase to phase or three phase fault on the Non-Class 1E circuits will be isolated by instantaneous operation of the affected branch feeder circuit breaker. Back-up protection is provided by fast operation of the Class 1E 480 Volt circuit breaker (0.2-0.3 sec clearing time) or by the 4.16kV circuit breaker (0.6-0.7 sec clearing time). In addition undervoltage sensors are provided at the input terminals of the Class 1E 480 Volt circuit breaker. These undervoltage sensors will initiate tripping of the Class 1E 480 Volt and 4.16kV circuit breakers within five (5) seconds upon sensing the undervoltage caused by loss of power or failure of the circuit breakers to clear a fault.

3) After the fault has been cleared the voltage at the 4.16kV bus will be restored to a minimum of 90 percent of nominal within (2) seconds, which will allow all connected loads to operate continuously.

g. The high impedance transformer used as an isolation device will be subjected to a short-circuit withstand test as part of the shop testing program at the manufacturer's facility. After the transformer has been energized a three phase fault will be applied at the secondary windings for the maximum duration of the fault. The purpose of this test is to demonstrate the mechanical and thermal capability of the transformer to withstand short-circuit stresses which the transformer could experience and to verify the transformer current limiting capability.

The system is designed to keep the number of associated circuits to a bare minimum. The associated circuits as defined in paragraph 4.5 of IEEE Std. 384-9174 are installed in accordance with the requirements placed on Class 1E circuits such as separation from Non-Class 1E cables, cable derating, environmental qualification, flame retardance, splicing restrictions and raceway fill limitations described in paragraph 8.3.1.4. The separation

criteria between associated circuits and Non-Class 1E circuits is described in Section 8.3.1.4. The analyses and testing of associated circuits will be performed in accordance with paragraphs 4.5(3), 4.6.2 and 5.1.1.2 of IEEE Std. 384-9174. The cable installation design prohibits the use of cable spicing inside the cable tray or conduit raceway system.

The physical identification of Class 1E equipment, cables and raceway systems are described in Section 8.3.1.5.

The design provides two separate cable spreading rooms, one above the Control Room and one below it. The design does not permit location of any high energy equipment in the cable spreading rooms as required by IEEE Std. 384-1974. The criteria for routing of circuits in the cable spreading rooms is given in Section 8.3.1.4.

The Divisions 1, 2 and 3 Class 1E Standby Diesel Generator units are described in Section 8.3.1.1.1. The diesel generator units and associated auxiliaries and control equipment are located in separate Seismic Category I structures having independent ventilating systems. The physical separation of circuits related to redundant Standby Diesel Generators are routed in accordance with the criteria specified in Section 8.3.1.4.

The Non-Class 1E and Class 1E DC batteries and related uninterruptible power supply (UPS) equipment are described in Section 8.3.2. DC battery and associated UPS equipment of each safety division is separated from equipment of the other safety division by reinforced concrete walls. The Class 1E batteries and UPS equipment are located in Seismic Category I structures. The physical separation of circuits related to each separate division of batteries and UPS system is in accordance with the criteria described in Section 8.3.1.4.

Question CS430.17 (8.3.1) (8.3.2)

Section 8.3.1.2.22 of the PSAR indicates that the Class 1E system will be designed to assure that a design basis event will not cause loss of electric power to more than one Class 1E load group at one time. This proposed design does not meet IEEE Standard 308-1974, justify noncompliance. Also provide the results of a failure mode and effects analysis in accordance with Section 4.8 of IEEE Standard 308-1974 for a design basis event that causes failure of one load group and a single failure in another load group.

Response

CRBRP electrical power distribution system design is in full compliance with IEEE Standard 308-1974 as described below:

1. All Class 1E electrical equipment will be specified and qualified such that the environmental conditions resulting from any design basis event will not cause loss of electric power to any Class 1E loads related to safety, surveillance or protection, thereby maintaining the safety of the plant at all times.

2. Loss of electric power to any Class 1E equipment or to any Class 1E division will not cause damage to the fuel or to the reactor coolant system.

3. In addition, Class 1E AC and DC Power Supplies and distribution systems have been designed as three physically and electrically independent safety divisions, each capable to safely shutdown the plant and conform to the requirements of Class 1E electrical system.

An analysis of the failure modes of Class 1E power systems and the effect of these failures on the electric power available to Class 1E loads will be performed in accordance with IEEE Standard 308-1974, to demonstrate that a single component failure will not prevent satisfactory performance of the minimum Class 1E loads required for safe shutdown and maintenance of post-shutdown or post-accident plant security. The results of this analysis will be included in the FSAR.

The Section 8.3.1.2.22 of the PSAR will be revised to reflect the above discussion as attached.

8.3.1.2.20 NRC Regulatory Guide 1.118, Rev. 1 (6/78)

CRBRP Design Criterion 16 (GDC 18) has been established to satisfy the requirements of IEEE Std. 279-1971 and 338-1977 and Regulatory Guide 1.118. This requires the design to provide for appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections and switchboards, to assess the continuity of the systems and the condition of their components to check the operability and functional performance of the system components such as on-site power sources, relays, switches, buses and the system as a whole under conditions as close to design as practical.

CRBRP design will comply with the above criteria and as a result, it will comply with IEEE Std. 279-1971, 338-1977 and Regulatory Guide 1.118. For details of compliance refer to Sections 8.3.1.1, 8.3.1.2, 8.3.1.2.1 and 8.3.1.3.

8.3.1.2.21 NRC Regulatory Guide 1.131, Rev. 0 (8/77)

The electric cables, field splices and connections will be designed, qualified and tested in accordance with IEEE Std. 383-1974, supplemented by Regulatory Guide 1.131, positions as discussed herein.

The medium voltage cables, low voltage power and control cables, and instrumentation cables are specified to be type tested and qualified to the requirements of IEEE Std. 383-1974 and IEEE Std. 323-1974 supplemented by Regulatory Guide 1.131 and to the design basis events described in Table 8.3-3. The field splicing of Cables inside the cable tray or conduit raceway system is prohibited in accordance with the requirements of IEEE Std. 384-1974 supplemented by Regulatory Guide 1.75. The environmental conditions for all cables include the maximum sodium oxide aerosol concentration, along with the values of pressure, temperature, radiation, chemical concentrations, humidity and time, and are specified as applicable to the design of the power plant.

8.3.1.2.22 IEEE Standard 308 - 1974

Class 1E AC and DC Power Supplies and distribution systems will be designed to conform to the requirements of Class 1E electrical system as discussed below.

All Class 1E electrical equipment will be specified and qualified for the environmental conditions such that no design basis event will cause loss of electric power to any loads related to safety, surveillance or protection, thereby maintaining the safety of the plant at all times.

Loss of electric power to any one equipment in any Class 1E division will not cause any damage to the fuel or to the reactor coolant system.

The Class 1E system is capable of performing its function when subjected to the effects of a design basis event at its location. (See Table 8.3-3) No significant radiation hazard to Class 1E loads has been identified for either normal or emergency conditions.

Class 1E loads are designed to perform their intended functions adequately for the variation of voltage or frequency in the Class 1E electric system.

Question CS430.18 (8.3.1) (8.3.2)

Section 8.3.1.2.22b of the PSAR states that "A loss of electric power to equipment that could result in a reactor power transient capable of causing significant damage to the fuel or to the plant operation. (See Section 15.1.2.") The last words of the above statement "to the plant operation" are not clear and are inconsistent with Section 4.1 (2) of IEEE Standard 308-1974. Provide clarification and justify noncompliance to IEEE Standard 308-1974.

Response

See the Response to Question CS430.17.

Question CS430.19 (8.3.1) (8.3.2)

You state in Section 8.3.1.2.22 of the PSAR that indicators and controls will be provided outside the control room in compliance with Section 4.4 of IEEE Standard 308-1974. Provide a description of the design provisions that assure electrical isolation between controls and indicators located in the control room and remote locations. The current staff position requires that no single failure in the control room shall cause failure at the remote locations.

Response

Controls and indicators located in the control room are electrically separated from controls and indicators at remote locations. Separation is by independent overcurrent protection for each source, so that overcurrent in the power source for control and indication at the control room does not affect operation of the power source for remote control and indication. Both control circuits (control room and remote) interface in the common control logic in the solid State Programmable Logic System Cabinet where they are electrically isolated. This design satisfies the staff position that no single failure in the control and indication at the control room shall cause failure in the control and indication at the remote location.

Question CS430.20 (8.3.1) (8.3.2)

Describe the source of control power to Division 3 AC switchgear and diesel generator.

Response

Control power to Division 3 AC switchgear and Division 3 diesel generator unit is provided from Division 3 DC power supply described in the PSAR Section 8.3.2.

Table 8.3-2C, "Class 1E Division 3 125V DC Load List", of the PSAR will be revised to include all DC loads required to support operation of Division 3 AC switchgear and Division 3 diesel generator unit as attached.

TABLE 8.3-2c

CLASS 1E DIVISION 3 125V DC LOAD LIST

LOAD DESCRIPTION	NORMAL (1) MAX. CONT. LOAD-AMPS	EMERGENCY (2) AMPS	EMERGENCY (2) DURATION	REMARKS
SGAHRS - STEAM TURBINE GOVERNOR CONTROL (1 KW)	4	4	0-120 MIN.	
120 VAC BUS 12NIE008C AS INVERTER LOAD	208	227 182 165	FIRST 1 MIN. NEXT 14 MIN. NEXT 105 MIN.	(NOTE 3)
D.G. CONTROL PANELS LOCAL AND MCR (0.7KW)	11.2	11.2	0-120 MIN.	
D.G. FIELD FLASHING (7.5KW)	-	60	FIRST 1 MIN.	
4.16kV SWITCHGEAR AND 480V USS BREAKER LOAD	4	38 4	FIRST 1 MIN. NEXT 119 MIN.	
TOTAL IN AMPS	227	340 204 184	FIRST 1 MIN. NEXT 14 MIN. NEXT 105 MIN.	

Question CS430.21 (8.3.1)

Operating experience at certain nuclear power plants which have two cycle tubocharged diesel engines manufactured by the Electromotive Division (EMD) of General Motors driving emergency generators have experienced a significant number of turbocharger mechanical gear drive failures. The failures have occurred as the result of running the emergency diesel generators at no load or light load conditions for extended periods. No load or light load operation could occur during periodic equipment testing or during accident conditions with availability of offsite power. When this equipment is operated under no load conditions insufficient exhaust gas volume is generated to operate the turbocharger. As a result the turbocharger is driven mechanically from a gear drive in order to supply enough combustion air to the engine to maintain rated speed. The turbocharger and mechanical drive gear normally supplied with these engines are not designed for standby service encountered in nuclear power plant application where the equipment may be called upon to operate at no load or light load condition and full rated speed for a prolonged period. The EMD equipment was originally designed for locomotive service where no load speeds for the engine and generator are much lower than full load speeds. The locomotive turbocharged diesel hardly ever runs at full speed except at full load. The EMD has strongly recommended to users of this diesel engine design against operation at no load or light load conditions at full rated speed for extended periods because of the short life expectancy of the turbocharger mechanical gear drive unit normally furnished. No load or light load operation also causes general deterioration in any diesel engine.

To cope with the severe service the equipment is normally subject to and in the interest of reducing failures and increasing the availability of their equipment EMD has developed a heavy duty turbocharger drive gear unit that can replace existing equipment. This is available as a replacement kit, or engines can be ordered with the heavy duty turbocharger drive gear assembly.

To assure optimum availability of emergency diesel generators on demand, applicant's who have in place an order or intend to order emergency generators drive by two cycle diesel engines manufactured by EMD, should be provided with the heavy duty turbocharger mechanical drive gear assembly as recommended by EMD for the class of service encountered in nuclear power plants. Discuss your plans to incorporate this improvement.

Response

The onsite (standby) AC power supplies for CRBRP consist of three diesel generator units. Two of these diesel generators, used for Class 1E

Divisions 1 and 2 have been procured from DeLaval Turbine Inc., Engine and Compressor Division; Oakland, California and do not have the turbocharger related design problems as identified in the NRC concern. The final vendor information regarding the diesel generator for Class 1E Division 3 is presently not available pending completion of the procurement process. However, if the engine of this diesel generator unit (Class 1E Division 3) is manufactured by the Electromotive Division (EMD) of General Motors, the following action will be taken:

a) The unit will be specified with a heavy duty turbocharger gear unit suitable for no load or light load operation of the diesel generator unit for a prolonged time, or

b) If the diesel generator is already manufactured without a heavy duty turbocharger gear unit, the turbocharger gear unit will be replaced with a heavy duty turbocharger gear assembly using the replacement kit from the Electromotive Division of General Motors.

Question CS430.22 (8.3.1)

Provide a detailed discussion (or plan) of the level of training proposed for your operators, maintenance crew, quality assurance, and supervisory personnel responsible for the operation and maintenance of the emergency diesel generators. Identify the number and type of personnel that will be dedicated to the operations and maintenance of the emergency diesel generators and the number and type that will be assigned from your general plant operations and maintenance groups to assist when needed.

In your discussion, identify the amount and kind of training that will be received by each of the above categories and the type of ongoing training program planned to assure optimum availability of the emergency generators.

Also discuss the level of education and minimum experience requirements for the various categories of operations and maintenance personnel associated with the emergency diesel generators.

Response

There are currently no plans for personnel to be dedicated only to the above listed tasks. The level of training, including the amount and kind of training, that will be received by each of the above categories, the type of training program planned, and the level of education and minimum experience requirements for the various categories of operations and maintenance personnel have not been determined. When these are finalized, information will be included in the FSAR. It is anticipated that the above plans will be very similar to those used by TVA and that manufacturer's recommendations and requirements will be utilized in developing these plans.

Question CS430.23 (8.3.1)

Periodic testing and test loading of an emergency diesel generator in a nuclear power plant is a necessary function to demonstrate the operability, capability and availability of the unit on demand. Periodic testing coupled with good preventive maintenance practices will assure optimum equipment readiness and availability on demand. This is the desired goal.

To achieve this optimum equipment readiness status the following requirements should be met:

1. The equipment should be tested with a minimum loading of 25 percent of rated load. No load or light load operation will cause incomplete combustion of fuel resulting in the formation of gum and varnish deposits on the cylinder walls, intake and exhaust valves, pistons and piston rings, etc., and accumulation of unburned fuel in the turbocharger and exhaust system. The consequences of no load or light load operation are potential equipment failure due to the gum and varnish deposits and fire in the engine exhaust system.

2. Periodic surveillance testing should be performed in accordance with the applicable NRC guidelines (R.G. 1.108), and with the recommendations of the engine manufacturer. Conflicts between any such recommendations and the NRC guidelines, particularly with respect to test frequency loading and duration, should be identified and justified.

3. Preventive maintenance should go beyond the normal routine adjustments, servicing and repair of components when a malfunction occurs. Preventive maintenance should encompass investigative testing of components which have a history of repeated malfunctioning and require constant attention and repair. In such cases consideration should be given to replacement of those components with other products which have a record of demonstrated reliability, rather than repetitive repair and maintenance of the existing components. Testing of the unit after adjustments or repairs have been made only confirms that the equipment is operable and does not necessarily mean that the root cause of the problem has been eliminated or alleviated.

4. Upon completion of repairs or maintenance and prior to an actual start, run, and load test, a final equipment check should be made to assure that all electrical circuits are functional, i.e., fuses are in place, switches and circuit breakers are in their proper position, no loose wires, all test leads have been removed, and all valves are in the proper position to permit a manual start of the equipment. After the unit has been satisfactorilfy started and load tested, return the unit to ready automatic standby service and under the control of the control room operator.

Provide a discussion of how the above requirements have been implemented in the emergency diesel generator system design and how they will be considered when the plant is in commercial operation, i.e., by what means will the above requirements be enforced.

Response

1. During periodic testing and test loading, each diesel generator unit will be tested at load in excess of the minimum 25 percent of the unit rated load, as described in Section 8.3.1.1.1 of the PSAR.

2. Diesel engine surveillance testing will be performed in accordance with NRC Regulatory Guide 1.108 (Rev. 1, 8/77) as described in Section 8.3.1.1.1 of the PSAR and in accordance with recommendations of the diesel engine manufacturer. Any conflicts between the manufacturer's recommendations and the NRC guidelines will be identified and discussed after receipt of the manufacturer's surveillance testing recommendations.

3. The Plant Maintenance Group, through the review of Work Requests, Licensee Event Reports and Surveillance Test Reports, will maintain awareness of problems associated with the diesel generator units. Repeated problems with any equipment or component important to safety will become a subject for a plant investigation to determine if the cause of the problem is related to improper maintenance, improper operation, poor design, or manufacturing deficiencies. If the problem is determined to be caused by improper maintenance or operation, preventative measures such as proper training or procedure changes will be implemented. If the problem is determined to be caused by design or manufacture, a request will be made to engineering for an evaluation and/or solution.

4. Administrative Procedure will specify for all systems, including the diesel generator units, that shift supervision shall "require a checklist to be performed on the affected system and on portions of other systems located in the areas in which significant maintenance was performed". Based on the activities performed, this checklist will include such items as valves, electrical and instrument alignments, tests to ensure that electrical circuits are functional, wiring check for loose connections, visual checks to ensure that proper fuses are in place and that the circuit breakers and disconnect switches are in proper position, etc.

Question CS430.24 (8.3.1)

The availability on demand of an emergency diesel generator is dependent upon, among other things, the proper functioning of its controls and monitoring instrumentation. This equipment is generally panel mounted and in some instances the panels are mounted directly on the diesel generator skid. Major diesel engine damage has occurred at some operating plants from vibration induced wear on skid mounted control and monitoring instrumentation. This sensitive instrumentation is not made to withstand and function accurately for prolonged periods under continuous vibrational stresses normally encountered with internal combustion engines. Operation of sensitive instrumentation under this environment rapidly deteriorates calibration, accuracy and control signal output.

Therefore, except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation should be installed on a free standing floor mounted panel separate from the engine skids, and located on a vibration free floor area. If the floor is not vibration free, the panel shall be equipped with vibration mounts.

Confirm your compliance with the above requirements or provide justification for noncompliance.

Response

Except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation for each diesel generator unit are installed on two (2) free standing floor mounted panels separate from the diesel generator unit skids.

The diesel generator units are located in a Seismic Category I building separate from all other plant buildings. The diesel generator units are installed on their own foundations which are isolated from the main building slab. The control panels are located on the floor area which is considered to be vibration free, and as such, no vibration mounts are required.

Section 8.3.1.1.1 of the PSAR will be revised to include the above clarification.

8.3.1.1.1 Standby AC Power Supply

The Standby AC Power Supply is a Class 1E system which supplies AC power to the Class 1E and certain essential Non-Class 1E loads when the Plant AC Power Supply, CRBRP Preferred Power Supply, and Reserve AC Power Supply are not available.

The Standby AC Power Supply consists of three Class 1E diesel generators, each supplying power to its own safety group loads. Safety Division 1 and 2 are redundant to each other. The diesel generators are physically and electrically independent of each other. The Divisions 1 and 2 diesel generators supply power to redundant load groups. The diesel generators are sized in accordance with IEEE Standard 387-1977, supplemented by Regulatory Guide 1.9, Rev. 2. The total demand during an emergency condition when off-site AC power supplies are unavailable is within the continuous rating of each diesel generator as indicated in Tables 8.3-1A, 8.3-1B, and 8.3-1C.

Each diesel generator is installed in a separate and independent diesel generator room. These rooms are located in a Seismic Category 1 structure and are capable of withstanding missiles as described in Section 3.8.4.1.4. Auxiliary equipment, local control boards and excitation cubicles associated with each diesel generator are located in the same room with the diesel generator. Except for sensors and other equipment that must be directly mounted on the associated piping, the controls and monitoring instrumentation for the diesel generator unit are installed on two (2) free standing floor mounted panels separate from diesel generator unit skids.

The Diesel Generator sets are installed on their own foundations which are isolated from the main building slab. The control panels are located on the floor area which is considered to be vibration free.

Cables for Standby AC Power Supplies will be installed in their own separate division of the Class 1E raceway system. Cables and raceways of the Standby AC Power Supply will be marked in a distinctive manner as described in Section 8.3.1.4.

The following support systems are those essential auxiliary systems or components required to start and operate the diesel generators.

a. The Safety-Related 125V DC Power System

   Each diesel generator is furnished with an independent DC supply from the Safety-Related 125V DC Power System. (Section 8.3.2 describes the 125V Class 1E DC system).

b. The Diesel Generator Fuel Oil Storage and Transfer System

   Fuel is provided for starting during initial operation using a shaft driven pump taking suction from a day tank. Fuel is provided for continuous operation using AC powered fuel transfer pumps taking suction from the underground storage tanks to replenish the day tank fuel supply. Each diesel generator is furnished with an independent fuel storage and transfer system. For details refer to Section 9.14.1.

c. Diesel Generator Cooling Water System

Each diesel generator is furnished with an independent cooling water support system. For details refer to Section 9.14.2.

Question 430.25 (8.3.2)

In Chapter 8 of the PSAR, you discuss three (3) emergency diesel generators. In Chapter 9, however, the discussion of emergency diesel generator auxiliary systems includes only two (2) diesel generators. Revise your PSAR so Chapters 8 and 9 are in agreement. The PSAR revisions should cover the text material, as well as applicable P&ID's and General Arrangement Drawings showing plan, elevation, and section views. Questions asked in Chapter 9 are applicable to all emergency diesel generators.

Response

The incorporation of the third emergency diesel generator into the plant design is pending completion of the procurement process of the third diesel generator. The design of the third diesel generator auxiliaries will be in accordance with the applicable requirements of SRP 9.5.4, 9.5.5, 9.5.6, 9.5.7 and 9.5.8. Section 9.14 of the PSAR will be updated in a future amendment to include the available additional information for the third emergency diesel generator.

Question CS430.26 (8.3.1)

In Section 8.3.1.1.2 of the PSAR, under the heading Circuit Protection, you list the emergency diesel generator protective trips. However, there is no discussion of protection in the event of excessive jacket water temperature or turbo-charger malfunctions. Expand your PSAR to discuss these protective features, or explain why such protection is not required.

Response

The design and description of all of the emergency diesel generator protective trips is not included in the PSAR since the final vendor information is not available, pending completion of the procurement process of the diesel generators. This information will be included in the FSAR. However, the emergency diesel generator will be provided with protection against excessive jacket water temperature, such that the operator will be alarmed if the temperature exceeds 190°F and the unit will be tripped on temperature in excess of 200°F. This protective trip feature will be bypassed when the unit is running in an emergency mode.

The turbocharger will be provided with alarms for low lube oil pressure, excessive vibration and high jacket water temperature to alert the operator of potential turbocharger malfunction. The performance of the turbocharger will be periodically observed during the testing of the unit. Should a failure of some part of the turbocharger prevent its operation, the engine can be operated as a normally aspirated engine until repairs can be made to the turbocharger.

The malfunction of the turbocharger will result in some loss of power output; however, since there is substantial margin in the load capability of the units, the ability of these units to perform their intended function during an emergency will not be affected. This will be confirmed with the vendor at a later date.

Question CS430.27

The PSAR Section covering onsite communications should be expanded to include the following information:

a) Identify all areas from which it will be necessary for plant personnel to communicate with the control room or the emergency shutdown panel during and following transients and/or accidents (including loss of offsite power) in order to mitigate the consequences of the emergency and to attain a safe, cold plant shutdown.

b) Indicate the types of communications that will be available in each of the above areas to provide an adequate communications under all normal operations and design basis accident conditions, including the safe shutdown earthquake.

Response

a) Table QCS430.27-1 identifies the vital areas by building, cell and cell designation from which it will be necessary for plant personnel to communicate with the control room or the emergency shutdown panels during the full spectrum of accident or incident conditions (including loss of offsite power).

b) Table QCS430.27-1 also identifies the types of communications that will be available in each of the above areas to communicate with the control room or the emergency shutdown panel during normal operation and accident conditions.

The communication system is designed for high reliability during normal and emergency operation of the plant within the plant and between the plant and other TVA facilities.

The communication system is not required to perform any safety function. Therefore, the operation of the communication system, except the portable radio system, cannot be ensured during and after a safe shutdown earthquake.

The system is designed to provide effective and diversified means of communication in all vital areas of the plant during the full spectrum of accident or incident conditions under the maximum potential noise levels. The various means of communications as described in PSAR Section 9.11 complement one another. Should for some reason one or more communication means be unavailable, diverse means should continue to be available.

The portable radio units which will be handcarried by plant personnel will provide them with the capability to communicate among themselves on an alternate frequency in case of loss of base station, antenna, satellite receiver and transmitter of portable radio system.

The communication equipment located in Seismic Category I structures will be mounted on seismically qualified supports.

