

KHNPDCDRAIsPEm Resource

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Sent: Tuesday, December 22, 2015 8:09 AM
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Cc: Carlson, Donald; McKirgan, John; Steckel, James; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 346-8434 (15.04.02 - Uncontrolled Control Rod Assembly Withdrawal at Power)
Attachments: APR1400 DC RAI 346 SRSB 8434.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: 395

Mail Envelope Properties (8ddedf56c8664cb69b9fe16576d53c13)

Subject: APR1400 Design Certification Application RAI 346-8434 (15.04.02 - Uncontrolled Control Rod Assembly Withdrawal at Power)
Sent Date: 12/22/2015 8:09:22 AM
Received Date: 12/22/2015 8:09:25 AM
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Files	Size	Date & Time
MESSAGE	498	12/22/2015 8:09:25 AM
APR1400 DC RAI 346 SRSB 8434.pdf		115297
image001.jpg	5040	

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Priority: Standard
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REQUEST FOR ADDITIONAL INFORMATION 346-8434

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: 15.04.02 - Uncontrolled Control Rod Assembly Withdrawal at Power

Application Section:

QUESTIONS

15.04.02-1

Question 15.4-4: Ranges of power and CEA withdrawal rates examined for DCD Section 15.4.2

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 15.4.2 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 1: *"the review considers the entire power range from low to full power and the allowed extreme range of reactor conditions during the operating (fuel) cycle, including rod configurations, power distribution, and associated reactivity feedback components... The review considers a full range of rod or bank withdrawals, up to maximum rod or bank worths and rates of reactivity addition."* In addition, Item 3 states that *"the reviewer ascertains that a full range of AOO conditions are analyzed..."* and gives a list of parameter ranges to consider, including: (a) initial power levels from low to full power, and (b) reactivity insertion rates from very low to maximum possible, including allowances for uncertainties. The reviewer is guided to verify that these ranges of conditions have been examined, and that the most limiting case has been analyzed.

ISSUE

In DCD Section 15.4.2.3.2, the applicant indicates that the initial power level is assumed to be 102% of the core thermal power. The applicant also states that beginning power levels from low to full power are analyzed in the design stage for the core operating limit supervisory system (COLSS) and the core protection calculator system (CPCS). Such analyses would partially address the requirement that the analysis include the entire power range from low to full power. The applicant's statement implies that such analyses have been completed, though a review of available documentation has not located sufficient information about the results of the power study. In particular, documentation addressing the results for rod withdrawal scenarios beginning at a range of power levels has not been provided.

Section 15.4.2.3.2 of the DCD also states that the rod withdrawal rate was selected based on the calculated control element assembly (CEA) worth and associated uncertainties to produce the worst transient. A calculated differential CEA worth and the maximum CEA withdrawal rate

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were used to compute the maximum expected reactivity insertion rate. The maximum rate was used in the analysis. The application also states that “*reactivity insertion rates from very low to maximum possible for the control system, including allowance for uncertainties, are analyzed in COLSS/CPCS design stage*”. Again, review of the available supporting documentation has not located any discussion of the analysis or results that address the requirement that a range of reactivity worths and insertion rates be evaluated for this scenario. The peak linear heat generation rate (PLHGR) for this event is 19.27 kW/ft and the AOO limit is 20 kW/ft. Thus, the PLHGR is close enough to the limit that further review is needed to verify that the limiting event is being analyzed. Additional documentation is needed for showing acceptable performance of the system in response to rod withdrawals using a range of reactivity insertion rates.

INFORMATION NEEDED

Please provide documentation supporting the assertion that ranges of power levels and reactivity insertion rates were examined for DCD Section 15.4.2, “Uncontrolled Control Element Assembly Withdrawal at Power.” Please include results from any sensitivity analyses that were performed.

As appropriate, the applicant should update the DCD and referenced technical reports.



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