Draft

Request for Additional Information No. 83 (1230,1132,1233,1234,976), Revision 0

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U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 10.04.09 - Auxiliary Feedwater System (PWR)
SRP Section: 10.04.07 - Condensate and Feedwater System
SRP Section: 10.04.05 - Circulating Water System
SRP Section: 10.04.02 - Main Condenser Evacuation System
SRP Section: 10.04.01 - Main Condensers
Application Section: 10.4.9
SBPA Branch

QUESTIONS

10.04.09-1

10 CFR 50, Appendix A, GDC-4, "Environmental and Dynamic Effects Design Bases," requires safety-related portions of the emergency feedwater systems to be protected against the adverse affects of events associated with pipe breaks. In Tier 1, Section 2.2.4 under arrangement, it is stated that physical separation exists between divisions of the EFWs. During review of the EFWS system, the staff noticed that suction piping from the EFWS storage pools is connected by normally open valves. Since the suction lines to all four storage pools are connected, a common-mode vulnerability may exist if a suction piping or pool leak develops.

The staff requests that the applicant:

1. Explain in the FSAR how there can be physical separation between divisions of EFWS if storage pools all connected by normally-open valves.

2. Discuss in the FSAR whether the valves are safety related and/or powered by class 1E sources and explain why the header isolation valves are not included in Tier 1, Table 2.2.4.1.

3. Explain in the FSAR the absence of pool or suction piping leaks in the failure modes and effects table for the EFWS.

4. Provide in the FSAR the methodology by which the system design, with the pool header isolation valve normally open, precludes the possibility of an internal hazard resulting from a EFWS pipe break in one of the EFWS supply lines adversley affecting the other trains.

10.04.09-2

10 CFR 50, Appendix A, GDC-4, "Environmental and Dynamic Effects Design Bases," requires that emergency feedwater systems be capable of withstanding the effects of

external and internally generated missiles, pipe whip and jet impingement forces associated with pipe breaks. The staff was unable to locate information in the FSAR discussing the provisions and plant designed features of the EFWS design to ensure compliance with GDC4. The staff requests that the applicant describe in the FSAR the provisions and design features used to ensure adequate protection against internal hazard and compliance with GDC 4.

10.04.09-3

GDC 4 requires safety-related portions of the emergency feedwater systems to be protected against hydraulic instabilities such as water-hammer events. Branch Technical Position 10-2, “Design Guidelines to Avoid Water Hammer in Steam Generators”, and NRC Generic Letter 2008-01, “Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems” contain design guidelines and recommendations to reduce or eliminate piping damage caused by water hammer transients.

FSAR Tier 2, Section 10.4.9.2.2.4 provides a discussion of the design features to minimize the potential for water hammer. In a review of the FSAR, the staff found no mention that lines need to be water-solid to prevent air entrainment, as discussed in Generic Letter 2008-01. Also, there was no information presented in the FSAR that will ensure development of operating and maintenance procedures by COL that will minimize the potential for water hammer in the EFWS during operation.

The staff request that the applicant provide an explanation of the procedural requirements in FSAR to prevent, or minimize water hammer and the methodology to maintain water-solid lines. The staff also requested that the applicant propose a COL information item to provide operating and maintenance procedures to address water hammer issues for the EFWS.

10.04.09-4

SRP Section 10.4.9 states, in part, that the system design should conform to the guidance of BTP 10-1, "Design Guidelines for Auxiliary Feedwater System Pump Drive and Power Supply Diversity for Pressurized Water Reactor Plants", as it relates to EFW pump drive and power supply diversity. Guideline B.1 in BTP 10-1 states that the EFWS should have at least two full-capacity, independent systems with diverse power sources. The U.S. EPR EFWS consist of four independent divisions each dedicated to one of the four steam generators. Typically for EFWS, Guideline B.1 for BTP 10.1 is met by use of a turbine-driven EFWS pump to ensure that the EFWS is capable of supplying feedwater to the steam generators independent of all offsite or onsite ac power supplies. The EFWS design for the EPR uses only motor-driven pumps.

The staff requests that the applicant explain in the FSAR the methodology for the system design meeting BTP 10.1, including a discussion on diversity of equipment, and power supplies.