LEGEND

PA-IC = Public Address Intra-plant Communications System

PAX = Private Automatic Exchange (Telephone System)

MCJ = Maintenance Communication Jacking System (Sound Powered Communication System)

PRS = Portable Radio System

CB = Control Building

RSB = Reactor Service Building

RCB = Reactor Containment Building

SGB = Steam Generator Building

DGB = Diesel Generator Building

ECT = Emergency Cooling Towers

FPH = Fire Protection Pump House

CR = Control Room

RSP = Remote Shutdown Panel

HVAC = Heating, Ventilating, and Air Conditioning

USS = 480V AC Unit Substation

MCC = Motor Control Center

AFW = Auxiliary Feedwater

SWGR = Medium Voltage Switchgear

SSPLS = Solid State Programmable Logic System

EI&C = Electrical Instrumentation & Control

EVST = Ex-vessel Storage Tank

EVSS = Ex-vessel Storage Subsystem

ABHX = Air Blast Heat Exchanger

TABLE QCS430.27-1

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
CB	410A	Control Room HVAC Cell	X		X	X
	410B	Control Room Filter Cell	X		X	X
	411A	Control Room HVAC Cell	X		X	X
	411B	Control Room Filter Cell	X		X	X
	412	Air Handling Unit Area	X	X	X	X
	413	Return Fan Area	X	X	X	X
	421	Security Room (Reserved)	X	X		X
	431	Main Control Room	X	X	X	X
	432	Computer Room	X	X	X	X
	446	USS and MCC Area	X	X	X	X
	451	125V Division 1 Battery Room	X		X	X
	453	250V Division 3 Battery Room	X		X	X
	454	Division 1 AC/DC Equipment Room	X		X	X
	455	Secondary Rod Control Room	X		X	X
	456	Prim. Rod Control MG Set Cell	X		X	X
	457	Prim. Rod Control Room	X		X	X
	458	125V Division 3 AC/DC Equipment Room	X		X	X
	459	Division 3 AC/DC Equipment Room	X	X	X	X
	460	Division 2 AC/DC Equipment Room	X	X	X	X

*Portable radios will be hand carried by plant personnel

TABLE 1
(cont'd)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
SGB	202	Auxiliary Bay Loop 1	X	X	X	X
	202A	Turbine AFW Pump			X	X
	202B	AFP Cooler Room			X	X
	204	Auxiliary Bay Loop2	X	X	X	X
	204A	AFW Pump A			X	X
	204B	AFW Pump B			X	X
	206	Auxiliary Bay Loop 3	X	X	X	X
	207	Steam Gen. Cell Loop 1	X		X	X
	208	Steam Gen. Cell Loop 2	X		X	X
	209	Steam Gen. Cell Loop 3	X		X	X
	215	SGAHRS PWST Room Auxiliary Bay	X		X	X
	216	Emer. Chiller Room Int. Bay	X		X	X
	217	Emer. Chiller Room Int. Bay	X		X	X
	221	Auxiliary Bay Loop 1	X	X	X	X
	222	Auxiliary Bay Loop 2	X		X	X
	223	Auxiliary Bay Loop 3	X	X	X	X
	241	Auxiliary Bay Loop 1	X	X	X	X
	242	Auxiliary Bay Loop 2	X	X	X	X
	243	Auxiliary Bay Loop 3	X	X	X	X
	244	Steam Gen. Cell Loop 1	X		X	X
	245	Steam Gen. Cell Loop 2	X		X	X
	246	Steam Gen. Cell Loop 3	X		X	X
	247	Intermediate Bay West	X	X	X	X

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
SGB	253	Intermediate Bay East	X		X	X
	262	Intermediate Bay Floor El. 816'-0"	X	X	X	X
	271	Intermediate Bay Floor El. 836'-0"	X	X	X	X
	272A	Remote Shutdown Cell A	X	X	X	X
	272B	Remote Shutdown Cell B	X	X	X	X
	272C	Remote Shutdown Cell C	X	X	X	X
	273	Motor Control Center Division 3 Cell	X		X	X
	281	Auxiliary Bay Loop 1	X	X	X	X
	282	Auxiliary Bay Loop 2	X		X	X
	283	Auxiliary Bay Loop 3	X	X	X	X

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May 1982

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
EEB	521	SWGR Bus and USS Cell	X	X	X	X
	524	SWGR Bus and USS Cell	X	X	X	X
	525	Fire Pump Area	X		X	X
	541	Fire Pump Area	X		X	X

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TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
DGB		Diesel Generator A and Auxiliaries	X	X	X	X
		Diesel Generator B and Auxiliaries	X	X	X	X
		Diesel Generator C and Auxiliaries	X	X	X	X
		DG A HVAC Equipment Room	X	X	X	X
		DG B HVAC Equipment Room	X	X	X	X
		DB C HVAC Equipment Room	X	X	X	X

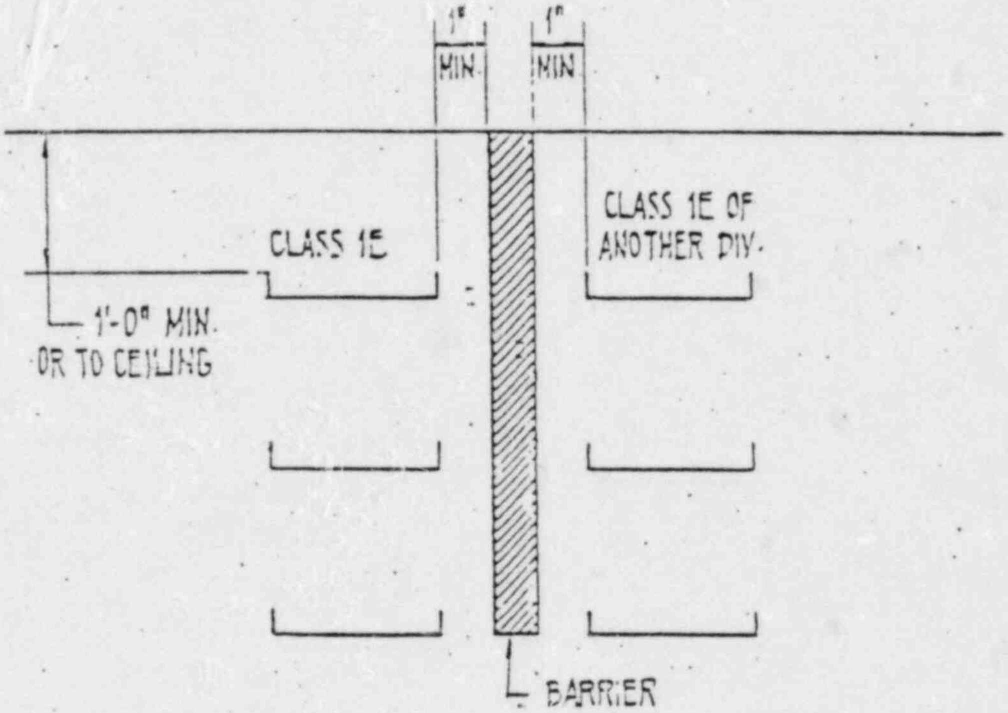


FIGURE 8.3-6 ARRANGEMENT WHEN HORIZONTAL SPATIAL SEPARATION IS NOT MAINTAINED NON-HAZARD ZONES.

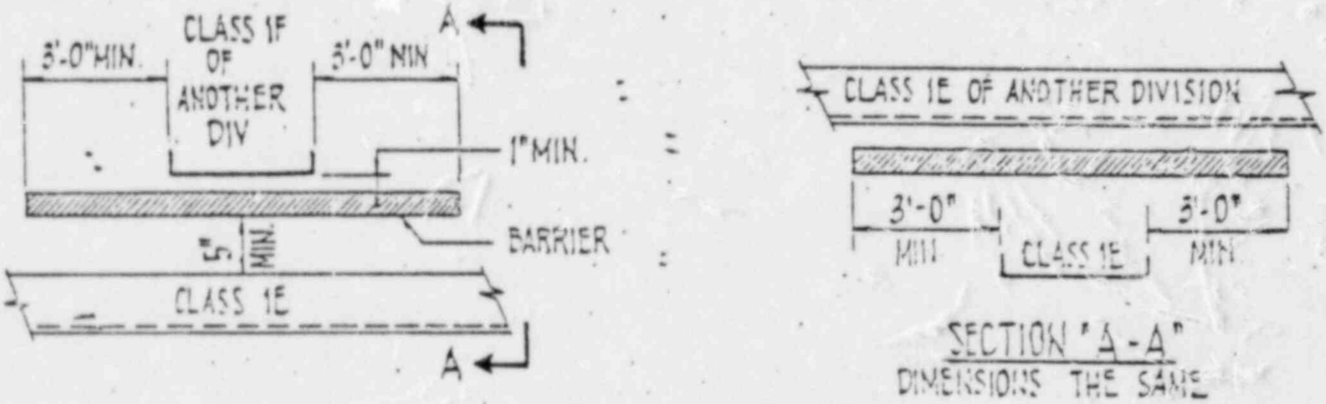


FIGURE 8.3-6 ARRANGEMENT FOR CLASS 1E CABLE TRAY CROSSINGS WHERE VERTICAL SEPARATION IS NOT MAINTAINED NON-HAZARD ZONES.

SHEET 4 OF 7

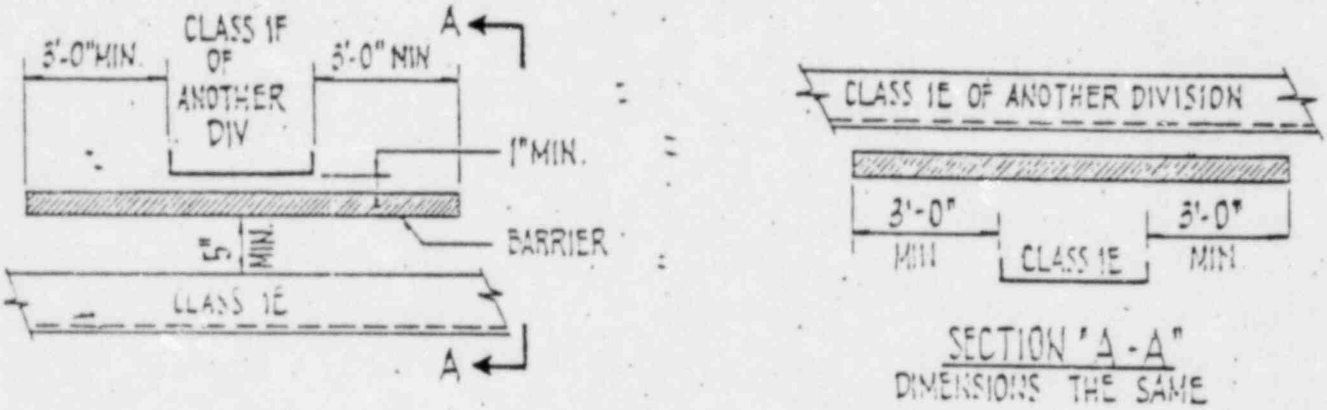


FIGURE 8.3-6 ARRANGEMENT FOR CLASS 1E CABLE TRAY CROSSINGS WHERE VERTICAL SEPARATION IS NOT MAINTAINED NON-HAZARD ZONES.

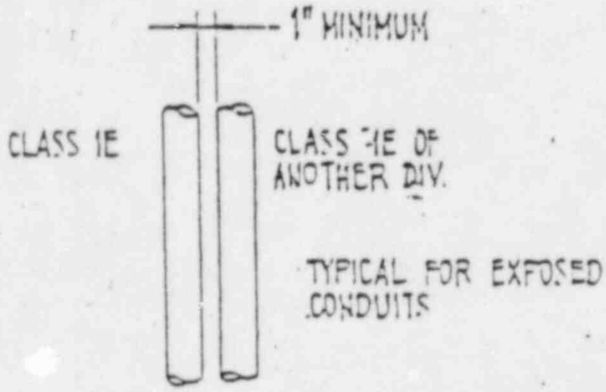
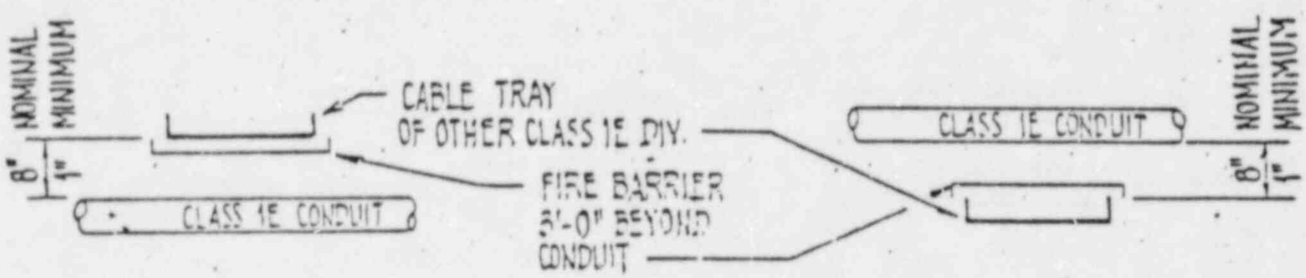


FIGURE 8.3-6 CONDUIT SPATIAL SEPARATION NON - HAZARD ZONES

SHEET 5 OF 7



SAFETY CONDUITS CROSSING OTHER CLASS 1E DIVISION CABLE TRAYS FROM BELOW NON-HAZARD ZONES

SAFETY CONDUITS CROSSING OTHER CLASS 1E DIVISION CABLE TRAYS FROM ABOVE. NON-HAZARD ZONES

FIGURE 8.3-6

SHEET 6 OF 7

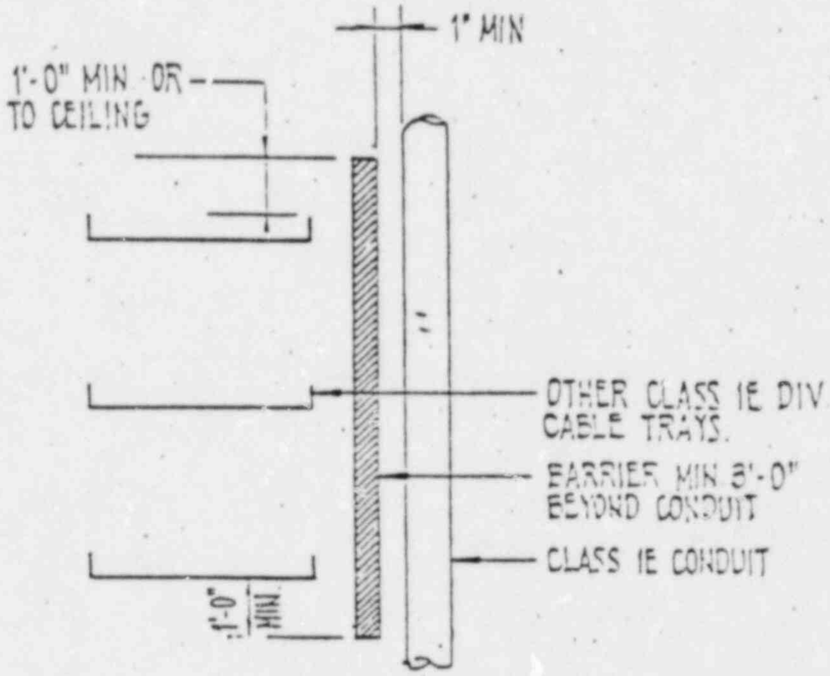


FIGURE 8.3-6 ARRANGEMENT FOR VERTICAL SAFETY CONDUITS CROSSING OTHER CLASS 1E DIVISION CABLE TRAYS NON-HAZARD ZONES.

SHEET 7 OF 7

Question CS430.11 (8.3.1) (8.3.2)

You state in section 8.3.1.4.E of the PSAR that only one safety division is routed in a fire hazard zone and that this one division is suitably protected so that a fire in the zone will not effect the safety functions of the other safety groups. This statement does not meet current regulatory guidelines. Current guidelines require that the one division be suitably protected so that fire in the zone will not affect the safety function of the one division located in the zone. The other safety groups must be separated by a three-hour fire rated barrier from the zone.

In addition to current guidelines, it is proposed that if the one division cannot be protected from the effects of fire in the zone (such as in areas of potential sodium fires) there must be a minimum of two remaining safety divisions outside the fire zone and separated by a barrier sufficient to contain the fire. The remaining safety divisions must be capable of safely shutting down the reactor in compliance with the single failure criteria. Indicate compliance with the above current and proposed guidelines in the PSAR or describe and justify an acceptable alternative.

Response

CRBRP equipment arrangements and fire suppression system design has been developed in a manner as to preclude the likelihood of a fire in an area reaching safety related equipment. Spacial separation and/or walls are provided between fire hazard and safety-related equipment, and general area sprinkler coverage has been provided wherever feasible to protect safety related equipment from potential exposure to fires.

In the event of a fire in a fire zone containing a safety division, which affects that division, there will be two remaining safety divisions outside the fire zone, separated by three-hour fire rated barriers and capable of safely shutting down the reactor. This will be in compliance with the proposed NRC guidelines. Furthermore, the CRBRP design will comply with BTP CMEB 9.5-1 position C.5.d governing the control of combustibles.

Question QCS430.12 (8.3.1) (3.3.2)

Fire hazard zones have been defined in the PSAR as areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of flammable material. Current regulatory guidelines define areas of credible accumulation as any open areas of the plant where transient combustables can be placed. This definition encompasses most areas of the plant including switchgear and cable spreading rooms. Revise the PSAR to incorporate the above definition or describe an alternative definition with justifications.

Response

Those areas of the plant where transient combustibles can be placed; will be considered in the fire hazard analysis and will be considered in the selection of fire suppression systems and arrangement of the fire barriers. The definition of Fire Hazard Zones will be deleted from Section 8.3 and will be provided in Section 9.13.1 as follows:

> "Areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible material."

The specific areas where transient combustibles are considered will be identified in the Fire Hazard Analysis. Our review of the plant layout indicated that neither the cable spreading room nor the Class 1E switchgear rooms need to be considered for placement of transient combustibles since they are not part of a pathway of any combustible traffic.

Furthermore, administrative controls governing the handling of transient fire loads will be implemented in accordance with BTP CMEB 9.5-1 position C.2c.

The minimum separation maintained between cables of each division varies according to cable location with respect to potential hazards. The design intent is to provide separation greater than the minimum listed where consistent with a practical plant layout. Six general classifications of hazard zones or areas are defined for electrical separation consideration:

I. Non-Hazard Zones

Areas in which the only potential hazard is a fire of an electrical nature.

II. Fire Hazard Zones

Areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible material as defined in PSAR Section 9.13.1.

III. Equipment Hazard Zone (Pipe Break Hazard Zone)

Areas in which a potential hazard could exist as a consequence of postulated pipe break events in high energy lines.

IV. Cable Spreading Rooms

Areas just above and below the main control room where control and instrumentation cables converge prior to entering the control room.

V. Containment Electrical Penetration Areas

The areas and assemblies that allow cable passage through the Containment Building pressure boundary.

VI. Control Room

Continuously manned room utilized by plant operators to monitor and control the plant.

Non-Hazard Zones

Redundant cables entering panels, cabinets or other equipment enter through separate openings.

In Non-Hazard Zones, no minimum vertical or horizontal physical separation is provided between conduits of the same division beyond that required for construction, installation or access clearances between conduits and/or metal enclosed ducts.

9.13 PLANT FIRE PROTECTION SYSTEM

9.13.1 Non-Sodium Fire Protection System

The Non-Sodium Fire Protection System (NSFPS) provides the plant with equipment, piping, valves, detectors, instrumentation and controls to prevent or mitigate the consequences of a non-sodium fire. Table 9.13-1 shows the areas covered by the Non-Sodium Fire Protection System. Fire Hazard Zones are areas in which a potential fire hazard could exist as a consequence of the credible accumulation of a significant quantity of fixed or transient combustible material.

9.13.1.1 Design Bases

a. Fires that could indirectly or directly affect Seismic Category I safety-related structures, systems and components are identified in Table 9.13-2. Potential fire hazards which provide the base for the design of the fire protection system in areas containing engineered safety-related structures, systems or components, are self-contained lube oil systems, diesel generator fuel oil system, electrical cable insulation, and activated carbon filters. The intensities of the maximum fires involving the above combustible materials are listed in Table 9.13-2 and described below.

   These maximum fires, together with lesser intensity design-basis fires, have served, via a preliminary fire hazards analysis, as the bases for the selection of fire protection measures taken will be confirmed in conjunction with a more detailed fire hazards analysis which will be provided in the PSAR.

   Lubricating Oil

   The maximum fire involving lubricating oil would develop in the turbine lubricating oil equipment located in the Turbine Generator Building and would have an intensity of 20,000 BTU/lb. Fire from this source does not involve safety-related areas and safe shutdown of the plant will not be jeopardized.

   Diesel Generator Fuel Oil

   The largest potential source of fire from fuel oil is in the vicinity of the standby diesel generator fuel oil storage tanks, located below grade adjacent to the Diesel Generator Building. As these tanks are located below grade, the chance of an accident is reduced. Physical separation provided between the two tanks limits

Question CS430.13

Separation of Class 1E raceways from high energy pipelines as defined in the PSAR is to be greater than 15 feet or less than 15 feet if the pipe is suitably restrained so as not to whip and strike the raceway. Current regulatory guidelines require that the Class 1E raceway be protected by a barrier so that pipe whip missiles, jet impingement or environmental effects of the pipe break will not cause failure of the Class 1E raceway. Fifteen feet of space is not considered adequate protection. Indicate compliance with the above guidelines in the PSAR or propose, describe, and justify an acceptable alternative.

Response

CRBRP has three (3) Class 1E Divisions with complete physical separation between divisions. Any damage to cable trays caused by pipe whip missiles, jet impingement, or environmental effect will be limited to the same safety division to which the pipe belongs, and the two other divisions capable of safely shutting down the plant will remain unaffected.

Additional protection will be provided against any single Class 1E Division cable tray damage due to high energy pipe whip missiles by restraint of high energy pipe lines in the vicinity of Class 1E raceways. The design of restraints and/or barriers will be determined by analysis to meet BTP APCSB 3-1, rather than the arbitrary 15 foot distance.

Protection against single Division damage due to high energy jet impingement or environmental effect is considered impractical and unnecessary since two additional safe shutdown Divisions will be available as noted above.

Question CS430.14

Separation between redundant raceways as defined in the PSAR takes into consideration the presence of rotating equipment, monorails, and equipment removal paths and the possibility that heavy equipment could be lifted and dropped and possibly cause failure of two raceway channels. Minimum separation between the two raceway channels is to be such as to preclude failure of both channels. Current regulatory guidelines, however, requires protection of each raceway as well as separation so that the dropped equipment will not cause failure of either raceway. An alternative to protection would be a design that provides an additional two independent systems each capable of shutting down the reactor and separated such that neither will be affected by the "dropped equipment" or failure of rotating equipment. Indicate compliance with the above guidelines in the PSAR or describe and justify an acceptable alternative.

Response

The routing of the safety-related raceways of CRBRP is such that any "dropped equipment" will not result in a failure of any of these raceways.

The CRBRP raceway design is in full compliance with IEEE Standard 384-1974 as supplemented by Regulatory Guide 1.75.

In addition, the safety systems design for CRBRP includes three physically and electrically independent divisions, each capable of shutting down the reactor. Equipment of each of these divisions are located and cables are routed in separate plant areas such that failure of rotating equipment will not cause failure of more than one safety division.

The PSAR Section 8.3.1.4 will be revised as attached.

In Non-Hazard Zones, a minimum horizontal clear space of three feet is maintained between cable trays of differenc divisions. If a horizontal dlearance of less than three feet is unavoidable, a fire barrier or a cover (top and bottom) on the trays is provided between the divisions.

Vertical stacking of cable trays of different divisions is avoided wherever possible. Where cable trays of different divisions are stacked vertically, a minimum clear space of five feet is provided between the divisions.

Fire Hazard Zones

In fire hazard zones, Class 1E conduits, trays, wireways or raceways of only one safety division are routed. This division is suitably protected by fire barriers and fire protection systems to mitigate the effects of fire in this zone on the safety function of the other safety groups.

Equipment Hazard Zone (Pipe Break Hazard Zone)

To the extent practical, Class 1E cables are routed in areas remote from high energy piping or areas of potential sodium fires; if unavoidable, the following precautions are taken:

a) Raceways are not less than fifteen feet from a high-energy pipeline unless the pipeline is suitably restrained so as not to whip and strike the raceway. This spacing applies regardless of whether the high energy pipeline is a safety system or non-safety system pipeline. The exception to this consideration is the acceptability of the mechanical failure of one safety system damaging the cable that provides service to components/systems of the mechanical system that has failed.

   Under no circumstances do safety-related raceways run less than fifteen feet from high-energy pipelines of the opposite safety system.

b) Redundant Class 1E circuits are routed or protected such that a postulated event in one system and division cannot preclude the operation of the other redundant systems or divisions.

c) In all areas of the plant, the separation between redundant Class 1E cable raceways takes into consideration the presence of rotating equipment, monorails, equipment removal paths and dropped equipment such that failure of rotating equipment will not cause failure of more than one safety division and any dropped equipment will not cause failure of any safety-related raceways.

d) In general, Class 1E electrical distribution equipment (e.g., switchgear, motor control centers, etc.) is not located in areas where high energy piping or other similar hazards are located.

Question CS430.15 (8.3.1) (8.3.2)

Section 8.3.1.2.14 of the PSAR indicates that Non-Class 1E loads will be connected to one division of the Class 1E system through an isolation device.

a) The proposed design for the isolation device addresses primarily protection of the Class 1E system due to worst case faults in the Non-Class 1E system. Justify why other failures of the Non-Class 1E system such as hot shorts are not considered in the design of the isolation devices.

b) The isolation device is to be designed as indicated in the PSAR so that voltage on the Class 1E system buses will not drop below 70 or 80 percent of nominal given a worst case fault in the Non-Class 1E system. With most Class 1E equipment designed to operate at not less than 90 percent of nominal, justify your design that allows lower voltage.

c) Describe the methods to be used to demonstrate the design capability of the isolation device.

Response

Faults and failure modes other than the worst case three phase fault have also been addressed in the design of the isolation system. However, the analysis provided in the PSAR includes the worst case condition only in order to demonstrate that even under this extreme condition the degradation of the Class 1E system will be within the acceptable limits. Protective devices have been provided in the design to clear any fault on the Non-Class 1E system such as phase to ground, phase to phase, and three phase faults, within a reasonable time such that there is no degradation to the Class 1E system.

a) A phase to ground fault (which is the most likely mode of failure) on a Non-Class 1E circuit will have no effect on the Class 1E system since the isolation system includes a 4.16kV/480V delta-wye connected transformer with the high resistance grounded neutral. The neutral is grounded through a 55.4 ohm resistor which will limit the phase to ground fault current to approximately 5 amperes. The Class 1E 480V and 4.16kV circuit breakers will be tripped to clear a ground fault in the case that the affected Non-Class 1E breaker fails to trip.

   Any phase to phase or three phase fault on the Non-Class 1E circuits will be isolated by instantaneous operation of the affected branch feeder circuit breaker. Back-up protection is provided by fast operation of the 480V supply circuit breaker (0.2-0.3 sec clearing time) or by the 4.16kV unit substation transformer feeder circuit breaker (0.6-0.7 sec clearing time). In addition undervoltage sensors are provided at the input terminals of the 480V supply circuit breaker. These undervoltage sensors will initiate tripping of the 480V and 4.16kV circuit breakers within five (5) seconds upon sensing the undervoltage caused by loss of power or failure of the circuit breakers to clear a fault.

b) The isolation system is designed so that impedance of the system is high enough that the worst possible fault (three phase bolted fault) on the 480V Non-Class 1E bus will not degrade the voltage at 4.16kV Class 1E bus below the following levels:

(1) When the 4.16kV Class 1E bus is being supplied from offsite power supply, the voltage at the bus will not drop below 80 percent of nominal.

(2) When the 4.16kV Class 1E bus is being supplied from onsite (standby) power supply the voltage at the bus will not drop below 75 percent.

The minimum voltage levels of 80 and 75 percent of nominal are chosen to be the same as the allowable minimum voltage levels during the sequential loading of the 4.16kV Class 1E bus or during starting of the largest motor after the bus has been fully loaded.

As discussed in a) above, any fault on 480V Non-Class 1E system will be cleared within five (5) seconds. After the fault has been cleared the voltage at the 4.16kV bus will be restored to a minimum of 90 percent of nominal within two (2) seconds, which will allow all connected loads to operated continuously.

c) The high impedance transformer used as an isolation device will be subjected to a short-circuit withstand test as part of the shop testing program at the manufacturer's facility. After the transformer has been energized a three phase fault will be applied at the secondwary windings for the maximum duration of the fault. The purpose of this test is to demonstrate the mechanical and thermal capability of the transformer to withstand short-circuit stresses which the transformer could experience and to verify the transformer current limiting capability.

Section 8.3.1.2.14 of the PSAR will be revised to add the above discussion.

8.3.1.2.14 NRC Regulatory Guide 1.75, Rev. 2 (9/78)

The electrical equipment and circuits comprising or associated with the Class 1E power system, Class 1E protection systems and Class 1E equipment will be designed, qualified and tested in accordance with IEEE Std. 384-1975, supplemented by Regulatory Guide 1.75, "Physical Independence of Electric Systems," positions as discussed herein.

The system will be designed so that the redundant equipment and circuits are separated in accordance with the criteria set forth in paragraph 8.3.1.4.

The AC loads which are not Class 1E but are required for plant availability will not be connected to the redundant Class 1E, Divisions 1 and 2.4.16KV buses, but will be connected to Division 3 switchgear through an isolation device, which is designed as follows:

a. The isolation system will consist of a 41.6KV cirult breaker, a 4.16KV/480V high impedance transformer and a 480V circuit breaker as shown in Figure 8.3-5. The isolation system will be qualified as Class 1E up to the load terminals of 480V circuit breaker.

b. The impedance of the isolation system will be high enough so that for the worst possible fault (three phase bolted fault) on the Non-Class 1E 480V bus, the following conditions will be met:

   (1) The pick-up value of the overcurrent relays protecting the Class 1E 4.16KV main supply circuit breaker will exceed the maximum current (combined maximum load current and maximum fault current contribution) flowing through the supply circuit breaker by a 2:1 margin.

   (2) When the 4.16 KV Class 1E bus is being supplied from offsite power, the voltage at the bus will not drop below 80% of nominal. When the Class 1E bus is being supplied from on-site (standby) power supply, the voltage at the bus will not drop below 75% of nominal. The voltage levels of 80 and 75 percent of nominal are chosen to be the same as the allowable minimum voltage levels during the sequential loading of the 4.16kV Class 1E bus or during starting of the largest motor after the bus has been fully loaded.

c. The isolation system 480 volt and 4.16KV circuit breakers will perform redundant isolation functions. They will be stored energy devices and will be physically separated.

d. Diverse means (electro-mechanical and solid state) will be used for fault sensing and tripping of the isolation system.

e. The isolation system will be able to accept any single component failure concurrent with the worst fault on the Non-Class 1E 480V bus without unacceptable consequences. (This does not include short circuits on the 4.16KV portion of the isolation system since this is considered an extension of the Class 1E bus).

f. Protective devices have been provided in the design to clear any fault on the Non-Class 1E system such as phase to ground, phase to phase and three phase faults within a reasonable time such that there is no degradation to the Class 1E system.

   1) A phase to ground fault (which is the most likely mode of failure) on a Non-Class 1E circuit will have no effect on the Class 1E system since the isolation system includes a 4.16kV/480V delta-wye connected transformer with the high resistance grounded neutral. The neutral is grounded through a 55.4 ohm resistor which will limit the line to ground current to approximately 5 amperes. The Class 1E 480 volt and 4.16kV circuit breakers will be tripped to clear a ground fault in the case that the affected Non-Class 1E feeder circuit breaker fails to trip.

   2) Any phase to phase or three phase fault on the Non-Class 1E circuits will be isolated by instantaneous operation of the affected branch feeder circuit breaker. Back-up protection is provided by fast operation of the Class 1E 480 Volt circuit breaker (0.2-0.3 sec clearing time) or by the 4.16kV circuit breaker (0.6-0.7 sec clearing time). In addition undervoltage sensors are provided at the input terminals of the Class 1E 480 Volt circuit breaker. These undervoltage sensors will initiate tripping of the Class 1E 480 Volt and 4.16kV circuit breakers within five (5) seconds upon sensing the undervoltage caused by loss of power or failure of the circuit breakers to clear a fault.

   3) After the fault has been cleared the voltage at the 4.16kV bus will be restored to a minimum of 90 percent of nominal within (2) seconds, which will allow all connected loads to operate continuously.

g. The high impedance transformer used as an isolation device will be subjected to a short-circuit withstand test as part of the shop testing program at the manufacturer's facility. After the transformer has been energized a three phase fault will be applied at the secondary windings for the maximum duration of the fault. The purpose of this test is to demonstrate the mechanical and thermal capability of the transformer to withstand short-circuit stresses which the transformer could experience and to verify the transformer current limiting capability.

The system is designed to keep the number of associated circuits to a bare minimum. The associated circuits as defined in paragraph 4.5 of IEEE Std. 384-9174 are installed in accordance with the requirements placed on Class 1E circuits such as cable derating, environmental qualification, flame retardance, splicing restrictions and raceway fill limitations described in paragraph 8.3.1.4. The analyses and testing of associated circuits will be

performed in accordance with paragraphs 4.5(3), 4.6.2 and 5.1.1.2 of IEEE Std. 384-9174. The cable installation design prohibits the use of cable spicing inside the cable tray or conduit raceway system.

The physical identification of Class 1E equipment, cables and raceway systems are described in Section 8.3.1.5.

The design provides two separate cable spreading rooms, one above the Control Room and one below it. The design does not permit location of any high energy equipment in the cable spreading rooms as required by IEEE Std. 384-1974. The criteria for routing of circuits in the cable spreading rooms is given in Section 8.3.1.4.

The Divisions 1, 2 and 3 Class 1E Standby Diesel Generator units are described in Section 8.3.1.1.1. The diesel generator units and associated auxiliaries and control equipment are located in separate Seismic Category I structures having independent ventilating systems. The physical separation of circuits related to redundant Standby Diesel Generators are routed in accordance with the criteria specified in Section 8.3.1.4.

The Non-Class 1E and Class 1E DC batteries and related uninterruptible power supply (UPS) equipment are described in Section 8.3.2. DC battery and associated UPS equipment of each safety division is separated from equipment of the other safety division by reinforced concrete walls. The Class 1E batteries and UPS equipment are located in Seismic Category I structures. The physical separation of circuits related to each separate division of batteries and UPS system is in accordance with the criteria described in Section 8.3.1.4.

Question CS430.16 (8.3.1) (8.3.2)

Section 8.3.1.2.14 of the PSAR indicates that analyses and testing of associated circuits will be performed in accordance with paragraphs 4.5(3), 4.6.2 and 5.1.1.2 of IEEE Standard 384-1974. Describe in the PSAR and in detail the analyses and testing that will be performed. The description should include the minimum separation distance between associated and Non-Class 1E cables that will be demonstrated by the proposed analyses and testing.

Response

All associated circuits as defined in IEEE Standard 384-1974, paragraph 3, will be treated and routed as Class 1E circuits of the same division. The criteria governing routing of Class 1E circuits are given in Section 8.3.1.4 as supplemented by the response to NRC Question CS430.10.

Based upon the above considerations, analysis and testing of associated circuits will not be required, per paragraph 4.5(1) of IEEE Standard 384-1974.

PSAR Section 8.3.1.2.14 will be revised, as attached.

e. The Isolation system will be able to accept any single component failure concurrent with the worst fault on the Non-Class 1E 480V bus without unacceptable consequences. (This does not include short circuits on the 4.16KV portion of the isolation system since this is considered an extension of the Class 1E bus).

f. Protective devices have been provided in the design to clear any fault on the Non-Class 1E system such as phase to ground, phase to phase and three phase faults within a reasonable time such that there is no degradation to the Class 1E system.

1) A phase to ground fault (which is the most likely mode of failure) on a Non-Class 1E circuit will have no effect on the Class 1E system since the isolation system includes a 4.16kV/480V delta-wye connected transformer with the high resistance grounded neutral. The neutral is grounded through a 55.4 ohm resistor which will limit the line to ground current to approximately 5 amperes. The Class 1E 480 volt and 4.16kV circuit breakers will be tripped to clear a ground fault in the case that the affected Non-Class 1E feeder circuit breaker fails to trip.

2) Any phase to phase or three phase fault on the Non-Class 1E circuits will be isolated by instantaneous operation of the affected branch feeder circuit breaker. Back-up protection is provided by fast operation of the Class 1E 480 Volt circuit breaker (0.2-0.3 sec clearing time) or by the 4.16kV circuit breaker (0.6-0.7 sec clearing time). In addition undervoltage sensors are provided at the input terminals of the Class 1E 480 Volt circuit breaker. These undervoltage sensors will initiate tripping of the Class 1E 480 Volt and 4.16kV circuit breakers within five (5) seconds upon sensing the undervoltage caused by loss of power or failure of the circuit breakers to clear a fault.

3) After the fault has been cleared the voltage at the 4.16kV bus will be restored to a minimum of 90 percent of nominal within (2) seconds, which will allow all connected loads to operate continuously.

g. The high impedance transformer used as an isolation device will be subjected to a short-circuit withstand test as part of the shop testing program at the manufacturer's facility. After the transformer has been energized a three phase fault will be applied at the secondary windings for the maximum duration of the fault. The purpose of this test is to demonstrate the mechanical and thermal capability of the transformer to withstand short-circuit stresses which the transformer could experience and to verify the transformer current limiting capability.

The system is designed to keep the number of associated circuits to a bare minimum. The associated circuits as defined in paragraph 4.5 of IEEE Std. 384-9174 are installed in accordance with the requirements placed on Class 1E circuits such as separation from Non-Class 1E cables, cable derating, environmental qualification, flame retardance, splicing restrictions and raceway fill limitations described in paragraph 8.3.1.4. The separation

criteria between associated circuits and Non-Class 1E circuits is described in Section 8.3.1.4. The analyses and testing of associated circuits will be performed in accordance with paragraphs 4.5(3), 4.6.2 and 5.1.1.2 of IEEE Std. 384-9174. The cable installation design prohibits the use of cable spicing inside the cable tray or conduit raceway system.

The physical identification of Class 1E equipment, cables and raceway systems are described in Section 8.3.1.5.

The design provides two separate cable spreading rooms, one above the Control Room and one below it. The design does not permit location of any high energy equipment in the cable spreading rooms as required by IEEE Std. 384-1974. The criteria for routing of circuits in the cable spreading rooms is given in Section 8.3.1.4.

The Divisions 1, 2 and 3 Class 1E Standby Diesel Generator units are described in Section 8.3.1.1.1. The diesel generator units and associated auxiliaries and control equipment are located in separate Seismic Category I structures having independent ventilating systems. The physical separation of circuits related to redundant Standby Diesel Generators are routed in accordance with the criteria specified in Section 8.3.1.4.

The Non-Class 1E and Class 1E DC batteries and related uninterruptible power supply (UPS) equipment are described in Section 8.3.2. DC battery and associated UPS equipment of each safety division is separated from equipment of the other safety division by reinforced concrete walls. The Class 1E batteries and UPS equipment are located in Seismic Category I structures. The physical separation of circuits related to each separate division of batteries and UPS system is in accordance with the criteria described in Section 8.3.1.4.

Question CS430.17 (8.3.1) (8.3.2)

Section 8.3.1.2.22 of the PSAR indicates that the Class 1E system will be designed to assure that a design basis event will not cause loss of electric power to more than one Class 1E load group at one time. This proposed design does not meet IEEE Standard 308-1974, justify noncompliance. Also provide the results of a failure mode and effects analysis in accordance with Section 4.8 of IEEE Standard 308-1974 for a design basis event that causes failure of one load group and a single failure in another load group.

Response

CRBRP electrical power distribution system design is in full compliance with IEEE Standard 308-1974 as described below:

1. All Class 1E electrical equipment will be specified and qualified such that the environmental conditions resulting from any design basis event will not cause loss of electric power to any Class 1E loads related to safety, surveillance or protection, thereby maintaining the safety of the plant at all times.

2. Loss of electric power to any Class 1E equipment or to any Class 1E division will not cause damage to the fuel or to the reactor coolant system.

3. In addition, Class 1E AC and DC Power Supplies and distribution systems have been designed as three physically and electrically independent safety divisions, each capable to safely shutdown the plant and conform to the requirements of Class 1E electrical system.

An analysis of the failure modes of Class 1E power systems and the effect of these failures on the electric power available to Class 1E loads will be performed in accordance with IEEE Standard 308-1974, to demonstrate that a single component failure will not prevent satisfactory performance of the minimum Class 1E loads required for safe shutdown and maintenance of post-shutdown or post-accident plant security. The results of this analysis will be included in the FSAR.

The Section 8.3.1.2.22 of the PSAR will be revised to reflect the above discussion as attached.

8.3.1.2.20 NRC Regulatory Guide 1.118, Rev. 1 (6/78)

CRBRP Design Criterion 16 (GDC 18) has been established to satisfy the requirements of IEEE Std. 279-1971 and 338-1977 and Regulatory Guide 1.118. This requires the design to provide for appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections and switchboards, to assess the continuity of the systems and the condition of their components to check the operability and functional performance of the system components such as on-site power sources, relays, switches, buses and the system as a whole under conditions as close to design as practical.

CRBRP design will comply with the above criteria and as a result, it will comply with IEEE Std. 279-1971, 338-1977 and Regulatory Guide 1.118. For details of compliance refer to Sections 8.3.1.1, 8.3.1.2, 8.3.1.2.1 and 8.3.1.3.

8.3.1.2.21 NRC Regulatory Guide 1.131, Rev. 0 (8/77)

The electric cables, field splices and connections will be designed, qualified and tested in accordance with IEEE Std. 383-1974, supplemented by Regulatory Guide 1.131, positions as discussed herein.

The medium voltage cables, low voltage power and control cables, and instrumentation cables are specified to be type tested and qualified to the requirements of IEEE Std. 383-1974 and IEEE Std. 323-1974 supplemented by Regulatory Guide 1.131 and to the design basis events described in Table 8.3-3. The field splicing of Cables inside the cable tray or conduit raceway system is prohibited in accordance with the requirements of IEEE Std. 384-1974 supplemented by Regulatory Guide 1.75. The environmental conditions for all cables include the maximum sodium oxide aerosol concentration, along with the values of pressure, temperature, radiation, chemical concentrations, humidity and time, and are specified as applicable to the design of the power plant.

8.3.1.2.22 IEEE Standard 308 - 1974

Class 1E AC and DC Power Supplies and distribution systems will be designed to conform to the requirements of Class 1E electrical system as discussed below.

All Class 1E electrical equipment will be specified and qualified for the environmental conditions such that no design basis event will cause loss of electric power to any loads related to safety, surveillance or protection, thereby maintaining the safety of the plant at all times.

Loss of electric power to any one equipment in any Class 1E division will not cause any damage to the fuel or to the reactor coolant system.

The Class 1E system is capable of performing its function when subjected to the effects of a design basis event at its location. (See Table 8.3-3) No significant radiation hazard to Class 1E loads has been identified for either normal or emergency conditions.

Class 1E loads are designed to perform their intended functions adequately for the variation of voltage or frequency in the Class 1E electric system.

Question CS430.18 (8.3.1) (8.3.2)

Section 8.3.1.2.22b of the PSAR states that "A loss of electric power to equipment that could result in a reactor power transient capable of causing significant damage to the fuel or to the plant operation. (See Section 15.1.2.") The last words of the above statement "to the plant operation" are not clear and are inconsistent with Section 4.1 (2) of IEEE Standard 308-1974. Provide clarification and justify noncompliance to IEEE Standard 308-1974.

Response

See the Response to Question CS430.17.

Question CS430.19 (8.3.1) (8.3.2)

You state in Section 8.3.1.2.22 of the PSAR that indicators and controls will be provided outside the control room in compliance with Section 4.4 of IEEE Standard 308-1974. Provide a description of the design provisions that assure electrical isolation between controls and indicators located in the control room and remote locations. The current staff position requires that no single failure in the control room shall cause failure at the remote locations.

Response

Controls and indicators located in the control room are electrically separated from controls and indicators at remote locations. Separation is by independent overcurrent protection for each source, so that overcurrent in the power source for control and indication at the control room does not affect operation of the power source for remote control and indication. Both control circuits (control room and remote) interface in the common control logic in the solid State Programmable Logic System Cabinet where they are electrically isolated. This design satisfies the staff position that no single failure in the control and indication at the control room shall cause failure in the control and indication at the remote location.

Question CS430.20 (8.3.1) (8.3.2)

Describe the source of control power to Division 3 AC switchgear and diesel generator.

Response

Control power to Division 3 AC switchgear and Division 3 diesel generator unit is provided from Division 3 DC power supply described in the PSAR Section 8.3.2.

Table 8.3-2C, "Class 1E Division 3 125V DC Load List", of the PSAR will be revised to include all DC loads required to support operation of Division 3 AC switchgear and Division 3 diesel generator unit as attached.

TABLE 8.3-2c

CLASS 1E DIVISION 3 125V DC LOAD LIST

LOAD DESCRIPTION	NORMAL (1) MAX. CONT. LOAD-AMPS	EMERGENCY (2) AMPS	EMERGENCY (2) DURATION	REMARKS
SGAHRS - STEAM TURBINE GOVERNOR CONTROL (1 KW)	4	4	0-120 MIN.	
120 VAC BUS 12NIE008C AS INVERTER LOAD	208	227 182 165	FIRST 1 MIN. NEXT 14 MIN. NEXT 105 MIN.	(NOTE 3)
D.G. CONTROL PANELS LOCAL AND MCR (0.7KW)	11.2	11.2	0-120 MIN.	
D.G. FIELD FLASHING (7.5KW)	-	60	FIRST 1 MIN.	
4.16kV SWITCHGEAR AND 480V USS BREAKER LOAD	4	38 4	FIRST 1 MIN. NEXT 119 MIN.	
TOTAL IN AMPS	227	340 204 184	FIRST 1 MIN. NEXT 14 MIN. NEXT 105 MIN.	

Question CS430.21 (8.3.1)

Operating experience at certain nuclear power plants which have two cycle tubocharged diesel engines manufactured by the Electromotive Division (EMD) of General Motors driving emergency generators have experienced a significant number of turbocharger mechanical gear drive failures. The failures have occurred as the result of running the emergency diesel generators at no load or light load conditions for extended periods. No load or light load operation could occur during periodic equipment testing or during accident conditions with availability of offsite power. When this equipment is operated under no load conditions insufficient exhaust gas volume is generated to operate the turbocharger. As a result the turbocharger is driven mechanically from a gear drive in order to supply enough combustion air to the engine to maintain rated speed. The turbocharger and mechanical drive gear normally supplied with these engines are not designed for standby service encountered in nuclear power plant application where the equipment may be called upon to operate at no load or light load condition and full rated speed for a prolonged period. The EMD equipment was originally designed for locomotive service where no load speeds for the engine and generator are much lower than full load speeds. The locomotive turbocharged diesel hardly ever runs at full speed except at full load. The EMD has strongly recommended to users of this diesel engine design against operation at no load or light load conditions at full rated speed for extended periods because of the short life expectancy of the turbocharger mechanical gear drive unit normally furnished. No load or light load operation also causes general deterioration in any diesel engine.

To cope with the severe service the equipment is normally subject to and in the interest of reducing failures and increasing the availability of their equipment EMD has developed a heavy duty turbocharger drive gear unit that can replace existing equipment. This is available as a replacement kit, or engines can be ordered with the heavy duty turbocharger drive gear assembly.

To assure optimum availability of emergency diesel generators on demand, applicant's who have in place an order or intend to order emergency generators drive by two cycle diesel engines manufactured by EMD, should be provided with the heavy duty turbocharger mechanical drive gear assembly as recommended by EMD for the class of service encountered in nuclear power plants. Discuss your plans to incorporate this improvement.

Response

The onsite (standby) AC power supplies for CRBRP consist of three diesel generator units. Two of these diesel generators, used for Class 1E

Question CS430.22 (8.3.1)

Provide a detailed discussion (or plan) of the level of training proposed for your operators, maintenance crew, quality assurance, and supervisory personnel responsible for the operation and maintenance of the emergency diesel generators. Identify the number and type of personnel that will be dedicated to the operations and maintenance of the emergency diesel generators and the number and type that will be assigned from your general plant operations and maintenance groups to assist when needed.

In your discussion, identify the amount and kind of training that will be received by each of the above categories and the type of ongoing training program planned to assure optimum availability of the emergency generators.

Also discuss the level of education and minimum experience requirements for the various categories of operations and maintenance personnel associated with the emergency diesel generators.

Response

There are currently no plans for personnel to be dedicated only to the above listed tasks. The level of training, including the amount and kind of training, that will be received by each of the above categories, the type of training program planned, and the level of education and minimum experience requirements for the various categories of operations and maintenance personnel have not been determined. When these are finalized, information will be included in the FSAR. It is anticipated that the above plans will be very similar to those used by TVA and that manufacturer's recommendations and requirements will be utilized in developing these plans.

Question CS430.23 (8.3.1)

Periodic testing and test loading of an emergency diesel generator in a nuclear power plant is a necessary function to demonstrate the operability, capability and availability of the unit on demand. Periodic testing coupled with good preventive maintenance practices will assure optimum equipment readiness and availability on demand. This is the desired goal.

To achieve this optimum equipment readiness status the following requirements should be met:

1. The equipment should be tested with a minimum loading of 25 percent of rated load. No load or light load operation will cause incomplete combustion of fuel resulting in the formation of gum and varnish deposits on the cylinder walls, intake and exhaust valves, pistons and piston rings, etc., and accumulation of unburned fuel in the turbocharger and exhaust system. The consequences of no load or light load operation are potential equipment failure due to the gum and varnish deposits and fire in the engine exhaust system.

2. Periodic surveillance testing should be performed in accordance with the applicable NRC guidelines (R.G. 1.108), and with the recommendations of the engine manufacturer. Conflicts between any such recommendations and the NRC guidelines, particularly with respect to test frequency loading and duration, should be identified and justified.

3. Preventive maintenance should go beyond the normal routine adjustments, servicing and repair of components when a malfunction occurs. Preventive maintenance should encompass investigative testing of components which have a history of repeated malfunctioning and require constant attention and repair. In such cases consideration should be given to replacement of those components with other products which have a record of demonstrated reliability, rather than repetitive repair and maintenance of the existing components. Testing of the unit after adjustments or repairs have been made only confirms that the equipment is operable and does not necessarily mean that the root cause of the problem has been eliminated or alleviated.

4. Upon completion of repairs or maintenance and prior to an actual start, run, and load test, a final equipment check should be made to assure that all electrical circuits are functional, i.e., fuses are in place, switches and circuit breakers are in their proper position, no loose wires, all test leads have been removed, and all valves are in the proper position to permit a manual start of the equipment. After the unit has been satisfactorilify started and load tested, return the unit to ready automatic standby service and under the control of the control room operator.

Provide a discussion of how the above requirements have been implemented in the emergency diesel generator system design and how they will be considered when the plant is in commercial operation, i.e., by what means will the above requirements be enforced.

Response

1. During periodic testing and test loading, each diesel generator unit will be tested at load in excess of the minimum 25 percent of the unit rated load, as described in Section 8.3.1.1.1 of the PSAR.

2. Diesel engine surveillance testing will be performed in accordance with NRC Regulatory Guide 1.108 (Rev. 1, 8/77) as described in Section 8.3.1.1.1 of the PSAR and in accordance with recommendations of the diesel engine manufacturer. Any conflicts between the manufacturer's recommendations and the NRC guidelines will be identified and discussed after receipt of the manufacturer's surveillance testing recommendations.

3. The Plant Maintenance Group, through the review of Work Requests, Licensee Event Reports and Surveillance Test Reports, will maintain awareness of problems associated with the diesel generator units. Repeated problems with any equipment or component important to safety will become a subject for a plant investigation to determine if the cause of the problem is related to improper maintenance, improper operation, poor design, or manufacturing deficiencies. If the problem is determined to be caused by improper maintenance or operation, preventative measures such as proper training or procedure changes will be implemented. If the problem is determined to be caused by design or manufacture, a request will be made to engineering for an evaluation and/or solution.

4. Administrative Procedure will specify for all systems, including the diesel generator units, that shift supervision shall "require a checklist to be performed on the affected system and on portions of other systems located in the areas in which significant maintenance was performed". Based on the activities performed, this checklist will include such items as valves, electrical and instrument alignments, tests to ensure that electrical circuits are functional, wiring check for loose connections, visual checks to ensure that proper fuses are in place and that the circuit breakers and disconnect switches are in proper position, etc.

Question CS430.24 (8.3.1)

The availability on demand of an emergency diesel generator is dependent upon, among other things, the proper functioning of its controls and monitoring instrumentation. This equipment is generally panel mounted and in some instances the panels are mounted directly on the diesel generator skid. Major diesel engine damage has occurred at some operating plants from vibration induced wear on skid mounted control and monitoring instrumentation. This sensitive instrumentation is not made to withstand and function accurately for prolonged periods under continuous vibrational stresses normally encountered with internal combustion engines. Operation of sensitive instrumentation under this environment rapidly deteriorates calibration, accuracy and control signal output.

Therefore, except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation should be installed on a free standing floor mounted panel separate from the engine skids, and located on a vibration free floor area. If the floor is not vibration free, the panel shall be equipped with vibration mounts.

Confirm your compliance with the above requirements or provide justification for noncompliance.

Response

Except for sensors and other equipment that must be directly mounted on the engine or associated piping, the controls and monitoring instrumentation for each diesel generator unit are installed on two (2) free standing floor mounted panels separate from the diesel generator unit skids.

The diesel generator units are located in a Seismic Category I building separate from all other plant buildings. The diesel generator units are installed on their own foundations which are isolated from the main building slab. The control panels are located on the floor area which is considered to be vibration free, and as such, no vibration mounts are required.

Section 8.3.1.1.1 of the PSAR will be revised to include the above clarification.

8.3.1.1.1 Standby AC Power Supply

The Standby AC Power Supply is a Class 1E system which supplies AC power to the Class 1E and certain essential Non-Class 1E loads when the Plant AC Power Supply, CRBRP Preferred Power Supply, and Reserve AC Power Supply are not available.

The Standby AC Power Supply consists of three Class 1E diesel generators, each supplying power to its own safety group loads. Safety Division 1 and 2 are redundant to each other. The diesel generators are physically and electrically independent of each other. The Divisions 1 and 2 diesel generators supply power to redundant load groups. The diesel generators are sized in accordance with IEEE Standard 387-1977, supplemented by Regulatory Guide 1.9, Rev. 2. The total demand during an emergency condition when off-site AC power supplies are unavailable is within the continuous rating of each diesel generator as indicated in Tables 8.3-1A, 8.3-1B, and 8.3-1C.

Each diesel generator is installed in a separate and independent diesel generator room. These rooms are located in a Seismic Category 1 structure and are capable of withstanding missiles as described in Section 3.8.4.1.4. Auxiliary equipment, local control boards and excitation cubicles associated with each diesel generator are located in the same room with the diesel generator. Except for sensors and other equipment that must be directly mounted on the associated piping, the controls and monitoring instrumentation for the diesel generator unit are installed on two (2) free standing floor mounted panels separate from diesel generator unit skids.

The Diesel Generator sets are installed on their own foundations which are isolated from the main building slab. The control panels are located on the floor area which is considered to be vibration free.

Cables for Standby AC Power Supplies will be installed in their own separate division of the Class 1E raceway system. Cables and raceways of the Standby AC Power Supply will be marked in a distinctive manner as described in Section 8.3.1.4.

The following support systems are those essential auxiliary systems or components required to start and operate the diesel generators.

a. The Safety-Related 125V DC Power System

   Each diesel generator is furnished with an independent DC supply from the Safety-Related 125V DC Power System. (Section 8.3.2 describes the 125V Class 1E DC system).

b. The Diesel Generator Fuel Oil Storage and Transfer System

   Fuel is provided for starting during initial operation using a shaft driven pump taking suction from a day tank. Fuel is provided for continuous operation using AC powered fuel transfer pumps taking suction from the underground storage tanks to replenish the day tank fuel supply. Each diesel generator is furnished with an independent fuel storage and transfer system. For details refer to Section 9.14.1.

c. Diesel Generator Cooling Water System

Each diesel generator is furnished with an independent cooling water support system. For details refer to Section 9.14.2.

Question 430.25 (8.3.2)

In Chapter 8 of the PSAR, you discuss three (3) emergency diesel generators. In Chapter 9, however, the discussion of emergency diesel generator auxiliary systems includes only two (2) diesel generators. Revise your PSAR so Chapters 8 and 9 are in agreement. The PSAR revisions should cover the text material, as well as applicable P&ID's and General Arrangement Drawings showing plan, elevation, and section views. Questions asked in Chapter 9 are applicable to all emergency diesel generators.

Response

The incorporation of the third emergency diesel generator into the plant design is pending completion of the procurement process of the third diesel generator. The design of the third diesel generator auxiliaries will be in accordance with the applicable requirements of SRP 9.5.4, 9.5.5, 9.5.6, 9.5.7 and 9.5.8. Section 9.14 of the PSAR will be updated in a future amendment to include the available additional information for the third emergency diesel generator.

Question CS430.26 (8.3.1)

In Section 8.3.1.1.2 of the PSAR, under the heading Circuit Protection, you list the emergency diesel generator protective trips. However, there is no discussion of protection in the event of excessive jacket water temperature or turbo-charger malfunctions. Expand your PSAR to discuss these protective features, or explain why such protection is not required.

Response

The design and description of all of the emergency diesel generator protective trips is not included in the PSAR since the final vendor information is not available, pending completion of the procurement process of the diesel generators. This information will be included in the FSAR. However, the emergency diesel generator will be provided with protection against excessive jacket water temperature, such that the operator will be alarmed if the temperature exceeds 190°F and the unit will be tripped on temperature in excess of 200°F. This protective trip feature will be bypassed when the unit is running in an emergency mode.

The turbocharger will be provided with alarms for low lube oil pressure, excessive vibration and high jacket water temperature to alert the operator of potential turbocharger malfunction. The performance of the turbocharger will be periodically observed during the testing of the unit. Should a failure of some part of the turbocharger prevent its operation, the engine can be operated as a normally aspirated engine until repairs can be made to the turbocharger.

The malfunction of the turbocharger will result in some loss of power output; however, since there is substantial margin in the load capability of the units, the ability of these units to perform their intended function during an emergency will not be affected. This will be confirmed with the vendor at a later date.

Question CS430.27

The PSAR Section covering onsite communications should be expanded to include the following information:

a) Identify all areas from which it will be necessary for plant personnel to communicate with the control room or the emergency shutdown panel during and following transients and/or accidents (including loss of offsite power) in order to mitigate the consequences of the emergency and to attain a safe, cold plant shutdown.

b) Indicate the types of communications that will be available in each of the above areas to provide an adequate communications under all normal operations and design basis accident conditions, including the safe shutdown earthquake.

Response

a) Table QCS430.27-1 identifies the vital areas by building, cell and cell designation from which it will be necessary for plant personnel to communicate with the control room or the emergency shutdown panels during the full spectrum of accident or incident conditions (including loss of offsite power).

b) Table QCS430.27-1 also identifies the types of communications that will be available in each of the above areas to communicate with the control room or the emergency shutdown panel during normal operation and accident conditions.

The communication system is designed for high reliability during normal and emergency operation of the plant within the plant and between the plant and other TVA facilities.

The communication system is not required to perform any safety function. Therefore, the operation of the communication system, except the portable radio system, cannot be ensured during and after a safe shutdown earthquake.

The system is designed to provide effective and diversified means of communication in all vital areas of the plant during the full spectrum of accident or incident conditions under the maximum potential noise levels. The various means of communications as described in PSAR Section 9.11 complement one another. Should for some reason one or more communication means be unavailable, diverse means should continue to be available.

The portable radio units which will be handcarried by plant personnel will provide them with the capability to communicate among themselves on an alternate frequency in case of loss of base station, antenna, satellite receiver and transmitter of portable radio system.

The communication equipment located in Seismic Category I structures will be mounted on seismically qualified supports.

LEGEND

PA-IC = Public Address Intra-plant Communications System

PAX = Private Automatic Exchange (Telephone System)

MCJ = Maintenance Communication Jacking System (Sound Powered Communication System)

PRS = Portable Radio System

CB = Control Building

RSB = Reactor Service Building

RCB = Reactor Containment Building

SGB = Steam Generator Building

DGB = Diesel Generator Building

ECT = Emergency Cooling Towers

FPH = Fire Protection Pump House

CR = Control Room

RSP = Remote Shutdown Panel

HVAC = Heating, Ventilating, and Air Conditioning

USS = 480V AC Unit Substation

MCC = Motor Control Center

AFW = Auxiliary Feedwater

SWGR = Medium Voltage Switchgear

SSPLS = Solid State Programmable Logic System

EI&C = Electrical Instrumentation & Control

EVST = Ex-vessel Storage Tank

EVSS = Ex-vessel Storage Subsystem

ABHX = Air Blast Heat Exchanger

TABLE QCS430.27-1

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
CB	410A	Control Room HVAC Cell	X		X	X
	410B	Control Room Filter Cell	X		X	X
	411A	Control Room HVAC Cell	X		X	X
	411B	Control Room Filter Cell	X		X	X
	412	Air Handling Unit Area	X	X	X	X
	413	Return Fan Area	X	X	X	X
	421	Security Room (Reserved)	X	X		X
	431	Main Control Room	X	X	X	X
	432	Computer Room	X	X	X	X
	446	USS and MCC Area	X	X	X	X
	451	125V Division 1 Battery Room	X		X	X
	453	250V Division 3 Battery Room	X		X	X
	454	Division 1 AC/DC Equipment Room	X		X	X
	455	Secondary Rod Control Room	X		X	X
	456	Prim. Rod Control MG Set Cell	X		X	X
	457	Prim. Rod Control Room	X		X	X
	458	125V Division 3 AC/DC Equipment Room	X		X	X
	459	Division 3 AC/DC Equipment Room	X	X	X	X
	460	Division 2 AC/DC Equipment Room	X	X	X	X

*Portable radios will be hand carried by plant personnel

TABLE 1
(cont'd)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
SGB	202	Auxiliary Bay Loop 1	X	X	X	X
	202A	Turbine AFW Pump			X	X
	202B	AFP Cooler Room			X	X
	204	Auxiliary Bay Loop2	X	X	X	X
	204A	AFW Pump A			X	X
	204B	AFW Pump B			X	X
	206	Auxiliary Bay Loop 3	X	X	X	X
	207	Steam Gen. Cell Loop 1	X		X	X
	208	Steam Gen. Cell Loop 2	X		X	X
	209	Steam Gen. Cell Loop 3	X		X	X
	215	SGAHRS PWST Room Auxiliary Bay	X		X	X
	216	Emer. Chiller Room Int. Bay	X		X	X
	217	Emer. Chiller Room Int. Bay	X		X	X
	221	Auxiliary Bay Loop 1	X	X	X	X
	222	Auxiliary Bay Loop 2	X		X	X
	223	Auxiliary Bay Loop 3	X	X	X	X
	241	Auxiliary Bay Loop 1	X	X	X	X
	242	Auxiliary Bay Loop 2	X	X	X	X
	243	Auxiliary Bay Loop 3	X	X	X	X
	244	Steam Gen. Cell Loop 1	X		X	X
	245	Steam Gen. Cell Loop 2	X		X	X
	246	Steam Gen. Cell Loop 3	X		X	X
	247	Intermediate Bay West	X	X	X	X

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
SGB	253	Intermediate Bay East	X		X	X
	262	Intermediate Bay Floor El. 816'-0"	X	X	X	X
	271	Intermediate Bay Floor El. 836'-0"	X	X	X	X
	272A	Remote Shutdown Cell A	X	X	X	X
	272B	Remote Shutdown Cell B	X	X	X	X
	272C	Remote Shutdown Cell C	X	X	X	X
	273	Motor Control Center Division 3 Cell	X		X	X
	281	Auxiliary Bay Loop 1	X	X	X	X
	282	Auxiliary Bay Loop 2	X		X	X
	283	Auxiliary Bay Loop 3	X	X	X	X

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
EEB	521	SWGR Bus and USS Cell	X	X	X	X
	524	SWGR Bus and USS Cell	X	X	X	X
	525	Fire Pump Area	X		X	X
	541	Fire Pump Area	X		X	X

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
DGB		Diesel Generator A and Auxillaries	X	X	X	X
		Diesel Generator B and Auxillaries	X	X	X	X
		Diesel Generator C and Auxillaries	X	X	X	X
		DG A HVAC Equipment Room	X	X	X	X
		DG B HVAC Equipment Room	X	X	X	X
		DB C HVAC Equipment Room	X	X	X	X

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
RCB	151	Head Access Area	X	X	X	X
	161A	Operating Floor	X	X	X	X
	163	EI&C Cubicle	X	X	X	X
	167	EI&C Cubicle	X	X	X	X
	169A	Annulus Above Operating Floor			X	X
	105F	Makeup Pump & Valve Cell	X	X	X	X
	105G	Personnel & Equipment Access	X		X	X
	105H	Corridor & Valve Gallery	X	X	X	X
	105Z	Makeup Pump Cooler Cell			X	X

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
RSB	305B	El. 733' Access Area	X		X	X
	305E	USS Cell	X		X	X
	305F	USS Cell	X		X	X
	305G	Heat Exchanger Cell	X		X	X
	305I	Heat Exchanger Cell	X		X	X
	306A	El. 755' Access Area	X	X	X	X
	306B	El. 755' Access Area	X		X	X
	307A	El. 779' Access Area	X	X	X	X
	307B	El. 779' Access Area	X		X	X
	308B	RSB Operating Floor	X	X	X	X
	309	MCC Area	X	X	X	X
	311	Refueling Communication Center	X	X	X	X
	314	Instrumentation Area	X		X	X
	325	EVSS Pump & Pineways Cooler			X	X
	326	ABHX Cell Unit Cooler	X	X		X
	327	ABHX Cell Unit Cooler	X		X	X
	347	Containment Clean-up Filter Cell	X		X	X
	347A	Radiation Monitor Cell			X	X
	348	Containment Clean-up Chase			X	X
	349	Containment Clean-up Chase			X	X
	352A	EVST, ABHX Loop A Cell	X		X	X
	353A	EVST, ABHX Loop B Cell	X		X	X

TABLE 1
(cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
RSB	359	Containment Clean-up Scrubber & Washer Cell	X		X	X
	391	Containment Clean-up Filter Cell	X		X	X
	395	RCB Annulus Filter Unit Cell	X		X	X
	398	RCB Annulus Filter Unit Cell	X		X	X

TABLE 1
(Cont'd.)

X = AVAILABLE

AREA			TYPE OF COMMUNICATION FROM CR & RSP TO AREA			
BLDG.	CELL	CELL DESIGNATION	PA-IC	PAX	MCJ	PRS*
ECT	121	Division 1 MCC Area	X	X	X	X
	122	Division 2 MCC Area	X	X	X	X

Question CS430.28 (9.11)

The final design of the onsite communications systems will be reviewed with regard to functional capability of all normal operating and accident conditions. Therefore, the PSAR should be expanded, to the extent practicable, to include the following:

a) A list of all working stations including locations and the type of communication system(s) provided at each location.

b) The maximum sound levels that will exist at each of the above identified working stations for all transient accident conditions.

c) The maximum background noise level that will exist at each working station during normal operation and accident condition and yet reliably expect effective communication with the control room using the communication system(s) available at that station.

d) Communication systems performance requirements and test procedures (including frequency) which will be imposed to ensure that effective communication with the control room or emergency shutdown panel is possible under all conditions.

e) A discussion of protective measures to be taken to ensure functional onsite communication systems, including considerations for component failure, loss of power, and severing of a communication line or trunk as a result of an accident or fire.

Response

a) The response to question CS430.27 provides a list of communications system locations.

b) The maximum sound level (noise) that will exist at each of the working stations identified in item (a) above for all transient accident conditions will be within the sound levels as shown under item (c) below.

The sound levels of the PA-IC speakers will be adjusted 5 db above the maximum background noise level.

c) The maximum background noise levels that will exist at each working station during normal operation and accident conditions is not determined at this time and will be included in FSAR. However, the maximum expected noise level in each area is given below.

Building	Area	Maximum Expected Noise Level (db)
Reactor Service Building	General Areas	90
	ABHX Unit Cooler Cell	95
	Containment Cleanup Scrubber and Washer Cell	95
Steam Generator Building	General Areas	90
	Emer. Chiller Room	95
	Auxiliary Bays	95
Control Building	General Areas	85
	HVAC Cell	100
	Equipment Rooms	90
Diesel Generator Building	General Areas	90
Turbine Generator Building & Other Balance of Plant Buildings	General Areas	90

The working stations for communication systems will be located to provide voice communication between two or more locations in the plant, even in areas of extreme noise levels. In the areas of high ambient noise (> 90 dbA) supplementary red flashing indicating lights are provided at a visible location above the working station to draw the attention of the operating personnel for an incoming call. The handsets will be located in sound absorbing booths in high noise areas. Headsets are provided for use at the maintenance communication jacking stations throughout the plant.

d) Communication systems performance requirements and test procedures (including frequency of testing) which will be imposed to ensure that effective communication with the control room or emergency shutdown panels is possible under all conditions will be included in the Plant Communication System test procedures and in the FSAR.

e) The following protective measures are taken to ensure functional onsite communication systems:

1. Diverse and redundant means of communication systems are used to ensure reliable and effective means of communication both intra-plant and external to the plant for all modes of plant operation including emergency conditions.

2. The communication subsystems are designed such that the failure of the power supply or the component of a subsystem or a communication loop, will not impair the operation of other subsystems or other communication loops of the subsystem. The power supplies are designed such that the complete Public Address Intra-plant Communication system is not lost in any area of the plant due to a single failure of the equipment or the power supply circuit.

3. The communication subsystems (except the maintenance communication jacking (MCJ System)) are powered from the non-Class 1E uninterruptible power supplies (UPS). The MCJ system is sound powered and requires no power for its operation.

4. Communication equipment location in the Reactor Containment Building are connected to their communications subsystem through a number of independent electrical containment penetrations. The failure of a penetration due to a single localized accident will not cause failure of the remaining communication subsystem(s) in the Reactor Containment Building.

5. The maintenance communication jacking (MCJ) sound powered system provides six independent and separate sound-powered telephone communication loops with three circuits each for communications between the ControlRoom and the different plant buildings. All of the five Nuclear Island Building sound powered loops are available for communication use between the remote shutdown panel and the Nuclear Island Buildings for supporting remote plant shutdown.

6. The communication equipment located in Seismic Category I structures will be mounted on seismically qualified supports.

This system is an alternate means of data and voice communications between CRBRP and other TVA generation and transmission facilities and TVA Control Centers.

9.11.2.5 Maintenance Communications Jacking System (MCJ)

The system consists of sound powered headset/microphones and jack stations. Each headset/microphone contains a transmitter/receiver and need be only plugged into a jack station for operation.

The purpose of this system is to facilitate the testing and calibration of equipment instrumentation and to provide for a fixed communications system for effective response to an emergency. The MCJ system may also be used for the support of remote plant shutdown. Jack stations are arranged and located where required throughout the plant. The CRBRP MCJ System consists of six loops distributed throughout the plant. The Reactor Containment Building, the Steam Generator Building, Diesel Generator Building, Control Building, and Reactor Service Building have one loop each. The BOP buildings and areas will be covered by one additional loop. Each of the loops consists of three circuits and can accommodate three concurrent conversations. All jack station loops are connected to the Control Room patch panel where connections can be made to permit the six building loops to communicate with one another. All Nuclear Island jack station loops are also connected to a patch panel located on the remote plant shutdown panel. The user wears a headset/microphone assembly, plugs the cable into either a jack station or a panel rock mounted jack and thereby has hands-free communications.

9.11.2.6 VHF Radio Station

The VHF Radio Station is provided to transmit emergency voice communications between the CRBRP Control Room and the TVA Power Production Emergency staff operations office. The CRBRP VHF Radio station transmits at 163.175 megahertz and receives at 170.075 megahertz. The radio will be frequency checked in accordance with FCC regulations and be given frequent operating checks.

9.11.2.7 Portable Radio System

This system consists of a number of selective all portable radios (walkie-talkies) with paper and voice actuated microphone that transmit a low power signal to the base station and its comparator. The comparator selects the strongest signal received from a satellite receiver (voting system) and then wire transmits the amplified signal to the base station which in turn retransmits the amplified signal.

The portable units have the capability to communicate among themselves on an alternate frequency.

Fixed repeaters which permit use of portable radio communication untis are protected from exposure to fire damage by fire rated cabinets.

Question CS430.29 (9.12)

Provide a tabulation of vital areas where emergency lighting is required for safe shutdown of the reactor and evacuation of personnel in the event of an accident.

Response

Emergency lighting for CRBRP is provided by the Standby Lighting System and the Emergency Lighting System as described in Sections 9.12.2 and 9.12.3 of the PSAR. The lighting system design for CRBRP is presently under development. A list of the areas utilizing emergency lighting will be included in PSAR Section 9.12 when available.

Question CS430.30 (9.12)

Identify the types of lighting that will be provided in the above tabulated vital areas. Show that lighting will be available in the event of a design basis accident, including the safe shutdown earthquake.

Response

The CRBRP Lighting System provides normal, standby and emergency lighting as described in Section 9.12 of the PSAR. The Normal Lighting System provides illumination under all normal plant operating conditins with power available from the Plant, Preferred, or Reserve power supply systems. The Standby Lighting System provides illumination under all plant operating conditins with power available from the Plant, Preferred, Reserve or Class IE Onsite AC Power System. Both Normal and Standby Lighting Systems utilize high pressure sodium and fluorescent light fixtures. The Emergency Lighting System provides illuminatin at points of egress, at remote shutdown locations and at all locations required for access to safety-related equipment. The Emergency Lighting System utilizes self-contained individual eight hour battery powered units with sealed beam lamps and self-contained eight hour battery powered exit signs.

All lighting fixtures in Nuclear Island buildings are seismically qualified to maintain structural integrity. The lighting fixtures and raceways are supported to meet Seismic I requirements as described in Sections 3.7.2 and 3.7.3 of the PSAR.

The Standby Lighting System is classified as 1E up to and including the lighting panel. The circuits to the light fixtures are associated 1E.

Question CS430.31 (9.12)

For all vital areas identified, indicate that illumination levels during accident conditions will be adequate for performance of any tasks associated with safe shutdown of the reactor, and for maintaining the reactor in a safe shutdown condition. Demonstrate that sufficient lighting will be available in the vital areas in the event of a prolonged loss of offsite power illumination levels should be in conformance with applicable sections of the Illumination Engineering Society (IES) Lighting Handbook.

Response

The Normal Lighting System provides illumination to the level recommended by the IES Handbook. Where illumination is required for operation or maintenance of safety-related equipment, the Standby Lighting System receives power from the Emergency Diesel Generator and provides 20 foot candles. During loss of offsite power, access routes to areas containing safety-related equipment are illuminated by the Standby Lighting System to a level of three foot candles. The Emergency Lighting System provides one foot candle illumination, per NFPA 101, Section 5-8, and IES recommendation, in all egress routes and where access is required for fire fighting in areas containing safety related equipment for a period of 8 hours, per Branch Technical Position CMEB 9.5-1, paragraph 5g.

Question CS430.32 (9.14.1)

Provide a general arrangement drawing for the Emergency Diesel Generator Fuel Oil Storage and Transter System. Show storage tank locations and piping runs in relation to the diesel generator building and any other structures in the vicinity. Include section views, as necessary, for clarity.

Response

The design of the Emergency Diesel Engine Fuel Oil Storage and Transfer System is pending the completion of the procurement process of the storage tanks and other related equipment. The general arrangement and piping drawings are not finalized. The final design for the Fuel Oil Storage and Transfer System will be in accordance with SRP 9.5.4. Chapter 9.14 of the PSAR will be updated to include the preliminary general arrangements for the emergency diesel generator fuel oil storage and transfer system.

Question CS430.33 (9.14.1)

Describe the instruments, controls, sensors and alarms provided for monitoring the diesel engine fuel oil storage and transfer system, and describe their function. Identify the temperature, pressue, and level sensors which alert the operator when these parameters are exceeded, and state where the alarms are annunciated. Discuss the system interlocks provided, to the extent practical.

Provide a discussion of the testing and maintenance program which will be implemented to ensure a highly reliable instrumentation, controls, sensors, and alarm system.

Response

The design of the emergency diesel engine fuel oil storage and transfer system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the fuel oil storage and transfer system will be consistent with SRP 9.5.4 and the following description.

Level switches will be provided on the Diesel Generator Building 7-day storage tanks assemblies to provide the following functions:

1. Provide local fuel level indication.

2. Annunciate an alarm in the Main Control Room when the fuel level drops below a 7-day supply.

3. Annunciate an alarm in the Main Control Room on high storage tank level.

4. Provide an interlock so that transfer pumps located in the Diesel Generator Building will shut off automatically on high level in the tanks to which they are pumping.

Fuel oil pressure will be monitored just upstream of engine injectors. Low fuel oil pressure will be indicated on the diesel engine control panel.

A Seismic Category I truck fill connection, condensate sump, and inspection-dipstick gauge manholes will be provided for each embedded 7-day storage tank assembly.

For the Division I and II Diesel Generators two electric motor driven fuel oil transfer pumps for each diesel generator will be provided to transfer fuel from the embedded 7-day storage tank assembly to the day tank. Each of these pumps will be independently capable of supplying fuel to the day tank.

Two sets of level switches will be provided for each day tank and associated transfer pumps. The level switches will be arranged so that one pump will be the primary pump and the other a backup. A selector switch will be provided on the engine control cabinet which will allow the operator to administratively select the primary pump. In addition, these level switches will provide both local and Main Control Room alarms to indicate high and low fuel oil level in the day tank.

From the day tank, fuel will be supplied to the diesel injectors by a shaft driven pump. An electric motor-driven fuel pump will be provided as a backup for the engine driven fuel pump. Separate suction and discharge lines will serve each pump. Each pump will have a suction duplex strainer and discharges to a duplex filter downstream from the discharge junction. Pressure indication will be provided on the suction and discharge of each fuel pump.

Periodic testing will be performed on the Diesel Generators to demonstrate that the units are operational as described in Section 8.3.1.1.1 of the PSAR. Portions of these surveillance requirements include:

- Verify the proper fuel oil levels in the day tank

- Verify the proper fuel oil level in the 7-day storage tanks

- Verify the fuel oil transfer pump can be started and that it can transfer fuel from the storage system to the day tank

- Verify the diesel starts and accelerates from standby condition to rated speed in 10 seconds

In addition, testing and maintenance of all fuel oil instruments will be addressed in the scheduled maintenance and calibration program for CRBRP.

The incorporation of the third emergency diesel generator into the plant design is pending the completion of the procurement process. The design of the third diesel generator auxiliaries will be consistent with the applicable criteria of SRP 9.5.4, 9.5.5, 9.5.6, 9.5.7 and 9.5.8. The PSAR will be expanded to include additional information for the third emergency diesel generator when available from the vendor.

Question CS430.34 (9.14.1)

Provide a discussion of the design provisions which will be used to protect the fuel oil storage tank fill and vent lines from damage by tornado missiles.

Response

The Fuel Oil Storage and Transfer System storage tank vent and fill lines will be protected from tornado damage by the application of:

- o appropriate thickness earth cover or
- o concrete tornado missile shielding or
- o the combination of the two methods described above.

The tornado missile protection will be in accordance with the requirements of SRP 3.3.2 "Tornado Loading" and SRP 3.5.3 "Barrier Design Procedures". Chapter 9.14 of the PSAR will be updated to include the description of the tornado missile protection fuel oil storage tank fill and vent lines.

Question CS430.35 (9.14.1)

Expand the PSAR to include a discussion of the fuel oil storage tank and how your design will conform to the requirements of ANSI N-195 and R.G. 1.137. Provide specific information on:

1. The method to be used in calculating the capacity of the fuel oil storage tanks.

2. The types of coatings or coating systems to be used to prevent internal and external corrosion of the fuel oil storage tanks and underground piping.

3. A discussion of the cathodic protection system which will be applied to the fuel oil storage tanks, or the rationale of why cathodic protection will not be used.

Response

The design of the Diesel Generator Fuel Oil Storage and Transfer System is pending completion of the procurement process of the storage tanks. The design and specification for the storage tanks is based on the applicable requirements of SRP 9.5.4.

The calculation of the storage tank capacity is based on the requirements of Regulatory Guide 1.137, utilizing the continuous seven (7) day operating method.

The cathodic protection system design is pending completion of the site survey for cathodic protection. The final cathodic protection design for the storage tanks will be in accordance with ANSI N-195.

Chapter 9.14 of the PSAR will be updated to include the applicable description of how the fuel oil storage tank design meets the requirements of ANSI N-195 and Regulatory Guide 1.137.

Question CS430.36 (9.14.1)

Expand the PSAR to include a discussion of the following:

1. The means for detecting or preventing growth of algae in the diesel fuel oil storage tanks. If it were detected, describe the methods which will be employed for cleaning the affected tank(s).

2. The method(s) to be employed for removal of water from the diesel fuel oil storage tanks and the day tanks, should water accumulate in either tank.

3. The provisions to be made to prevent the entrance of deliterious material into the diesel fuel oil storage tanks during filling, and as a consequence of adverse environmental conditions.

Response

The design of the emergency diesel engine fuel oil storage and transfer system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design and operating procedures for the fuel oil storage and transfer system will be in accordance with Regulatory Guide 1.137, ANSI N-195 and SRP 9.5.4.

Following the availability of vendor data and completion of the operating procedures, Chapter 9.14 of the PSAR will be expanded to include the methods for the maintenance of the quality of the fuel oil.

Question CS430.37 (9.14.1)

Assume an unlikely event has occurred requiring operation of a diesel generator for a prolonged period that would require replenishment of fuel oil without interrupting operation of the diesel generator. What provision will be made in the design of the fuel oil storage fill system to minimize the creation of turbulence of the sediment in the bottom of the storage tank. Stirring of this sediment during addition of new fuel has the potential of causing the overall quality of the fuel to become unacceptable and could potentially lead to the degradation or failure of the diesel generator.

Response

The design of the Emergency Diesel Fuel Oil Storage and Transfer System is pending completion of the procurement process of the storage tanks and other related equipment. The design of the fuel oil storage tank fill system will meet the requirements of ANSI N-195, Appendix B, as it relates to the minimization of turbulence of the sediment on the bottom of the storage tank. Chapter 9.14 of the PSAR will include the description of the provisions to prevent sediment turbulence during filling of the fuel oil tank as this information becomes available.

Question CS430.38 (9.14.1)

In the PSAR, you state that fuel can be delivered to the site within 24 hours. Expand your PSAR to include a discussion of how the fuel will be delivered, both in normal operations and in the event of extremely unfavorable environmental conditions. In your discussion, include the sources where quality diesel fuel is available and the distances to be traveled from the source to the site, to the extent practical.

Response

The sources where quality diesel fuel is available have not been determined. The sources will be determined in accordance with SRP 9.5.4, Section I.1.e. Chapter 9.14 of the PSAR will be expanded to include a discussion relating to the availability of the quality fuel.

Question CS430.39 (9.14.1)

Discuss the design considerations that will determine the physical location of the diesel engine fuel oil day tank(s) at your facility. Assure that the proposed physical location of the fuel oil day tank(s) meet(s) the requirements of the diesel engine manufacturers.

Response

The design of the Emergency Diesel Engine Fuel Oil Storage and Transfer System is pending completion of the procurement process of the related equipment. The physical location of the day tank will meet the requirements of SRP 9.5.4, Section III.6.c. Chapter 9.14 of the PSAR will include the design basis and design description for the physical location of the diesel engine fuel oil day tank.

Question CS430.40 (9.14.1)

What is the purpose of the standby motor driven fuel oil pump shown of Figure 9.14.7? Expand the PSAR to include a description or this pump, its function, the pump control scheme, and the source of electrical power for the motor.

Response

The purpose of the standby fuel oil pump is to enhance the reliability of the fuel oil transfer system. Automatic interlocking controls shall be provided to provide automatic transfer from the pump in "Auto Start" mode to the pump in "Standby" mode in the event of failure of the pump selected to start in "Auto Start" mode. The pumps are controlled from level switch on the day tank; on low level a pump will start and on high level the pump will stop. The pump motors are connected to Class 1E power from the Safety Division which it serves. Chapter 9.14 of the PSAR will be updated to include the above information.

Question CS430.41 (9.14.1)

What is the source of electrical power for the diesel fuel oil transfer pumps? Also, provide the salient pump characteristics; i.e., capacity, discharge head, NPSH requirements, and motor HP; to the extent possible.

Response

The electrical power for each diesel fuel oil transfer pump is provided from the same diesel generator for which the fuel oil transfer pump provides service. The procurement of the diesel fuel oil transfer pumps is currently in the process of being completed. Chapter 9.14 of the PSAR will include the characteristics of the diesel fuel oil transfer pumps as this information becomes available.

Question CS430.42 (9.14.1)

Discuss the precautionary measures that will be taken to assure the quality and reliability of the fuel oil supply for emergency diesel generator operation. Include the type of fuel oil, impurity and quality limitation as well as diesel index number or its equivalent, cloud point, entrained moisture, sulfur, particulates and other deliterious insoluble substances; procedure for testing newly delivered fuel, periodic sampling and testing of on-site fuel oil (including interval between tests), interval of time between periodic removal of condensate from fuel tanks and periodic system inspection. In your discussion include reference to industry (or other) standard which will be followed to assure a reliable fuel oil supply to the emergency generators.

Response

The procedure for assurance of the quality and reliability of the fuel oil supply has not been finalized. The procedure will be completed in accordance with Regulatory Guide 1.137, ANSI N-195 and SRP 9.5.4. Chapter 9.14 of the PSAR will be expanded to include the procedural requirements relating to assurance of the fuel oil quality and reliability following the completion of the operating procedures.

