KHNPDCDRAIsPEm Resource

From:	Ciocco, Jeff
Sent:	Tuesday, March 08, 2016 8:00 AM
To:	apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Andy Jiyong Oh; Christopher Tyree
Cc:	Haider, Syed; Karas, Rebecca; Steckel, James; Lee, Samuel; Williams, Donna
Subject:	APR1400 Design Certification Application RAI 431-8504 (15.00.02 - Review of Transient and Accident Analysis Methods 01/2006)
Attachments:	APR1400 DC RAI 431 SRSB 8504.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. However, KHNP requests, and we grant, the following RAI question response times. We may adjust the schedule accordingly.

15.00.02-11: 90 days
15.00.02-12: 30 days
15.00.02-13: 30 days
15.00.02-14: 30 days
15.00.02-15: 30 days
15.00.02-16: 60 days

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

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 431-8504

Issue Date: 03/08/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 15.00.02 - Review of Transient and Accident Analysis Methods 01/2006
Application Section: 15.0.2, "Review of Transient and Accident Analysis Methods"

QUESTIONS

15.00.02-11

Key Questions about the Licensing-basis Computer Codes Used for the APR1400 SBLOCA T/H Analysis

NUREG-0800, Standard Review Plan (SRP) Section 15.0.2, “Review of Transient and Accident Analysis Methods,” specifies that an evaluation model must be able to predict all important physical phenomena determined to be necessary for the accident under consideration reasonably well from both qualitative and quantitative points of view. However, it is not clear that the applicant’s small break loss of coolant accident (SBLOCA) evaluation model is meeting this guidance with respect to loop seal clearing, and the staff is concerned that the modeling of the loop seal clearing phenomena may not be conservative.

The staff’s review of APR1400 DCD Section 15.0.2, “Review of Transient and Accident Analysis Methods,” and the referenced Technical Report (TeR) APR1400-F-A-NR-14001-P, Rev.0,“Small Break LOCA Evaluation Model,” has raised several questions as submitted in this RAI. The information being sought is part of the analytical procedures that the staff uses to establish that the evaluation model treats loop seal clearing phenomena realistically or conservatively. The regulatory bases identified above are applicable to all subsequent questions in this RAI. The applicant is also requested to update the DCD and the TeR as appropriate to ensure that the analysis method and results are documented.

The TeR describes the APR1400 SBLOCA evaluation model in broad terms. In Section 1 of the TeR, “Introduction”, it is stated that the SBLOCA methodology used for APR1400 is very similar to the conventional Combustion Engineering (CE) SBLOCA methodology used for currently operating US CE-fleet PWRs. However, the report did not provide a discussion of the differences between the CE methodology and the KHNP methodology used for APR1400. SRP Section 15.0.2 suggests review of any changes to the previously approved evaluation models to ensure the changes do not invalidate the previous approval. The applicant is requested to specify the exact approved CE SBLOCA methodology revision upon which the KHNP SBLOCA methodology is based, and discuss any differences between the two. The staff needs to understand all the changes made to the SBLOCA methodology and computer codes since they were last approved, in order to ensure that there is nothing new in the methodology that could invalidate the previous approval of the applicability or limitations of the methodology. The staff needs to review all the modifications made in the mathematical modeling, computer codes (CEFLASH-4AS, COMPERC-II, STRIKIN-II, and PARCH) used to analyze the APR1400 SBLOCA, as well as any differences in data transfer between the codes since they were last approved. The staff also needs to know if the material properties for ZIRLO and M5 were incorporated into STRIKIN and PARCH. If so, the documentation and verification of the code changes should be submitted to the staff. If not, justification for not incorporating the ZIRLO and M5 material properties should be provided.

15.00.02-12

Have the computer codes used in the licensing basis calculations for APR1400 been qualified for core uncovery, peak cladding temperature (PCT), and the formation and clearing of the loop seal phenomena? If not, please justify using them for the APR1400 loop seal modeling and SBLOCA analysis for both the direct vessel injection (DVI) line and cold leg (CL) breaks.

15.00.02-13

Section 2 of the TeR gives a brief discussion of the computer codes (CEFLASH-4AS, STRIKIN-II, COMPERC-II, and PARCH) used in the SBLOCA methodology and an overview of the data transferred between the codes. However, no explanation is given about exactly what information is transferred between the codes and how it is transferred, automatically or manually. The staff therefore requests the applicant to demonstrate the methodology for a typical SBLOCA calculation in which all four codes are exercised. Identify the time intervals where each of the codes is being used.

15.00.02-14

The applicant is requested to justify the applicability of various heat transfer correlations used in the licensing basis codes for the range of thermal-hydraulic conditions encountered in the APR1400 SBLOCA analysis. Were these correlations used within their prescribed correlation limits? If not, please justify their out-of-bound usage to be conservative. The staff is especially interested in the FLECHT heat transfer correlations used in COMPERC-II, and the various pool boiling, film boiling, and critical heat flux (CHF) correlations used in the STRIKIN-II and PARCH codes.

15.00.02-15

According to Section 3.2, “Reflood Hydraulics,” of the TeR, the reflood period of an SBLOCA is defined as the period of time following initiation of emergency core cooling (ECC) injection by the safety injection tanks (SITs). It is the staff’s understanding that the COMPERC-II code is used only for the reflood phase. Please explain why a computer code different from CEFLASH-4AS is needed to analyze this phase of the transient. Why was CEFLASH-4AS not run for the entire transient to generate the hydraulic input parameters for PARCH and STRIKIN-II, and why was COMPERC used?

15.00.02-16

REQUEST FOR ADDITIONAL INFORMATION 431-8504

The CE-ABB SBLOCA methodology being used by KHNP was approved for power ratings up to 3800 MWt, per the letter from Parr (NRC) to Stern (CE), dated June 13, 1975. The APR1400 SBLOCA calculations for the APR1400 design are conducted at a power level of 4062.7 MWt (102% of 3983 MWt), which is significantly higher than the 3800 MWt restriction on the CE-ABB SBLOCA methodology. Document the revision of the SBLOCA methodology being used and provide the justification for using the methodology and the computer codes at this higher power level. The justification should include references to other instances where the CE-ABB SBLOCA methodology has been approved by the NRC for higher power levels. The applicant needs to demonstrate the conservatism of the methodology at the APR1400 power level, and establish that there are no phenomenological departures due to APR1400 power level or design differences that would invalidate the use of the SBLOCA methodology or the computer codes approved up to 3800 MWt applications.

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