10.04.09-5

In FSAR Section 10.4.9.3, the minimum required water inventory for the bounding cases with or without offsite power is given as less than 1.14×10^6 L (300,000 gallons). The applicant states that this inventory is sufficient to remove heat over the entire range of reactor operation and cool the plant to the residual heat removal (RHR) system cut-in temperature assuming a single active failure with a loss of offsite power. During its review the staff was unable to find sufficient information for the basis to calculate the required water inventory necessary for cooldown. Provide in the FSAR the basis for using the 1.14×10^6 L (300,000 gallons) as the minimum required water volume to be able to provide a sufficient supply of water to the steam generators under all conditions.

10.04.09-6

Tier 2, FSAR Section 10.4.9.2.1 states that the EFWS design flow requirement provides 400 gpm to a minimum of two SGs following a main feedwater line break when pumping against the main steam relief valve (MSRV) setpoint pressure. Technical Specification Bases 3.7.5 states that the MSRV has a lift setpoint of ≥ 1416.2 psig and ≤ 1503.8 psig and another MSRV lift setpoint of ≥ 1445.3 psig and ≤ 1534.7 psig.

Revised the FSAR to identify and justify the setpoint pressure used in the hydraulic analysis of the EFWS.

10.04.09-7

Regulatory Guide 1.155, Section 3.3.2 specifies that there be sufficient condensate storage to remove decay heat for the duration of a station blackout (SBO). The staff was unable to find information in the DCD specifying the EFWS water inventory required for decay heat removal to support the system during the required SBO coping duration. Provide in the FSAR the SBO water inventory requirements and the basis used for the inventory calculation for decay heat removal for the duration of the SBO.

10.04.09-8

A minimum flow check valve for each EFWS pump is listed in Tier 1, Table 2.2.4-1 and depicted in Figure 2.2.4-1. A minimum flow recirculation line back to each storage pool is provided for each EFW pump. There is no discussion in the FSAR about pump minimum flow requirements addressed in NRC IE Bulletin 88-04, “Potential Safety-Related Pump Loss”. This Bulletin discusses, in part, pump minimum flow requirements as they relate not only to pump cooling due to fluid temperature rise, but also to hydraulic instability due to insufficient minimum flow, resulting in pump cavitation and potential damage of the impeller. This Bulletin recommends that the limitations associated with these hydraulic phenomena be considered when specifying minimum flow capacity. However, no mention of IEB 88-04 was located in the FSAR. Provide in the FSAR the methodology for determining the pump minimum flow requirements of IE Bulletin 88-04.

10.04.09-9

The storage pool design function is to provide a water source to the EFW pumps. The applicable EFW Storage Pools' LCO is provided in Tier 2 Section 16; LCO 3.7.6. The LCO includes two action levels for the following conditions:

(1) One EFW Storage Pool inoperable (Immediately verify usable volume in three remaining pools ≥ 300,000 gallons, and declare associated EFW train inoperable). In its review the staff noticed that all of the storage pool suction sources are aligned to a common header.

The staff requests the applicant to explain in the FSAR the methodology used to determine the specific EFW train, which is connected to a common header, associated with the inoperable storage pool .

(2) Two or more EFW storage pools inoperable, or usable volume in EFW SPs < 300,000 gallons (be in Mode 3 in 6 hours and Mode 4 in 24 hours without reliance on SGs for heat removal).

If there is not sufficient storage pool volume available in MODE 1, 2, or 3, the unit is in a seriously degraded condition with no safety related means for conducting a cooldown. In such a condition, the unit should not be perturbed by any action, including a power change that might result in a trip. The seriousness of this condition should require action similar to what is required for EFW System LCO 3.7.5.D.1. That is, the OPERABLE status of the storage pool should be restored immediately. The staff requests the applicant to provide in the FSAR a justification/basis for action specified for this LCO.

10.04.09-10

Surveillance requirements for the following parameters for the EFW storage pools are provided: (1) storage pool volume, and, (2) EFW SP supply cross-connect valves locked open. Because locking open the cross tie valves removes the train independence, the staff requests that the applicant provide justification in the FSAR for locking open the storage pool cross tie valves.