Question CS430.43 (9.14.1)

Discuss what precautions have been taken in the design of the fuel oil system in locating the fuel oil day tank and connecting fuel oil piping in the diesel generator room with regard to possible exposure to ignition sources such as open flames and hot surfaces.

Response

The design of the Emergency Diesel Engine Fuel Oil Storage and Transfer System is pending completion of the procurement process of the related equipment. The design of the system as it is related to protection from possible exposure to ignition sources will be in accordance with the requirements of BTP CMEB 9.5-1, Section C.7.i. and j. Chapter 9.14 of the PSAR will describe the specific precautions taken in the design of the fuel oil system, including the day tank and interconnecting piping with regarding exposure to potential ignition sources.

Question CS430.44 (9.14.1)

What is the purpose of the piping run identified as 3-HBDW-D6B on Figure 9.14.1? Also, what is the actual location of line 2-HBCW-D4 on Figure 9.14.1; i.e., inside or outside the diesel generator building?

Response

The pipe lines 6A and 6B are connected to the fuel oil transfer pump discharge line and they transfer fuel oil from the storage tank to an outdoor hose connection for the purpose of the storage tank cleaning. The pipe line D4 and the fuel oil transfer pumps will be located inside the Diesel Generator Building.

Question CS430.45 (9.14)

Diesel generator auxiliary systems should be designed to Seismic Category 2, ASME Section III, Class 3, or Quality Group C requirement in conformance with Regulatory Guides 1.26 and 1.29. Expand your PSAR to include a discussion of the engine mounted fuel oil piping and components, and provide the industry standards that were used in the design, manufacturing, and inspection of the piping and components. Also, show on the appropriate drawings where the Quality Group Classification changes from Quality Group C.

Provide similar discussions and drawings for the other diesel generator auxiliary systems, i.e., lubricating oil, cooling water, air starting, and combustion air intake and exhaust systems, to the extent practical.

Response

The engine mounted part of the fuel oil piping and components will be designed in accordance with the requirements of ANSI N-195. The other than engine mounted part of the fuel oil piping and components will be designed to meet the requirements of Regulatory Guide 1.26, 1.29 and ANSI N-195. The discussion of the applied standards for design, manufacturing and inspection of engine mounted fuel oil piping and components will be included in Chapter 9.14 of the PSAR following the availability of the required information from the diesel generator vendor.

Question CS430.46 (9.14)

Identify all high and moderate energy lines and systems that will be installed in the diesel generator room. Discuss the measures that will be taken in the design of the diesel generator facility to protect the safety related systems, piping and components from the effects of high and moderate energy line failure to assure availability of the diesel generators when needed.

Response

The design of the emergency diesel engine auxiliary systems are pending completion of the procurement process of the related components. The design of the systems are not finalized. The final design for the emergency diesel engine auxiliary systems will be in accordance with SRP 3.6.1 and 3.6.2 as it is related to the protection of the emergency diesel generators from high and moderate energy pipe failures.

Following the availability of the vendor information and completion of the design, Chapter 9.14 of the PSAR will be expanded to include the description of the provisions for protecting the diesel generators from the affects of high and moderate energy pipe failures.

NRC Question CS430.47 (9.14)

The diesel generator structures are designed to seismic and tornado criteria and are isolated from one another by a reinforced concrete wall barrier. Describe the barrier (including openings) in more detail and, its capability to withstand the effects of internally generated missiles resulting from a crankcase explosion, failure of supports for one or all of the starting air receivers, or failure of any high or moderate energy line and initial flooding from the cooling system so that the assumed effects will not result in loss of an additional generator.

Response

The assumed effects from the events described will not result in loss of an additional generator due to the design as described below. The Diesel Generator Building is designed to provide complete separation between the independent divisions. This is accomplished by providing completely separate bays for housing the redundant diesel generators, Diesel Auxiliaries, and cell cooling equipment. Each bay is separated by a concrete wall barrier with no openings. Separate outside access is provided to each bay.

The separation walls are sized to withstand the worst case internally generated missile within each bay without resulting in concrete spalling. These evaluations are performed using criteria, such as the modified Petry, the modified NDRC formulas and the equivalent static load formula from the paper by R. A. Williamson and R. R. Alvy, November, 1973 (Reference 7, PSAR Section 3,5). See PSAR Section 3.5.4 for additional details on the calculation methods outlined above.

Failure of the structural supports for the starting air receivers is precluded by designing as Seismic Category I supports.

Equipment housed in each of the Diesel Generator Bays are mounted on concrete pads to prevent failure of essential equipment in the event of the worst case internal flooding condition. Since no openings are provided between independent bays, propagation of internal flooding accidents to an adjacent bay is prevented.

It should be pointed out that the Division 1 and 2 Class 1E diesel generators are being relocated to a new Category I structure located west of the Emergency Cooling Tower. The Division 3 Class 1E diesel generator will also be located in this structure. The design of this structure will comply with the design requirements outlined above. Additional details on the new Diesel Generator Building will be provided in an upcoming PSAR amendment.

Question CS430.48 (9.14)

Expand the PSAR to include a discussion of non-seismic systems or structures in the diesel generator building or near the fuel oil storage tanks and piping. Show that the failure of any non-seismic system or structures will not result in damage to any of the diesel generator auxiliary system with the attendant loss of its respective diesel generator.

Response

The design of the emergency diesel engine fuel oil storage and transfer system is pending completion of the procurement process of the storage tanks and other related equipment. The general arrangement and piping drawings are not finalized. The final design for the fuel oil storage and transfer system will be in accordance with SRP 9.5.4.

After the completion of the design, Chapter 9.14 of the PSAR will be expanded to include the analysis relating to the effect of non-seismic or structure failure on the fuel oil storage tanks and piping.

Question CS430.49 (9.14.2)

Expand your PSAR to include a section on how the diesel generator cooling water system design conforms to the design criteria and bases detailed in SRP 9.5.5 (NUREG-0800). Provide justification for non-conformance, as applicable.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design tor the cooling water system will be in accordance with SRP 9.5.5. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to show conformance of the cooling water system with SRP 9.5.5.

Question CS430.50 (9.14.2)

Describe the instrumentation, controls, and sensors and alarms provided for monitoring of the diesel engine cooling water system and describe their function. Discuss the testing necessary to maintain and assure a highly reliable instrumentation, controls, sensors, and alarm system, and where the alarms are annunciated. Identify the temperature, pressure, level, and flow (where applicable) sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe what operator actions are required during alarm conditions to prevent harmful effects to the diesel engine. Discuss the systems interlocks provided, to the extent practical.

Response

The design of the emergency diesel engine cooling water system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the cooling water system will be consistent with SRP 9.5.5 and the following description.

Cooling (jacket) water sensors and alarms will be provided for control of the Division I and II diesel engine jacket cooling water parameters during normal operation and standby mode. These sensors and alarms will consist of the following:

1. Low temperature - jacket water inlet.

2. High temperature - jacket water inlet.

3. Low temperature - jacket water outlet.

4. High temperature - jacket water outlet.

5. High-High temperature - jacket water outlet.

6. Low pressure - jacket water pump discharge header.

7. Low level - jacket water standpipe.

8. Low-Low pressure - jacket water pump discharge header.

All of the above jacket water sensors will actuate an alarm or light. The high-high temperature and low-low pressure will alarm both locally and in the Main Control Room. The remaining sensors will alarm in the Main Control Room through an "Engine Trouble" alarm with the individual alarms annunciated locally. The high-high temperature and low-low pressure alarm will affect a diesel engine trip if the engine is in the test mode. This will prevent damage to the engine. However, if such an alarm is received during the

emergency mode (i.e., supplying power to the plant), the trip signal will be locked out and the engine continues to run. The trip alarms in the emergency condition will alert the Control Room operator to prepare to operate without the affected safety train. The local (Diesel Generator) operator will determine and if possible correct the cause of the alarm. A thermostatically controlled jacket water immersion heater and an electric motor driven keep-warm pump will be provided for each engine to maintain the recommended jacket water standby temperature of 150°F. This will reduce thermal stresses and help assure fast starting.

At least once every 18 months during shutdown a simulated loss of offsite power test will be conducted. A portion of this test will be to verify the Diesel Generator jacket cooling water system trips are bypassed during the emergency mode of operation. In addition, the testing and maintenance of all the jacket cooling water instrumentation will be addressed in the scheduled maintenance and calibrated program for the CRBRP.

The incorporation of the third emergency diesel generator into the plant design is pending the completion of the procurement process. The design of the third diesel generator auxiliaries will be consistent with the applicable requirements of SRP 9.5.4, 9.5.5, 9.5.6, 9.5.7 and 9.5.8. Chapter 9.14 of the PSAR will be updated to include the additional information for the third emergency diesel generator when available from the vendor.

Question CS430.51 (9.14.2)

Provide a more complete description of how the diesel generator cooling water system functions. Include a description of all components that make up, or interface with the cooling water system, and describe their function. Show how cooling water temperature is maintained at a predetermined level during operation in any condition from no load to maximum load. Include seismic and quality group classifications.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the cooling water system will be in accordance with SRP 9.5.5. Following the availability of the vendor design information from the diesel generator vendors, a detailed description of the diesel generator cooling water system will be added to Chapter 9.14 of the PSAR including the description of the temperature control method, quality group classifications, etc.

Question CS430.52 (9.14.2)

In PSAR sections 9.14.2.2 d and e, you discuss the diesel engine jacket water "keepwarm" system for use when the engine is not running. The information presented in these PSAR sections and on Figure 9.14-2 is not sufficient for a comprehensive review of the system design and function. Therefore, expand your PSAR to include a complete description of the cooling water system design and functions with respect to the "keepwarm" or standby mode of operation. Show that the entire cooling water system is maintained at 125°F. Include details of the circulating pump, electric heater, source of power, flow path, and controls scheme. Revise Figure 9.14-2, as required. In the event of a failure in this system, describe how the failure will be detected, and what actions must be taken by the operator(s) to insure that diesel engine standby temperatures are maintained. Provide seismic and quality group classifications for this system.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the cooling water system will be in accordance with SRP 9.5.5. Following the availability of the vendor information from the diesel generator vendors, the detailed description of the diesel generator jacket water "keepwarm" system will be included in Chapter 9.14 of the PSAR.

Question CS430.53 (9.14.2)

A three-way, air operated temperature control valve is shown on Figure 9.14-8. Provide more detail on this valve and how it operates. Describe the control air system, including the air supply, how the pressure is regulated, consequences of a malfunction resulting in either too high or too low pressure, provisions for manual override, if any, alarms and indictions, and any other pertinent data, to the extent practical.

Response

The design of the emergency diesel engine cooling water system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the cooling water system will be consistent with SRP 9.5.5.

Following the availability of the vendor information, Chapter 9.14 of the PSAR will be expanded to include the description of the control system for the cooling water including the temperature control valve and its operator.

Question CS430.54 (9.14.2)

Indicate the measures to preclude long-term corrosion and organic fouling in the diesel engine cooling water system that would degrade system cooling performance, and the compatibility of any corrosion inhibitors or antifreeze compounds used with the materials of the system. Indicate if the water chemistry is in conformance with the engine manufacturer's recommendations, or the plan to verify conformance.

Response

The design of the emergency diesel engine cooling water system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design and operating procedures for the cooling water system will be consistent with SRP 9.5.5, Sections I.3.c and II.4.d.

Following the availability of the vendor information and completion of the operating procedures outlines, Chapter 9.14 of the PSAR will be expanded to include the description of the measures to preclude corrosion and fouling of the cooling water system components.

Question CS430.55 (9.14.2)

Describe the provisions made in the design of the diesel engine cooling water system to assure that all components and piping are filled with water.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the cooling water system will be in accordance with SRP 9.5.5, Section III.2 as it relates to the venting and filling of the system. Following the availability of the vendor design information from the diesel generator vendors, the information concerning the provision to keep diesel generator cooling water system components and piping filled with water will be included in Chapter 9.14 of the PSAR.

Question CS430.56 (9.14.2)

In the PSAR, you state that the expansion tank has sufficient capacity to replace water evaporated in the jacket water system. The final design of the cooling water system will be reviewed with regard to the system capacity for makeup due to minor system leaks at pump shaft seals, valve stems, and other components, and to maintain required NPSH on the system circulating pump. Therefore, to the maximum extent possible, expand your PSAR to provide the size fo the expansion tank size will be adequate to maintain required pump NPSH and makeup water for seven days continuous operation of the diesel engine at full rated load without makeup, or provide a seismic Category I, safety Class 3 makeup water supply to the expansion tank.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the cooling water system will be in accordance with SRP 9.5.5. Following the availability of the vendor design information from the diesel generator vendors, a detailed description of the diesel generator cooling water system, including the expansion tank sizing, will be added to Chapter 9.14 of the PSAR.

Question CS430.57 (9.14.2)

Provide a tabulation showing the individual and total heat removal rates for each major component and subsystem of the diesel generator cooling water system. Discuss the design margin (excess heat removal capability) included in the design of major components and subsystems.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. Following the availability of the vendor design information from the diesel generator vendors, the individual heat removal rates for each component and applied design margin will be added to Chapter 9.14 of the PSAR.

Question CS430.58 (8.14.2)

Recent licensee event reports have shown that tube leaks are being experienced in the heat exchangers of diesel engine jacket cooling water systems. Provide a discussion on the provisions which will be made to detect tube leakage, and the corrective actions that will be taken. Include jacket water leakage into the lube oil system (standby mode), lube oil leakage into the jacket water (operating mode), jacket water leakage into the engine combustion air intake and governor oil systems (operating or standby modes). Provide the permissable inleakage or outleakage in each of the above conditions which can be tolerated without degrading engine performance or causing engine failure. The discussion should also include the effects of jacket water/service water systems leakage, to the extent practical.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. Following the availability of the vendor design information from the diesel generator vendors, the provisions to detect tube leakage in the jacket cooling water system and required corrective action will be added to Chapter 9.14 of the PSAR.

Question CS430.59 (9.14.2)

The diesel generators are required to start automatically on loss of all offsite power and in the event of a DBA. The diesel generator sets should be capable of operation of less than full load for extended periods without degradation of performance or reliability. Should a DBA occur with availability of offsite power, discuss the design provisions and other parameters that have been considered in the selection of the diesel generators to enable them to run unloaded (on standby) for extended periods without degradation of engine performance or reliability. Expand your PSAR to include and explicitly define the capability of your design with regard to these requirements.

Response

The diesel generator sets for CRBRP will be designed to have the capability to operate at less than full load for extended periods without degradation of performance or reliability.

The manufacturer of the diesel generators for Class 1E divisions 1 and 2 (DeLaval Turbine Inc., Engine and Compressor Division in Oakland, California) has conducted no-load endurance tests on a diesel generator set essentially identical to those intended for use on CRBRP. The objective of this test was to establish that the diesel generator set could successfully pick up and carry the designated loads after operating at a no-load and synchronous speed for an extended period of time.

The engine was run in a no-load rated speed condition for 168 hours and performed without developing abnormal engine responses, noise or vibration. The engine successfully performed with a load of 4000KW after the no-load run.

The diesel generator set of Division 3 will also be tested to ensure its capability to operate at less than full load for extended periods.

Upon receipt of an emergency signal (as a result of a DBA), the diesel generator sets will automatically start and will run on no-load (on a standby mode) if the offsite power is still available. Administrative controls will be used to shutdown the units within a reasonable time after ensuring the stability of the offsite power. The operation of the units at no-load during this time will not result in any degradation of engine performance or reliability as demonstrated by the no-load test described above.

Question CS430.60 (9.14.2)

Provide the source of power for the diesel engine motor driven jacket water keepwarm pump and electric jacket water heater. Provide the motor and electric heater characteristics, i.e., motor hp., operating voltage, phase(s), frequency and kw output as applicable. Also include the pump capacity and discharge head, if available.

Response

The design of the Emergency Diesel Engine Cooling Water System is pending completion of the procurement process of the related components. Following the availability of the vendor design information from the diesel generator vendors, the detailed description of the diesel generator jacket water "keep warm" system will be included in Chapter 9.14 of the PSAR.

Question CS430.61 (9.14.3)

Expand your PSAR to include a section on how the emergency diesel engine air startng system will conform to the design criteria and bases detailed in SRP 9.5.6 (NUREG-0800). Provide justification for non-conformance, as applicable.

Response

The design of the Emergency Diesel Engine Starting System is pending the completion of the procurement process of the related components. The design of the system is not finalized. The final design for the starting system will be in accordance with SRP 9.5.6. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will include the design basis and description for emergency diesel air starting system and it will include a discussion concerning the conformance of SRP 9.5.6.

Question CS430.62 (9.14.3)

Expand your PSAR to include a detailed description of the diesel engine mounting portion of the air start system. Include such things as the function of the air line to the fuel rack, activation of the air start solenoid and air relay valves, type and number of air start motors, and any other pertinent data, if available.

Response

The design of the Emergency Diesel Engine Starting System is pending completion of the procurement process of the related components. The design of the system is not finalized. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and description for the emergency diesel air starting system and it will include a discussion concerning the engine mounted portion of the system.

Question CS430.63 (9.14.3)

Describe the operation of the emergency diesel engine air start system. Begin with an engine start signal and continue through engine running. Include all components in the system and the function of each. Show how a component failure will not result in total failure of an engine air start system. Also, state whether the air start system, once activated, will continue to operate until all compressed air is exhausted, or will it shut down after a specified period of time to allow successive starting attempts. Refer to Figure 9.14-3, as applicable.

Response

The design of the Emergency Diesel Engine Starting System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the starting system will be in accordance with SRP 9.5.6. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and description for the emergency diesel air starting system and it will include a discussion concerning the operation of the system.

Question CS430.64 (9.14.3)

Describe the air dryers in the air start system. State whether they are refrigerant or dessicant type, and the air quality levels they will maintain. Provide a discussion of how the compressd air quality will be monitored, and the provisions that will be made in your operation and maintenance programs to ensure consistently high quality compressed air to the receivers.

Response

The design of the Emergency Diesel Engine Starting System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the starting system will be in accordance with SRP 9.5.6, Section II.4f and j as it is related to the air dryers. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and description for the emergency diesel air starting system and it will include a discussion concerning the air dryers for the system.

QUESTION CS430.65 (9.14.3)

Describe the instrumentation, controls, sensors and alarms provided for monitoring the diesel engine air starting system and describe their function. Describe the testing necessary to maintain a highly reliable instrumentation, control, sensors and alarm system and where the alarms are annunciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe any operator actions required during alarm conditions to prevent harmful effects to the diesel engine. Discuss system interlocks provided, to the extent practical.

Response

The design of the emergency diesel engine air starting system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the air starting system will be consistent with SRP 9.5.6 and the following description.

Upon receipt of either a manually or automatically generated start signal, the following steps in starting the Division I or II Diesel Generators will occur, provided that the overspeed and generator differential trips are permissive and that DC power is available:

1. When energized by the DC power source, solenoid valves will open, admitting starting air from the primary receiver to the engine cylinders.

2. Field flash timers will be started.

3. Flashing of the generator field will occur when the field flash time delay times out or one set of contacts on the relay tachometer closes.

4. Starting air will be cutoff upon reaching synchronous speed by the closure of a second set of contacts on the relay tachometer. The cylinder head start air valves will be closed by combustion pressure.

5. When voltage approximates normal, ready-to-load signals will be generated.

When the unit is in the maintenance mode, the unit will be able to be turned over on starting air without starting by using the engine roll button on the local panel. The barring device, actuated by the service air system, will also be able to be used for this purpose.

Each accumulator will be equipped with the shutoff valves, a pressure gauge, drain valves, a safety relief valve, and low-pressure alarm contacts. The alarm contacts will alert operating personnel if the pressure of any air accumulator falls below the minumum allowable value. Both local and Main Control Room alarms will be activated when the starting air pressure in any accumulator falls below 210 psig. When this occurs, steps taken to correct the low-pressure condition will include:

1. Determining if compressor is operational.

2. Check for pressure switch malfunction.

3. Check for starting air system valve malfunction.

4. Check for system leakage.

5. Verify that the redundant starting air system is operational and available for service.

The operator will only be notified by the alarms that a faulted condition does exist. The above actions will be performed by locally examining the system. By means of the automatic operated pressure control switch and the DGSS instrumentation and controls, the accumulator pressures will automatically be maintained within an allowable operating range.

Testing and maintenance of the air starting system instrumentation will be addressed in the scheduled maintenance and calibration program for CRBRP.

The incorporation of the third emergency diesel generator into the plant design is pending the completion of the procurement process. The design of the third diesel generator auxiliaries will be consistent with the applicable requirements of SRP 9.5.4, 9.5.5, 9.5.6, 9.5.7 and 9.5.8. Chapter 9.14 of the PSAR will be updated to include the additional information for the third emergency diesel generator when available from the vendor.

Question CS430.66 (9.14.4)

Expand your PSAR to include a section on how the emergency diesel engine lubricating oil system will conform to the design criteria and bases detailed in SRP 9.5.7 (NUREG-0800). Provide justification for non-compliance.

Response

The design of the Emergency Diesel Engine Lubrication System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the lubrication system will be in accordance with SRP 9.5.7. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and description of the diesel engine lubricating oil system and it will describe how the design satisfies SRP 9.5.7.

Question CS430.67 (9.14.4)

Expand your description of the emergency diesel engine lubricating oil system. The PSAR text should include a detailed system description of what is shown on Figure 9.14-4. The PSAR text should also describe: 1) components and their function, 2) instrumentation, controls, sensors and alarms, and 3) a diesel generator starting sequence for a normal start and an emergency start. Also Figure 9.14-4 should show the diesel engine lubrication circuits, to the extent practical.

Response

The design of the Emergency Diesel Engine Lubrication System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the lubricating system will be in accordance with SRP 9.5.7. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and description of the diesel engine lubricating oil system.

Question CS430.68 (9.14.4)

An emergency diesel generator unit in a nuclear power plant is normally in the ready standby mode unless there is a loss of offsite power, an accident, or the diesel generator is under test. Long periods on standby have a tendency to drain or nearly empty the engine lube oil piping system. On an emergency start of the engine as much as 5 to 14 or more seconds may elapse from the start of cranking until full lube oil pressure is attained even though full engine speed is generally reached in about five seconds. With an essentially dry engine, the momentary lack of lubrication at the various moving parts may bearing surfaces producing incipient or actual component failure with resultant equipment unavailability.

The emergency condition of readiness requires this equipment to attain full rated speed and enable automatic sequencing of electric load within ten seconds. For this reason, and to improve upon the availability of this equipment on demand, it is necessary to establish as quickly as possible an oil film in the wearing parts of the diesel engine. Lubricating oil is normally delivered to the engine wearing parts by one or more engine driven pump(s). During the starting cycle, the pump(s) accelerate slowly with the engine and may not supply the required quantity of lubricating oil where needed fast enough. To remedy this condition, as a minimum, an electrically deiven lubricating oil pump, powered from a reliable DC power supply, should be installed in the lube oil system to operate in parallel with the engine driven main lube pump. The electric driven prelube pump should operate only during the engine cranking cycle or until satisfactory lube oil pressure is established in the engine main lube distribution header. The installation of this prelube pump should be coordinated with the respective engine manufacturer. Some diesel engines include a lube oil circulating pump as an integral part of the lube oil preheating system which is in use while the diesel engine is in the standby mode. In this case an additional prelube oil pump may not be needed.

Confirm your compliance with the above requirement or provide your justification for not installing an electric prelube oil pump.

Response

The design of the Emergency Diesel Engine Lubrication System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the lubrication system will be in accordance with SRP 9.5.7, Section III.1.h. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and description of the diesel engine lubricating oil system including the operation of the engine prelube features.

Question CS430.69 (9.14.4)

Several fires have occurred at some operating plants in the area of the diesel engine exhaust manifold and inside the turbocharger housing which have resulted in equipment unavailability. The fires were started from lube oil leaking and accumulating on the engine exhaust manifold and accumulating and igniting inside the turbocharger housing. Accumulation of lube oil in these areas, on some engines, is apparently caused from an excessively long prelube period, generally longer than five minutes, prior to manual starting of a diesel generator. This condition does not occur on an emergency start since the prelube is minimal.

When manually starting the diesel generators for any reason, to minimize the potential fire hazard and to improve equipment availability, the prelube period should be limited to a maximum of three to five minutes unless otherwise recommended by the diesel engine manufacturer. Confirm your compliance with this requirement or provide your justification for requiring a longer prelube time interval prior to manual starting of the diesel generators. Provide the prelube time interval your diesel engine will be exposed to prior to manual start.

Response

The design of the Emergency Diesel Engine Lubrication System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the lubrication system will be in accordance with the SRP 9.5.7, Section III.1.g and h as it is related to the design of the prelube system. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and description of the diesel engine lubrication oil system and it will describe the operation of the engine prelube system.

Question CS430.70 (9.14.4)

A three-way, air operated, temperature control valve in the lube oil discharge circuit is shown on Figure 9.14-4. Provide more detail on this valve and how it operates. Describe the control air system and how it is used to regulate lube oil temperature. Indicate the source of the control air, and show how the pressure is regulated, the consequences of a malfunction resulting in either too high or too low pressure, any provision for manual override, all alarms and indications, and any other pertinent data, to the extent practical.

Response

The design of the emergency diesel engine lubrication system is pending completion of the procurement process of the related components, the design of the system is not finalized. The final design for the lubrication system will be in accordance with SRP 9.5.7, Sections I.3.e and f and III.1.f.

Following the availability of vendor information, Chapter 9.14 of the PSAR will be expanded to include the description of the lubrication system, including the operation of the lube oil temperature control valve.

Question CS430.71 (9.14.4)

Describe the instrumentation, controls, sensors and alarms provided for monitoring the emergency diesel engine lubricating oil system, and describe their function. Describe the testing necessary to maintain a highly reliable instrumentation, control, sensors and alarm system and where the alarms are annunciated. Identify the temperature, pressure and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer and describe any operator actions required during alarm conditions to prevent harmful effects to the diesel engine. Discuss system interlocks provided. Coordinate the text material with the instrumentation and controls shown on Figure 9.14-4, to the extent practical.

Response

The design of the emergency diesel engine lubricating oil system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the lubricating oil system will be consistent with SRP 9.5.7 and the following description.

Lubricating oil pressure and temperature sensors and alarms will be provided for control and monitoring of the Division I and II diesel engine lubricating oil parameters during normal operation and standby mode. The sensors and alarms will consist of the following:

1. Low temperature - lubricating oil in.
2. High temperature - lubricating oil out.
3. Low pressure - lubricating oil.
4. High differential pressure - lubricating oil filter.
5. Low pressure - turbocharger oil.
6. Low level - lubricating oil reservoir.
7. High pressure - crankcase oil.
8. Low-low pressure - turbocharger oil.
9. High temperature - bearing oil.
10. High-high temperature - lubricating oil out.

All of the above lubricating oil sensors will actuate an alarm or light. The high pressure-crankcase oil, low-low pressure - turbocharger oil, high temperature - bearing oil and high-high temperature - lubricating oil out

alarm locally and in the control room and will affect a diesel engine trip if the engine is in the test mode. However, if the alarm is received during the emergency mode (i.e., supplying power to the plant), the trip signal will be locked out and the engine will continue to run. The trip alarms in the emergency condition will alert the control room operator to prepare to operate without the affected safety train. The local (diesel generator) operator will determine and if possible correct the cause of the alarm.

The oil will be heated by an immersion heater in the lube oil sump tank to insure rapid starting. The lube oil temperature will be maintained between 110^{o}F. and 120^{o}F. An alarm will sound locally in the appropriate Diesel Generator Building and actuate a DG Trouble Alarm in the control room if the lube oil temperature falls below 110^{o}F.

At least once every 18 months during shutdown a simulated loss of offsite power test will be conducted. A portion of this test will be to verify the diesel generator lubricating system trips are bypassed during the emergency mode of operation. In addition, testing and maintenance of all the lubricating instruments will be addressed in the scheduled maintenance and calibration program for CRBRP.

