KHNPTopRptsRAIsPEm Resource

From: Ciocco, Jeff
Sent: Thursday, April 07, 2016 9:13 AM
To: apr1400rai@khnp.co.kr; KHNPTopRptsRAIsPEm Resource; Jungho Kim (jhokim082@gmail.com); Andy Jiyong Oh; Christopher Tyree
Cc: Gilmer, James; Karas, Rebecca; Steckel, James; Williams, Donna
Subject: APR1400 Topical Report RAI 7-8567 (Topical Report: APR1400-F-A-TR-12004 Realistic Evaluation Methodology for Large-Break LOCA of the APR1400)
Attachments: APR1400 TR RAI 7 SRSB 8567.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:

TR Realistic Evaluation Methodology for LBLOCA of the APR1400-4: 45 days
TR Realistic Evaluation Methodology for LBLOCA of the APR1400-5: 45 days
TR Realistic Evaluation Methodology for LBLOCA of the APR1400-6: 30 days
TR Realistic Evaluation Methodology for LBLOCA of the APR1400-7: 30 days
TR Realistic Evaluation Methodology for LBLOCA of the APR1400-8: 30 days
TR Realistic Evaluation Methodology for LBLOCA of the APR1400-9: 30 days

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

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 7-8567

Issue Date: 04/07/2016
Application Title: APR1400 Topical Reports
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. PROJ 0782
Review Section: TR Realistic Evaluation Methodology for LBLOCA of the APR1400
Application Section: Topical Report: APR1400-F-A-TR-12004 Realistic Evaluation Methodology for Large-Break LOCA of the APR1400

QUESTIONS

TR Realistic Evaluation Methodology for LBLOCA of the APR1400-4

10 CFR 50.46(a) states that the evaluation model for calculating the emergency core cooling system performance must adequately account for uncertainty in the calculated results. Section 15.0.2 of the standard review plan (NUREG-0800) states that the major sources of uncertainty must be addressed consistent with the results of the accident sequence identification process.

In the development of the phenemena identification and ranking table (PIRT) for analysis of the APR1400 large break loss of coolant accident, [ ] phenema or processes were ranked as important. The topical report identifies [ ] uncertainty parameters to be sampled. NRC staff is questioning whether the selection of uncertainty parameters adequately addresses the important phenemena identified in the PIRT. NRC staff requests the following additional information:

1. Explain how the sampled uncertainty parameters (identified in Table 5-1 of the topical report) were selected.

2. Explain how all the important phenomena identified in the PIRT are covered by the selected uncertainty parameters.

TR Realistic Evaluation Methodology for LBLOCA of the APR1400-5

10 CFR 50.46(a) states that the evaluation model for calculating the emergency core cooling system performance must adequately account for uncertainty in the calculated results. Section 15.0.2 of the standard review plan (NUREG-0800) states the uncertainty analysis must address all important sources of code uncertainty, including the mathematical models in the code and user modeling, such as nodalization.

Section 4.2.1 of topical report APR1400-F-A-TR-12004, Rev. 0 discusses the radial nodalization of the core. The discussion in the topical report does not discuss the assessment of the radial nodalization, which has caused NRC staff to question if the nodalization can capture the multi-dimensional effects in a realistic or suitably-conservative manner. NRC requests that KHNP provide additional justification for the radial nodalization used in the large break loss of coolant accident analyses.

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TR Realistic Evaluation Methodology for LBLOCA of the APR1400-6

10 CFR 50.46(a) states that the evaluation model for calculating the emergency core cooling system performance must adequately account for uncertainty in the calculated results. Section 15.0.2 of the standard review plan (NUREG-0800) states the uncertainty analysis must address all important sources of code uncertainty, including the mathematical models in the code and user modeling.

The phenomena identification and ranking table for the APR1400 large break loss of coolant accident identifies the cold leg to containment flow path as being a significant parameter during the refill and reflood phases. The friction and form losses associated with the cold leg to containment flow path are not included in the uncertainty parameters. This has caused NRC staff to question whether the treatment of uncertainty of these significant parameters is suitably conservative. NRC staff requests that KHNP justify their treatment of uncertainty associated with the cold leg to containment flow path in the refill and reflood phases.

TR Realistic Evaluation Methodology for LBLOCA of the APR1400-7

10 CFR 50.46(a) states that the evaluation model for calculating the emergency core cooling system (ECCS) performance must include sufficient supporting justification to show that the analytical technique realistically describes the behavior of the reactor system during a loss-of-coolant accident.

Evaluation of ECCS bypass included a comparison against data from the upper plenum test facility (UPTF). KHNP selected test UPTF-4A, with cold leg injection, to determine the ECCS bypass bias during the refill phase. Tests UPTF-21A and UPTF-21B involve downcomer injection of the ECCS. Because the APR1400 utilizes direct vessel injection, NRC staff is questioning if test UPTF-4A is the appropriate choice for determining ECCS bypass bias. NRC staff requests that KHNP justify their selection of the UPTF-4A test, with cold leg injection, to determine ECCS bypass bias during the refill phase in their evaluation model.

TR Realistic Evaluation Methodology for LBLOCA of the APR1400-8

10 CFR 50.46(a) states that the evaluation model for calculating the emergency core cooling system (ECCS) performance must include sufficient supporting justification to show that the analytical technique realistically describes the behavior of the reactor system during a loss-of-coolant accident.

Evaluation of ECCS bypass included a comparison against data from the advanced thermal-hydraulic test loop for accident simulation (ATLAS). For ATLAS Test 15, downcomer wall temperatures and collapsed liquid levels in the core and downcomer region appear to show that

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RELAP is under-predicting ECCS bypass. This has caused NRC staff to question whether the evaluation model can capture ECCS bypass during reflood in a suitably conservative way. NRC staff requests the following information of KHNP:

1. Explain the cause of RELAP5 over-predicting the collapsed liquid level in the core and downcomer for ATLAS Test 15.

2. Explain how the evaluation model for large break loss-of-coolant accident analysis captures the phenomena of ECCS bypass in a suitably conservative way.

TR Realistic Evaluation Methodology for LBLOCA of the APR1400-9

10 CFR 50.46(a) states that the evaluation model for calculating the emergency core cooling system performance must adequately account for uncertainty in the calculated results. Section 15.0.2 of the standard review plan (NUREG-0800) states the uncertainty analysis must address all important sources of code uncertainty, including the mathematical models in the code and user modeling.

Section 5.1.4 of topical report APR1400-F-A-TR-12004-P, Rev. 0, discusses the treatment of the uncertainty associated with the pump two-phase degradation multiplier. The topical report states that the pump is assumed to be [ ].

This has caused NRC staff to question the treatment of uncertainty associated with pump two-phase performance. Additionally, the mean value provided for the distribution function is stated to be below the minimum value for the distribution. NRC staff requests the following additional information:

1. Provide justification for the chosen uncertainty range for the pump two-phase pump degradation multiplier.

2. Correct the information in Section 5.1.4 regarding the distribution.