KHNPDCDRAIsPEm Resource

From:	Ciocco, Jeff
Sent:	Monday, November 16, 2015 1:32 PM
To:	apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Harry (Hyun Seung) Chang; Andy Jiyong Oh; Young H. In (yhin@KHNP.co.kr); James Ross
Cc:	Schaperow, Jason; Mrowca, Lynn; Steckel, James; Lee, Samuel
Subject:	APR1400 Design Certification Application RAI 313-8366 (19 - Probabilistic Risk Assessment and Severe Accident Evaluation)
Attachments:	APR1400 DC RAI 313 SPRA 8366.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

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United States Nuclear Regulatory Commission
Protecting People and the Environment

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Subject: APR1400 Design Certification Application RAI 313-8366 (19 - Probabilistic Risk Assessment and Severe Accident Evaluation)
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From: Ciocco, Jeff

Created By: Jeff.Ciocco@nrc.gov

Recipients:
"Schaperow, Jason" <Jason.Schaperow@nrc.gov>
Tracking Status: None
"Mrowca, Lynn" <Lynn.Mrowca@nrc.gov>
Tracking Status: None
"Steckel, James" <James.Steckel@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
"Young H. In (yhin@KHNP.co.kr)" <yhin@KHNP.co.kr>
Tracking Status: None
"James Ross" <james.ross@aecom.com>
Tracking Status: None

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Options
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Return Notification: No
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REQUEST FOR ADDITIONAL INFORMATION 313-8366

Issue Date: 11/16/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section:

QUESTIONS

19-19

NRC regulations 10 CFR 52.47(a)(23) and 10 CFR 52.47(a)(27) require that the applicant perform a probabilistic risk assessment and an analysis of design features for the prevention and mitigation of severe accidents.

Chapter 19.0 of the NRC's Standard Review Plan (SRP), Revision 3 (draft), includes the following guidance to the NRC reviewer: "…the reviewer carries out an independent assessment of the plant response to selected severe accident scenarios using the latest version of the MELCOR computer code. The assessment should examine accident scenarios from the PRA, which are chosen based on a combination of frequency, consequence, and dominant risk. Some of these scenarios should be similar or identical to sequences analyzed by the applicant and reported in the PRA."

The staff developed a MELCOR model for the APR1400 design, selected scenarios from the applicant's PRA and severe accident analysis, and performed MELCOR simulations for those scenarios. The selected scenarios and their objectives as related the PRA were as follows:

- STC10 – estimate source term for scenario without containment failure (DBA leakage only)
- STC11 - estimate source term for basemat melt-through scenario
- STC16 – estimate source term for scenario with late containment failure of 0.1 ft^2 hole
- Q03 – estimate containment pressure for scenario with dry cavity

Using detailed MAAP output provided by the applicant for those scenarios, the staff compared the MELCOR simulations with the MAAP simulations. For the staff to reach a reasonable assurance finding that the MAAP simulations are realistic, please respond to the items below and update the DCD as needed. Also, please provide justification if the response information is excluded from the DCD.

a. Please explain the basis for the decay power used in the analysis. For example, on what fuel burnup, operating power, and time in the operating cycle (e.g., end of cycle) was the decay power based?

b. Please describe the assumptions made in the analysis for feedwater injection coastdown and MSIV closure timing.

c. Please provide the basis for not including reactor coolant pump seal leakage/failure flow paths and the resulting flow in the analysis.

d. It is unclear to the staff how many pressurizer pilot-operated safety relief valves (POSRVs) were opened and why they were opened at 1 hour. Thus, please provide the

number of POSRVs opened and the basis for the quantity and the timing of opening POSRVs. (STC10, STC11, STC16)

e. The MAAP RCS pressure plot indicates that the depressurization was stopped from 3640 sec to 4370 sec. Please explain why the pressurization was stopped. (STC10)

f. It is observed that not including safety injection tank (SIT) injection in the analysis may be an unrealistic assumption. Please explain the basis for not including SIT injection.

g. Please explain the basis for the MAAP steam generator (SG) pressure to start trending down after 100,000 sec. (STC10)

h. The MAAP SG water level plot seems to show that water level increases from a level of zero starting at 140,000 sec. Please explain the basis for reintroduction of water into the SGs at this time. (STC10)

i. MAAP appears to be calculating no ablation, even though core debris is in contact with the cavity concrete floor. Please explain the basis for this modeling. (STC10)

j. Please explain what is being assumed for hydrogen sinks in the simulation. For example, are passive autocatalytic recombiners (PARs) and igniters assumed to be operating? Under what conditions are hydrogen burns assumed to occur?

k. It is unclear to the staff how many 3-way valves were opened and why they were opened at 1800 sec (30 minutes) after the core exit thermocouple temperature reaches 922K. Please provide the number of 3-way valves being opened and the basis for the quantity and the timing of opening 3-way valves. (STC10, STC11, STC16)

l. From 12,400 to 55,000 sec, the MAAP cavity water level plot appears to show water in the cavity. However, the ablation depth and containment pressure plots during this time frame seem to indicate that the water is not taking away any heat from the core debris. Please explain the basis as to why overlying water is not taking away heat from the core debris. (STC11)

m. The MAAP cavity water level plot shows water level decreasing more slowly from 12,400 to 41,500 than from 41,500 to 55,000 sec. Please explain the basis as to why the water level decreases faster after 41,500 sec. (STC11)

n. Starting at 55,000 sec, the MAAP cavity water level plot seems to show that water level drops below the bottom of the cavity (i.e., below 0 meters). Please explain the basis as to how the water can drop below the bottom of the cavity. (STC11)

o. After the containment spray starts (around 100,000 sec), the MAAP containment water level plot shows containment spray water going into the holdup volume tank but not into the cavity. Please provide the basis for containment spray water not reaching the cavity, which is the lowest point in the containment. (STC11)

p. It is observed that not including PARS in the analysis may be an unrealistic assumption. Please explain the basis for not including PARS. (STC16)

q. The scenario includes a hole in the containment as a result of a hydrogen burn around 100,000 sec. While the MAAP output plots indicate a hole in the containment at this time, they do not indicate that a burn occurred. For example, there was no decrease in mole fractions of combustibles and no increase in containment pressure at the time of the burn. Please provide the basis for not modeling the effect of the burn on the progression of the accident. (STC16)

r. The MAAP output plots indicate that the reactor vessel lower head ruptures when the reactor vessel is still at high pressure. However, it appears that the effects of the resulting high pressure melt ejection were not modeled. Please provide the basis for not modeling these effects. (Q03)

s. It is observed that not modeling severe accident induced hot leg rupture may be an unrealistic assumption. Please explain the basis for not modeling severe accident induced hot leg rupture. (Q03)

t. The MAAP output plots appear to show core debris exiting the vessel more slowly in the Q03 scenario than in the STC16 scenario. Please explain the basis for this.

u. The MAAP output plots appear to show more CO_2 being produced in the Q03 scenario than in the STC16 scenario. Please explain the basis for this.


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