The incorporation of the third emergency diesel generator into the plant design is pending the completion of the procurement process. The design of the third diesel generator auxiliaries will be consistent with the applicable requirements of SRP 9.5.4, 9.5.5, 9.5.6, 9.5.7 and 9.5.8. Chapter 9.14 of the PSAR will be updated to include the additional information for the third emergency diesel generator when available from the vendor.

Question CS430.72 (9.14.4)

A lube oil storage tank in the diesel generator room is shown on Figures 1.2-77 and 9.14-4. Explain the purpose of this tank, and state whether the stored lube oil will be used to replenish the emergency diesel engine sump during normal operation and prolonged emergency (seven days) operation. If this is the case, then the storage tank and interconnecting piping must meet Seismic Category 1 and ASME Section III Class 3 requirements. Revise your PSAR accordingly.

Response

The purpose of the lube oil storage tank is for convenience only. The emergency diesel engine sump will contain a sufficient amount of oil to maintain the engine during normal operation and prolonged emergency (seven days) operation without the need for additional oil. Need for the lube oil storage tank will be evaluated upon receipt of the diesel generator manufacturer's recommendation. If it is concluded that the tank is not required, the tank will be deleted and Chapter 9.14 of the PSAR will be revised accordingly.

Question CS430.73 (9.14.4)

What measures have been taken to prevent entry of deliterious materials into the engine lubrication oil system due to operator error during recharging of lubricating oil or normal operation? What provisions have been made to prevent corrosion of the storage tank interior surfaces with resulting contamination of the stored lube oil?

Response

The design of the emergency diesel engine lubrication system is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design and operating procedures for the lubrication system will be consistent with SRP 9.5.7, Section I.3.c and III.1.d as it is related to the maintenance of the lube oil quality.

The coating system for the lube oil storage tanks will meet the requirements of the Diesel Engine Manufacturers Association (DEMA) Standards.

Following the availability of the vendor information and completion of the operating procedures outlines, Chapter 9.14 of the PSAR will be expanded to include the description of the operation of the lubrication system.

Question CS430.74 (9.14.4)

For the diesel engine lubrication system in Section 9.5.7 provide the following information: 1) define the temperature differential flow rate, and heat removal rate of the interface cooling system external to the engine and verify that these are in accordance with recommendations of the engine manufacturer; 2) discuss the measures that will be taken to maintain the required quality of the oil, including the inspection and replacement when oil quality is degraded; 3) describe the protective features (such as blowout panels) provided to prevent unacceptable crankcase explosion and to mitigate the consequences of such an event; and 4) describe the capability for detection and control of system leakage, to the extent practical.

Response

The design of the Emergency Diesel Engine Lubrication System is pending completion of the procurement process of the related components. The design of the system is not finalized. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be updated to include the design basis and descriptions of the diesel engine lubrication oil system.

Question CS430.75 (9.14.5)

Provide a description of the emergency diesel engine combustion air intake and exhaust system complete with test material and P&IDs. This description should conform to RG 1.70 and SRP 9.5.8 (NUREG-0800). Revise your PSAR accordingly.

Response

The design of the Emergency Diesel Engine Combustion Air and Intake and Exhaust System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the combustion air intake and exhaust system will be in accordance with SRP 9.5.8. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be expanded to include the design basis and description of the emergency diesel combustion air intake and exhaust system and the description will demonstrate how the design conforms with SRP 9.5.8. The updated PSAR description will be in conformance with Regulatory Guide 1.70.

Question CS430.76 (9.14.5)

Describe the instrumentation, controls, sensors and alarms provided in the design of the diesel engine combustion air intake and exhaust system which alert the operator when parameters exceed ranges recommended by the engine manufacturer and describe any operator action required during alarm conditions to prevent harmful effects to the diesel engine. Discuss systems interlocks provided, to the extent practical.

Response

The design of the Emergency Diesel Engine Combustion Air Intake and Exhaust System is pending completion of the procurement process of the related components. The design of the system is not finalized. Following the availability of the vendor design information from the diesel generator vendors, Chapter 9.14 of the PSAR will be expanded to include the design basis and description of the emergency diesel combustion air intake and exhaust system and the description will include the associated instrumentation and control features.

Question CS430.77 (9.14.5)

Provide the results of an analysis that demonstrates that the function of your diesel engine air intake and exhaust system design will not be degraded to an extent which prevents developing full engine rated power or cause engine shutdown as a consequence of any meteorological or accident condition. Include in your discussion the potential and effect of fire extinguishing (gaseous) medium, recirculation of diesel combustion products, or other gases that may intentionally or accidentally be released on site, on the performance of the diesel generator, to the extent practical.

Response

The design of the Emergency Diesel Engine Combustion Air Intake and Exhaust System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the combustion air intake and exhaust system will be in accordance with SRP 9.5.8, Section III.5 and 6 as it relates to protection from adverse conditions. Chapter 9.14 of the PSAR will be updated to include the results of the analysis which demonstrates that the function of the diesel engine air intake and exhaust system will not be degraded as a consequence of any meteorological or accident conditions.

Question CS430.78 (9.14.5)

Discuss the provisions made in your design of the diesel engine combustion air intake and exhaust system to prevent possible clogging, during standby and in operation, from abnormal climatic conditions (heavy rain, freezing rain, dust storms, ice and snow) that could prevent operation of the diesel generator on demand.

Response

The design of the Emergency Diesel Engine Combustion Air Intake and Exhaust System is pending completion of the procurement process of the related components. The design of the system is not finalized. The final design for the combustion air intake and exhaust system will be in accordance with SRP 9.5.8, Section III.5 as it relates to protection from adverse climatic conditions. Chapter 9.14 of the PSAR will be updated to include the results of the analysis which demonstrates that the function of the diesel engine air intake and exhaust system will not be degraded as a comsequence of any meteorological or accident conditions.

Question CS430.79 (9.14.5)

Show that a potential fire in the diesel generator building together with a single failure of the fire protection system will not degrade the quality of the diesel combustion air so that the remaining diesel will be able to provide full rated power.

Response

The design of the Emergency Diesel Engine Building is pending completion of the procurement process of the related components. The design of the building is not finalized. The final design for the Diesel Building will be in accordance with SRP 9.5.1 and BTP CMEB 9.5-1. Chapter 9.14 of the PSAR will be updated to include the results of an analysis to demonstrate that a fire and single failure in the fire protection system will not degrade the quality of the diesel combustion air to the remaining diesel generators.

Question CS430.80 (9.14.5)

Experience at some operating plants has shown that diesel engines have failed to start due to accumulation of dust and other deliterious material on electrical equipment associated with starting of the diesel generators (e.g., auxiliary relay contacts, control switches - etc.). Describe the provisions that have been made in your diesel generator building design, electrical starting system, and combustion air and ventilation air intake design(s) to preclude this condition to assure availability of the diesel generator on demand.

Also describe under normal plant operation what procedure(s) will be used to minimize accumulation of dust in the diesel generator room; specifically address concrete dust control to the extent practical.

Response

Chapter 9.14 of the PSAR will be updated to include the descripton of the design provisions to prevent failure to diesel generator and auxiliaries due to accumulation of dust and other deleterious material. This description will include normal operating procedures and it will specifically address the method for coating the concrete walls for dust control.

Question CS430.81 (10.2)

Expand your discussion of the turbine speed control and overspeed protection system. Provide additional explanation of the generator electrical load following capability for the turbine speed control system with the aid of system schematics (including turbine control and extraction steam valves to the heaters). Tabulate the individual speed control protection devices (normal, emergency and backup), the design speed (or range of speed) at which each device begins operation to perform its protective function (in terms of percent of normal turbine operating speed). In order to evaluate the adequacy of the control and overspeed protection system, provide schematics and include identifying numbers to valves and mechanisms (mechanical and electrical) on the schematics. Describe in detail, with reference to the identifying numbers, the sequence of events in a turbine trip including response times, and show that the turbine stabilizes. Provide the results of a failure mode and effects analysis for the overspeed protection system. Show that a single steam valve failure cannot disable the turbine overspeed trip from functioning. (SRP 10.2, Part III, Items 1, 2, 3 and 4.)

Response

The discussion of the turbine speed control and overspeed protection systems in the PSAR was expanded resulting in the revision of Section 10.2. Specifically, the turbine load following capability is discussed in Section 10.2.2.8, while the response of the extraction system to a transient is discussed in Section 10.2.2.7. The turbine speed control and emergency trip systems are explained in Section 10.2.2.6. Finally, the system arrangement to prevent a turbine overspeed due to the failure of a single main steam valve is discussed in Sections 10.2.2.6. A description of the possible failures in the turbine generator system and the effects on the turbine control system is also included in Section 10.2.2.6.

10.2.2 Description

The turbine consists of one single flow, high pressure cylinder and three double flow, low pressure cylinders. The turbine is equipped with extraction nozzles to provide steam for six stages of feedwater heaters.

Bleed steam for feedwater heating is provided from the following sources:

Heater	Extraction Source/Stage
6	LP turbine bleed - 13th
5	LP turbine bleed - 12th
4	LP turbine bleed - 11th
3 (Deaerator)	LP turbine bleed - 9th
2	HP turbine exhaust -7th
1	HP turbine bleed - 4th

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10.2.2.1 Each of the four main steam lines is provided with a stop valve and a control valve which are automatically activated by the turbine control system. During an event resulting in turbine stop and control valve fast closure, turbine inlet steam flow will be stopped in less than .2 seconds. Since the steam goes directly from the high pressure (HP) turbine to the low pressure (LP) turbine instead of going to a reheater or moisture separator, no additional energy or large volume of stored energy exists and, therefore, stop and intercept valves are not required between the HP and LP turbines.

10.2.2.2 A shaft sealing system, using steam to seal the annular openings where the shaft emerges from the casings, prevents steam outleakage and air inleakage along the shaft. The gland sealing system includes all necessary piping, valves, controls, and a steam packing exhauster which exhausts to atmosphere through a roof vent.

10.2.2.3 The hydrogen and water cooled generator, rated at 485.3 MVA at 90 percent power factor, produces power at 22KV and 60 Hz. Generator rating, temperature rise and class of insulation are in accordance with the manufacturer's codes and standards. Excitation is provided by a shaft driven alternator with its output rectified. Stator conductors are water cooled.

10.2.2.4 Turbine generator bearings are lubricated by a conventional oil system. A turbine shaft driven lube oil pump takes suction from the lube oil tank through an oil-driven booster pump. At shaft speeds below approximately 3,240 rpm, or upon a drop in oil pressure, a motor-driven auxiliary oil pump provides lubrication. In addition, upon succeeding drops in lube oil pressure to predetermined set points, the turbine generator will trip, and lubrication for coastdown will be provided by either an AC oil pump or a DC emergency bearing oil pump. Heat from bearing friction is removed by the Secondary Service Closed Cooling Water system in either of two full capacity oil coolers.

10.2.2.5 Supervisory instruments continuously monitor and record, except as noted, such turbine generator parameters as:

a. Shaft vibration at the main bearings
b. Shell expansion
c. Control valve position (when unit is synchronized)
d. Turbine speed (when unit is not synchronized)
e. Shaft eccentricity (at turning gear speed only)
f. Differential expansion
g. Rotor expansion
h. Shell temperature
i. Vibration phase angle (as needed)
j. Throttle pressure
k. Exhaust hood temperature
l. Stop and control valve temperatures
m. Steam seal header temperature
n. Crossover temperatures

Other parameters to be continuously recorded are:

a. Turbine generator bearing metal temperatures
b. Lube oil temperatures
c. Thrust bearing metal/drain temperatures
d. Throttle temperature

10.2.2.6 The turbine uses an Electro Hydraulic Control (EHC) System whose prime function is to control the speed of the turbine when the generator is not synchronized with the system and to control the output of the unit when the generator is on the line. This is accomplished by positioning the previously mentioned control valves to regulate the flow of steam to the turbine. The control valves are operated by piston type servo-motors, using a pressurized non-flammable hydraulic fluid for opening the valves. The hydraulic system receives control signals from the speed governor and emergency governor.

To assure high reliability of the trip circuits, multiple logic consisting of two out of two and two out of three logic system for important and vital trip functions are utilized in the EHC System. The trip solenoid and the trip relay will be energized if at least two out of the three actuating relays close their contacts. Failure of one relay to close contacts will not prevent the trip action, and accidental actuation of one relay causing contact closure will not result in a false trip.

There are four methods of turbine overspeed control protection. They are:

a. EHC speed control unit
b. EHC trip anticipator
c. Mechanical overspeed trip
d. Back-up overspeed trip

The speed control unit of the electro hydraulic control system provides speed error signals for repositioning the control valves. Three distinct speed error signals are darived by this unit and applied to a low value gate which permits propogation of the signal demanding the smaller valve opening.

The trip anticipator's functions are to avoid a turbine overspeed following a load rejection which is accompanied by a failure of one or more of the control valves to close, and to prevent a turbine trip when the speed control unit is functioning properly. A closing signal to the main stop valves is generated by comparing the rotor speed with a load dependent reference signal. The reference signal has a characteristic which linearly decreases in magnitude as the load increases. Thus, the speed at which the trip anticipator provides a closing signal decreases with increasing load, thereby, reducing the possibility of an excessive overspeed. After the trip anticipator has closed the stop valves and shaft speed has decreased to near rated speed the trip anticipator will reset causing the stop valves to reopen. This will be followed by opening the control valves by the speed control unit to maintain the generator at rated speed. At this point, the Turbine-Generator unit is ready for reloading.

If the turine accelerates to approximately 110% of rated speed, the mechanical overspeed trip mechanism trips the turbine. This system makes use of the conventional eccentric ring type overspeed trip device. The operation of the mechanical trip mechanism causes the stop and control valves to trip closed, as described in detail below, thereby, preventing all steam from entering the turbine.

In addition, there is a back up electrical overspeed tirp set at approximately 1% above the mechanical overspeed trip setting. This protective system makes use of three magnetic speed pick ups which provide electrical signals proportional to rotor speed. If two out of three of these signals exceed the set point, a trip signal is generated. The set point differential between the mechanical and electrical overspeed trip systems permits each trip device to be tested separately.

The turbine has two separate and distinct trip systems, both of which cause Hydraulic fluid to be dumped from the stop, control and air pilot valves. Refer to Figure 10.2-3, Protection System Block Diagram.

1. The mechanical trip system requires the activation of the mechanical trip latch assembly by one of the following: a) operation of the mechanical trip solenoid valve (MSTV) which is energized by an electrical signal from the 125V DC trip bus or the overspeed trip test logic, b) operation of the mechanical overspeed trip (OST) mechanism initiated by an overspeed or loss of bearing oil pressure, c) operation of the mechanical trip handle. Once the trip latch assembly is activated, it operates the mechanical trip pilot valve which in turn actuates the mechanical trip pilot valve. This causes the high pressure hydraulic fluid to be released resulting in the closure of the stop control and air relay dump valves.

2. The electrical trip system operates by energization of the electrical trip solenoid valve (ETSV) with a signal from the trip anticipator, the 24 DC trip bus or the overspeed trip test logic. This solenoid actuates the electrical trip valve (ETV) which in turn will cause the release of high pressure hydraulic fluid and the closure of the stop control and air relay dump valves.

Either the mechanical overspeed or the backup overspeed trips will shut down the turbine by simultaneoulsy closing all the main steam stop and control valves. The failure of any one stop or control valve to close will not disable the turbine overspeed control function,

because the valves are in series. Therefore, if one valve fails to close, the other valve will stop the steam flow. A failure of one control valve causes the other valves to increase or decrease their opening to compensate for that valve. If one valve fails open at low load condition, the other valves close. If the closing of the other valves is not enough to compensate for that valve, the turbine overspeeds thereby resulting in the operation of the overspeed protection system.

The valves described above will be closed daily by using the valve test mode of the turbine control system. Pressure variations caused by closing a control valve cause the other control valves to open. Therefore, if operating near full load, testing must be done at a reduced power level to provide sufficient margin for pressure control.

In addition to providing speed and load control and overspeed protection, the control system automatically trips the turbine generator under any of the following conditions:

a. Excessive shaft vibration,
b. Generator electrical faults,
c. Low condenser vacuum,
d. Thrust bearing failures,
e. Low bearing oil pressure,
f. Low hydraulic pressure,
g. High exhaust hood temperature,
h. Manual operation of several trip levers,
i. Loss of stator coolant, or
j. Low throttle pressure.

10.2.2.7 The extraction steam system is designed to withstand the transients imposed on it by a turbine trip and to prevent reverse flow of steam or water into the turbine. Each of the extraction steam lines has at least one non-return valve and a motor driven isolation valve with the exception of the extraction lines to the low pressure heaters 6A, 6B, 6C. Whether one or two non-return valves are required in an extraction line is dependent upon the amount of unrestrained energy available in the extraction line and heater. Upon a turbine trip, air pressure is released from the actuator on the non-return valves allowing the springs in these valves to drive the valves in the closed direction. Under static conditions (no flow), these valves will close in less than 2 seconds and upon a flow reversal, the valves also get a close demand upon a turbine trip. Because of the fast closure time of the non-return valves and the short distance between the above valves and the extraction points at the turbine, steam in the extraction steam system does not affect the turbine coastdown following a turbine trip.

The total amount of energy which would accelerate the turbine upon a turbine generator trip is that steam which is trapped in the turbine and the lines to the extraction steam check valves. The turbine steam system does not incorporate stop and intercept valves between the high pressure and low pressure turbine since the steam goes directly from the high pressure turbine to the low pressure tubine instead of going to a reheater or moisture separator and, therefore, no additional energy or large volume of stored energy exists. This total stored energy is calculated based on the piping volume and extraction steam conditions and cannot exceed an energy value set by the turbine generator contractor for stable shutdown.

The Extraction Steam Check (Non-Return) Valve is a positive closing, free swinging disc check valve. The valve is of the power assisted (spring) closing type in which the operating cylinder is held in a neutral position (free swing) by air pressure until a trip signal releases the air the spring forces the check valve closed. Additionally, the extraction check valve is counter-weighted to reduce the required closing moment.

10.2.2.8 The turbine generator is designed to accept the loss of external electrical load and remain in service supplying the plant's auxiliary load. If the unit is suddenly subjected to a 40% or greater loss of load, the following events will take place in rapid succession.

1. The power load unbalance circuitry will start running the load set motor back toward zero load.

2. The turbine will begin accelerating.

3. The control valves will close at the maximum rate by means of the fast acting solenoid, this being initiated by the power load unbalance circuits.

   Also if the unit is above approximately 70% load, the trip anticipator may close the stop valves as was discussed earlier.

4. The entrained steam between the valves and the turbine in the turbine casing and in the extraction lines will expand within approximately 1.5 seconds.

5. When the entrained steam has ceased expanding the rotor speed will start decreasing gradually at a rate depending on the auxiliary load remaining on the generator.

6. If the trip anticipator was actuated, it will reset at this point reopening the stop valves. The power/load unbalance circuit will clean automatically when the load reference motor reaches the no load flow point.

7. When the speed has decreased to approximately 100% of rated speed the control valves will start to reopen under speed control.

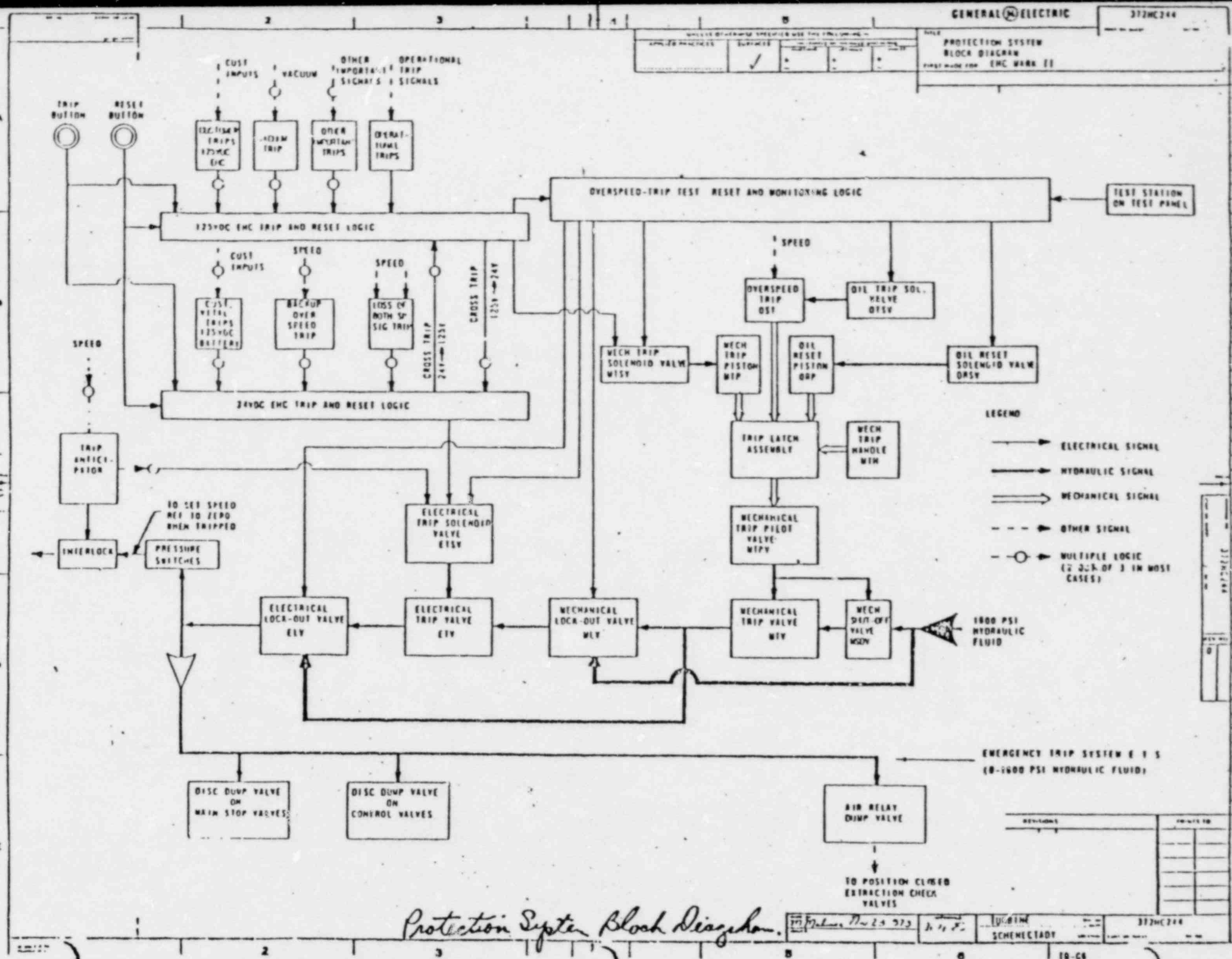
8. The unit will now be close to rated speed ready for resynchronization.

10.2.2.9 For overpressure protection rupture diaphragms are provided in each low pressure turbine exhaust hood. Additional protective devices include exhaust hood high temperature alarm and trip and a pilot dump valve for protective closing of extraction non-return valves.

10.2.2.10 The generator hydrogen control system includes pressure regulators for control of the hydrogen gas, and a circuit for supplying and controlling the carbon dioxide used in purging the generator during filling and degassing operations. To maintain the hydrogen within the generator casing at the purity level required, the generator, is designed with shaft seals and associated control equipment to prevent leakage of the hydrogen. This seal

function is provided for by a pressure oil supply which is furnished with a separate, package-type combination of equipment including filters, coolers, emergency DC seal oil pump, seal oil control equipment and necessary detraining tanks, loop seals and pressure switches required for detraining the gases from the oil before it is sent to the shaft seals.

10.2.2.11 The bulk hydrogen and carbon dioxide storage systems consist of several pre-assembled modules located outdoors with interconnecting piping. The storage bank is composed of ASME Coded Section VIII storage units manifolded in active and reserve banks. Each storage cylinder is mounted in supporting frames restrained from movement. Shut off valves and vents are provided for each storage cylinder.



Protection System Block Diagram.

Figure 10.2-7

<u>Question CS430.82 (10.2)</u>

The turbine speed control and overspeed protection system does not incorporate stop and intercept valves between the high pressure and low pressure elements of the main turbine. Provide a discussion why such valves are not required, and show that the turbine stabilizes following a trip without the aid of stop and intercept valves. Revise your PSAR accordingly.

<u>Response</u>

See revised PSAR Section 10.2.2.7 for the requested information.

because the valves are in series. Therefore, if one valve fails to close, the other valve will stop the steam flow. A failure of one control valve causes the other valves to increase or decrease their opening to compensate for that valve. If one valve fails open at low load condition, the other valves close. If the closing of the other valves is not enough to compensate for that valve, the turbine overspeeds thereby resulting in the operation of the overspeed protection system.

The valves described above will be closed daily by using the valve test mode of the turbine control system. Pressure variations caused by closing a control valve cause the other control valves to open. Therefore, if operating near full load, testing must be done at a reduced power level to provide sufficient margin for pressure control.

In addition to providing speed and load control and overspeed protection, the control system automatically trips the turbine generator under any of the following conditions:

a. Excessive shaft vibration,
b. Generator electrical faults,
c. Low condenser vacuum,
d. Thrust bearing failures,
e. Low bearing oil pressure,
f. Low hydraulic pressure,
g. High exhaust hood temperature,
h. Manual operation of several trip levers,
i. Loss of stator coolant, or
j. Low throttle pressure.

10.2.2.7 The extraction steam system is designed to withstand the transients imposed on it by a turbine trip and to prevent reverse flow of steam or water into the turbine. Each of the extraction steam lines has at least one non-return valve and a motor driven isolation valve with the exception of the extraction lines to the low pressure heaters 6A, 6B, 6C. Whether one or two non-return valves are required in an extraction line is dependent upon the amount of unrestrained energy available in the extraction line and heater. Upon a turbine trip, air pressure is released from the actuator on the non-return valves allowing the springs in these valves to drive the valves in the closed direction. Under static conditions (no flow), these valves will close in less than 2 seconds and upon a flow reversal, the valves also get a close demand upon a turbine trip. Because of the fast closure time of the non-return valves and the short distance between the above valves and the extraction points at the turbine, steam in the extraction steam system does not affect the turbine coastdown following a turbine trip.

The total amount of energy which would accelerate the turbine upon a turbine generator trip is that steam which is trapped in the turbine and the lines to the extraction steam check valves. The turbine steam system does not incorporate stop and intercept valves between the high pressure and low pressure turbine since the steam goes directly from the high pressure turbine to the low pressure tubine instead of going to a reheater or moisture separator and, therefore, no additional energy or large volume of stored energy exists. This total stored energy is calculated based on the piping volume and extraction steam conditions and cannot exceed an energy value set by the turbine generator contractor for stable shutdown.

The Extraction Steam Check (Non-Return) Valve is a positive closing, free swinging disc check valve. The valve is of the power assisted (spring) closing type in which the operating cylinder is held in a neutral position (free swing) by air pressure until a trip signal releases the air the spring forces the check valve closed. Additionally, the extraction check valve is counterweighted to reduce the required closing moment.

Question CS430.83 (10.2)

In the turbine generator section discuss: 1) the valve closure times and the arrangement for the main steam stop and control valves in relation to the effect of a failure of a single valve on the overspeed control functions; 2) the valve closure times and extractio n steam valve arrangements in relation to stable turbine operation after a turbine generator system trip; 3) effects of missiles from a possible turbine generator failure on safety-related systems or components. (SRP 10.2, Part III, Items 3 and 4.)

Response

1. See PSAR Sections 10.2.2.1 and 10.2.2.6 for the requested information.

2. See PSAR Section 10.2.2.7 for the requested information.

3. The turbine generator is located in a non-safety-related building which does not contain safety-related systems or components. PSAR Section 10.2.3 presents the results of an evaluation of the potential for turbine missiles to impact safety-related equipment in adjacent buildings.

