KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Tuesday, December 22, 2015 7:55 AM
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Cc: Carlson, Donald; McKirgan, John; Steckel, James; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 345-8433 (15.04.01 - Uncontrolled Control Rod Assembly Withdrawal from a Subcritical or Low Power Startup Condition)
Attachments: APR1400 DC RAI 345 SRSB 8433.pdf

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.

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

Thank you,

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Hearing Identifier: KHNP_APR1400_DCD_RAI_Public
Email Number: 394

Mail Envelope Properties (50cfa1e3b9b84345ac2a13e074d46800)

Subject: APR1400 Design Certification Application RAI 345-8433 (15.04.01 - Uncontrolled Control Rod Assembly Withdrawal from a Subcritical or Low Power Startup Condition)
Sent Date: 12/22/2015 7:55:00 AM
Received Date: 12/22/2015 7:55:01 AM
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REQUEST FOR ADDITIONAL INFORMATION 345-8433

Issue Date: 12/22/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 15.04.01 - Uncontrolled Control Rod Assembly Withdrawal from a Subcritical or Low Power Startup Condition
Application Section: 15.4.1-3

QUESTIONS

15.04.01-1

Question 15.4-1: Justification of kinetics parameters used in DCD Sections 15.4.1-3

REQUIREMENTS AND GUIDANCE

In 10 CFR Part 50 Appendix A, General Design Criterion (GDC) 10 requires the core and associated coolant, control, and protection systems to be designed with appropriate margin to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded during any condition of normal operation, including the effects or anticipated operational occurrences (AOOs). GDC 20 requires, in part, that the protection system be designed to initiate automatically the operation of appropriate systems to ensure that SAFDLs are not exceeded as a result of AOOs. GDC 25 requires the protection system to be designed to ensure that SAFDLs are not exceeded for any single malfunction of the reactivity control systems.

Section 15.4.1 of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” Subsection III, “Review Procedures,” states the following under Item 4: “*The input to the neutron kinetics analysis model should be examined to assure that the input is appropriately conservative both for the state of the reactor and for the particular way it is used in the analysis….”*

ISSUE

Section 15.4 of the DCD includes the following three AOO events: (1) “Uncontrolled Control Element Assembly Withdrawal from a Subcritical or Low-Power Startup Condition” [15.4.1], (2) “Uncontrolled Control Element Assembly Withdrawal at Power [15.4.2], and (3) “Control Element Assembly Misoperation” [15.4.3]. Each event is analyzed using reactivity feedback coefficients for fuel temperature and moderator temperature in combination with kinetics parameters that include effective delayed neutron fractions, neutron lifetimes, and decay constants for delayed neutron precursors. However, the applied kinetics parameters are not described within the respective DCD sections, nor does the DCD incorporate or cite references that detail the respective calculations. The applicant has nevertheless made available three related calculation notes for audit by the NRC staff. The audited calculation notes, which are dated July and August 2012, include appendices containing earlier pre-submittal drafts of the respective DCD sections.

The calculation note for the CEA misoperation event (15.4.3) indicates the conservative use of the most strongly negative reactivity feedback coefficients, which occur at EOC, in combination with the minimum delayed neutron fraction, which likewise occurs at EOC, and notes that minimizing the delayed neutron fraction conservatively maximizes the limiting heat flux increase in that event (Audit Reference 3). For the two CEA withdrawal events (15.4.1 and 15.4.2), the applicant assumes the least negative fuel temperature coefficient and the most positive moderator temperature coefficient, both of which occur at beginning of cycle (BOC) conditions.

Although not stated as such, the analysis appears to use EOC kinetics parameters like those used in the CEA misoperation event (Audit References 1 and 2).

In general, the staff is concerned that the reviewed submittal and audited calculation notes do not adequately describe the assumed kinetics parameters and do not provide supporting information to show that the applied parameters yield appropriately conservative analysis predictions for the respective events.

INFORMATION NEEDED

Please describe and provide the basis for the kinetics parameters (delayed neutron fractions, neutron lifetimes, decay constants) used for the respective events in DCD Sections 15.4.1-3. This should include justification for using the same EOC kinetics parameters for both BOC and EOC conditions and a discussion of how the assumption of a higher delayed neutron fraction would affect the peak linear heat generation rate (PLHGR) and the departure from nucleate boiling ratio (DNBR) in relation to the respective SAFDLs. The justification should show the assumed kinetics parameters to be appropriately conservative for each of the three events. If supporting sensitivity cases were run with different sets of kinetics parameters, please provide a discussion of those results.

As appropriate, update the DCD or the docketed techncial reports to enable the staff to make a finding based on the docketed information.

Audit References

1. APR1400-F-A-TM-12037-P, Rev. 0, “Bank CEA Withdrawal from Subcritical or Low Power Analysis for US-APR1400,” July 2012
2. APR1400-F-A-TM-12036-P, Rev. 0, “Bank CEA Withdrawal at Power Analysis for US-APR1400,” July 2012
3. APR1400-F-A-TM-12004-P, Rev. 0, “CEA Drop Analysis for US-APR1400,” August 2012


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