ArevaEPRDCPEm Resource

From: RYAN Tom (AREVA) [Tom.Ryan@areva.com]
Sent: Wednesday, June 13, 2012 3:02 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); GUCWA Len (EXTERNAL AREVA); Miernicki, Michael; WILLIFORD Dennis (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 540 (6300, 6308, 6329), FSAR Ch. 6, Supplement 1
Attachments: RAI 540 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for technically correct and complete responses to the 6 questions in RAI 540 on April 23, 2012. The attached file, "RAI 540 Supplement 1 Response US EPR DC.pdf" provides a technically correct and complete response to Question 06.02.01.05-2.

The following table indicates the respective pages in the response document, "RAI 540 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question. Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 540 Question 06.02.01.05-2.

Question #	Start Page	End Page
RAI 540 — 06.02.01.05-2	2	3

The schedule for technically correct and complete responses for the remaining 5 questions is unchanged and provided below.

Question #	Response Date
RAI 540 — 06.02.01.01.A-3	**July 6, 2012**
RAI 540 — 06.02.05-27	**July 17, 2012**
RAI 540 — 06.02.05-28	**July 17, 2012**
RAI 540 — 06.02.05-29	**July 17, 2012**
RAI 540 — 06.02.05-30	**July 17, 2012**

Sincerely,

Tom Ryan for
Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Monday, April 23, 2012 1:29 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 540 (6300, 6308, 6329), FSAR Ch. 6

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 540 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the six questions cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 540 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 540 — 06.02.01.01.A-3	2	2
RAI 540 — 06.02.01.05-2	3	3
RAI 540 — 06.02.05-27	4	4
RAI 540 — 06.02.05-28	5	5
RAI 540 — 06.02.05-29	6	6
RAI 540 — 06.02.05-30	7	7

The schedule for a technically correct and complete response to these 6 questions is provided below.

Question #	Response Date
RAI 540 — 06.02.01.01.A-3	**July 6, 2012**
RAI 540 — 06.02.01.05-2	**June 14, 2012**
RAI 540 — 06.02.05-27	**July 17, 2012**
RAI 540 — 06.02.05-28	**July 17, 2012**
RAI 540 — 06.02.05-29	**July 17, 2012**
RAI 540 — 06.02.05-30	**July 17, 2012**

Sincerely,

Dennis Williford, P.E.
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, March 22, 2012 4:43 PM
To: ZZ-DL-A-USEPR-DL

Cc: Peng, Shie-Jeng; Grady, Anne-Marie; McKirgan, John; Gleaves, Bill; Segala, John; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 540 (6300, 6308, 6329), FSAR Ch. 6

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on March 5, 2012, and discussed with your staff on March 15 and 22, 2012. Draft RAI Question 06.02.01.01.A-2 was deleted and Draft RAI Question 06.02.01.05-2 (a) 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
Sr. Project Manager
NRO/DNRL/LB1
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 3948

Mail Envelope Properties (68A588D0DDE96547855C97AF83A8CAFDA0ADF6)

Subject: Response to U.S. EPR Design Certification Application RAI No. 540 (6300, 6308, 6329), FSAR Ch. 6, Supplement 1
Sent Date: 6/13/2012 3:02:17 PM
Received Date: 6/13/2012 3:02:52 PM
From: RYAN Tom (AREVA)

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Files	**Size**	**Date & Time**
MESSAGE	4425	6/13/2012 3:02:52 PM
RAI 540 Supplement 1 Response US EPR DC.pdf		166108

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

Response to

Request for Additional Information No. 540, Supplement 1

3/22/2012

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 06.02.01.01.A - PWR Dry Containments, Including Subatmospheric Containments
SRP Section: 06.02.01.05 - Minimum Containment Pressure Analysis for Emergency Core Cooling System Performance Capability Studies
SRP Section: 06.02.05 - Combustible Gas Control in Containment

Application Section: 6.2

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)

Question 06.02.01.05-2:

OPEN ITEM

Based on 10 CFR 50.46, the purpose of this RAI is to ensure the validity of the analysis (Sec. 6.2.1.5) that will produce the minimum possible containment pressure as applied to the ECCS performance evaluation.

a. Additional Information for the Outside Atmospheric Temperature.