10.2.2.1 Each of the four main steam lines is provided with a stop valve and a control valve which are automatically activated by the turbine control system. During an event resulting in turbine stop and control valve fast closure, turbine inlet steam flow will be stopped in less than .2 seconds. Since the steam goes directly from the high pressure (HP) turbine to the low pressure (LP) turbine instead of going to a reheater or moisture separator, no additional energy or large volume of stored energy exists and, therefore, stop and intercept valves are not required between the HP and LP turbines.

10.2.2.2 A shaft sealing system, using steam to seal the annular openings where the shaft emerges from the casings, prevents steam outleakage and air inleakage along the shaft. The gland sealing system includes all necessary piping, valves, controls, and a steam packing exhauster which exhausts to atmosphere through a roof vent.

10.2.2.3 The hydrogen and water cooled generator, rated at 485.3 MVA at 90 percent power factor, produces power at 22KV and 60 Hz. Generator rating, temperature rise and class of insulation are in accordance with the manufacturer's codes and standards. Excitation is provided by a shaft driven alternator with its output rectified. Stator conductors are water cooled.

10.2.2.4 Turbine generator bearings are lubricated by a conventional oil system. A turbine shaft driven lube oil pump takes suction from the lube oil tank through an oil-driven booster pump. At shaft speeds below approximately 3,240 rpm, or upon a drop in oil pressure, a motor-driven auxiliary oil pump provides lubrication. In addition, upon succeeding drops in lube oil pressure to predetermined set points, the turbine generator will trip, and lubrication for coastdown will be provided by either an AC oil pump or a DC emergency bearing oil pump. Heat from bearing friction is removed by the Secondary Service Closed Cooling Water system in either of two full capacity oil coolers.

10.2.2.5 Supervisory instruments continuously monitor and record, except as noted, such turbine generator parameters as:

a. Shaft vibration at the main bearings
b. Shell expansion
c. Control valve position (when unit is synchronized)
d. Turbine speed (when unit is not synchronized)
e. Shaft eccentricity (at turning gear speed only)
f. Differential expansion
g. Rotor expansion
h. Shell temperature
i. Vibration phase angle (as needed)
j. Throttle pressure
k. Exhaust hood temperature
l. Stop and control valve temperatures
m. Steam seal header temperature
n. Crossover temperatures

Other parameters to be continuously recorded are:

a. Turbine generator bearing metal temperatures
b. Lube oil temperatures
c. Thrust bearing metal/drain temperatures
d. Throttle temperature

10.2.2.6 The turbine uses an Electro Hydraulic Control (EHC) System whose prime function is to control the speed of the turbine when the generator is not synchronized with the system and to control the output of the unit when the generator is on the line. This is accomplished by positioning the previously mentioned control valves to regulate the flow of steam to the turbine. The control valves are operated by piston type servo-motors, using a pressurized non-flammable hydraulic fluid for opening the valves. The hydraulic system receives control signals from the speed governor and emergency governor.

To assure high reliability of the trip circuits, multiple logic consisting of two out of two and two out of three logic system for important and vital trip functions are utilized in the EHC System. The trip solenoid and the trip relay will be energized if at least two out of the three actuating relays close their contacts. Failure of one relay to close contacts will not prevent the trip action, and accidental actuation of one relay causing contact closure will not result in a false trip.

There are four methods of turbine overspeed control protection. They are:

a. EHC speed control unit
b. EHC trip anticipator
c. Mechanical overspeed trip
d. Back-up overspeed trip

The speed control unit of the electro hydraulic control system provides speed error signals for repositioning the control valves. Three distinct speed error signals are derived by this unit and applied to a low value gate which permits propogation of the signal demanding the smaller valve opening.

The trip anticipator's functions are to avoid a turbine overspeed following a load rejection which is accompanied by a failure of one or more of the control valves to close, and to prevent a turbine trip when the speed control unit is functioning properly. A closing signal to the main stop valves is generated by comparing the rotor speed with a load dependent reference signal. The reference signal has a characteristic which linearly decreases in magnitude as the load increases. Thus, the speed at which the trip anticipator provides a closing signal decreases with increasing load, thereby, reducing the possibility of an excessive overspeed. After the trip anticipator has closed the stop valves and shaft speed has decreased to near rated speed the trip anticipator will reset causing the stop valves to reopen. This will be followed by opening the control valves by the speed control unit to maintain the generator at rated speed. At this point, the Turbine-Generator unit is ready for reloading.

If the turine accelerates to approximately 110% of rated speed, the mechanical overspeed trip mechanism trips the turbine. This system makes use of the conventional eccentric ring type overspeed trip device. The operation of the mechanical trip mechanism causes the stop and control valves to trip closed, as described in detail below, thereby, preventing all steam from entering the turbine.

In addition, there is a back up electrical overspeed tirp set at approximately 1% above the mechanical overspeed trip setting. This protective system makes use of three magnetic speed pick ups which provide electrical signals proportional to rotor speed. If two out of three of these signals exceed the set point, a trip signal is generated. The set point differential between the mechanical and electrical overspeed trip systems permits each trip device to be tested separately.

The turbine has two separate and distinct trip systems, both of which cause Hydraulic fluid to be dumped from the stop, control and air pilot valves. Refer to Figure 10.2-3, Protection System Block Diagram.

1. The mechanical trip system requires the activation of the mechanical trip latch assembly by one of the following: a) operation of the mechanical trip solenoid valve (MSTV) which is energized by an electrical signal from the 125V DC trip bus or the overspeed trip test logic, b) operation of the mechanical overspeed trip (OST) mechanism initiated by an overspeed or loss of bearing oil pressure, c) operation of the mechanical trip handle. Once the trip latch assembly is activated, it operates the mechanical trip pilot valve which in turn actuates the mechanical trip pilot valve. This causes the high pressure hydraulic fluid to be released resulting in the closure of the stop control and air relay dump valves.

2. The electrical trip system operates by energization of the electrical trip solenoid valve (ETSV) with a signal from the trip anticipator, the 24 DC trip bus or the overspeed trip test logic. This solenoid actuates the electrical trip valve (ETV) which in turn will cause the release of high pressure hydraulic fluid and the closure of the stop control and air relay dump valves.

Either the mechanical overspeed or the backup overspeed trips will shut down the turbine by simultaneoulsy closing all the main steam stop and control valves. The failure of any one stop or control valve to close will not disable the turbine overspeed control function,

because the valves are in series. Therefore, if one valve fails to close, the other valve will stop the steam flow. A failure of one control valve causes the other valves to increase or decrease their opening to compensate for that valve. If one valve fails open at low load condition, the other valves close. If the closing of the other valves is not enough to compensate for that valve, the turbine overspeeds thereby resulting in the operation of the overspeed protection system.

The valves described above will be closed daily by using the valve test mode of the turbine control system. Pressure variations caused by closing a control valve cause the other control valves to open. Therefore, if operating near full load, testing must be done at a reduced power level to provide sufficient margin for pressure control.

In addition to providing speed and load control and overspeed protection, the control system automatically trips the turbine generator under any of the following conditions:

a. Excessive shaft vibration,
b. Generator electrical faults,
c. Low condenser vacuum,
d. Thrust bearing failures,
e. Low bearing oil pressure,
f. Low hydraulic pressure,
g. High exhaust hood temperature,
h. Manual operation of several trip levers,
i. Loss of stator coolant, or
j. Low throttle pressure.

10.2.2.7 The extraction steam system is designed to withstand the transients imposed on it by a turbine trip and to prevent reverse flow of steam or water into the turbine. Each of the extraction steam lines has at least one non-return valve and a motor driven isolation valve with the exception of the extraction lines to the low pressure heaters 6A, 6B, 6C. Whether one or two non-return valves are required in an extraction line is dependent upon the amount of unrestrained energy available in the extraction line and heater. Upon a turbine trip, air pressure is released from the actuator on the non-return valves allowing the springs in these valves to drive the valves in the closed direction. Under static conditions (no flow), these valves will close in less than 2 seconds and upon a flow reversal, the valves also get a close demand upon a turbine trip. Because of the fast closure time of the non-return valves and the short distance between the above valves and the extraction points at the turbine, steam in the extraction steam system does not affect the turbine coastdown following a turbine trip.

The total amount of energy which would accelerate the turbine upon a turbine generator trip is that steam which is trapped in the turbine and the lines to the extraction steam check valves. The turbine steam system does not incorporate stop and intercept valves between the high pressure and low pressure turbine since the steam goes directly from the high pressure turbine to the low pressure tubine instead of going to a reheater or moisture separator and, therefore, no additional energy or large volume of stored energy exists. This total stored energy is calculated based on the piping volume and extraction steam conditions and cannot exceed an energy value set by the turbine generator contractor for stable shutdown.

The Extraction Steam Check (Non-Return) Valve is a positive closing, free swinging disc check valve. The valve is of the power assisted (spring) closing type in which the operating cylinder is held in a neutral position (free swing) by air pressure until a trip signal releases the air the spring forces the check valve closed. Additionally, the extraction check valve is counter-weighted to reduce the required closing moment.

Question QCS430.84 (10.2)

Expand your PSAR to include a discussion of the steam extraction valves design and operation. Provide the closure times for the extraction steam valves installed in the extraction steam lines to the feedwater heaters. Show that stable turbine operation will result after a turbine trip. (SRP 10.2, Part III, Item 4)

Response

See revised PSAR Section 10.2.2.7 for the requested information.

because the valves are in series. Therefore, if one valve fails to close, the other valve will stop the steam flow. A failure of one control valve causes the other valves to increase or decrease their opening to compensate for that valve. If one valve fails open at low load condition, the other valves close. If the closing of the other valves is not enough to compensate for that valve, the turbine overspeeds thereby resulting in the operation of the overspeed protection system.

The valves described above will be closed daily by using the valve test mode of the turbine control system. Pressure variations caused by closing a control valve cause the other control valves to open. Therefore, if operating near full load, testing must be done at a reduced power level to provide sufficient margin for pressure control.

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a. Excessive shaft vibration,
b. Generator electrical faults,
c. Low condenser vacuum,
d. Thrust bearing failures,
e. Low bearing oil pressure,
f. Low hydraulic pressure,
g. High exhaust hood temperature,
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i. Loss of stator coolant, or
j. Low throttle pressure.

10.2.2.7 The extraction steam system is designed to withstand the transients imposed on it by a turbine trip and to prevent reverse flow of steam or water into the turbine. Each of the extraction steam lines has at least one non-return valve and a motor driven isolation valve with the exception of the extraction lines to the low pressure heaters 6A, 6B, 6C. Whether one or two non-return valves are required in an extraction line is dependent upon the amount of unrestrained energy available in the extraction line and heater. Upon a turbine trip, air pressure is released from the actuator on the non-return valves allowing the springs in these valves to drive the valves in the closed direction. Under static conditions (no flow), these valves will close in less than 2 seconds and upon a flow reversal, the valves also get a close demand upon a turbine trip. Because of the fast closure time of the non-return valves and the short distance between the above valves and the extraction points at the turbine, steam in the extraction steam system does not affect the turbine coastdown following a turbine trip.

The total amount of energy which would accelerate the turbine upon a turbine generator trip is that steam which is trapped in the turbine and the lines to the extraction steam check valves. The turbine steam system does not incorporate stop and intercept valves between the high pressure and low pressure turbine since the steam goes directly from the high pressure turbine to the low pressure tubine instead of going to a reheater or moisture separator and, therefore, no additional energy or large volume of stored energy exists. This total stored energy is calculated based on the piping volume and extraction steam conditions and cannot exceed an energy value set by the turbine generator contractor for stable shutdown.

The Extraction Steam Check (Non-Return) Valve is a positive closing, free swinging disc check valve. The valve is of the power assisted (spring) closing type in which the operating cylinder is held in a neutral position (free swing) by air pressure until a trip signal releases the air the spring forces the check valve closed. Additionally, the extraction check valve is counter-weighted to reduce the required closing moment.

Question CS430.85

Provide a discussion of the inservice inspection program for throttle stop and control steam valves and the capability for testing essential components during turbine generator system operation.

Response

The turbine stop and control valves are not safety-related items and as such the requirements of the ASME Boiler and Pressure Code, Section XI, Division I - Inservice Inspection are not applicable.

However, the turbine stop and control valves will be subject to a surveillance program. These requirements, though not fully developed at this time, are expected to include cycling of each stop and control valve based on the turbine manufacturer's recommendation.

These activities will be in addition to the planned maintenance for this equipment. The details of the complete surveillance program will be discussed in the PSAR.

Question QCS430.86 (10.2)

Discuss the effects of a high and moderate energy piping failure or failure of the connection from the low pressure turbine to condenser on nearby safety related equipment or systems. Discuss what protection will be provided the turbine overspeed control system equipment, electrical wiring and hydraulic lines from the effects of a high or moderate energy pipe failure so that the turbine overspeed protection system will not be damaged to preclude its safety function. (SRP 10.2, Part III, Item 8)

Response

As stated in 10.3.3 and 10.3.1, failure of the main steam (or any high or moderate energy piping) line cannot jeopardize any safety related equipment since there is no safety related equipment in the turbine generator building. Failure of the connection from the low pressure turbine to condenser would result in loss of condenser vacuum, thereby initiating a turbine trip. There is no special protection provided or required for the turbine overspeed control systems equipment since the overspeed system is not a safety related function. The purpose of the turbine overspeed protection system is to prevent damage to the turbine which is not a safety related component. The possibility of a turbine missile being generated as a result of overspeed is discussed in 10.2.3.

Question QCS430.87

In the PSAR, you do not discuss the in-service inspection, testing and exercising of the extraction steam valves. Provide a detailed description of:

1. The extraction steam valves.

2. Your in-service inspection and testing program for these valves. Also provide the time interval between periodic valve exercising to assure the extraction steam valves will close on turbine trip.

Response

See revised PSAR Section 10.2.2.7 for the requested information.

The Extraction Steam System is classified as a Non-Safety Related item and as such the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Division 1 - Inservice Inspection are not applicable.

However, the Extraction Steam Check valves will be subject to a Surveillance program. These requirements, are not developed at this time.

This activity is in addition to the planned maintenance for this equipment. The details of the complete surveillance program will be discussed in the FSAR.

because the valves are in series. Therefore, if one valve fails to close, the other valve will stop the steam flow. A failure of one control valve causes the other valves to increase or decrease their opening to compensate for that valve. If one valve fails open at low load condition, the other valves close. If the closing of the other valves is not enough to compensate for that valve, the turbine overspeeds thereby resulting in the operation of the overspeed protection system.

The valves described above will be closed daily by using the valve test mode of the turbine control system. Pressure variations caused by closing a control valve cause the other control valves to open. Therefore, if operating near full load, testing must be done at a reduced power level to provide sufficient margin for pressure control.

In addition to providing speed and load control and overspeed protection, the control system automatically trips the turbine generator under any of the following conditions:

a. Excessive shaft vibration,
b. Generator electrical faults,
c. Low condenser vacuum,
d. Thrust bearing failures,
e. Low bearing oil pressure,
f. Low hydraulic pressure,
g. High exhaust hood temperature,
h. Manual operation of several trip levers,
i. Loss of stator coolant, or
j. Low throttle pressure.

10.2.2.7 The extraction steam system is designed to withstand the transients imposed on it by a turbine trip and to prevent reverse flow of steam or water into the turbine. Each of the extraction steam lines has at least one non-return valve and a motor driven isolation valve with the exception of the extraction lines to the low pressure heaters 6A, 6B, 6C. Whether one or two non-return valves are required in an extraction line is dependent upon the amount of unrestrained energy available in the extraction line and heater. Upon a turbine trip, air pressure is released from the actuator on the non-return valves allowing the springs in these valves to drive the valves in the closed direction. Under static conditions (no flow), these valves will close in less than 2 seconds and upon a flow reversal, the valves also get a close demand upon a turbine trip. Because of the fast closure time of the non-return valves and the short distance between the above valves and the extraction points at the turbine, steam in the extraction steam system does not affect the turbine coastdown following a turbine trip.

The total amount of energy which would accelerate the turbine upon a turbine generator trip is that steam which is trapped in the turbine and the lines to the extraction steam check valves. The turbine steam system does not incorporate stop and intercept valves between the high pressure and low pressure turbine since the steam goes directly from the high pressure turbine to the low pressure tubine instead of going to a reheater or moisture separator and, therefore, no additional energy or large volume of stored energy exists. This total stored energy is calculated based on the piping volume and extraction steam conditions and cannot exceed an energy value set by the turbine generator contractor for stable shutdown.

The Extraction Steam Check (Non-Return) Valve is a positive closing, free swinging disc check valve. The valve is of the power assisted (spring) closing type in which the operating cylinder is held in a neutral position (free swing) by air pressure until a trip signal releases the air the spring forces the check valve closed. Additionally, the extraction check valve is counter-weighted to reduce the required closing moment.

Question QCS430.88 (10.2)

Provide P&IDs for the generator hydrogen control and bulk storage system. Identify all components in the system, and revise the PSAR text to include a description of the components and their function in the systems. Show the bulk hydrogen storage system in relation to other buildings on the site.

Response

The design of the Turbine Generator Hydrogen Control and Storage System is pending completion of the procurement process of the vendor design. The next revision of Section 9.10 will include the available vendor information and other details for the turbine generator hydrogen control and bulk storage system will be discussed more fully in the FSAR. The bulk hydrogen storage system is located 65'-0" south of the Maintenance Shop and Warehouse and 75'-0" east of the Maintenance Bay. Refer to PSAR Figure 2.1-5A.

Question QCS430.90 (10.4.1)

Provide a tabulation in your PSAR showing the physical characteristics and performance requirements of the main condensers. In your tabulation include such items, as: 1) the number of condenser tubes, material and total heat transfer surface, 2) overall dimensions of the condenser, 3) number of passes 4) hot well capacity, 5) special design features, 6) minimum heat transfer, 7) normal and maximum steam flows, 8) normal and maximum cooling water temperature, 9) normal and maximum exhaust steam temperature with no turbine by-pass flow and with maximum turbine by-pass flow, 10) limiting oxygen content in the condensate in cc per liter, and 11) other pertinent data. (SRP 10.4.1, Part III, Item 1).

Response

1) See PSAR Table 10.4-1
2) See PSAR Table 10.4-1
3) See PSAR Table 10.4-1
4) See PSAR Table 10.4-1
5) None
6) No minimum heat transfer.
7) See PSAR Figure 10.1-2 and 10.1-3
8) See PSAR Table 10.4-1
9) See PSAR Table 10.4-1
10) See PSAR Table 10.4-1
11) None

TABLE 10.4-1

DESIGN AND PERFORMANCE PARAMETERS FOR THE CONDENSER

Surface (ft^2)	226,780
Number of passes	1
Number of tubes	19,464
Effective tube length (ft)	60
Tube diameter (in)	7/8
Tube material- - Periphery and air removal sections	18,004 tubes of 90-10 Cu-Ni 1,460 tubes of 70-30 Cu-Ni
Tube velocity (fps)	6.0
Condenser duty (Btu/hr)	2326×10^6 (2)
Circulating water flow (gpm)	185,200
Maximum expected inlet circulating water temperature (deg. F)	88 (1)
Cooling water temperature	Normal 87°F, Max. 90°F
Circulating water temperature rise (deg. F)	25 (2)
Exhaust steam temp. (no bypass)	Normal 108°F-158°F, Max. 160°F
Turbine bypass steam temp.	Normal 450°F, Max. 450°F (3)
Condenser vacuum with maximum expected circulating water temperature (in. Hg. Abs.)	3.35 (2)
Max. O_2 concentration cc/1 at rated load	0.005
Min. Hotwell Storage (gallons)	17,200
Overall dimensions	75'-9"L x 18'-0"W x 38'-6"H

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(1) based on 76 deg. F Wet Bulb 1 percent of peak summer hours
(2) stretched load condition = 1121 MWt
(3) maximum turbine bypass flow occurs with turbine tripped

Question CS430.91 (10.4.1)

Discuss the effect of main condenser degradation (leakage, vacuum loss) on reactor operation. (SRP 10.4.1, Part II, Item 1.)

Response

Main condenser degradation falls essentially into two categories.

1. Circulating water inleakage will contaminate the condensate. See revised PSAR Section 10.4.6.1 for design basis for the Condensate Cleanup System. Should the circulating water inleakage be excessive, sufficient monitoring/sampling is provided to assess the effects on continued operation and technical specification limits will be established in the FSAR to address operation above design limits.

2. Loss of condenser vacuum is discussed in revised PSAR Section 10.4.2.

10.4.1.4 Testing and Inspection Requirements

Following erection, the condenser is checked for leakage by filling the shell to a level above the expansion joint. The water-boxes are shop hydrostatically tested.

The condenser shell, hotwell, and waterboxes are proved with access openings to permit inspection or repairs.

10.4.1.5 Instrumentation Application

Level controllers and alarms are provided as required in the condenser hotwell. The condenser pressure and temperature are continuously monitored. Pressure switches trip the turbine upon high back pressure.

10.4.2 Condenser Air Removal System

The Condenser Air Removal System is shown in figure 10.4-1.

10.4.2.1 Design Bases

The Condenser Air Removal System removes air and non-condensible gases from the condenser. The system includes two full capacity mechanical vacuum pumps. Piping is furnished in accordance with ANSI B31.1. The air removal system is not safety related. Detection of tritium in the exhaust of Condenser Air Removal System is discussed in Section 11.4.2.2.4. Detection of tritium in the drains from the vacuum pump is discussed in Section 11.2.6.2.

10.4.2.2 Description

The two full capacity mechanical vacuum pumps have an individual holding capacity of 20 scfm of free dry air at a suction pressure of 1 inch Hg Abs. At startup, a vacuum of 4 inch Hg. Abs. is obtained in approximately 40 minutes by operation of both vacuum pumps. Each rotary-type vacuum pump is furnished with sealing water.

The two vacuum pumps are arranged in parallel and take suction from a common header which is connected to the condenser shell.

The condenser vacuum pump exhaust (off-gas) is routed to the turbine building ventilation system. Drains from the two vacuum pumps will be directed to a sump and processed through the waste water treatment system.

10.4.2.3 Evaluation

In normal operation, one of the two full capacity vacuum pumps is operating with the other pump in standby. The standby vacuum pump will start automatically if the suction manifold pressure increases to 3.5 inch Hg. Abs. or if the running vacuum pump trips. In the event that the above actions are not sufficient to maintain the requisite condenser vacuum, the turbine will automatically trip upon high back pressure.

b. Suspended and dissolved solids which may be introduced by small leakages of circulating water through the condenser tubes.

c. Solids carried in by the makeup water and miscellaneous drains.

At the design condensate flow and with circulating water in leakage within the capacity of the system the Condensate Cleanup System will produce effluent of the quality required by the Steam Generation System given in Section 5.5.3.11.

The Condensate Cleanup System polishes 100 percent of the condensate and is designed for continual performance. Total head loss from inlet to outlet terminal points will not exceed 50 psi. In addition, the system design provides for removing impurities in the condensate caused by an intermittent in-leakage in the condenser of cooling water from the Circulating Water System. To assure that condensate/feedwater quality is maintained within the safe limits, the condensate polishing system is provided with capability to operate, without regeneration, for a period of 8 hours, with permissible cooling water inleakage of 90 GPM. The basis for this operating condition is as follows:

a) one vessel on line and at a point of exhaustion under normal operating conditions.

b) one vessel on line and half exhausted under normal operating conditions.

c) one vessel in standby and fully regenerated.

The condensate polishing system is also capable of operating for 5 days, with cooling water inleakage of 5 GPM and meet the effluent requirements for operation above 5% Power. The basis for this operating condition is that regeneration shall not be required for more than one service vessel per day.

The circulating water analysis is given on Table 10.4-2. The maximum analysis shall be used for the condenser leak design conditions.

The design also provides a bypass of the entire Condensate Cleanup System. The design of the polisher units and regeneration equipment is based on the Condensate Cleanup System operating on the hydrogen cycle.

Piping is furnished in accordance with ANSI B31.1 Power Piping. Pressure vessels which fall within the jurisdiction of ASME Section VIII are furnished in accordance with that code. The Condensate Cleanup System is not safety related.

10.4.6.2 Description

The Condensate Cleanup System consists of three half-capacity ion exchangers, each containing a bed of mixed resins in the proportion of one-part cation resin to one-part anion resin by volume. The third (spare) ion exchangers may be placed in service if desired or in the event of a condenser tube leak. The Condensate Cleanup System is piped directly into the feedwater cycle downstream of the condensate pumps.

Each resin bed is periodically transferred from the ion exchanger to an external backwash and regeneration system as required for removal of solids and/or chemical regeneration.

Spare charges of resins may be held in the external backwash and regeneration system for immediate replacement of the exhausted beds so that an exchanger may be made available for prompt replacement of a spent exchanger. An effluent strainer in the discharge piping from each ion exchanger protects the feedwater system against a discharge of resin in the event of an underdrain failure.

TABLE 10.4-2

CIRCULATING COOLING WATER ANALYSIS*

	Expressed as	Average	Maximum
Calcium	Ca	85	108
Magnesium	Mg	19.5	21.3
Sodium	Na	5.3	6.3
Potassium	K	3.5	4.8
Chloride	Cl	11.8	32.5
Sulfate	SO_4	38	58
Nitrate	NO_3	3.3	5.5
Phospate	PO_4	0.13	1.0
Silica	SiO_2	9.8	15.3
Manganese	Mn	0.13	0.18
Total Iron	Fe	0.95	1.72
Total Alkalinity	$CaCO_3$	240	290
pH		7.9	8.3
Total Dissolved Solids		355	435
Total Suspended Solids		33	115
Chlorine Residual**	Cl_2	0.2	5 (upset)
Specific Conductance @ 25°C (micromhos/cm)		787	936

* Concentrations and conductance are based on 2.5 times river water values. All analysis values except pH and Specific Conductance are stated in ppm as expressed above.

**Chlorine is added intermittently as a biograde and controlled by special instrumentation.

The maximum analysis used for the condenser leak design conditions.

Question QCS430.92 (10.4.1)

Discuss the measures taken; 1) to prevent loss of vacuum, and 2) to prevent corrosion/erosion of condenser tubes and components (SRP 10.4.1, Part III, Item 1).

Response

See revised PSAR Section 10.1 for the requested information.

CHAPTER 10.0 STEAM AND POWER CONVERSION SYSTEM

10.1 SUMMARY DESCRIPTION

The Steam and Power Conversion System is designed to convert the heat produced in the reactor to electrical energy. The operation of the equipment, piping and valves in the system do not affect the reactor and its safety features. The CRBRP is a three-loop concept plant. Sodium coolant in the Primary Heat Transport System enters the reactor where it is heated and pumped to intermediate heat exchangers (IHX's). The intermediate heat exchangers transfer heat to the intermediate sodium coolant, which is pumped through the Steam Generator System. Heat is transferred to the Main Steam System by the steam generator modules in each of three loops. Sufficient superheated steam is provided to to drive a tandem compound steam turbine with a maximum capability of 436,799 KWe for the stretched reactor output of 1121 MWt and its auxiliaries operating in a closed condensing cycle with six stages of regenerative feedwater heating. The turbine generator has a capability of 374,567 KWe for the rated reactor output of 975 MWt. Exhaust steam is condensed in one surface type steam condenser and returned to the steam generators as heated feedwater with a major portion of its gaseous, dissolved, and particulate impurities removed.

The major components of the Steam and Power Conversion System are: turbine-generator-exciter, main condenser, condensate pumps, turbine gland steam system, turbine bypass steam system, condensate demineralizer system, steam generator feed pumps and feedwater heaters (Figure 10.1-1). The heat rejected in the main condenser is removed by the circulating water system to the mechanical draft cooling tower for ultimate disposal of waste heat to the atmosphere.

