REQUEST FOR ADDITIONAL INFORMATION 42-7945

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Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section: 19

QUESTIONS

19-2

10 CFR 52.47(a)(27) requires that a standard design certification applicant provide a description of the design specific PRA and the results. SRP Chapter 19, Revision 3 (Draft), "Design-Specific PRA (PRA for Non-Power Modes of Operation)" states that, "Given that shutdown risk may be highly outage-specific, the staff reviews the shutdown PRA insights to confirm that operational assumptions used to develop an average shutdown model (e.g., use of nozzle dams, outage schedule, containment status, procedural requirements) have been clearly documented in the FSAR." Staff reviewed the Low Power Shutdown (LPSD) PRA results and found that the frequency of overdraining events (basic event, SO), which result in loss of the Shutdown Cooling System (SCS) pumps from air entrainment during midloop operations, to be key LPSD risk contributors. The staff then reviewed DCD Section 5.4.7 for design and operational details that support the frequency of overdraining used in the PRA. FSAR Section 5.4.7 states that the Reactor Coolant System (RCS) level is maintained higher than the RCS low water level of [ ] above the loop center, and an SCS flow rate of [ ] is maintained. DCD Section 19.2.2.2, states "The shutdown cooling suction lines do not contain loop seals, thereby minimizing the potential to trap gas. The suction piping layout allows self-venting of accumulated gas (or air)." The staff also reviewed the Shutdown Evaluation Report, Section 2.3 "Reduced Inventory Operations and Generic Letter No. 88-17 Fixes" which states, "The APR1400 SCS suction lines do not contain any loop seals. The suction piping also has high point vents in order to release the gas accumulation. SCS pumps can be restarted with suitable venting procedures, providing reasonable assurance of an expedited reflood of the shutdown cooling pump suction."

General Design Criteria 34 requires a residual heat removal (RHR) system designed to maintain specified acceptable fuel design limits and to meet design conditions that are not exceeded if a single failure occurs simultaneous with failure of specified electrical power systems. The enclosure to NRC Generic Letter (GL) 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems" specifically addresses gas accumulation concerns in decay heat removal (DHR) piping. The Generic Letter covers both gas accumulation and vortexing from suction sources.

Consistent with General Design Criteria 34 (GDC 34) and GL 2008-01, the staff needs to determine that the potential for gas accumulation in the SCS was addressed. Also, the staff needs to determine that vortexing does not initiate at the specific hotleg levels and SCS flow rates specified above. There was insufficient information in the application to support both determinations. In accordance with SRP Chapter 19, the operational assumptions used to develop the LPSD PRA model should be clearly documented in the FSAR. Thus, the staff requests the following information be included in the FSAR:

1. The results of tests or analyses and key assumptions that conclude that vortexing does not initiate at the hot leg levels and the SCS flow rates specified above. This is needed because the staff could not find this information in the application
2. The key design details that support the assumptions in Section 19.2.2.2 of the DCD that the SCS suction lines do not contain loop seals and the SCS suction piping allows self-venting of accumulated gas or air. These key design details should be verified by an ITAAC (per SRP 14.3) and included in the APR1400 Risk Insights Table, or justification why these additions are not necessary should be provided
3. An ITAAC verifying that decay heat removal can be maintained at the highest anticipated operational flow rate [ ] and the lowest anticipated hotleg level [ ] inches above hot leg centerline) without indications of vortexing. This information is necessary to show conformance with GDC 34

19-3

10 CFR 52.47(a)(27) requires that a standard design certification applicant provide a description of the design specific PRA and the results. SRP Chapter 19, Revision 3 (Draft), states, "The staff will determine that the applicant has performed risk importance studies at the system, train, and component level that adequately provide insights about (1) the systems that contribute the most in achieving the low risk level assessed in the PRA, (2) events (e.g., component failures or human errors) that contribute the most to decreases in the built-in plant safety level, and (3) events that contribute the most to the assessed risk." In this context, the tables reporting risk assessment worth (RAW) values for the low power shutdown (LPSD) PRA appear to have omitted risk significant initiating events, such as RCS overdraining at mid-loop, and PRA initiating event %SO, from the risk achievement analyses. Either add LPSD initiating events in the risk achievement worth analyses for the staff to determine which shutdown initiating events contribute most to the assessed risk, should they occur, or justify why this addition is not necessary.

19-4

10 CFR 52.47(a)(27) requires that a standard design certification applicant provide a description of the design specific PRA and the results. SRP Chapter 19, Revision 3 (Draft), "Design-Specific PRA (PRA for Non-Power Modes of Operation)" states that, "Given that shutdown risk may be highly outage-specific, the staff reviews the shutdown PRA insights to confirm that operational assumptions used to develop an average shutdown model (e.g., use of nozzle dams, outage schedule, containment status, procedural requirements) have been clearly documented in the FSAR." The staff reviewed the applicant's definitions of Plant Operational States (POSs) defined in Table 19.1-81, LPSD Plant Operating States. The staff notes that POS development is a high level requirement in the ANS LPSD PRA standard issued for trial use. POS development is also necessary to perform a shutdown PRA since POS definitions are used to define success criteria for core cooling and timing for containment closure for each assessed shutdown plant operational state. The timing for core boiling and core uncovery is needed to confirm the numerical estimates for operator recovery, which drives shutdown

risk. The staff needs more information regarding the POS definitions used to develop the average shutdown model. For each POS provide the following information in the FSAR:

1. The anticipated decay heat level and the associated time post shutdown
2. The size and locations of any RCS vents
3. The assumed RCS water level
4. The time to RCS boiling given a loss of the decay heat removal function
5. The time to core unrecovery
6. The thermal-hydraulic code used to assess the POS and a discussion of the acceptability of the code to assess that POS