10.04.09-11

Generic Safety Issue 93 addresses the potential for a common mode failure of the pumps in an auxiliary or emergency feedwater system. Hot water leaking through one or more isolation valves can flash to steam at the auxiliary feedwater pump potentially resulting in the failure of the pump to operate if required because of steam binding. The

NRC addressed this issue in Bulletin 85-01, and reinforced it in Generic Letter 88-03, by requesting that the fluid conditions in the auxiliary feedwater system be monitored and procedures be developed to recognize steam binding and restore the auxiliary feedwater system to operable status if steam binding should occur. The staff requests that the applicant propose in the FSAR a new COL information item to provide operating and maintenance procedures to address steam binding issues for the EFWS.

10.04.07-1

10 CFR 50, Appendix A, GDC-4, "Environmental and Dynamic Effects Design Bases," requires safety-related portions of the condensate and feedwater systems to be protected against the adverse affects of events associated with pipe break, such as internal flooding. FSAR Tier 2, Section 10.4.7.3 states that outside the feedwater valve rooms, critical components of the CFS are located at a sufficient elevation to be protected from flooding events. The FSAR do not identify what critical components outside the valve room are being protected from flooding, and includes no requirement for the COL applicant to verify that for the as-built plant, these components are located at sufficient elevation to protect against flooding events. Therefore, the staff request that the applicant identify in the FSAR the critical components of the CFS located outside the valve room that will be protected, and that the applicant include in the FSAR a COL information item or an ITAAC to verify that the location of critical components of the CFS located outside the feedwater valve room are located at sufficient elevation to be protected from flooding events.

10.04.07-2

SRP Section 14.3.2 Acceptance Criteria Number 6, for Seismic II/I specifies: For non-seismic Category I Structures, Systems, and Components (SSCs), the need for ITAAC to verify that their failure will not impair the ability of near-by safety-related SSCs to perform their safety-related functions should be assessed based on the specific design. If the design detail and as-built and as-procured information for many non-safety-related systems (e.g., field-run piping and balance-of-plant systems) is not provided by the applicant for design certification and the spatial relationship between such systems and seismic Category I SSCs cannot be established until after the as-built design information is available, the non-seismic to seismic (II/I) interaction cannot be evaluated until the plant has been constructed. Therefore, the staff requested that the applicant describe the process for completion of the design of the CFS to minimize II/I interactions, and to specify how they would provide a COL information item or an ITAAC to ensuret that the CFS as built design satisfies SRP Section 14.3.2 acceptance criteria for Seismic II/I Interactions.

10.04.07-3

GDC 4 requires safety-related portions of the condensate and feedwater systems to be protected against hydraulic instabilities such as water-hammer events.

FSAR Tier 2, Section 10.4.7.3 states that the steam generators have features that minimize the potential for water hammer, and states that the features are described in FSAR Tier 2, Section 5.4.2. Section 5.4 2 does not discuss feedwater system water-hammer events, but only discusses steam generator tube vibration. FSAR Tier 2, Section 10.4.7.3 further states that the condensate and feedwater system design is consistent with the guidance contained in Branch Technical Position (BTP) 10-2 for reducing the potential for water hammers in steam generators. There is no information provided in FSAR Tier 1, or Tier 2 describing design features of the feedwater piping system that have been incorporated to protect the feedwater piping, and other equipment, from water hammer events, as described in BTP 10-2. There is no information provided in FSAR that describes feedwater control valve and controller designs with respect to water hammer potential, nor is there COL information item in the FSAR for applicants to provide operating and maintenance procedures to address water hammer issues. This information is described in SRP Section 10.4.7, Section IV.2.

The staff request that the applicant provide a discussion in the FSAR of design features of the feedwater system to preclude damage by water-hammer events, and add a COL information item in the FSAR for the COL applicant to provide operating and maintenance procedures to address water hammer issues.