The superheated steam produced by the steam generator is passed through the high pressure turbine where the steam is expanded and then exhausted to the low pressure turbines. From the low pressure turbines, the steam is exhausted into the main condenser where it is condensed, and then returned to the cycle as condensate. Condensate pumps take suction on the hotwell and discharge through the condensate demineralizer ion exchanger, steam packing exhauster, three stages of low pressure feedwater heaters and into the deaertor. The steam generator feed pumps take suction from the deaerator and supply feedwater through two stages of high pressure heaters then through topping heaters to the steam generators. The feedwater is heated in the heating cycle by steam supplied from turbine extractions and also by recovering heat from the continuous steam generator drum drains.

The Circulating Water System is designed to receive and dissipate 65% of the total heat produced in the reactor following an abnormal shutdown of the turbine generator from a rated load condition. Heat dissipation under these circumstances is accomplished in the various plant cooling systems, turbine bypass to the condenser and deaerator and the steam generator atmosphere relief valves. The turbine bypass system is designed to control steam generator pressure by dumping excess steam during startup, shutdown and for transient periods during power operation when the steam generation exceeds the turbine steam requirements.

The condenser is provided with an air extraction system to prevent loss of vacuum due to non-condensible gas accumulation in the condenser. The air extraction system is designed to maintain the condenser at 2" Hg absolute pressure and the exhaust pressure is monitored in the main control room. If the exhaust pressure increases to 4.5" Hg absolute, the alarm in the control room will be on and the second vacuum pump will be automatically put in service.

Corrosion of the condenser tubes is controlled by the proper material selected (90 cu-10 Ni/70 cu-30 Ni) and chemical treatment of the circulated water. Corrosion/erosion of the exterior of the condenser tubes is controlled by the proper treatment of the condensate (i.e., deaerating, condensate polishing, blowdown) to ensure low disolved oxygen and solid content and protection of the tubes from high velocity steam by the use of impingement plates.

The following design features have been provided to preclude failures of condenser tubes or components from turbine bypass, blowdown or other high temperature drains into the condenser shell.

a) Impingement baffles are provided at all inlets except the make-up water inlet, main steam bypass and the exhaust neck. These baffles which are provided for all drains and blowdown lines are designed to preclude any possibility of steam impingement tube erosion.

b) The condenser is protected during main steam bypass through the use of perforated pipe discharge headers. These headers are designed to distribute the bypass flow evenly throughout the condenser.

The principal design and performance characteristics of the Steam and Power Conversion System are summarized in Table 10.1-1. The system heat balances for both rated load and stretched load conditions are shown in Figures 10.1-2 and 10.1-3.

Question CS430.93 (10.4.1)

Indicate and describe the means of detecting and controlling radioactive leakage into and out of the condenser and the means for processing excessive amounts. (SRP 10.4.1, Part III, Item 2.)

Response

See revised PSAR paragraph 11.3.6.2 for tritium production and disposal.

Eight (8) release points (points 20A thru 20H in Fig. 11.3-9) are associated with Thermal Margins Beyond Design Basis (TMBDB) design features which receive exhausts from the Annulus Air Cooling System (this system is described in Section 9.6.2). This system is not required to operate during normal operations or to mitigate the consequences of any design basis accidents. Activity would only be released from these points in the event of very low probability accidents beyond the design basis, such as a hypothetical core disruptive accident. If required these exhausts would be initiated no sooner than twenty-four (24) to thirty-six (36) hours after the TMBDB scenario. On line monitoring for particulate, iodine and radiogas will be provided for these exhausts in the event of such an accident.

The Containment Cleanup System/Annulus Pressure Maintenance and Filtration System have a common exhaust (release point 21 in Fig. 11.3-9). During normal operation, the Annulus Pressure Maintenance and Filtration System exhausts thru release point 21 on top of the RCB dome. In the event of very low probability accidents beyond the design basis (TMBDB) the Containment Cleanup System would exhaust thru the same release point, and the Annulus Pressure Maintenance and Filtration System would no longer be in use. Particulates, radioiodines, radiogases, and plutonium are monitored continuously in the effluent stream.

11.3.6.2 Balance of Plant

A small fraction of tritium produced in the fuel and control rods passes into the steam-water system by diffusion through stainless steel in the IHX and through the steam generators tubes. Tritium is expected to be in the steam-water system in the form of tritiated water. The condenser air removal system removes non-condensible gases (vapors) from the condensing steam. Tritiated water vapor, present in the off-gas flow, constitutes the only expected gaseous release contribution from the balance of the plant.

Mechanical vacuum pumps will remove the vapors together with the noncondensible gases and will discharge them to the exhaust plenum of the Turbine Generator Building (which corresponds to release point 7 on Figure 11.3-9). The vapors will mix with the exhaust air. The resulting gaseous tritium release from the TGB is provided in Table 11.3-16.

The Deaerator Exhaust and Steam Packing Exhauster exhaust are independently vented to atmosphere from the Turbine Generator Building (release points 24 and 24 on Figure 11.3-9). The BOP tritium contribution is included in the dose calculations presented in Section 11.3-8. Balance of Plant tritium release is based on the following assumptions: (1) Plant Capacity Factor of 0.68, (2) Vacuum Pump Operating Factor of 0.85, (3) Radioactivity Input to Steam-Water System 0.016 Ci/day, and (4) Condenser off-gas removal 7 scfm. The design value release of tritiated water vapor amounts to 6.3×10^{-5} Ci/day.

Description, design bases, and evaluation of the BOP design are provided in Section 10.

Thirteen other release points associated with the balance of plant could contain some radioactivity. These points are:

1) Plant Service Building (PSB) exhausts from the hot laboratory and decontamination area, identified as Point 19 on Figure 11.3-9. Levels of radioactivity in these areas will make no significant contribution to offsite dose rates.

2) Turbine Generator Building exhausts receiving ventilation exclusively from the Turbine Generator Building atmosphere are identified as Points 7 thru 18 on Figure 11.3-9. Levels of radioactivity in these areas are expected to make no significant contribution to off-site dose rates. However, as per Section 11.4.2.2.3, samples of the TGB atmosphere will periodically be analyzed.

The location, height, discharge flow rate, discharge velocity, discharge air temperature, and size and shape of the discharge orifice, for each BOP release point, are presented in Table 11.3-20.

11.3.7 Dilution Factors

The maximum dose at the site boundary due to normal releases from the gaseous waste system will occur at a point on the boundary that has the highest average annual x/Q as determined from meteorological data. For the CRBRP site, the average annual x/Q for this point is 5.10×10^{-5} s/m^3.

11.3.8 Dose Estimates

The release of radioactive noble gases in the gaseous effluent from the CRBRP during normal operation will create a slightly radioactive plume downwind of the site; this will expose the public located in the downwind direction to small doses of external gamma and beta radiation. An external beta dose to body tissue will be received from the relatively small amount of tritium discharged to the atmosphere. It should be noted that these exposure pathways imply a public completely exposed to the environment, whereas, in reality, most persons spend a significant portion of the lives within structures that reduce the exposure of these types of radiation. The reduction in external dose could range from a factor of two to 1,000 depending on the type of structure and the location of the person within (Ref. 1).

Exposure to tritium in the form of tritiated water vapor (HTO) can occur through several pathways including:

1) Inhalation and skin absorption

2) Ingestion of milk contaminated by the fallout of HTO to the cow's forage and by inhalation by the cow

Question CS430.94 (10.4.1)

Discuss the measures taken for detecting, controlling and correcting condenser cooling water leakage into the condensate stream. (SRP 10.4.1, Part III, Item 2.)

Response

PSAR Section 5.5.3.11.4 presents monitoring and alarms for the condensate stream. A condenser leak within the design parameters will be controlled by the condensate cleanup system (see PSAR Section 10.4.6.1). See revised PSAR Section 10.4.1.2 for provisions to correct a condenser cooling water inleakage problem.

Corrosion allowances for both steam and sodium side 2-1/4 Cr-1 Mo steel will be included in the design. These corrosion allowances are based on recommendations from the steam generator module designer (Ref. 3).

No specific protection is required for protecting Type 304 SS or 2-1/4 CR-1 Mo steels against intergranular attack, stress-corrosion or general corrosion, provided that specified sodium purity is maintained.

In water or steam, carbon steel and 2-1/4 Cr-1 Mo steel are susceptible to caustic gouging and possibly caustic stress corrosion cracking. Maintaining the feedwater and steam drum purity levels as stated below will prevent these forms of localized attack. For normal operation other than start-up conditions, the feedwater and steam drum purity will be specified as follows:

Feedwater Impurities		Feedwater	Steam Drum
Suspended Solids	PPM	--	0.1
Dissolved Oxygen	PPM	.005	-
Silica	PPM	--	0.1
Iron as Fe	PPM	.01	-
Copper as Cu	PPM	.002	-
Hydrazine	PPM	.005 - .015	-
Chlorides	PPM	--	.015
Sodium	PPM	.001	.006
Sulfate	PPM	--	.015
pH @ 77°F		8.8-9.2	8.8-9.2
Conductivity (After Cation Removal) @ 77°F micro-mho/cm		0.2	1.0

Limited duration operation with impurity levels above specified limits is allowable for periods not to exceed 24 hours in special instances. These special instances are defined to include condensate polishing system perturbations, such as those immediately associated with a termination of regeneration.

Corrosion impurities may enter the feedwater system through condenser leakage and/or poor makeup water. To guard against damage from such sources, the feedwater and steam drum water are maintained at levels within stated limits by full flow demineralization and continuous steam drum drainflow (blowdown) at a nominal rate of 10% of full power steam flow (See Section 10.4.7).

To determine the feedwater quality, continuous analysers with alarms are provided to sample conductivity, dissolved oxygen, hydrazine, turbidity, pH, sodium, chloride and silica. Continuous samples of steam drum downcomer water and periodic samples of drum drain (blowdown) water are monitored for conductivity, sodium, silica and pH. the downcomer continuous sample monitors

are also alarmed if out of specification conditions occur. The condenser hot-well is monitored for conductivity and sodium ions to guard against condenser leakage. the demineralizer effluent is guarded against impurities break-through by in-line measurements of silica, conductivity and sodium. Finally, the feedwater train is monitored downstream of the deaerator for pH and oxygen content to prevent potential corrosion of this portion of the steam system. An alarm is coupled with the most critical in-line measurements to signal departure from specified levels.

10.4 OTHER FEATURES OF STEAM AND POWER CONVERSION SYSTEM

None of the subsystems described in this section are related to plant nuclear safety. Tests, inspections, and instrumentation applications will therefore not exceed those dictated by conventional good practice for steam power plants. Residual heat removal systems are discussed in Section 5.6.

10.4.1 Condenser

10.4.1.1 Design Bases

The condenser is designed for operation at all loads up to and including the maximum expected load (stretch load 115 percent of rated load); it also provides capability to accept up to 65 percent of the steam flow at 975 MWt upon instantaneous turbine load rejection. The condenser hotwell is designed for three minute storage capacity, approximately 17,200 gallons, at maximum load and to provide capability for deaeration in order to maintain a dissolved oxygen concentration of less than 0.005 cc/1. Table 10.4-1 gives design and performance parameters.

The condenser is furnished in accordance with Heat Exchanger Institute Standards for Steam Surface Condensers. It is not regarded as safety related equipment because emergency residual heat removal is performed by the SGAHRS (see Section 5.6).

10.4.1.2 Description

The single shell condenser is mounted beneath the low pressure turbine exhausts with the condenser tubes oriented parallel to the turbine shaft and provides capability to accept up to 65 percent of the steam flow at 975 MWt upon instantaneous turbine load rejection. Four 24-inch diameter turbine bypass steam inlets to the condenser shell provide means of exhausting the rejected steam into the condenser without any detrimental effects to the condenser or turbine internals.

The condenser is divided into two sections, east and west. Thus, to correct a condenser cooling water inleakage problem the plant could be powered down so that the condenser section found to be leaky can be isolated. The leak will then be located, repaired and the isolated condenser section put back into service.

10.4.1.3 Evaluation

The condenser is designed to maintain an oxygen content of 0.005 cc/1 or less. The non-condensible gases are concentrated in the air removal zones of the condenser and are removed by the air removal system (Section 10.4.2).

b. Suspended and dissolved solids which may be introduced by small leakages of circulating water through the condenser tubes.

c. Solids carried in by the makeup water and miscellaneous drains.

At the design condensate flow and with circulating water in leakage within the capacity of the system the Condensate Cleanup System will produce effluent of the quality required by the Steam Generation System given in Section 5.5.3.11.

The Condensate Cleanup System polishes 100 percent of the condensate and is designed for continual performance. Total head loss from inlet to outlet terminal points will not exceed 50 psi. In addition, the system design provides for removing impurities in the condensate caused by an intermittent in-leakage in the condenser of cooling water from the Circulating Water System. To assure that condensate/feedwater quality is maintained within the safe limits, the condensate polishing system is provided with capability to operate, without regeneration, for a period of 8 hours, with permissible cooling water inleakage of 90 GPM. The basis for this operating condition is as follows:

a) one vessel on line and at a point of exhaustion under normal operating conditions.

b) one vessel on line and half exhausted under normal operating conditions.

c) one vessel in standby and fully regenerated.

The condensate polishing system is also capable of operating for 5 days, with cooling water inleakage of 5 GPM and meet the effluent requirements for operation above 5% Power. The basis for this operating condition is that regeneration shall not be required for more than one service vessel per day.

The circulating water analysis is given on Table 10.4-2. The maximum analysis shall be used for the condenser leak design conditions.

The design also provides a bypass of the entire Condensate Cleanup System. The design of the polisher units and regeneration equipment is based on the Condensate Cleanup System operating on the hydrogen cycle.

Piping is furnished in accordance with ANSI B31.1 Power Piping. Pressure vessels which fall within the jurisdiction of ASME Section VIII are furnished in accordance with that code. The Condensate Cleanup System is not safety related.

10.4.6.2 <u>Description</u>

The Condensate Cleanup System consists of three half-capacity ion exchangers, each containing a bed of mixed resins in the proportion of one-part cation resin to one-part anion resin by volume. The third (spare) ion exchangers may be placed in service if desired or in the event of a condenser tube leak. The Condensate Cleanup System is piped directly into the feedwater cycle downstream of the condensate pumps.

Each resin bed is periodically transferred from the ion exchanger to an external backwash and regeneration system as required for removal of solids and/or chemical regeneration.

Spare charges of resins may be held in the external backwash and regeneration system for immediate replacement of the exhausted beds so that an exchanger may be made available for prompt replacement of a spent exchanger. An effluent strainer in the discharge piping from each ion exchanger protects the feedwater system against a discharge of resin in the event of an underdrain failure.

Question CS430.95

Provide the permissible cooling water inleakage and time of operation with inleakage to assure that condensate/feedwater quality can be maintained within safe limits.

Response

See revised PSAR Section 10.4.6.1 for the requested information.

b. Suspended and dissolved solids which may be introduced by small leakages of circulating water through the condenser tubes.

c. Solids carried in by the makeup water and miscellaneous drains.

At the design condensate flow and with circulating water in leakage within the capacity of the system the Condensate Cleanup System will produce effluent of the quality required by the Steam Generation System given in Section 5.5.3.11.

The Condensate Cleanup System polishes 100 percent of the condensate and is designed for continual performance. Total head loss from inlet to outlet terminal points will not exceed 50 psi. In addition, the system design provides for removing impurities in the condensate caused by an intermittent in-leakage in the condenser of cooling water from the Circulating Water System. To assure that condensate/feedwater quality is maintained within the safe limits, the condensate polishing system is provided with capability to operate, without regeneration, for a period of 8 hours, with permissible cooling water inleakage of 90 GPM. The basis for this operating condition is as follows:

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b) one vessel on line and half exhausted under normal operating conditions.

c) one vessel in standby and fully regenerated.

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The circulating water analysis is given on Table 10.4-2. The maximum analysis shall be used for the condenser leak design conditions.

The design also provides a bypass of the entire Condensate Cleanup System. The design of the polisher units and regeneration equipment is based on the Condensate Cleanup System operating on the hydrogen cycle.

Piping is furnished in accordance with ANSI B31.1 Power Piping. Pressure vessels which fall within the jurisdiction of ASME Section VIII are furnished in accordance with that code. The Condensate Cleanup System is not safety related.

10.4.6.2 <u>Description</u>

The Condensate Cleanup System consists of three half-capacity ion exchangers, each containing a bed of mixed resins in the proportion of one-part cation resin to one-part anion resin by volume. The third (spare) ion exchangers may be placed in service if desired or in the event of a condenser tube leak. The Condensate Cleanup System is piped directly into the feedwater cycle downstream of the condensate pumps.

Each resin bed is periodically transferred from the ion exchanger to an external backwash and regeneration system as required for removal of solids and/or chemical regeneration.

Spare charges of resins may be held in the external backwash and regeneration system for immediate replacement of the exhausted beds so that an exchanger may be made available for pro , t replacement of a spent exchanger. An effluent strainer in the discharge piping from each ion exchanger protects the feedwater system against a discharge of resin in the event of an underdrain failure.

Amend. 69
May 1982

Question QCS430.96

In section 10.4.1.4 you have discussed tests and initial field inspection but not the frequency and extent of inservice inspection of the main condenser. Provide this information in the PSAR.

Response

The Main Condenser is classified as a non-safety related item and as such it does not fall under the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Division 1 - Inservice Inspection.

However, the Main Condenser will be subject to a Surveillance program. These requirements are not fully developed at this time.

This activity will be in addition to the planned maintenance for this equipment. The details of the complete surveillance program will be discussed in the FSAR.

Question QCS 430.97 (10.4.1)

Indicate what design provisions have been made to preclude failures of condenser tubes or components from turbine by-pass blowdown or other high temperature drains into the condenser shell. (SRP 10.4.1, Part III, Item 3)

Response

See PSAR Section 10.1 for the requested information.

CHAPTER 10.0 STEAM AND POWER CONVERSION SYSTEM

10.1 SUMMARY DESCRIPTION

The Steam and Power Conversion System is designed to convert the heat produced in the reactor to electrical energy. The operation of the equipment, piping and valves in the system do not affect the reactor and its safety features. The CRBRP is a three-loop concept plant. Sodium coolant in the Primary Heat Transport System enters the reactor where it is heated and pumped to intermediate heat exchangers (IHX's). The intermediate heat exchangers transfer heat to the intermediate sodium coolant, which is pumped through the Steam Generator System. Heat is transferred to the Main Steam System by the steam generator modules in each of three loops. Sufficient superheated steam is provided to to drive a tandem compound steam turbine with a maximum capability of 436,799 KWe for the stretched reactor output of 1121 MWt and its auxiliaries operating in a closed condensing cycle with six stages of regenerative feedwater heating. The turbine generator has a capability of 374,567 KWe for the rated reactor output of 975 MWt. Exhaust steam is condensed in one surface type steam condenser and returned to the steam generators as heated feedwater with a major portion of its gaseous, dissolved, and particulate impurities removed.

The major components of the Steam and Power Conversion System are: turbine-generator-exciter, main condenser, condensate pumps, turbine gland steam system, turbine bypass steam system, condensate demineralizer system, steam generator feed pumps and feedwater heaters (Figure 10.1-1). The heat rejected in the main condenser is removed by the circulating water system to the mechanical draft cooling tower for ultimate disposal of waste heat to the atmosphere.

The superheated steam produced by the steam generator is passed through the high pressure turbine where the steam is expanded and then exhausted to the low pressure turbines. From the low pressure turbines, the steam is exhausted into the main condenser where it is condensed, and then returned to the cycle as condensate. Condensate pumps take suction on the hotwell and discharge through the condensate demineralizer ion exchanger, steam packing exhauster, three stages of low pressure feedwater heaters and into the deaertor. The steam generator feed pumps take suction from the deaerator and supply feedwater through two stages of high pressure heaters then through topping heaters to the steam generators. The feedwater is heated in the heating cycle by steam supplied from turbine extractions and also by recovering heat from the continuous steam generator drum drains.

The Circulating Water System is designed to receive and dissipate 65% of the total heat produced in the reactor following an abnormal shutdown of the turbine generator from a rated load condition. Heat dissipation under these circumstances is accomplished in the various plant cooling systems, turbine bypass to the condenser and deaerator and the steam generator atmosphere relief valves. The turbine bypass system is designed to control steam generator pressure by dumping excess steam during startup, shutdown and for transient periods during power operation when the steam generation exceeds the turbine steam requirements.

The condenser is provided with an air extraction system to prevent loss of vacuum due to non-condensible gas accumulation in the condenser. The air extraction system is designed to maintain the condenser at 2" Hg absolute pressure and the exhaust pressure is monitored in the main control room. If the exhaust pressure increases to 4.5" Hg absolute, the alarm in the control room will be on and the second vacuum pump will be automatically put in service.

Corrosion of the condenser tubes is controlled by the proper material selected (90 cu-10 Ni/70 cu-30 Ni) and chemical treatment of the circulated water. Corrosion/erosion of the exterior of the condenser tubes is controlled by the proper treatment of the condensate (i.e., deaerating, condensate polishing, blowdown) to ensure low disolved oxygen and solid content and protection of the tubes from high velocity steam by the use of impingement plates.

The following design features have been provided to preclude failures of condenser tubes or components from turbine bypass, blowdown or other high temperature drains into the condenser shell.

a) Impingement baffles are provided at all inlets except the make-up water inlet, main steam bypass and the exhaust neck. These baffles which are provided for all drains and blowdown lines are designed to preclude any possibility of steam impingement tube erosion.

b) The condenser is protected during main steam bypass through the use of perforated pipe discharge headers. These headers are designed to distribute the bypass flow evenly throughout the condenser.

The principal design and performance characteristics of the Steam and Power Conversion System are summarized in Table 10.1-1. The system heat balances for both rated load and stretched load conditions are shown in Figures 10.1-2 and 10.1-3.

Question QCS430.98 (10.4.1)

Discuss the effect of loss of main condenser vacuum on the operation of the main steam isolation valves (SRP 10.4.1, Part III, item 3).

Response

Loss of condenser vacuum has no direct effect on the main steam isolation valves (superheater outlet isolation valves).

Question CS430.99 (10.4.4)

Provide additional description (with the aid of drawings) of the turbine bypass system (condenser dump valves and atmosphere dump valves) and associated instruments and controls. In your discussion include:

1. The size, principle of operation, construction and set points of the valves.

2. The malfunctions and/or modes of failure considered in the design of the system.

3. The maximum electric load step change the reactor is designed to accommodate without reactor control rod motion or steam bypassing. (SRP 10.4.4, Part III, Items 1 and 2).

Response

See revised PSAR Figure 10.3-1 for the drawing of the turbine bypass system. See PSAR Figure 5.1-4 for drawings showing the location of pressure relief devices.

See revised PSAR Section 10.3.2 for details of the pegging steam control valve, condenser dump valves and desuperheaters.

The safety/power relief valves ae discussed in revised Section 5.5.2.4 of the PSAR.

The maximum electric load step change the reactor is designed to accommodate without reactor control rod motion or steam bypassing is plus or minus two percent reactor power. See PSAR Section 7.7.1.2 and 7.7.1.8 for additional information.

Functionally, the drum receives a saturated water/steam mixture from the evaporators and subcooled feedwater and produces saturated steam of low moisture content for the superheater and subcooled water of low steam content for the recirculation pump. The water/steam mixture from the evaporators enters the drum through the water/steam nozzles and flows into an annular volume along the sides of the inner drum wall created by a girth baffle volume along the sides of the inner drum wall created by a girth baffle extending along the side of the drum for the length of the cylinder. Centrifugal steam separators mounted along the length of the drum draw from this annular volume, separate the mixture into phases, and direct the steam upward and the water downward into the inner volume of the drum. The main feedwater enters the drum through a single nozzle which feeds two distribution pipes through a "Y" connection inside the drum. The feedwater is distributed along the length of the drum by rows of orifice holes in the two pipes which are located along each side of the drum beneath the steam separators. The auxiliary feedwater enters through a separate nozzle and is distributed along the length of the drum by two rows of spray nozzles in a single distribution pipe located above the water level in the drum. Feedwater mixes with the water from the separators and is drawn downward and out through the water outlet nozzles by the recirculation pump. The steam passes upward through chevron type dryers in the upper portion of the drum and out through the steam outlet nozzles to the superheater. The dryers remove all but the last fractional percent of the moisture from the steam and drain this moisture back to mix with the resident drum water. Drum drain piping, located along either side of the drum in the region where the water from the separators enters the drum inner volume, draws water of high impurity concentration from the drum.

5.5.2.4 Overpressure Protection

Location of Pressure Relief Devices

Safety/power relief valves are located in the steam generation system to:

1. Prevent a sustained pressure rise of more than 10 percent above system design pressure at the design temperature within the pressure boundary of the system protected by the valve under any pressure transients anticipated; and

2. Provide steam generator module blowdown capability.

Installation of the valves will comply with the requirements as specified in Section 3.9.2.5. Safety/power relief valves are installed on the outlet lines from each evaporator to provide venting capability and a portion of the required safety/relief capability. Safety valves are installed on the steam drum to provide the remainder of the safety capability for the recirculation loop. Additional safety/power relief valves are installed on the steam exit line from the superheater because the steam lines to and from the superheater have isolation valves. The P&ID for the Steam Generation System, Figure 5.1-4 shows the locations of these safety/power relief valves. The power operation feature of the relief valves is fail closed to assure continued integrity of the system. In addition, an acoustic sensor is located on the outlet of each valve to inform the operator that the valves are not opening or not closing. Additional details of sizes and pressure rating are given in Table 5.5-8.

Steam to the deaerator is controlled by a 6" control valve. Construction details are not available at this time. This valve serves two functions:

1. During low load operation (less than 25%) the valve maintains a minimum pressure of 21 psia in the deaerator.

2. Upon a turbine trip, the valve allows as much as 15% of rated steam flow to the deaerator to maintain a pressure of 65 psia in the deaerator.

To protect the deaerator the valve fails closed and safety valves are provided on the deaerator.

Steam to the condenser is controlled by four pressure reducing control valves. These valves are 6" globe-type. air operated diaphragm, butt weld ends, alloy steel. 2500 ANSI pressure-rating, fail closed normally closed. The pressure reducing control valves operate as follows:

During normal plant operation (above 40% reactor power) the valves are automatically controlled by the Plant Control System based upon a load error signal (TG load vs. reactor power). For rapid reductions in the load, the valves are opened to minimize transients on the reactor and the valves are then gradually closed as reactor power approaches the load.

During turbine trip or operation below 40% power the bypass valves are controlled by steam pressure only. That is, they will open and close as necessary to keep steam header pressure at 1.450 psig.

See PSAR Section 7.7.1.8 for more detailed information on the steam dump and bypass control system.

Each valve can pass 16% of rated steam flow and maintain control down to 1/2 of 1% of rated steam flow. To protect the condenser. the valves are fail closed design. They also close upon high condenser vacuum (5" Hg absolute) and desuperheater malfunction. Desuperheater malfunction is determined by monitoring bypass steam temperature to the condenser. The pressure reducing control valves reduce the pressure to 250 psia and are designed to open in less than three seconds.

The desuperheater consists of a mixing nozzle mounted in a 24" diameter pipe spool which is located in the bypass dump line between the condenser and the pressure reduing control valve. The mixing nozzle injects atomized condensate into the dump line in order to lower the dump steam temperature to 450°F. The temperature is controlled by a water control vavle which regulates the amount of condensate to the desuperheater nozzle. The water control valve is regulated by a thermocouple downstream of the desuperheater. Because of the fast opening time of the pressure reducing valves. the water control valve initially opens to the full open position and remains full open for 5-10 seconds and then respond to the thermocouple controller, thus avoiding the possibility of superheater steam being dumped into the condenser. The condensate is atomized by steam from the main steam header. A drip pot is located downstream ofthe desuperheater and any condensate in the line is returned to the desuperheater.