

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: 7.8

Date of RAI Issue: 01/28/2016

Question No. 07-3

The applicant provided a qualitative D3 analysis regarding the uncontrolled control element assembly (CEA) withdrawal from subcritical or low-power startup condition event in Section 5.3.4.1 of APR1400-ZA-NR-14019-P, Rev. 0, "CCF Coping Analysis." In this section of the technical report, the applicant concluded that the DPS high pressurizer pressure trip would terminate the event prior to the DNBR SAFDL being reached because the D3 event utilizes nominal pressurizer pressure which is 75 psi higher than in the Chapter 15 analysis. However, in Figure 15.4.1-3, "Uncontrolled CEA Withdrawal at low Power: RCS Pressure vs. Time," of the DCD, the RCS pressure response shows a peak pressure of approximately 2250 psia at approximately 33 seconds. Figure 15.4.1-4, "Uncontrolled CEA Withdrawal at Low Power: Minimum DNBR vs. Time," of the DCD shows the MDNBR occurred at approximately 29 seconds following a variable overpower trip. Because the MDNBR occurs approximately 4 seconds before the peak pressure is obtained in the Chapter 15 analysis of the event, and because the DNBR decreases at a rapid rate prior to the trip, the staff was unable to conclude that the D3 event transient could be arrested via the DPS high pressurizer pressure trip before a DNBR SAFDL would be violated.

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 an uncontrolled CEA withdrawal from low power or subcritical conditions event 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 provide a detailed analysis of the uncontrolled CEA withdrawal from subcritical or low power conditions concurrent with a CCF.

Response

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Table 1 Assumptions and Initial Conditions for the CEA Withdrawal with a CCF in the
PPS/ESF-CCS Event at Low Power

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Table 2 Sequence of Events for the CEA Withdrawal with a CCF in the PPS/ESF-CCS
Event at Low Power

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Figure 1 Core Power vs. Time
(CEA Withdrawal with a CCF in the PPS/ESF-CCS at Low Power)

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Figure 2 RCS Pressure vs. Time
(CEA Withdrawal with a CCF in the PPS/ESF-CCS at Low Power)

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Figure 3 Minimum DNBR vs. Time
(CEA Withdrawal with a CCF in the PPS/ESF-CCS at Low Power)

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.

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Application Section: 7.8

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Question No. 07-4

The applicant provided a discussion regarding the uncontrolled CEA withdrawal at power event in Section 5.3.4.2 of APR1400-Z-A-NR-14019-P, Rev. 0, "CCF Coping Analysis." In this section of the technical report, the applicant concluded this event need not be analyzed because its evaluation is essentially similar to the evaluation of the event at subcritical or low power conditions. The applicant reports in the Chapter 15 analysis of the event (15.4.2) that the variable overpower trip arrests the transient; however, given that this trip is not available assuming a CCF, the staff cannot determine that adequate diversity and defense-in-depth is provided by the APR1400 design. Furthermore, the staff is unable to conclude that an uncontrolled CEA withdrawal at power event concurrent with a CCF is less limiting than the same event at low power or startup conditions.

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 an uncontrolled CEA withdrawal at power event 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 qualitative analysis of the uncontrolled CEA withdrawal at power event concurrent with a CCF to determine if a detailed (computer) analysis is necessary. If the applicant concludes that a detailed quantitative analysis is necessary, the staff requests the applicant to provide it as well.

Response

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Table 1 Assumptions and Initial Conditions for the CEA Withdrawal with a CCF in the
PPS/ESF-CCS Event at Full Power

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Table 2 Sequence of Events for the CEA Withdrawal with a CCF in the PPS/ESF-CCS
Event at Full Power

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Figure 1 Core Power vs. Time
(CEA Withdrawal with a CCF in the PPS/ESF-CCS at Full Power)

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Figure 2 RCS Pressure vs. Time
(CEA Withdrawal with a CCF in the PPS/ESF-CCS at Full Power)

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Figure 3 Minimum DNBR vs. Time
(CEA Withdrawal with a CCF in the PPS/ESF-CCS at Full Power)

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.