COMBUSTION ENGINEERING

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Mr. Rabindra Singh, Project Manager
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Response to NRC Request for Additional Information Concerning CESSAR-DC, Chapter 10, Plant Systems Branch

Reference: Letter, G. S. Vissing (NRC) to A. E. Scherer (C-E), dated October 20, 1988.

Dear Mr. Singh:

The Reference requested that Combustion Engineering provide additional information concerning the Combustion Engineering Standard Safety Analysis Report - Design Certification (CESSAR-DC), Chapter 10, Emergency Feedwater System. Enclosure I to this letter provides our responses and Enclosure II provides the proposed corresponding revisions to CESSAR-DC.

Should you have any question, please feel free to contact me or Mr. S. E. Ritterbusch of my staff at (203) 285-5206.

Very truly yours,

COMBUSTION ENGINEERING, INC.

A. E. Scherer
Director
Nuclear Licensing

AES:jeb

Enclosures: As Stated

cc: F. Ross (DOE-Germantown)

D032 1/1 Change: Pm To: Rabindra Singh Ltr 2 Encl 2


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# RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

## CONCERNING CHAPTER 10

## PLANT SYSTEMS BRANCH

Question 410.17:

Provide large size legible copies of Figure 10.4.9-1 Sheets 1 and 2.

Response 410.17:

Legible copies of Figure 10.4.9-1 Sheets 1 and 2 have been provided in the formal printing of CESSAR-DC, Submittal Group C, June 30, 1988.

Question 410.18:

Demonstrate that the Emergency Feedwater System EFWS is designed to have sufficient flow capacity to remove decay heat during various reactor operations, and to cool the plant to the Shutdown Cooling System cut-in temperature, by providing summary of analyses that supports the design criteria (G) and (J) of Section 10.4.9.1.2 of the submittal.

Response 410.18:

The EFW system flow capacity was assured of being adequate to remove decay heat during various reactor operations by selecting the worst case event for system sizing. Thus, the required minimum EFW pump flow (Section 10.4.9.1.1.G) was based upon ensuring the System 80+ EFW system has sufficient flow capacity to meet the safety analysis acceptance criteria for a main feedwater line break event.

A parametric study of the feedwater line break event with the failure of one emergency diesel generator to start, demonstrated that 500 gpm was adequate to ensure that: (1) the peak RCS pressure remains less than 110% of the system design pressure (2750 psia); (2) core subcooling is maintained; and (3) there is no two-phase fluid discharge through the primary safety valves. An additional calculation was performed to show that the 500 gpm minimum flow is sufficient to maintain the intact steam generator inventory during a subsequent cooldown of the RCS to the Shutdown Cooling System cut-in temperature at the administrative limit of 75 deg-F/hour. Results of the System 80+ feedwater line break analysis will be included in CESSAR-DC Section 15.2.8.

The minimum safety-related condensate storage volume of 350,000 gallons (Section 10.4.9.1.2.J) was verified as being adequate for various reactor operations by considering two different limiting cases:

1.0 The first limiting case considered was a calculation of the total storage volume necessary to accommodate the main feedwater line break analysis as outlined above, but also includes storage volume to account for: (1) EFW flow to the ruptured steam generator for 30 minutes, (2) refill of the intact steam generator, (3) eight hours of operation at cooling system cut-in conditions, and (4) continuous operation of one reactor coolant pump.

2.0 The second limiting case considered involved ensuring sufficient safety grade condensate storage volume to perform a natural circulation cooldown to Shutdown Cooling System entry conditions following a complete loss of offsite power in accordance with the guidelines of Branch Technical Position (BTP) RSB 5-1. BTP RSB 5-1 requires demonstrating the ability to cooldown the plant using only safety grade equipment following a loss of offsite power with a subsequent limiting single failure. For this case, a previous analysis for the current System 80 design was reviewed for its applicability to the System 80+ design. It was concluded that the 350,000 gallon volume provided a large margin for the System 80 design and that similar or better results would be expected for the System 80+ design.

Question 410.19:

As stated in Section 10.4.9.3, "all EFW System components are located in Seismic Category 1 structures...". Are the Emergency Feedwater Storage Tanks (EFWSTs) also covered and protected from external environmental hazards by these structures? If they are, demonstrate that the EFWST failure or leakage will not adversely affect other essential components housed in the same structures.

Response 410.19:

All components, including the Emergency Feedwater Storage Tanks (EFWSTs) will be contained in Seismic Category I structures which protect the EFW System from external environmental hazards such as tornados, hurricanes, floods, and external missiles. This is stated in Item D of Section 10.4.9.1.2, Section 10.4.9.2.2.3, and Section 10.4.9.3.

The final location of each EFWST has not yet been determined. The standard design shall provide adequate provisions to ensure that failure or leakage of an EFWST will not adversely affect other essential components. To ensure that the EFWSTs are properly located and protected in any site specific design, the second paragraph of Section 10.4.9.2.2.3 has been revised (Amendment E) as follows:

> "Each tank is safety grade, seismically designed, contained in a Seismic Category I structure, and protected against environmental hazards. Adequate provisions are provided such that a failure or leak of the tank will not adversely affect other essential components."

Question 410.20:

As described in the submittal, the steam-driven pumps are designed to provide emergency feedwater in the event of a station blackout. However, the length of the battery-backed power for the turbine governor speed control and the steam generator (SG) water level is not specified (i.e., designated as "later"). Thus, the length of the battery-backed power is to be addressed, and supporting technical information should be provided.

Response 410.20:

Power to the turbine governor speed control, steam generator isolation valves, and steam generator level indication is provided from the 125V DC Vital Instrumentation and Control Power System (Section 8.3.2.1.2.1). The 125V DC Vital Instrumentation and Control Power Channel designation from which each component receives power is given in Table 10.4.9-5.

During a station blackout, power is provided from the 125V DC Vital Instrumentation and Control Power Batteries. The batteries are capable of providing station blackout coping capability with manual load shedding for at least 4 hours. In addition to the batteries, an alternate AC source of standby power (Section 8.1.3) is provided for extended station blackout periods. The alternate AC source of power is capable of supplying power to the turbine governor speed control, steam generator isolation valves, and steam generator level indication through the 125 V DC Vital Instrumentation and Control Power System inverters.

