RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**416-8358**
SRP Section:	**SRP 19**
Application Section:	**19.1**
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Question No. 19-38

Item 11 of Section II, "Acceptance Criteria," of the (Draft) Revision 3 SRP, states, "The PRAs that meet the applicable supporting requirements for Capability Category I and meet the high-level requirements as defined in the ASME PRA Standard (ASME/ANS RA-S-2008 and addenda ASME/ANS RA-Sa–2009) should generally be acceptable for DC and COL applications. Alternatively, the applicant may identify, and justify the acceptability of, alternative measures for addressing PRA quality and technical adequacy. The staff should specifically review the acceptability of these alternative measures in the context of the specific uses and applications of the PRA."

The staff reviewed the APR1400 design control document (DCD) Section 19.1.4.1.1, "Description of Level 1 Internal Events PRA for Operations at Power," and found insufficient information describing the accident sequence analysis performed. Specifically, the applicant did not describe how the class 1E 'A' and 'B' battery assumptions are modeled in the PRA and why varying assumptions are used in different sections of the DCD. The staff found the following assumptions in the DCD:

1. DCD Section 19, states that the class 1E 'A' and 'B' batteries have a 2-hour capacity and require load shedding to extend the capacity to 8 hours which is contrary to information in DCD Section 8, Table 8.3.2-2

2. In DCD Table 19.1-2 (page 7 of 10), the class 1E 'A' and 'B' batteries have a 4 hour capacity

3. DCD Table 19.1-3 (page 1 of 5), does not specify which battery trains have extended battery life to 16 hours

4. DCD Section 19.2.3.3.4.1.1, states class 1E 'A' and 'B' batteries have a minimum capacity of 4 hours and require load management.

Therefore, in order for the staff to reach an assurance finding on the conformance to Standard Review Plan (SRP) Chapter 19.0 regarding PRA technical adequacy, please resolve the inconsistency, revise the key assumptions table as necessary and revise the DCD accordingly.

Response

1. It is described that the battery is sized based on the duty cycle in DCD Section 8.3.2.1.2.6, and the duty cycle of class 1E A/B batteries is 8 hours long in DCD Table 8.3.2-1.

   It is also described that the class 1E A/B batteries can supply dc power up to 2 hours without load shedding and an additional 6 hours with load shedding in 5.1.2.6.1.2, Evaluations & Design Enhancements to Incorporate Lessons Learned from Fukushima Dai-Ichi Nuclear Accident (APR1400-E-P-NR-14005-P, Rev. 0

2. DCD Table 19.1-2 (page 7 of 10) will be revised as shown in the Attachment 1.

3. DCD Table 19.1-3 (page 1 of 5) will be revised as shown in the Attachment 2.

4. DCD Section 19.2.3.3.4.1.1 will be revised as shown in the Attachment 3.

Impact on DCD

Table 19.1-2 (7 of 10), Table 19.1-3 (1 of 5) and Section 19.2.3.3.4.1.1 will be revised as shown in the Attachment 1, 2 and 3.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on the Technical/Topical/Environmental Report.

Table 19.1-2 (7 of 10)

System	SSC Configuration	Key Functional Description	Design Feature
Emergency Diesel Generator	• Four independent EDGs • One 7-day fuel oil capacity storage tank per EDG	• Each EDG supplies emergency onsite power to respective Class 1E 4.16 kV bus	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Alternative ac Power	• One non-Class 1E train of AAC gas turbine generator with independent room cooling system and independent dc power supply	• Provides diverse onsite emergency power to Class 1E SWGR during SBO • Eliminates the potential of CCFs between AAC and EDGs	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
125 Vdc power system	• Four Class 1E dc batteries with two battery chargers per dc bus • ~~4~~-hour capacity for trains A and B • 16-hour capacity for trains C and D	• Provide control dc power for operation of safety-related equipment or equipment important to safety • Provides extended time for recovery of offsite power following a SBO	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences

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Table 19.1-3 (1 of 5)

Design Features Addressing Potential Risk Challenges

Potential Risk Challenges	Design Features and Operational Strategies
Design Features for Preventing Core Damage	
Loss of offsite power (LOOP) / Station blackout (SBO): • LOOP event occurrence • Onsite emergency power capability • RCP seal cooling	• House load operation (HLO) minimizes reactor trip during LOOP event • Improvements on the onsite emergency power capability - Four EDGs with large fuel storage capacity - A diverse AAC using combustion gas turbine - ~~Extended battery life to 16 hours~~ Extended battery life to 16 hours for trains C and D - Mobile EDGs - Mobile battery chargers and batteries • Improvements on RCP seal challenges - Advanced seal design - Improved seal injection cooling system - Auxiliary charging pump in addition to two charging pumps
LOCA: • ECCS recirculation for long-term operation • RCS inventory makeup for LOCAs • Challenges associated with long-term cooling • Containment heat removal and pressure control	• Elimination of ECCS recirculation phase - IRWST integrated into containment with a continual makeup via holdup tank • Improvements to deal with any sizes of LOCAs - Four redundant SIP trains - Improved SIT design with fluidic device (FD) • Improvements made for long-term cooling - SC pumps capable of long-term injection or SDC operation

19.2.3.3.4.1 Mitigation Features

Mitigation features provided for HPME and DCH are the rapid depressurization (RD) function and reactor cavity design. The rapid depressurization function provides reasonable assurance that the reactor vessel is at low pressure when the vessel fails. The unique reactor cavity design provides reasonable assurance that even if the vessel fails at high pressure, most of the corium ejected stays in the subcompartment.

19.2.3.3.4.1.1 Rapid Depressurization Function

The RD function is a multi-purpose dedicated system designed to serve important roles in severe accident prevention and mitigation. Figure 19.2.3-13 shows some details of the RD function.

In the APR1400 design, the POSRVs are designed to allow for depressurization of the RCS below the cutoff pressure for HPME to occur. For the APR1400 design, the rapid depressurization function is initiated by operator action as part of the severe accident management strategy. When CET temperature exceeds 922.04 K (1,200 °F), the operator identifies entry into a severe accident condition and starts rapid depressurization by opening the required POSRVs.

The RD function design requirement related to severe accident mitigation is the capability to depressurize the RCS from approximately 175.8 kg/cm^2 (2,500 psia) to approximately 17.6 kg/cm^2 (250 psia) prior to reactor vessel breach. The target pressure of the RD function is determined on the basis of DOE/ID-10271 (Reference 17).

The power for each RD valve is supplied from a respective Class 1E direct current (dc) bus. The power is provided such that a bleed path can be established in case of a loss of offsite power, four emergency diesel generators (EDGs), and the AAC source. Each train of dc loads is provided with a separate and independent battery charger and a standby charger. The battery chargers are powered from the 480 V ac Class 1E power distribution systems of the same trains. A load management strategy provides reasonable assurance of dc power availability for ~~a minimum of 4 hours~~ for Trains A and B and 16 hours for Trains C and D following an SBO.

8 hours