

KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Thursday, July 16, 2015 12:26 PM
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Cc: Stubbs, Angelo; Dias, Antonio; Betancourt, Luis; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 86-8003 (10.04.09 - Auxiliary Feedwater System (PWR))
Attachments: APR1400 DC RAI 86 SPSB 8003.pdf; image001.jpg

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, 60 days to respond to the RAI question. We may adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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Subject: APR1400 Design Certification Application RAI 86-8003 (10.04.09 - Auxiliary Feedwater System (PWR))
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REQUEST FOR ADDITIONAL INFORMATION 86-8003

Issue Date: 07/16/2015

Application Title: APR1400 Design Certification Review – 52-046

Operating Company: Korea Hydro & Nuclear Power Co. Ltd.

Docket No. 52-046

Review Section: 10.04.09 - Auxiliary Feedwater System (PWR)

Application Section:

QUESTIONS

10.04.09-1

In accordance with SRP 10.4.9 Section III, Item 3, the auxiliary feedwater system (AFWS) design should have features to meet the generic recommendations of NUREG-0611 and NUREG-0635. Also, Generic Short Term Recommendation No. 4 (GS-4) recommends emergency procedures be available for transferring to alternate sources of AFW supply.

DCD Tier 2, Section 10.4.9.5.4 states that level indication and low-level alarms for the auxiliary feedwater storage tanks (AFWSTs) are provided in the main control room (MCR) and remote shutdown room (RSR) by redundant level instrumentation on each tank. The low-level alarm is set to allow 30 minutes for alignment of the other AFWST or the non-safety backup makeup supply before the level decreases to a point where pump suction is lost. In the applicant's DCD the capability to use alternate water sources to supply the AFW system, and the alerting of the control room of when to begin alignment of alternate source are identified; however, the staff could not find a specific commitment to assure that the COL applicant specifically addresses the development of emergency procedures for transferring the AFWS to an alternate AFW supply source.

- A. The applicant is requested to demonstrate how it will be assured that emergency procedures will be developed for switchover of water to the alternate source prior to time at which AFW pump suction will be lost
- B. The applicant is requested to identify the AFWST level used to provide the alarm in the control room alerting operators that the AFWST level has fallen to the point where AFW suction will be lost if operator action to switchover to an alternate water source is not taken. The applicant is also requested to provide the basis for the selected AFWST water level assumed and the appropriate justification.

10.04.09-2

10 CFR 50.63, "Loss of all alternating current power," requires that the design must be able to withstand for a specified duration and recover from a station blackout.

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DCD Tier 2, Section 10.4.9.3 indicates that the turbine-driven auxiliary feedwater (TDAFW) pump is relied on in the event of a station blackout or an extended loss of AC power (ELAP). The TDAFW pumps are housed in the TDAFW pump rooms, along with their associated support and control systems. The TDAFW pumps are classified as safety-related; however the TDAFW pump room cooling system is not classified as safety-related. The AFW pump room is identified as being "mild" and is not an area serviced by safety-related cooling. Operation of the TDAFW pump may result in substantial heat generation in the room which would result in elevated room temperatures when room cooling is not available. Since the TDAFW pump rooms contain equipment used to respond to station blackout or ELAPs, there will be substantial heat generation in the AFW pump room, and no operational heat removal systems will be available during these events, reasonable assurance of TDAFW pump room equipment operability should be provided.

- A. The applicant is requested to provide the EQ room temperature envelope for the TDAFW pump room, showing both the calculated transient room temperature, and the EQ envelope temperature.
- B. The applicant is requested to provide documentation in the DCD to support the determination that, in the event of a station blackout, there is reasonable assurance of TDAFW pump room equipment operability for both mechanical and electrical equipment. The applicant is requested to also include documentation on the turbine control system environmental qualification that justifies why TDAFW pumps will continue to operate stably for the duration for which they are credited after loss of all room cooling).
- C. The applicant is requested to identify if access to the TDAFW pump room may be required by operators at the start or during TDAFW operation and, if so, discuss if any restriction to access the area will result due to room heatup during the loss of TDAFW room cooling.

10.04.09-3

In accordance with SRP 10.4.9 Section III, Item 3, the AFWS design should have features to meet the generic recommendations of NUREG-0611 and NUREG-0635. Generic Short Term Recommendation No. 6 (GS-6) recommends confirmation of availability of an AFW flow path that has been taken out of service to perform periodic testing or maintenance, including Technical Specification requirements and procedures that require an operator to verify proper alignment of the flow path. These procedures should include an independent check by a second operator to verify the flow path alignment.

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The staff could not find a specific commitment that the COL applicant would develop procedures that specifically require confirmation of the availability of an AFW flow path that has been previously taken out of service to perform periodic testing or maintenance, including independent verification by a second operator.

The applicant is requested to identify the procedure that demonstrates how the AFWS design meets Generic Short Term Recommendation No. 6 (GS-6) listed in NUREG-0611 and NUREG-0635. The applicant is to provide a DCD markup of this response.

10.04.09-4

In accordance with SRP 10.4.9 Section III, Item 3, the AFWS design should have features to meet the generic recommendations of NUREG-0611 and NUREG-0635. SRP 10.4.9 Section III, Item 3, also indicates that a 48-hour test is acceptable rather than the 72-hour test.

In NUREG 0611 and NUREG-0635 additional short-term recommendation 2 states that a 72-hour endurance test should be performed on all AFWS pumps. Following the 72-hour pump run, the pumps should be shut down and cooled down and then restarted for one hour. Test acceptance criteria should include demonstrating that the pump remains within the design limits with respect to bearing/bearing oil temperatures and vibration, and that pump room ambient conditions (temperature, humidity) do not exceed environmental qualification limits for safety-related equipment in the room.

While the applicant makes reference to a 48-hour endurance test in section 10.4.9 of the DCD, the staff was unable to find any information on the requirements of the endurance test in DCD Tier 2, Section 14.2.12.1.34, "Auxiliary Feedwater System Test."

The applicant is requested to specify the requirements for the AFWS pump endurance test, including specifying the required test duration in DCD Tier 2, Section 14.2.12.1.34

10.04.09-5

NRC IE Bulletin IEB 88-04, "Potential Safety-Related Pump Loss," 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

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associated with these hydraulic phenomena be considered when specifying minimum flow capacity.

The staff reviewed DCD Tier 2, Section 10.4.9.1.2 of the DCD and found that the design included provisions to provide recirculation flow for AFWS pumps.. In DCD Section 10.4.9.1.2 it is stated that flow recirculation is provided downstream of each pump discharge to allow for (a) A continuous recirculation of the AFWST for pump, (b) Full or minimum recirculation flow testing of the pump. The pump recirculation lines discharge recirculation water back into the AFWSTs. There does not appear to be a discussion in DCD about pump minimum flow requirements as addressed in NRC IE Bulletin IEB 88-04.

The applicant is requested to demonstrate how the AFWS design meets the pump minimum flow requirements listed in NRC IE Bulletin IEB 88-04, "Potential Safety-Related Pump Loss." The applicant is also requested to clarify item (a) on page 10.4-77 of the DCD. The applicant is to provide a DCD markup of this response.

10.04.09-6

NUREG-0800, SRP 10.4.9, Section II, SRP Acceptance Criteria Item 5 states that, in regards to GDC 34, and 44, the recommendations of NUREG-0611 and NUREG-0635 shall also be met.

TMI Action Plan item II.E.1.1 of NUREG-0737 and 10 CFR 50.34(f)(1)(ii) for applicants subject to 10 CFR 50.34(f) require an AFWS reliability analysis. An acceptable AFWS should have unreliability in the range of 10^{-4} to 10^{-5} per demand, exclusive of station blackout scenarios. Compensating factors (e.g., other methods of accomplishing AFWS safety functions or other reliable methods for cooling the reactor core during abnormal conditions) may be considered to justify a larger AFWS unavailability.

DCD Tier 2, Section 10.4.9.1.2 (Item O) indicates that an AFWS reliability analysis was performed in accordance with Three Mile Island (TMI) Action Item II.E.1.1 of NUREG-0737, and that the AFWS is designed to have unavailability from 10^{-5} to 10^{-4} per demand as described in DCD Tier 2, Chapter 19. The staff was unable to locate the referenced information in Chapter 19.

The applicant is requested to provide the staff with the description and results of the AFWS reliability analysis that reference was made to in DCD Section 10.4.9.1.2.