Item C of Section 10.4.9.1.2, the fourth sentence of Section 10.4.9.2.3, the last sentence of the fifth paragraph of Section 10.4.9.3, and the third sentence of 10.4.9.5.4-Item B have already been revised (Amendment E) as follows:

Section 10.4.9.1.2 - Item C

"The EFW System is equipped with diverse pump drive mechanisms. This is accomplished by providing one full-capacity motor-driven pump and one full-capacity steam-driven pump in each EFW mechanical train. All controls, instrumentation, and valves which are essential to the emergency operation of the steam-driven pumps subtrains are powered by battery-backed Class 1E power. The batteries are capable of powering the EFW steam-driven pump subtrains for a station blackout up to four hours with appropriate load shedding. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period."

Section 10.4.9.2.3 - Fourth Sentence

"Battery-backed power is available to the steam-driven pump turbine governor speed control and steam generator water level indication in order to provide steam generator level indication for at least 4 hours considering appropriate load shedding following a station blackout. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period."

Section 10.4.9.3 - Fifth Paragraph, Last Sentence

"Battery-backed power is also available to the turbine governor speed control and steam generator water level indication in order to provide steam generator level control for at least 4 hours with appropriate load shedding. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period."

Section 10.4.9.5.4 - Item B, Third Sentence

"The level instrumentation has battery-backed power for 4 hours with appropriate load shedding, so that indication is available for a station blackout event. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period."

Question 410.21

With regard to the EFWSTs, each tank has the storing capacity of 50% of the total volume of emergency feedwater required for plant operation (about 350,000 gallons). The two tanks are connected and separated by a normally locked closed, local manually operated isolation valve. Since the operation of the EFWS is essential to the plant safety, provide the information on the timing of the switchover between the EFWSTs. Also, justify the lack of automatic switchover between the tanks.

Response 410.21:

Two EFWSTs are provided in order to provide complete separation of the mechanical EFW divisions. This ensures that a leak or rupture of an EFWST will not cause a complete loss of the safety condensate volume. Automatic switchover between the tanks is not provided since this would allow the second tank to automatically empty into the ruptured tank; thus, allowing the possible loss of both tanks. With manual alignment, the plant operator can ensure the tank is intact before the other EFWST or non-safety condensate source is manually aligned.

For events where both steam generators are available, no realignment of EFWSTs will be required as long as both mechanical divisions are available. Realignment is only required for events where only one steam generator is available for heat removal, such as a main steam or feedwater line break, or should the plant operator decide to utilize only one division of EFW (one or both EFW pumps) to bring the plant to shutdown cooling entry condition.

When low EFWST level is alarmed in the control room or the remote shutdown panel, the plant operator shall ensure that the tank is intact, determine if the opposite EFWST or non-safety condensate source should be aligned by checking the tank levels, and then align the appropriate EFWST or non-safety condensate source by manually opening the appropriate valves.

Each EFWST is provided with redundant safety grade water level instrumentation, with low level alarm in the control room and remote shutdown panel. The low level alarm is set at a water level to ensure that the plant operator has adequate time (minimum of 30 minutes) to assess conditions and to manually make the appropriate realignment before pump suction is lost.

This is discussed in Item J of Section 10.4.9.1.2, the third paragraph of Section 10.4.9.3, and Item A of Section 10.4.9.5.4.

Question 410.22:

Provide information on the cooling requirements for the motor-driven EFW pumps.

Response 410.22:

The motor-driven EFW pump motor coolers are cooled by the Component Cooling Water System (Section 9.2.2). Section 9.2.2 was submitted with Amendment E. In addition, the following has been added in Amendment E to Section 10.4.9.2.2.1:

> "The motors for the motor-driven pumps are cooled by the Component Cooling Water System (Section 9.2.2)."

Question 410.23:

As per design criterion (B), "all components and piping essential to the emergency function are designed to Seismic Category I requirements...." However, it is not clear whether or not the turbines for the steam-driven pumps and associated equipment are safety grade. Clarify the above.

Response 410.23

The steam-driven EFW pumps are provided with safety grade turbines, associated equipment, and controls. To clarify this, the first sentence of Section 10.4.9.2.2.2 (Amendment E) has been revised as follows:

> "Each steam-driven EFW pump is provided with a safety-grade atmospheric discharge, non-condensing turbine."

Question 410.24:

The steam-driven pump turbine exhaust is designed to release directly to the atmosphere via vent lines through the roof. Are these exhaust lines equipped with devices that can be used to monitor releases of activity to the atmosphere?

Response 410.24:

The steam-driven pump turbine exhausts are not provided with devices to monitor releases of activity to the atmosphere.

The EFW pumps are not utilized during normal plant operating conditions, including plant startup and shutdown, except for periodic testing. A non-safety motor-driven startup pump is provided in the Main Feedwater System, to perform normal plant startup and shutdown feedwater functions. Therefore, the steam-driven pump turbine exhausts are isolated and do not release to the atmosphere during normal plant conditions. Periodic testing of the steam-driven pumps is prohibited, if activity on the secondary side is above acceptable limits. Therefore, devices to monitor normal releases of activity to the atmosphere, to ensure 10 CFR 20 guidelines are not exceeded, are not required.

During emergency conditions, requiring heat removal through the steam generator, secondary side steam is released through the secondary side safety valves, steam-driven EFW pumps turbine exhaust, and the atmospheric dump valves should the turbine bypass system, condenser, and startup feedwater pumps be unavailable. Any off-site activity releases will be monitored by the Environmental Monitoring System.

During a steam generator tube rupture event, the steam generator with the ruptured tube is manually isolated by the plant operator and cooldown to Shutdown Cooling System entry condition is accomplished by utilizing the EFW pumps and atmospheric dump valve associated with the intact steam generator. The steam-driven EFW pump associated with the steam generator with the ruptured tube is isolated from the steam generator by closing the turbine trip-and-throttle valve (this trips the turbine and isolates the atmospheric discharge), the steam supply continuous drain isolation valve, and the steam generator isolation valve.

Chapter 15 analysis will demonstrate that all design basis accident off-site releases are below the guidelines of 10 CFR 100, considering initial steam generator tube leakage is at the maximum allowed by plant technical specifications.

Question 410.25:

The automatic actuation of the EFWS is provided by the Emergency Feedwater Actuation System (EFAS) or the Alternate Protection System (APS). Provide the interface requirements for these systems.

Response 410.25:

The Emergency Feedwater Actuation Signal (EFAS) or the Alternate Emergency Feedwater Actuation Signal (AEFAS) initiates emergency feedwater flow to each steam generator when either system is actuated on low steam generator water level or when either system is manually initiated. There is a separate EFAS system for each steam generator. See Section 7.3.2.2.6 for a description of the EFAS.

In summary, the EFAS or the AEFAS is actuated by:

1. Low water level in that steam generator (i.e., EFAS-1 is initiated by low water level in SG-1 and EFAS-2 is initiated by low water level in SG-2); or
2. Manual initiation from either the Emergency Feedwater Actuation System or the Alternate Protection System.