   In Rev.0 DCD FSAR Sec. 6.2.1.5, it described that the outside atmospheric temperature used in the analysis was 20ºF. In Rev.3 DCD FSAR Sec. 6.2.1.5, such a data is not presented. Justify why the data is not shown in Rev.3 DCD FSAR Sec. 6.2.1.5. Justify the use of the data and document the data in FSAR that is assumed in the analysis for Sec. 6.2.1.5.to reflect the minimum temperature as specified in the Rev.3 DCD FSAR Table 2.1-1-U.S. EPR Site Design Envelope.

b. Consideration of Containment Purge

   It is not described in the FSAR Sec. 6.2.1.5 that the containment purge has been considered in the analysis of minimum containment pressure. Since the containment purge system can be used during plant normal operation, an inclusion of containment purge in the analysis should be considered according to SRP Branch Technical Position 6-2. If the containment purge has been modeled in the analysis, provide modeling information and its impact on the analysis results in the FSAR. Otherwise, provide justification if it is not assumed or modeled in the analysis.

Response to Question 06.02.01.05-2a:

Justify why the 20°F is not shown in Rev.3 DCD FSAR Sec. 6.2.1.5.

The ICECON model reported in U.S. EPR FSAR, Tier 2, Rev. 0, Section 6.2.1.5 models the heat structures representing the containment walls and liner as being in contact with the containment atmosphere on one side. The other side, representing the boundary between the containment wall and the containment annulus, is treated as insulated. Under this original approach, the initial outside air temperature does not affect the containment pressure calculation. This component of the ICECON model has since been updated as described below.

Justify the use of the data that is assumed in the analysis for Sec. 6.2.1.5.

As discussed in U.S. EPR FSAR, Tier 2, Section 6.2.1.5., the ICECON model includes heat transfer to the containment annulus. The revised analysis models the annulus temperature at 45°F, which is the minimum winter design value for the containment annulus based on a minimum outside air temperature of -40°F, as specified in U.S. EPR FSAR, Tier 2, Table 2.1-1—U.S. EPR Site Design Envelope.

Document the data in the FSAR

U.S. EPR FSAR, Tier 2, Section 6.2.1.5.2 will be revised to provide additional information regarding the containment annulus temperature and the analytical containment model.

Response to Question 06.02.01.05-2b:

The containment purge system can be used during normal plant operation. However, the containment purge valves are shut when the containment pressure reaches the high containment pressure setpoint (19.2 psia with uncertainty). As explained in the response to RAI 82, Question 06.02.01.05-1g (Supplement 3, May 22, 2009), ICECON cannot model the purge system isolation function during the transient event; therefore, the system is not accounted for in the minimum containment pressure calculation. However, calculations performed with the GOTHIC computer model of the containment determined that inclusion of the purge system produces only a slight decrease in the containment pressure, which results in an insignificant effect on the peak cladding temperature.

U.S. EPR FSAR, Tier 2, Section 6.2.1.5.2 will be revised to provide additional information regarding the analytical containment model.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 6.2.1.5.2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

building design pressure of 62 psig, or 309.1°F. Figure 6.2.1-35 shows that the analysis predicts that the containment vapor temperature is above the saturation temperature for approximately two minutes.

6.2.1.5 Minimum Containment Pressure Analysis for Performance Capability Studies on Emergency Core Cooling System

6.2.1.5.1 Mass and Energy Release Data

Containment pressure calculations are performed by the ICECON module within the S-RELAP5 code. ICECON is a variant of the CONTEMPT/LT-022 containment code series. The tabular mass and energy release data are not explicitly generated because they are part of the internal code calculations at each time step. The mathematical models that calculate the mass and energy releases to the containment are described in Section 15.6 and conform to the realistic ECCS evaluation models of 10 CFR 50.46(a)(1)(i).

