

## 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.:** 379-8476

**Review Section:** 07-19 Branch Technical Position – Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems

**Application Section:** 07.08

**Date of RAI Issue:** 01/28/2016

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### **Question No. 07-5**

The applicant provided a qualitative analysis regarding the large-break loss of coolant accident (LBLOCA) event in Section 5.3.6.5 of APR1400-Z-A-NR-14019-P, Rev. 0, "CCF Coping Analysis." Furthermore, the applicant provided a quantitative analysis regarding the LBLOCA event in Section 5.4.2.7 of the technical report. In this section of the technical report, the applicant concluded the D3 analysis of this event is bounded by the Chapter 15 analysis due to the use of best-estimate conditions; however, the staff noted that the applicant did not provide much information regarding the D3 analysis for a small-break LOCA (SBLOCA). The staff is unable to conclude that a SBLOCA concurrent with a CCF is bounded by the corresponding Chapter 15 analysis. In addition, regarding the D3 analysis of SBLOCA, an RCP trip will not occur due to the assumed CCF in the RPS. The lack of an automatic RCP trip for SBLOCA is not in conformance with TMI Action Plan (NUREG-0737) Requirement II.K.3.5 (automatic trip of reactor coolant pumps during loss-of-coolant accident). However, the staff has accepted a manual RCP trip for SBLOCA based, for example, on zero degrees hot leg subcooling indication (GL 85-12, "Implementation of TMI Action Item II.K.3.5, Automatic Trip of Reactor Coolant Pumps").

In accordance with BTP 7-19 Point 2, which is quoted from the SRM on SECY-93-087, the applicant shall demonstrate adequate diversity in the design of the digital I&C safety systems to ensure that a LOCA concurrent with a CCF does not challenge the plant's safety more than the event does as analyzed in Chapter 15 of the DCD. The staff is unable to confirm that the applicant's current analysis is adequate; therefore, the staff cannot conclude the applicant is in compliance with BTP 7-19 Point 2.

The staff requests the applicant to first provide a detailed qualitative analysis of a SBLOCA concurrent with a CCF to determine if a detailed quantitative analysis is necessary. If the applicant concludes that a detailed quantitative analysis is necessary, the staff requests the applicant to provide it as well. The evaluation should address the lack of an automatic RCP trip in the diverse actuation system (DAS).

### **Response**

In the case of a small break loss of coolant accident, the operator will recognize the accident from the low pressurizer pressure alarm, and will perform actions in accordance with the emergency operating procedure. However, the important operator action will be limited to manual trip of the reactor coolant pumps (RCPs). The RCPs will be manually tripped two by two when subcooling is less than the minimum setpoint. The diverse protection system will automatically trip the reactor and start the safety injection before the operator can take action in accordance with the emergency operating procedure. As the break occurs, the reactor coolant system pressure is abruptly decreased, and the containment pressure is increased by the break flow. As the containment pressure reaches the diverse protection system high containment pressure reactor trip setpoint, the core power rapidly decreases due to reactor trip. The turbine is tripped following the reactor trip.

As the reactor coolant system pressure continues to decrease due to the break flow and reaches the diverse protection system low pressurizer pressure safety injection actuation setpoint, the safety injection pump starts and provides safety injection. The safety injection increases reactor coolant system inventory and keeps the core submerged.

The RCPs are assumed to operate until they are manually tripped by the operator. The operator trips the RCPs when the reactor coolant system subcooling is less than the minimum setpoint, as specified in the emergency operating procedure. The delay in turning off the RCPs does not pose a problem due to the safety injection system maintaining the reactor coolant system inventory at an acceptable level until the RCPs are turned off.

In the case of the small break loss of coolant accident, core coolability is maintained continuously because the reactor coolant system inventory is maintained by automatic reactor trip followed by safety injection initiated from the diverse protection system. Thus, results of the accident are bounded by the large break loss of coolant accident. Therefore, the quantitative analysis is not required.

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### **Impact on DCD**

There is no impact on the DCD.

**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 Reports.