Once the EFAS or AEFAS has been actuated, the signal performs the following:

1. Starts the motor driven emergency feedwater pump for the steam generator indicating a low water level (See Figure 10.4.9-1 Sheet 1);
2. Opens the steam bypass valve to the emergency feedwater pump turbine for the steam generator indicating low level allowing steam from the steam generator to flow to the turbine (See Figure 10.4.9-1 Sheet 2);
3. Opens the emergency feedwater flow control valves EF-104 and EF-106 for Steam Generator 1 or EF-105 and EF-107 for Steam Generator 2 when that steam generator indicates a low water level (See Figure 10.4.9-1 Sheet 1);

4. Opens the emergency feedwater isolation valves EF-100 and EF-102 for Steam Generator 1 or EF-101, and EF-103 for Steam Generator 2 when that steam generator indicates a low water level (See Figure 10.4.9-1 Sheet 1).

These system interface requirements are listed in the first paragraph, Items A through F of Section 10.4.9.2.4.

In addition, the EFAS shall meet the following design requirements specified in CESSAR-DC:

1. Control system separation criteria specified in Section 5.1.4.E;
2. Flow-time restraints specified in Section 5.1.4.G.5 or 10.4.9.1.2.F;
3. EFAS design criteria specified in Section 7.3.2.2.6, Emergency Feedwater Actuation Signal; and
4. The general Engineered Safety Feature Actuation System (ESFAS) design criteria specified in Section 7.3.2.3.1.

Question 410.26:

The EFWS reliability analysis is scheduled for a later submittal. Demonstrate that the EFWS meets the design criterion (N) of Section 10.4.9.1.2. In particular, provide detailed information on the analysis, including methodology, scope, model and data used in the reliability assessment of the system.

Response 410.26:

Information on the reliability of the Emergency Feedwater System was included in CESSAR-DC as Appendix 10A (Amendment E). This appendix provides detailed information on the reliability analysis, defines the methodology, analysis scope, the system model and data used in the analysis. The final EFWS reliability will be included in CESSAR-DC, Amendment F.

Question 410.27:

Provide information on the Inservice Inspection and Performance Testing Program and associated surveillance testing schedule for the EFWS.

Response 410.27:

The program for the inservice inspection and performance testing will be provided on a schedule compatible with the Technical Specification effort to be provided in Amendment F. That program will be in compliance with ASME Boiler and Pressure Vessel Code, Section XI (See CESSAR-DC Section 10.4.9.4). The inspection program for System 80+ will be similar to that for System 80, Technical Specifications on Engineered Safety Features Actuation System Instrumentation (3/4.3.2) which were approved by the NRC for System 80 plants (NUREG-0852).

Question 410.28:

Verify that the EFWS has capability to detect, collect, and control system leakage. Also, provide the interface requirements for the Equipment and Floor Drainage System.

Response 410.28:

Collection and detection of EFW system leakage is handled by the Equipment and Floor Drainage System (Section 9.3.3). This section was included in Amendment E.

The Equipment and Floor Drainage System is capable of collecting and detecting EFW system leakage which may originate in each EFW pump room, in each Emergency Feedwater Storage Tank room or enclosure, and areas containing EFW system piping where a moderate or high energy pipe rupture is postulated. The control room shall be alerted on detection of excessive leakage in these areas.

The following has been added (Amendment E) to Section 10.4.9.1.2 as Item U:

> "The Equipment and Floor drainage System (Section 9.3.3) provides for collection and detection of EFW system leakage which may originate in each EFW pump room, in each Emergency Feedwater Storage Tank room or enclosure, and areas containing EFW system piping where a moderate or high energy pipe rupture is postulated, as defined in Section 3.8. The control room is alerted on detection of excessive leakage."

In addition to the Equipment and Floor Drainage System, the following parameters aid in detecting and determining the location of excessive EFW system leakage:

EFW Pumps Not Running

EFWST-1 Level, Low
EFWST-2 Level, Low
Main Steam Isolation Signal (Section 7.0)

EFW Pumps Running

EFWST-1 Level, Lower than expected
EFWST-2 Level, Lower than expected
Motor-Driven Pump 1 Flow, Abnormally High or Low
Motor-Driven Pump 2 Flow, Abnormally High or Low
Steam-Driven Pump 1 Flow, Abnormally High or Low
Steam-Driven Pump 2 Flow, Abnormally High or Low
Motor-Driven pump 1 Recirc. Flow, Abnormally High or Low
Motor-Driv  ıp 2 Recirc. Flow, Abnormally High or Low
Steam-Driven Pump 1 Recirc. Flow, Abnormally High or Low
Steam-Driven Pump 2 Recirc. Flow, Abnormally High or Low
Motor-Driven Pump 1 Discharge Pressure, Low
Motor-Driven Pump 2 Discharge Pressure, Low
Steam-Driven Pump 1 Discharge Pressure, Low
Steam-Driven Pump 2 Discharge Pressure, Low
Motor-Driven Pump 1 Suction Pressure, Low
Motor-Driven Pump 2 Suction Pressure, Low
Steam-Driven Pump 1 Suction Pressure, Low
Steam-Driven Pump 2 Suction Pressure, Low
Main Steam Isolation Signal (Section 7.0)

Each train of EFW including the Emergency Feedwater Storage Tank is physically separated from each other such that a single leak or rupture in the EFW system can not disable the other train. The cross connection lines between the EFWSTs and between the EFW pump discharges contain locked closed valves that are manually operated. These valves shall remain closed unless emergency conditions require a cross connection to be opened.

The plant operator shall ensure that the pressure boundary to be fed from the opposite train is intact before the cross connect valves are opened (see response to question 410.21 for EFWST alignment). In addition, each subtrain can be isolated from the other, if leakage is detected within a subtrain. This is accomplished by closing the pump suction valve and steam generator isolation valve associated with the leaking subtrain.

Normal leakage from the steam-driven pump turbine steam supply and exhaust low point drains, turbine trip-and-throttle valve before and after seat drains, turbine trip-and-throttle valve leakoff, turbine governor valve leakoff, turbine gland steam to atmosphere, and turbine case drains are collected and returned to the condensate storage system. This is shown in Figure 10.4.9-1 and discussed in the seventh paragraph of Section 10.4.9.2.1.