6.2.1.5.2 Initial Containment Internal Conditions

The U.S. EPR containment in ICECON is modeled as a dry containment with only one compartment: the drywell compartment. The reactor vessel and primary system are represented as a mass and energy source to the containment volume. The containment building is modeled as being in contact with the containment volume on the interior side and the containment annulus on the exterior side.

The dominant phenomenon of interest related to the ICECON containment model is the effect of containment pressure on PCT. Containment pressure is treated statistically in the RLBLOCA methodology by ranging the containment volume from the best estimate value to the maximum possible free volume. For each case in the RLBLOCA analysis, the initial values for the containment volume conditions are representative of 100 percent rated thermal power and a pressure of 14.664 psia. The containment volume temperature is sampled between 100°F and 131°F. The containment vapor and liquid, including the liquid in the IRWST, are modeled at the same sampled temperature. The relative humidity of the vapor region is 100 percent.

6.2.1.5-2

A containment annulus temperature of 45°F and relative humidity of 70 percent are assumed and modeled within the ICECON module. The 45°F temperature is the minimum winter design value. for the containment annulus based on site design envelope temperatures. The heat transfer coefficient for heat transfer to the containment annulus is 5.0 Btu/hr-ft^2-°F. The value of 5 Btu/hr-ft^2-°F is used for free convection in air and is the upper range of values for a free convection application, as stated in *Principles of Heat Transfer* (Reference 16). The containment pressure response using 1.0 Tagami plus 1.0 Uchida was compared to 1.7 Uchida alone. For the U.S. EPR design, using 1.7 Uchida for condensation heat transfer produces a lower containment pressure than 1.0 Tagami + 1.0 Uchida. In addition, the 1.7 Uchida

coefficient was found to be conservative with respect to experimental data. Therefore, 1.7 Uchida is used to calculate the minimum containment pressure.

The containment purge system can be used during normal plant operation. However, the containment purge valves are shut after the containment pressure reaches the high containment pressure setpoint. The inclusion of containment purge in the minimum containment pressure analysis was considered. However, ICECON cannot model the purge system's valve closure when the high containment pressure setpoint is reached and therefore the system is not accounted-for in the minimum containment pressure analysis. A modified GOTHIC containment model determined that including the containment purge subsystem produced only a slight decrease in containment pressure, which translates to an insignificant effect on the PCT results.

6.2.1.5-2

6.2.1.5.3 Other Parameters

The RLBLOCA methodology sets the initial containment pressure by sampling the containment volume. The combined containment free volume is 2.888 x 10^6 ft^3 which represents the sum of the nominal containment free volume and the nominal IRWST water volume, and is the lower bound of the containment volume sampling range. The sum of the combined containment volume and the internal structure volume yields the maximum containment free volume, 3.934 x 10^6 ft^3, the upper bound of the containment volume sampling range. The maximum containment free volume is conservative because a lower containment backpressure results in the highest calculated peak cladding temperature.

Heat transfer between the IRWST water and containment vapor is treated in a conservative manner. The IRWST is assumed to be well mixed, so the liquid temperature at the interface between the IRWST water and the containment vapor space is the bulk liquid temperature. This neglects heating of the surface water and maximizes the temperature differential for heat transfer. Water spillage rates from the accumulator in the broken loop are determined as part of the core reflooding calculation and are included in the containment code calculational model.

Developing the heat sinks in the ICECON model begins with the heat structure groups in the U.S. EPR GOTHIC containment model. Assumptions used in the GOTHIC model are then assessed for applicability to a conservative minimum back-pressure calculation. The passive heat sinks and thermo-physical properties were derived in accordance with Branch Technical Position 6-2, “Minimum Containment Pressure Model for PWR ECCS Performance Evaluation.” Thus, an additional heat sink representing the uninsulated systems and components is incorporated into the ICECON model. However, the volume impact from this additional heat sink is not considered in the combined containment free volume or the maximum containment free volume calculations. An additional assumption increases the nominal heat