10.04.05-1

1. U.S. EPR DCD, FSAR Tier 2 Section 10.4.5.2.2, under “Piping and Valves,” and also in the DCD COL Information Item 10.4-5A, it is stated that the COL applicant that references the U.S. EPR design certification will provide the site-specific CWS piping design pressure. However, the DCD does not provide reference design parameters for the CWS, including but not limited to, cooling tower inlet and outlet temperatures, inlet temperature at the condenser, and piping and valve design pressures. Higher circulating water temperature results in increased pressure in the condenser due to decreased rate of steam condensation. The reference design data in a DCD will help the COL applicants in performing site-specific analysis to accommodate limiting site-specific weather conditions. Therefore, the staff requests the applicant to provide reference design parameters for the CWS and the major components. Also, the staff requests the applicant to provide freeze protection measures for CWS operations during cold weather conditions for startup and normal plant operations.

2. FSAR Tier 2, Section 10.4.5.3, “Safety Evaluation,” states that design provisions for flooding control in response to a failure in the CWS are described in FSAR Tier 2 Section 3.4. The staff finds no such description in Section 3.4. Also, there is no COL information item identified in the FSAR for flood control due to cooling tower collapse, or due to failure of yard piping. In order to comply with GDC 4 requirements, the staff requests the applicant to revise the FSAR to include (1) design provisions for flooding control in response to a failure in the CWS in Section 3.4 and (2) a COL information item to address the cooling tower and yard ping failure effects as related to the CWS flood control, .

10.04.02-1

1. In FSAR Tier 2 Sections 10.2.4.1, “General Description,” and FSAR Tier 2 Section 10.4.2.4, “Safety Evaluation,” the DCD describes the monitoring of the radioactive effluents from the main condenser evacuation system (MCES) to meet the General Design Criteria (GDC) 64 criteria. While it is clear that monitoring is provided, it is not clear to the staff from the design descriptions which mechanical vacuum pumps are monitored versus the location of the effluent radiation monitor. Also, the staff finds FSAR Tier 2 Sections 10.4.2.1 and 10.4.2.4 describe that the MCES effluent discharges into the nuclear auxiliary building ventilation system,

whereas, the FSAR Figure 10.4.2-1 shows that the system discharges into the turbine building air vent system. Clarify in the FSAR this discrepancy between the system description and the depiction of the MCES in the flow diagram as related to effluent monitoring.

2. With respect to hydrogen buildup and explosive mixtures, in FSAR Section 10.4.2.4, the applicant stated that for the U.S. EPR no hydrogen buildup is expected in the main condensers for the U.S. EPR. The amounts of oxygen are negligible compared to the levels of gas and vapor being evacuated by the system. Therefore, there is no potential for explosive mixtures within the MCES, thus the MCES is not required to be designed to withstand the effects of an explosion. However, the FSAR does not provide any additional details in support of the conclusion that explosive mixtures can not exist in EPR MCES. The GDC-60 criteria requires that the MCES design to include provisions to prevent excessive release of radioactivity to the environment which may result from potential explosive mixtures. In PWRs, radioactive materials may be deposited in the main condensers, if there is a primary-to-secondary steam generator tube leak. Also, the SRP acceptance criteria, Item 1.A, in SRP Section 10.4.2, describes that explosive mixture potential does not exist where systems are designed to maintain steam content above 58% by volume in hydrogen-air mixtures or nitrogen content above 92% by volume in hydrogen-air mixtures in all components of the main condenser evacuation system. The staff finds no such details in the application to justify that the system does not produce excessive explosive mixtures in the MCES. Provide the basis for the conclusion that explosive mixture potential does not exist in EPR MCES. Also provide in the FSAR the documentation, including any hydrogen-air mixture calculations or other analyses, that have been performed.

10.04.01-1

EPR DCD Tier 2, FSAR Section 10.4.1.1, “Design Basis,” states that the main condenser (MC) system is designed to accommodate up to 50% of the valves-wide-open main steam flow, which is bypassed directly to the MC by the turbine bypass system. However, the staff was unable to conclude that design provisions have been incorporated into the MC to preclude tube damage or failures due to steam blowdown from the turbine bypass system. The Standard Review Plan (SRP) Section 10.4.1, Subsection III, “Review Procedures,” Item 3.D, states that design provisions be incorporated into the MC that preclude component or tube failures due to steam blowdown from the turbine bypass system. Therefore, in order for the NRC staff to complete its review of the EPR main condenser design in accordance with the guidance provided in the above cited SRP review procedure, the staff requests the applicant to provide additional design details associated with these features and main condenser internals, and also to reflect these additions in the FSAR.