Question 410.29:

Based on the Generic Letter 88-14, "Instrument Air Supply System Problem Affecting Safety-Related Equipment," the provision of a safety-grade instrument air supply is highly desirable to minimize the adverse effects of loss of air to safety-related equipment. The consideration should be given to provide a safety-grade instrument air supply for the EFWS active pneumatic valves (EFWS control valves, steam supply isolation valves and steam supply bypass valves). Also, provide the corresponding interface requirements for the safety-grade instrument air system.

Response 410.29:

As the electrical system design was finalized, it was necessary to reevaluate portions of the EFWS design. Part of that evaluation reviewed the use of motor-operated versus air-operated valves. Our response to this question cannot be completed at this time. Any changes in design will be included in CESSAR-DC, Amendment F. We will respond to this question, after Amendment F is finalized.

Question 410.30:

Discuss conformance with the requirements of 10 CFR 50.63, "Loss of all Alternating Current Power," as related to the support systems regarding 1) sufficient amount of water (condensate storage system), 2) sufficient flow path (condensate and feedwater system), 3) sufficient flow delivery (EFWS), and 4) capability of operating main steam supply system atmospheric dump valves either locally or remotely to assure that core is cooled by removing decay heat independent of preferred and onsite emergency ac power in the event of a station blackout for the specified duration in accordance with the guidance of Regulatory Guide 1.155, "Station Blackout," Positions C.3.2 through C.3.5, as applicable.

Response 410.30:

The EFW design conforms with applicable portions of 10 CFR 50.63 and with the intent of Regulatory Guide 1.155.

Following a station blackout, the plant is maintained at hot standby until AC power (normal or emergency) is restored. Residual heat is removed through the steam generators by utilizing the steam-driven emergency feedwater pumps (Section 10.4.9) and the atmospheric dump valves or the main steam ASME Code Safety Valve(s) (Section 10.3). These systems are capable of keeping the plant at hot standby for a station blackout period of at least 8 hours. When AC power is restored, the plant is cooled down to shutdown cooling system entry conditions by utilizing the atmospheric dump valves and EFW system.

The following discusses each item of the question:

1. Sufficient amount of water (condensate storage system)

   Sufficient amount of condensate is contained between the two Emergency Feedwater Storage Tanks (EFWSTs) to maintain the plant at hot standby for at least 8 hours during the station blackout event and then cool the plant to shutdown cooling entry conditions after AC power is restored. Should the station blackout extend beyond 8 hours, or should additional condensate be required, a non-safety source of condensate can be aligned which gravity feeds to the EFWSTs. The EFWST condensate volume is discussed in Item J of Section 10.4.9.1.2, realignment of a non-safety source of condensate is discussed in the third paragraph of Section 10.4.9.2.1, and EFWSTs are discussed in Section 10.4.9.2.2.3.

2. Sufficient flow path (condensate and feedwater system)

The EFW system delivers flow to the steam generators through the downcomer feedwater lines. The EFW system connection is located in the downcomer feedwater line between the redundant feedwater isolation check valves and the steam generator downcomer nozzle. This is shown on Figure 10.1-1 and is discussed in Item 7 of Section 10.4.7.2.2. The check valves prevent back flow of EFW to other portions of the Main Feedwater System. Since there are no valves located between the connection of EFW to the downcomer feedwater line and the steam generator downcomer nozzle, the flow path is always open.

3. Sufficient flow delivery (EFWS)

Two 100% capacity steam-driven pumps are provided in the Emergency Feedwater System. Each pump is capable of providing the minimum required flow of 500 GPM against a maximum steam generator downcomer nozzle pressure of 1217 PSIA which accounts for the steam generator design pressure, safety valve lift uncertainty, and feednozzle losses from the downcomer nozzle to the steam generator steam space. This is discussed in the second paragraph of Section 10.4.9.2.1 and Item G of Section 10.4.9.1.2. Therefore, each steam-driven pump is capable of providing adequate feedwater flow to the steam generators during a station blackout event to maintain a normal steam generator water level, while steam is being released through the atmospheric dump valve(s) or the main steam safety valve(s).

Each steam-driven pump subtrain is mechanically and electrically separated from each other. Therefore, the EFW system is designed to meet the single failure for this event as discussed in the fifth paragraph of Section 10.4.9.3. This exceeds the requirements of 10 CFR 50.63.

To ensure that each steam-driven pump subtrain can be actuated and controlled during a station blackout event, all controls, instrumentation, and valves which are essential to the emergency operation of the steam-driven pump subtrains are powered by battery-backed Class 1E power from the 125V DC Vital Instrumentation and Control Power System. The batteries are capable of providing station blackout coping capability with manual load shedding for at least 4 hours. In addition to the batteries an alternate AC source of power is provided for extended station blackout periods which can supply DC power to the essential steam-driven pump subtrain controls, instrumentation, and valves through the 125V DC Vital Instrumentation and Control Power inverters. This is discussed in the response to Question 410.20.

As stated in the response to Question 410.29, instrument air is not required for operation of the EFW system. In the event of a station blackout the solenoids for the steam supply isolation valves, steam supply bypass valves and emergency feedwater control valves will ensure that the operators will be de-energized and fail to the full open position. Steam generator level is controlled by adjusting the governor controlled turbine speed from the control room, or by manually throttling the emergency feedwater control valves locally with the handwheels.

The Emergency Feedwater Pump Turbine Bearing Oil Coolers are cooled by supplying water from the first stage of the steam-driven pumps and returned to the pump suctions. This is discussed in the ninth paragraph of Section 10.4.9.2.1 and the second paragraph of Section 10.4.9.2.2.1. Therefore, plant cooling water system are not required.

4. Capability of operating main steam supply system atmospheric dump valves either locally or remotely.

   The Emergency Operating Procedures (EOPs) will allow the secondary pressure to be controlled during a station blackout by the operator positioning the Atmospheric Dump Valves (ADVs) or without operator intervention, using the main secondary safety valves (MSSVs). If the ADVs are available, the operator may elect to control the secondary pressure by manually positioning any of the ADVs from the Main Control Room or the Remote Shutdown Panel. The ADVs are supplied with handwheels, located at the valves, which may be used to manually adjust the valve position(s). If the ADVs are not available, the MSSVs may be used to control the secondary pressure, without operator intervention.

   When AC power is restored, the plant is cooled to shutdown cooling system entry conditions by utilizing the atmospheric dump valves and the EFW system.

   The atmospheric dump valves are provided with safety-related electrical, instrumentation and control systems that comply with the intent of BTP RSB 5-1. Section 10.3.2.3.3.2 states this with the following:

   A. Operator interface to the atmospheric dump valve control system is provided in the main control room (MCR) and at the remote shutdown panel (RSP). The following are provided:

1. The capability to manually close and position the valve.

2. Valve position indication (both analog position and open/close indication lights).

B. No single failure of the control circuits prevents operation of at least one ADV on each steam generator. The control circuits are designed to the applicable parts of IEEE Standard 279-1971 and IEEE Standard 308-1974.

