KHNPDCDRAIsPEm Resource

From:	Ciocco, Jeff
Sent:	Monday, November 30, 2015 12:02 PM
To:	apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Harry (Hyun Seung) Chang; Andy Jiyong Oh; Erin Wisler
Cc:	Haider, Syed; Segala, John; Umana, Jessica; Lee, Samuel
Subject:	APR1400 Design Certification Application RAI 322-8393 (6.2.1.3: Mass and Energy Release Analyses for Postulated Loss-of Coolant Accidents)
Attachments:	APR1400 DC RAI 322 SCVB 8393.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, 45 days to respond to this RAI. We may adjust the schedule accordingly.

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

Thank you,

Jeff Ciocco
New Nuclear Reactor Licensing
301.415.6391
jeff.ciocco@nrc.gov

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Hearing Identifier: KHNP_APR1400_DCD_RAI_Public
Email Number: 371

Mail Envelope Properties (1f47b9e081c049ecbe8c372fd18b2562)

Subject: APR1400 Design Certification Application RAI 322-8393 (6.2.1.3: Mass and Energy Release Analyses for Postulated Loss-of Coolant Accidents)
Sent Date: 11/30/2015 12:01:44 PM
Received Date: 11/30/2015 12:01:47 PM
From: Ciocco, Jeff

Created By: Jeff.Ciocco@nrc.gov

Recipients:
"Haider, Syed" <Syed.Haider@nrc.gov>
Tracking Status: None
"Segala, John" <John.Segala@nrc.gov>
Tracking Status: None
"Umana, Jessica" <Jessica.Umana@nrc.gov>
Tracking Status: None
"Lee, Samuel" <Samuel.Lee@nrc.gov>
Tracking Status: None
"apr1400rai@khnp.co.kr" <apr1400rai@khnp.co.kr>
Tracking Status: None
"KHNPDCDRAIsPEm Resource" <KHNPDCDRAIsPEm.Resource@nrc.gov>
Tracking Status: None
"Harry (Hyun Seung) Chang" <hyunseung.chang@gmail.com>
Tracking Status: None
"Andy Jiyong Oh" <jiyong.oh5@gmail.com>
Tracking Status: None
"Erin Wisler " <erin.wisler@aecom.com>
Tracking Status: None

Post Office: HQPWMSMRS07.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	608	11/30/2015 12:01:47 PM
APR1400 DC RAI 322 SCVB 8393.pdf	95239	
image001.jpg	5040	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information 322-8393

Issue Date: 11/30/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 06.02.01.03 - Mass and Energy Release Analysis for Postulated Loss-of-Coolant Accidents (LOCAs)
Application Section: 6.2.1.3: Mass and Energy Release Analyses for Postulated Loss-of Coolant Accidents

QUESTIONS

06.02.01.03-2

Modeling Fluidic Device and Direct Vessel Injection for the Limiting LOCA

General Design Criterion (GDC) 50, "Containment design basis," and Appendix K to 10 CFR Part 50, "ECCS Evaluation Models" require, in part, that the selected combination of power distribution shape and peaking factor should be the one that results in the most severe calculated consequences for the spectrum of postulated breaks and single failures that are analyzed. NUREG-0800, SRP Section 6.2.1.3, "Mass and Energy Release Analysis for Postulated Loss-of-Coolant Accidents (LOCAs)" suggests that containment design basis calculations should be performed for a spectrum of possible pipe break sizes and locations to assure that the worst case has been identified. APR-1400 methodology identifies a double-ended discharge leg slot break (DEDLSB) with maximum safety injection (SI) flow to be the most limiting LOCA, as documented in Table 3-1, "Containment P/T with 1 Percent Metal-Water Reaction", in the Technical Report (TeR) APR1400-Z-A-NR-14007-P, Rev.0, "LOCA Mass and Energy Release Methodology".

It can be postulated that a higher safety injection rate and flow enthalpy would result in a higher mass and energy release and subsequently higher peak containment pressure and temperature. In this regard, the staff seeks the following information to address safety concerns about the CEFLASH-4A treatment of the fluidic device (FD) flow as a reactor coolant system (RCS) boundary condition for the limiting LOCA analysis for the containment. The applicant is also requested to update the APR1400 DCD and the TeR to document the respective explanations.

Table 3-1 in the TeR shows that, for the limiting cold leg LOCA, it takes 324.1 seconds from the start of the accident until the containment peak pressure is reached. TeR Table 4-2 shows that it takes 49.35 seconds for the safety injection tank (SIT) flow to be turned down to the low-flow rate by the FD. This leaves 324.1 – 49.35 = 274.75 seconds for the remaining SIT flow to contribute to the containment peak pressure. However, it is argued in TeR Section 3.11.1 that the effect of the FD flow rate on steam condensation in the downcomer of the intact loop is conservatively ignored considering the FD flow rate to be small. Clarification is sought regarding the treatment of the SIT water below the top of the stand pipe. The following two questions inquire about whether or not the SIT water inventory is credited in the analysis to enter the RCS after the SIT water level drops below the top of the FD stand pipe.

(a) If no SIT water inventory is credited in the analysis, the extent of conservatism by ignoring steam condensation is reduced, as the SIT water below the top of stand pipe does not enter the core to pick up heat and transfer to containment for pressurization. In that case, please justify using a less than 100% SIT flow as the limiting cold leg break LOCA uses maximum safety injection.

(b) On the contrary, if the entire SIT water inventory is credited in the analysis, please justify the capability of the CEFLASH-4A code for modeling the FD to account for its contribution to containment peak pressure.

06.02.01.03-3

Figure 2-2 in the TeR shows the unique APR1400 feature of direct vessel injection (DVI), delivering safety injection flow to the downcomer during a LOCA. According to Figure 2-2 of the TeR and Figure 5.3-8 of the DCD, the DVI nozzle elevation is well above the cold leg. In this backdrop, the applicant is requested to address the following questions.

(a) The traditional PWR cold leg injection credits the emergency coolant injection only into three out of the four cold legs for core cooling, with the broken leg coolant added to the containment as spillage flow. The spillage flow rates for APR1400 design are given in Table 4-2 of the TeR. Please state the fraction of the coolant flow that spills out of the break into the containment. In other words, how does the spillage flow as a percentage of total safety injection compare with the 25% for the traditional PWR cold leg injection?

(b) The safety injection into the RCS by the SITs and the safety injection pumps (SIPs) during the blowdown, refill, and the reflood phases of a LOCA are modeled by using the CEFLASH-4A and FLOOD-3 codes. Have these modeling codes been validated and approved to model DVI type injection?

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment