## AREVAEPRDCPEm Resource

**From:** Tesfaye, Getachew
**Sent:** Wednesday, July 25, 2012 4:27 PM
**To:** 'usepr@areva.com'
**Cc:** Grady, Anne-Marie; Ashley, Clinton; McKirgan, John; Budzynski, John; Donoghue, Joseph; Gleaves, Bill; Segala, John; ArevaEPRDCPEm Resource
**Subject:** U.S. EPR Design Certification Application RAI No. 553 (6573, 6463), FSAR Ch. 6
**Attachments:** RAI_553_SCVB_6573_SRSB_6463.doc

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on June 26, 2012, and discussed with your staff on June 27, July 3 and July 10, 2012. Draft RAI Question 06.02.05-31(e) was modified as a result of those discussions. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
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**Hearing Identifier:** AREVA_EPR_DC_RAIs
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**From:** Tesfaye, Getachew

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Request for Additional Information No. 553(6573, 6463), Revision 0

7/25/2012

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 06.02.05 - Combustible Gas Control in Containment
SRP Section: 06.03 - Emergency Core Cooling System

Application Section: FSAR Chapter 6

QUESTIONS for Containment & Ventilation Branch (SCVB)

QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)

06.02.05-31

Open Item

Follow-up to RAI 471, Question 06.02.05-21

a. In response to RAI 471 Question 6.2.5-21, AREVA has introduced an external make-up (source) of hydrogen into the reactor coolant system over a period of several thousand seconds (i.e., 6,400 to 14,400 seconds) for the scenarios analyzed. For the LOOP-TR scenario, this relatively long period of release (14,400 seconds) for the external hydrogen source is not consistent with the period over which MAAP calculates the in-vessel oxidation to occur. The injection of the external hydrogen source over a shorter time period may result in temporarily exceeding the recombination capacity of PARs, and therefore, a higher containment hydrogen concentration, especially for cases involving a conversion efficiency of 50 percent for PARs. Please provide a sensitivity study for the LOOP-TR scenario to evaluate the importance of faster release rate for the external hydrogen source on the performance of the CGCS.

b. For each scenario analyzed in response to RAI 471 Question 6.2.5-21, the in-vessel hydrogen productions are calculated to be either higher or lower when the efficiency of PARs was changed. This effect is particularly significant for the LOOP-TR scenario. Please provide an explanation clarifying the reasons for observing an impact from the operation of PARs inside the containment on the in-vessel hydrogen production. If this variability is due to any numerical and/or time stepping issues in MAAP, please perform a time step sensitivity study for two most frequency-dominant relevant severe accident scenarios, and provide the calculated results for typical severe accidents signatures (e.g., timing of key events, the core debris mass relocating into the lower plenum/reactor pit, the time of melt-plug failure, the magnitude of in-vessel hydrogen generation, etc.).

c. Because the analyses results are highly dependent on the assumptions related to the accident progression and the various pathways (openings) between the containment compartments, please identify the specific accident scenarios as listed in the response to RAI 6, Questions 19-82 and 19-95 that were used in the

response to RAI #471, question 6.2.5-21. In a telecon with AREVA, it was agreed that this information would be available from the phenomenological evaluation, Table 6.2.1.

d. For the accident scenarios documented in the response to RAI #471, question, 6.2.5-21, please provide the input assumptions related to the following:

1) The percent of open area for the foils,

2) The percent of open area for the dampers,

3) The number of safety related doors in pressurizer rooms that remain open, and

4) The specific compartment doors in the containment that are credited to be in open position (other than the doors in the pressurizer compartment).

e. Revise the FSAR, in chapter 6.2.5 to reflect the revised analysis. Provide a detailed description of the revised analysis method and provide figures depicting the hydrogen concentration at each node for the most limiting severe accident scenario. In FSAR chapter 19.2 distinguish the analytical basis of figure 19.2-5, hydrogen concentration throughout containment, from the figures in chapter 6.2.5 depicting the hydrogen concentration in all containment nodes.

06.03-18

Open Item

Follow-up to RAI 416, Question 6.3-15

In response to RAI 416, Question 06.03-15 (June 2011), the applicant references SECY 11-0014, "Use of Containment Accident Pressure in Analyzing Emergency Core Cooling System and Containment Heat Removal System Pump Performance in Postulated Accidents" (January, 2011).

In this Commission paper (SECY 11-0014, ML102590196), the staff presented options to the Commission to resolve outstanding issues related to the use of containment accident pressure (CAP) in determining the net positive suction head (NPSH) margin of safety related pumps.

The Commission provided direction to the staff in Staff Requirements Memorandum (SRM) SECY 11-0014 (ML110740254), on March 15, 2011. Included in the Commission's response was direction to implement the staff's guidance.

In FSAR 6.3.3 markup in response to RAI 498 Supplement 4 Question 06.02.02-119 AREVA clarifies that the US EPR does use containment accident pressure in assessing the adequacy of NPSH for ECCS pumps.

However, in response to RAI 416, Question 06.03-15, the applicant did not include a description of how or if the US EPR met the staff guidance contained in SECY 11-0014. Therefore, the staff request AREVA provide information that addresses the guidance, as appropriate.

As an example, the SECY paper guidance (section 6.3) discusses evaluating effective required NPSH (NPSHreff) and Cavitation Erosion. For NPSHreff, the staff guidance proposes that the NPSH margin be calculated from NPSHa − NPSHreff, where NPSHreff is the NPSHr3% value with uncertainties in NPSHr included. This calculated NPSH margin should be equal to or greater than zero. For Cavitation Erosion (or maximum erosion zone) staff guidance states that pump tests indicate that the zone of maximum erosion rate lies between NPSH ratios of 1.2 to 1.6 for

pumps operating outside of the zone of suction recirculation. The staff selected a time limit of 100 hours for the time permitted in the maximum erosion zone. NPSH ratio = NPSHa/NPSHreff.

To complete the staff evaluation of the 6.3 SER Phase 2 Open Item 06.03-15 in support of ECCS pump performance, the staff request that AREVA address guidance contained in SECY 11-0014 and provide key NPSH information in FSAR section 6.3 that identifies the limiting or worst case NPSH evaluation for the ECCS pumps with justification for the selected data. At a minimum, the staff expects the FSAR to contain the limiting ECCS pump NPSH evaluation, to include the following parameters and plots, and to specify the basis for the ECCS pump flowrate selected and NPSHr uncertainty. Note, all heads and pressures should be expressed in feet of liquid at the pumping temperature selected for the evaluation.

NPSHa

- Minimum elevation (static) head (feet)
- Strainer loss (feet)
- Line/friction loss (feet)
- Atmosphere Pressure (feet)
- Vapor Pressure of liquid at pump suction (feet)

NPSHreff where NPSHreff = (1 + uncertainty) x NPSHr3%

Plot of NPSHa and NPSHreff vs. Time

In addition, as a follow-up to RAI 498, Question 6.2.2-119, the applicant is requested to describe why Tables 6.3-2 and 6.3-3 of the FSAR does not identify pump characteristics for flow rates up to 3220 gpm and 1110 gpm for the LHSI and MHSI pumps since these upper flow rates are identified in Section G.2.5 of Technical Report ANP-10293.