C. A safety-grade air pressure supply shall be provided to operate the ADV actuators should the normal air supply fail to be available. This safety-grade backup pressure supply may be a nitrogen supply or a Type A source of air as defined in ANS 59.3/N187 (1984) - Safety Criteria for Control Air Systems.

The ADV control circuits are powered by battery backed Class 1E power from the 125 V dc Vital Instrumentation and Control Power System. During a station blackout, the power is provided by the 125 V dc Vital Instrumentation and Control Power System. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period. The alternate source of AC power is capable of providing power to the ADV control circuits, through the 125 V dc Vital Instrumentation and Control Power System inverters.

Compressed nitrogen or air accumulators provide the motive power for positioning the ADVs during a station blackout. Should nitrogen or air pressure be depleted, the ADVs may be positioned utilizing local ADV handwheels or the decay heat may be removed through the main steam safety valves as discussed above.

Question 410.31:

Provide the following information (now shown as "later") in order to permit the staff to perform an integrated review of the EFWS:

1) Table 10.4.9-4, "Emergency Feedwater System Instrumentation and Control" - Remote Shutdown Station Information

2) Section 5.1.4.G.5 through 5.1.4.G.8 (Amendment B, dated March 31, 1988) - Interface Requirements for the Nuclear Steam Supply System

3) Table 5.4.7-1 - Shutdown Cooling Heat Exchanger Data on Shell Side

4) Table 5.4.7-2 - Interface Requirements for Component Cooling Water

Response 410.31:

The following information is provided to: (1) complete the CESSAR-DC information, and (2) aid in your review of the EFWS:

1. The instrumentation for the Remote Shutdown Panel (RSP) has been finalized. Table 10.4.9-4 has been updated in CESSAR-DC, Amendment E. In addition, a more complete listing of the RSP instrumentation is listed in Table 7.4-1. The basic functions to be performed during an emergency shutdown from outside the control room are discussed in Section 7.4.1.1.10. The functional requirements have been expanded to include plant shutdown to cold shutdown conditions.

2. Listed below are the updated Sections 5.1.4.G.5 through 5.1.4.G.8:

Section 5.1.4.G.5

(The following response was included in CESSAR-DC, Amendment D, dated September 30, 1988.)

The Emergency Feedwater System shall be available to deliver flow to the steam generator(s) automatically upon receipt of an EFAS as follows:

a. Within approximately 60 seconds when normal offsite or normal onsite power is available.
   or
b. Within approximately 60 seconds when both normal onsite and normal offsite power are not available.

Section 5.1.4.G.6

This section addresses the minimum EFW flow and the downcomer nozzle pressure. This information is provided in Section 10.4.9.1.2-Item G. Therefore, Section 5.1.4.G.6 has been deleted from CESSAR-DC, Chapter 5.

Section 5.1.4.G.7

This section addresses the minimum and maximum feedwater temperatures. This information is provided in Section 10.4.9.1.2-Item I. Therefore, Section 5.1.4.G.7 has been deleted from CESSAR-DC, Chapter 5.

Section 5.1.4.G.8.

This section addresses the minimum EFW inventory of 350,000 gallons of liquid to be stored in the EFWSTs. This information is provided in Section 10.4.9.1.2 - Item J. Therefore, Section 5.1.4.G.8 has been deleted from CESSAR-DC, Chapter 5.

3. Table 5.4.7-1, Shutdown Cooling Design Parameters, was revised in Amendment E to provide Shutdown Cooling Heat Exchanger (SDCHX) shell side data.

4. The final data to update Table 5.4.7-2, Shutdown Cooling System Interface Requirements for Component Cooling Water, are not available at this time. Component Cooling Water data will be provided in CESSAR-DC Submittal Group F.

Enclosure II to
to LD-89-091

# PROPOSED REVISIONS TO THE
# COMBUSTION ENGINEERING STANDARD SAFETY ANALYSIS REPORT - DESIGN CERTIFICATION

B. All components and piping (upstream of the automatic steam generator isolation valves and essential to the emergency function) are ANS Safety Class 3. Components and piping involved in containment integrity (downstream of the automatic steam generator isolation valves) are ANS Safety Class 2. The line classifications are consistent with the requirements specified in ANS 51.10. All components and piping essential to the emergency function are designed to Seismic Category I requirements as described in Section 3.7. The seismic category and safety and quality classification of the EFW System components are listed in Table 3.2-1. C

C. The EFW System is equipped with diverse pump drive mechanisms. This is accomplished by providing one full-capacity motor-driven pump and one full-capacity steam-driven pump in each EFW mechanical train. All controls, instrumentation, and valves, which are essential to the emergency operation of the steam-driven pumps subtrains, are powered by battery-backed Class 1E power. The batteries are capable of powering the EFW steam-driven pump subtrains for a station blackout up to four hours with appropriate load shedding. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period. E Q/R 410.20

D. The EFW System components are located in Seismic Category I structures which also protect the components from external environmental hazards such as tornados, hurricanes, floods, and external missiles. Each redundant and diverse subtrain of the EFW System is physically separated from the others within these structures. C

E. All essential components are designed to account for, located to protect against, or protected from internal flooding, internal missiles, interactions from earthquakes, or the effects of high or moderate energy line breaks as described in Chapter 3.

F. The EFW System is designed so that it can be either manually initiated or automatically initiated by the Emergency Feedwater Actuation System (EFAS), described in Section 7.3.1, or the Alternate Protection System (APS) described in Section 7.7. The EFW System is designed to deliver flow to the steam generator(s) within 60 seconds upon receipt of an EFAS signal.

G. Each EFW pump is capable of providing 100% of the required minimum flow of 500 gpm, to meet the design basis heat removal requirements. Each pump is capable of delivering this flow under the following coincident parameters:

T. A four-channel control scheme is provided to preclude inadvertent actuation in the event of a single failure. A four-channel design is provided for the initiation logic, actuation logic, and power. C

U. The Equipment and Floor Drainage System (Section 9.3.3) provides for collection and detection of EFW system leakage which may originate in each EFW pump room, in each Emergency Feedwater Storage Tank room or enclosure, and areas containing EFW system piping where a moderate- or high-energy pipe rupture is postulated, as defined in Section 3.8. The control room is alerted on detection of excessive leakage. E Q/R 410.28

### 10.4.9.2 System Description

C

#### 10.4.9.2.1 General Description

The EFW System is shown in Figure 10.4.9-1, Sheets 1 and 2.

The EFW System is configured into two separate mechanical trains. Each train is aligned to feed its respective steam generator. Each train consists of one Emergency Feedwater Storage Tank (EFWST), one 100% capacity motor-driven pump subtrain, one 100% capacity steam-driven pump subtrain, valves, one cavitating venturi, and specified instrumentation. Each pump subtrain takes suction from its respective EFWST and has its respective discharge header. Each subtrain discharge header contains a pump discharge check valve, flow regulating valve, steam generator isolation valve and steam generator isolation check valve. The motor-driven subtrain and steam-driven subtrain are joined together inside containment to feed their respective steam generator through a common EFW header which connects to the steam generator downcomer feedwater line. Each common EFW header contains a cavitating venturi to restrict the maximum EFW flow rate to each steam generator. The cavitating venturi restricts the magnitude of the two pump flow as well as the magnitude of individual pump runout flow to the steam generator.

A cross-connection is provided between each EFWST so that either tank can supply either train of EFW. The two EFWSTs are safety grade tanks of seismic design in which each tank contains 50% of the total volume specified in Section 10.4.9.1.2.J. A normally locked closed, local manually operated isolation valve is provided for each EFWST to provide separation. A line connected to a non-safety source of condensate is also provided with local manual isolation so that it can be manually aligned for gravity feed to either of the EFWSTs, should the EFWSTs reach low level before Shutdown Cooling System entry conditions are prevent water slugs from entering the turbine on an automatic emergency start. A power-operated valve is provided in this line so that it can be remotely isolated from the control room should high activity be present. A bypass is provided around each drain orifice should additional drain capacity be required. C

Cooling water to the Emergency Feedwater Pump Turbine Bearing Oil Coolers is supplied from the first stage of the steam-driven pumps and returned to the pump suctions.

#### 10.4.9.2.2 Component Description

A summary of design parameters and codes for the major EFW System components is given in Table 10.4.9-1.

##### 10.4.9.2.2.1 Emergency Feedwater Pumps

The EFW pumps are horizontal multi-stage centrifugal pumps. Each pump is capable of delivering the system design flow of 500 gpm to the steam generator(s) over the entire range of steam generator pressures (0 to 1217 psia) while recirculating the required flow for pump protection back to the EFWSTs.

The first stage of the steam-driven pumps is capable of producing the above flow requirements while providing the required cooling flow to the turbine bearing oil coolers.

Flanges are provided on each pump suction and discharge, and each pump is provided with casing vents and drains to facilitate maintenance.

The motors for the motor-driven pumps are cooled by the Component Cooling Water System (Section 9.2.2). E Q/R 410.22

##### 10.4.9.2.2.2 Steam-Driven Emergency Feedwater Pump Turbines

Each steam-driven EFW pump is provided with a safety grade atmospheric discharge non-condensing turbine. E Q/R 410.23

Each turbine is supplied with a hydraulic governor control valve, and a trip and throttle (stop) valve with motor reset capability. The turbine is brought up to speed by governor control upon being supplied with steam by opening of the steam isolation valve EF-108 or EF-109. The governor then controls the turbine speed at the pump rated speed by modulating the governor control valve. The governor controlled turbine speed can be adjusted from the main control room, the remote shutdown panel, or manually at the governor. C

The turbine is stopped by remotely tripping the trip and throttle (stop) valve from the main control room or remote shutdown panel. The trip and throttle (stop) valve is automatically tripped for turbine overspeed protection by an electrical trip at 115% of rated speed and by a mechanical trip at 125% of rated speed. The electronic overspeed trip is "non-fatal" (i.e., the valve can be reset from the control room or remote shutdown station). The mechanical overspeed trip is "fatal" (i.e., in that reset can only be accomplished at the turbine trip and throttle (stop) valve). C

**10.4.9.2.2.3 Emergency Feedwater Storage Tanks**

An assured source of emergency feedwater is provided by the two emergency feedwater storage tanks (one tank in train 1 and one tank in train 2). Each tank contains 50% of the required water volume given in Section 10.4.9.1.2.J.

Q/R 410.19

Each tank is safety grade, seismically designed, contained in a Seismic Category I structure, and protected against environmental hazards. Adequate provisions are provided such that a failure or leak of the tank will not adversely affect other essential components. E

The condensate stored in each tank is of the same quality for secondary makeup except there is no restriction on oxygen. C

The tanks are vented to atmosphere and are protected from overpressure by adequately sized vents and overfill lines.

The tanks are provided with makeup, drain, and condensate cleanup supply and return connections.

The minimum and maximum temperatures of the condensate supplied or stored in each tank are 40°F and 120°F, respectively.

**10.4.9.2.2.4 Emergency Feedwater Cavitating Venturis**

A cavitating venturi is located in the common EFW supply line to each steam generator. Each cavitating venturi limits the maximum EFW flow that can be fed to a steam generator. The cavitating venturis prevent pump cavitation due to pump runout, and minimize other potentially adverse effects of having excessive emergency feedwater flow, such as overfill of the steam generators, excessive reactor coolant system cooldown rates, excessive mass/energy input into containment following a main steam line break, and excessive draw down of the EFWST.

C

G. Turbine Trip-and-Throttle (Stop) Valves

These valves are part of the turbine package. The valves are latched open at all times. A motor operator is supplied to power the valve to the open-latched position. An overspeed signal generated by the turbine protection system trips the valve and immediately stops steam flow to the turbine. Remote manual open/trip control is provided in the main control room and at the remote shutdown panel. If the valve is closed by a mechanical overspeed trip, the trip must be reset locally at the trip and throttle (stop) valve.

H. Turbine Governor Valves (control valves)

These valves are part of the turbine package and they control steam flow to provide the required turbine speed. These valves are controlled by the turbine governor.

I. Steam Supply Continuous Drain Isolation Valves

Motor operated valves EF-110 and EF-111 are provided for remote isolation of the steam supply continuous drain line for prevention of release of high activity to the atmosphere due to a steam generator tube rupture. These valves can be individually opened or closed from the main control room.

**10.4.9.2.3 Electrical Power Supply**

Each subtrain of the EFW System receives power from its associated Class 1E Emergency Power System. In the event of loss of normal onsite and offsite power, power is supplied by the emergency diesel generators. All instrumentation, controls and valves that are essential to the operation of the steam-driven pump subtrains are supplied from battery-backed vital Class 1E power supplies. Battery-backed power is available to the steam-driven pump turbine governor speed control and steam generator water level indication in order to provide steam generator level indication for at least 4 hours considering appropriate load shedding following a station blackout. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period. Each motor-driven pump subtrain is supplied by a Class 1E Emergency Power train that is totally independent and separated from the other motor-driven pump subtrain. Each steam-driven pump subtrain is supplied by a Class 1E Emergency Power train that is totally independent and separated from the other steam-driven pump subtrain and totally independent and separated from the associated motor-driven pump subtrain that feeds the same steam generator. The emergency bus designation for the EFW System

E Q/R 410.20

C

(A) Q/R 410.18

of piping separation, redundancy, and diversity. An EFW System active component failure analysis is presented in Table 10.4.9-3. Analysis of transients and accidents requiring the EFW System to function (discussed in Chapter 15), demonstrates that the EFW System satisfies the design basis described in Section 10.4.9.1. C

An adequate safety-related water supply is available to allow the plant to remain at hot standby for 8 hours followed by an orderly cooldown to shutdown cooling system entry conditions. This is possible even if the initiating event is a main feedwater line break with a spill of EFW for 30 minutes at the maximum EFW flow. Level instrumentation and a low level alarm are provided on the Emergency Feedwater Storage Tanks to allow the operator 30 minutes at full flow to align the EFWST from the other train or a non-safety source of condensate in order to preclude the tank from being emptied before Shutdown Cooling System entry conditions are reached.

Following a primary side loss-of-coolant-accident, the EFW System may be used to assure that the steam generator tubes are covered to enhance the closed system containment boundary. The two motor-driven pumps will be used for this purpose as steam for the steam-driven pumps may or may not be available. In the event of failure of one of the motor-driven pumps, the water supply to one of the steam generators would be temporarily unavailable. By opening the cross-connection valves between the pump discharge lines, the one operating motor-driven pump may be used to fill and maintain level in both steam generators.

In the unlikely event of a station blackout, the steam-driven subtrains are capable of providing emergency feedwater to the steam generators coincident with a single failure. The steam-driven pump discharge valves are assured to open by providing battery-backed power. Battery-backed power is also available to the turbine governor speed control and steam generator water level indication in order to provide steam generator level control for at least 4 hours with appropriate load shedding. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period. E Q/R 410.20

The EFW System piping is arranged to minimize the potential for water hammer occurrences induced by the piping system. Specific design considerations are covered in Section 10.4.9.1. C

All components and piping are designed to protect against the effects of high and moderate energy pipe ruptures as discussed in Section 3.6.

(B) Q/R 410.24

## INSERT A

The EFW system flow capacity was assured of being adequate to remove decay heat during various reactor operations by selecting the worst case event for system sizing. Thus, the required minimum EFW pump flow (Section 10.4.9.1.1.G) was based upon ensuring the System 80+ EFW system has sufficient flow capacity to meet the safety analysis acceptance criteria for a main feedwater line break event.

A parametric study of the feedwater line break event with the failure of one emergency diesel generator to start, demonstrated that 500 gpm was adequate to ensure that: (1) the peak RCS pressure remains less than 110% of the system design pressure (2750 psia); (2) core subcooling is maintained; and (3) there is no two-phase fluid discharge through the primary safety valves. An additional calculation was performed to show that the 500 gpm minimum flow is sufficient to maintain the intact steam generator inventory during a subsequent cooldown of the RCS to the Shutdown Cooling System cut-in temperature at the administrative limit of 75 deg-F/hour. Detailed results of the System 80+ feedwater line break analysis will be included in CESSAR-DC Section 15.2.8.

The minimum safety-related condensate storage volume of 350,000 gallons (Section 10.4.9.1.2.J) was verified as being adequate for various reactor operations by considering two different limiting cases:

1.0 The first limiting case considered was a calculation of the total storage volume necessary to accommodate the main feedwater line break analysis as outlined above, but also includes storage volume to account for: (1) EFW flow to the ruptured steam generator for 30 minutes, (2) refill of the intact steam generator, (3) eight hours of operation at cooling system cut-in conditions, and (4) continuous operation of one reactor coolant pump.

2.0 The second limiting case considered involved ensuring sufficient safety grade condensate storage volume to perform a natural circulation cooldown to Shutdown Cooling System entry conditions following a complete loss of offsite power in accordance with the guidelines of Branch Technical Position (BTP) RSB 5-1. BTP RSB 5-1 requires demonstrating the ability to cooldown the plant using only safety grade equipment following a loss of offsite power with a subsequent limiting single failure. For this case, a previous analysis for the current System 80 design was reviewed for its applicability to the System 80+ design. It was concluded that the 350,000 gallon volume provided a large margin for the System 80 design and that similar or better results would be expected for the System 80+ design.

# INSERT B

The EFW pumps are not utilized during normal plant operating conditions, including plant startup and shutdown, except for periodic testing. A non-safety motor-driven startup pump is provided in the Main Feedwater System, to perform normal plant startup and shutdown feedwater functions. Therefore, the steam-driven pump turbine exhausts are isolated and do not release to the atmosphere during normal plant conditions. Periodic testing of the steam-driven pumps is prohibited if activity on the secondary side is above acceptable limits. Therefore, devices to monitor normal releases of activity to the atmosphere, to ensure 10 CFR 20 guidelines are not exceeded, are not required.

During emergency conditions, requiring heat removal through the steam generator, secondary side steam is released through the secondary side safety valves, steam-driven EFW pumps turbine exhaust, and the atmospheric dump valves should the turbine bypass system, condenser, and startup feedwater pumps be unavailable. Any off-site activity releases will be monitored by the Environmental Monitoring System.

During a steam generator tube rupture event, the steam generator with the ruptured tube is manually isolated by the plant operator and cooldown to Shutdown Cooling System entry condition is accomplished by utilizing the EFW pumps and atmospheric dump valve associated with the intact steam generator. The steam-driven EFW pump associated with the steam generator with the ruptured tube is isolated from the steam generator by closing the turbine trip-and-throttle valve (this trips the turbine and isolates the atmospheric discharge), the steam supply continuous drain isolation valve, and the steam generator isolation valve.

Chapter 15 analysis will show that all design basis accident off-site releases are below the guidelines of 10 CFR 100, considering initial steam generator tube leakage is at the maximum allowed by plant technical specifications.

C

### 10.4.9.5.4 Level Instrumentation

A. Emergency Feedwater Storage Tank Level

Level indication and low level alarm for EFWST 1 and 2 are provided in the main control room and at the remote shutdown panel. This is provided by redundant level instrumentation on each tank.

The low level alarm is set at a point to allow 30 minutes for manual alignment of the other EFWST or the non-safety supply of condensate before the level decreases to a point where pump suction is lost.

This instrumentation is designed and procured to meet the criteria given in Regulatory Guide 1.97.

B. Steam Generator Level

Steam generator level indication is provided at the steam-driven EFW pump control valves EF-104 and EF-105 and motor-driven EFW pump control valves EF-106 and EF-107. This allows steam generator level control by manual handwheel control of the valves. The level instrumentation has battery-backed power for 4 hours with appropriate load shedding, so that indication is available for a station blackout event. In addition to the batteries, an alternate AC source of standby power is provided for an extended station blackout period. Steam generator level indication is also provided close to the remote manual controls for EFW operation in the main control room and at the remote shutdown panel. This provides indication for proper EFW flow regulation.

E Q/R 410.20

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C. Steam Supply and Exhaust Drain Level Alarms

An alarm sounds in the main control room, should the level in drain pots for the low point drains in the steam turbine supply and exhaust lines be excessive. This alerts the operator that the orifice bypass valves should be opened.

### 10.4.9.5.5 Steam-Driven Pumps Turbine Speed

Instrumentation is provided in the main control room and at the remote shutdown panel for manual adjustment of the turbine governor control speed. This instrumentation allows the operator to adjust the turbine governor control speed after automatic ramp control from turbine ideal speed to turbine rated speed. If the operator should lower the speed to a point which will not produce adequate EFW flow, the Emergency Feedwater Actuation System

TABLE 10.4.9-4

(Sheet 1 of 4)

EMERGENCY FEEDWATER SYSTEM
INSTRUMENTATION AND CONTROL

Q/R
410.31

| Controls | Main Control Room | Remote Shutdown Control Room |
|---|---|---|
| Motor-Driven Pump 1 Start/Stop | X | X |
| Motor-Driven Pump 2 Start/Stop | X | X |
| Steam-Driven Pump 1 Start/Stop | X | X |
| Steam-Driven Pump 2 Start/Stop | X | X |
| Individual Emergency Feedwater Steam Generator Isolation Valves EF-100, EF-101, EF-102, EF-103 Open/Close | X | X |
| Individual Valve Position Controls for EFW Flow Control Valves EF-104, EF-105, EF-106, EF-107 | X | X |
| Steam Supply Bypass Valves EF-112, EF-113 Open/Close | X | X |
| Steam Supply Isolation Valves EF-108, EF-109 Open/Close | X | X |
| Turbine Trip and Throttle (Stop) Valves 1 & 2 Trip/Reset Control | X | X |
| Turbine 1 & 2 Speed Control | X | X |
| Steam Supply Continuous Drain Isolation Valves EF-110, EF-111 Open/Close | X | |
| EFAS Override | X | X |

E

TABLE 10.4.9-4 (Cont'd)

(Sheet 2 of 4)

EMERGENCY FEEDWATER SYSTEM
INSTRUMENTATION AND CONTROL

Q/R
410.31

| Controls | Main Control Room | Remote Shutdown Control Room |
|---|---|---|
| Motor-Driven Pump 1 Discharge Pressure | X | X |
| Motor-Driven Pump 2 Discharge Pressure | X | X |
| Steam-Driven Pump 1 Discharge Pressure | X | X |
| Steam-Driven Pump 2 Discharge Pressure | X | X |
| Motor-Driven Pump 1 Suction Pressure and Low Pressure Alarm | X | X |
| Motor-Driven Pump 2 Suction Pressure and Low Pressure Alarm | X | X |
| Steam-Driven Pump 1 Suction Pressure and Low Pressure Alarm | X | X |
| Steam-Driven Pump 2 Suction Pressure and Low Pressure Alarm | X | X |
| Steam-Driven EFW Pump Turbine 1 Inlet Pressure | X | X |
| Steam-Driven EFW Pump Turbine 2 Inlet Pressure | X | X |
| Steam Generator Isolation Valves EF-100, EF-101, EF-102, EF-103 Upstream Temperature and High Temperature Alarm | X | |
| Emergency Feedwater Pump Turbines 1 & 2 Bearing Temperature | X | |
| EFWST 1 Temperature and High and Low Temperature Alarm | X | |
| EFWST 2 Temperature and High and Low Temperature Alarm | X | |

E

TABLE 10.4.9-4 (Cont'd)

(Sheet 3 of 4)

EMERGENCY FEEDWATER SYSTEM
INSTRUMENTATION AND CONTROL

Q/R
410.31

| Controls | Main Control Room | Remote Shutdown Control Room |
|---|---|---|
| Motor-Driven Pump 1 Flow | X | X |
| Motor-Driven Pump 2 Flow | X | X |
| Steam-Driven Pump 1 Flow | X | X |
| Steam-Driven Pump 2 Flow | X | X |
| Motor-Driven Pump 1 Recirculating Flow | X | X |
| Motor-Driven Pump 2 Recirculating Flow | X | X |
| Steam-Driven Pump 1 Recirculating Flow | X | X |
| Steam-Driven Pump 2 Recirculating Flow | X | X |
| EFWST-1 Level and Low Alarm | X | X |
| EFWST-2 Level and Low Alarm | X | X |
| Steam Generator 1 Level | X | X |
| Steam Generator 2 Level | X | X |
| Individual Steam Supply and Exhaust Drain Pot High Level Alarms | X | |
| Steam-Driven EFW Pump 1 Turbine Speed | X | X |
| Steam-Driven EFW Pump 2 Turbine Speed | X | X |
| Motor-Driven Pump 1 Running Status | X | X |
| Motor-Driven Pump 2 Running Status | X | X |
| Steam-Driven Pump 1 Running Status | X | X |
| Steam-Driven Pump 2 Running Status | X | X |

E

TABLE 10.4.9-4 (Cont'd)

(Sheet 4 of 4)

Q/R
410.31

EMERGENCY FEEDWATER SYSTEM
INSTRUMENTATION AND CONTROL

| Controls | Main Control Room | Remote Shutdown Control Room |
|---|---|---|
| Individual Emergency Feedwater Steam Generator Isolation Valves EF-100, EF-101, EF-102, EF-103 Open/Close Position | X | X |
| Individual EFW Flow Control Valves EF-104, EF-105, EF-106, EF-107 Open/Close Position | X | X |
| Steam Supply Bypass Valves EF-112, EF-113 Open/Close Position | X | X |
| Steam Supply Isolation Valves EF-108, EF-109 Open/Close Position | X | X |
| Turbine Trip and Throttle (Stop) Valves 1 & 2 Open/Close Position and Close Position Alarm | X | X |
| Steam Supply Continuous Drain Isolation Valves EF-110, EF-111 Open/Close Position | X | |

E