ArevaEPRDCPEm Resource

From: WELLS Russell (AREVA) [Russell.Wells@areva.com]
Sent: Wednesday, March 09, 2011 5:07 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); GUCWA Len (EXTERNAL AREVA); RANSOM James (AREVA); BROWNSON Doug (AREVA); BALLARD Bob (AREVA); HALLINGER Pat (EXTERNAL AREVA); RYAN Tom (AREVA); WILLIFORD Dennis (AREVA)
Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 416, FSAR Ch. 6, Question 06.03-15
Attachments: RAI 416 Question 06.03-15 Response US EPR DC - DRAFT.pdf

Getachew,

Attached is a draft response for RAI No. 416, Question 06.03-15 in advance of the final response date April 7, 2011 as shown below.

Let me know if the staff has questions or if this can be sent as a final response.

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)
434-942-6375 (cell)
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Russell.Wells@Areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, February 11, 2011 8:06 PM
To: Getachew.Tesfaye@nrc.gov
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 416, FSAR Ch. 6, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 416 on August 25, 2010. Supplement 1 response to RAI 416 was sent on November 5, 2010 and provided a response to 2 of the 3 questions.

The response schedule for Question 06.03-15 is changed as shown below to provide additional opportunity to interact with the NRC staff.

Question #	Response Date
RAI 416 — 06.03-15	April 7, 2011

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Friday, November 05, 2010 7:54 AM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 416, FSAR Ch. 6, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI 416 on August 25, 2010. The attached file, "RAI 416 Supplement 1 Response US EPR DC.pdf" provides technically correct and complete responses to 2 of the 3 remaining questions, as committed. 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 416 Question 06.02.01-94.

The following table indicates the respective pages in the response document, "RAI 416 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 416 — 06.02.01-94	2	31
RAI 416 — 06.02.01-95	32	35

The response schedule for Question 06.03-15 is changed to provide additional opportunity to interact with the NRC staff as shown below.

Question #	Response Date
RAI 416 — 06.03-15	February 24, 2011

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (External RS/NB)
Sent: Wednesday, August 25, 2010 8:13 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 416, FSAR Ch. 6

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 416 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 3 questions cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 416 Response US EPR DC.pdf," that contains AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 416 — 06.02.01-94	2	3
RAI 416 — 06.02.01-95	4	4
RAI 416 — 06.03-15	5	6

A complete answer is not provided for 3 of the 3 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 416 — 06.02.01-94	November 6, 2010
RAI 416 — 06.02.01-95	November 6, 2010
RAI 416 — 06.03-15	November 6, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
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Martin.Bryan.ext@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Monday, July 26, 2010 6:52 AM
To: ZZ-DL-A-USEPR-DL
Cc: Peng, Shie-Jeng; Jackson, Christopher; McKirgan, John; Ashley, Clinton; Lu, Shanlai; Donoghue, Joseph; Carneal, Jason; Colaccino, Joseph
Subject: U.S. EPR Design Certification Application RAI No. 416(4767,4749),FSAR Ch. 6

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on June 6, and discussed with your staff on June 30, 2010. No change is made to the draft RAI as a result of that discussion. 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/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 2680

Mail Envelope Properties (1F1CC1BBDC66B842A46CAC03D6B1CD410412C637)

Subject: DRAFT Response to U.S. EPR Design Certification Application RAI No. 416, FSAR Ch. 6, Question 06.03-15
Sent Date: 3/9/2011 5:07:25 PM
Received Date: 3/9/2011 5:07:35 PM
From: WELLS Russell (AREVA)

Created By: Russell.Wells@areva.com

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Tracking Status: None
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Tracking Status: None

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Files	**Size**	**Date & Time**
MESSAGE	5889	3/9/2011 5:07:35 PM
RAI 416 Question 06.03-15 Response US EPR DC - DRAFT.pdf		344713

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

Response to

Request for Additional Information No. 416(4767, 4749), Revision 1

7/26/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 06.02.01 - Containment Functional Design
SRP Section: 06.03 - Emergency Core Cooling System

Application Section: FSAR Chapter 6

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)
QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)

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Question 06.03-15:

Follow-up to RAI 212, Question 6.03-6

RG 1.1 establishes the regulatory position that emergency core cooling and containment heat removal systems should be designed so that adequate NPSH is provided to system pumps assuming maximum expected temperatures of pumped fluids and no increase in containment pressure from that present prior to postulated LOCAs.

RG 1.82 Revision 3 states:

> ECC and containment heat removal systems should be designed so that sufficient available NPSH is provided to the system pumps, assuming the maximum expected temperature of pumped fluid and no increase in containment pressure from that present prior to the postulated LOCA.
>
> For sump pools with temperatures less than 212F, it is conservative to assume that the containment pressure equals the vapor pressure of the sump water. This ensures that credit is not taken for the containment pressurization during the transient.

NRC Standard Review Plan (SRP) 6.2.2, "Containment Heat Removal Systems" (NUREG-0800, Revision 5, dated March 2007) states that RG 1.82, Revision 3 describes methods acceptable to the staff for evaluating NPSH. SRP 6.3, "Emergency Core Cooling System" states that the design of the ECCS should conform to the recommendations of Regulatory Guide 1.1.

US EPR DCD Table 1.9-2 shows that US EPR conforms to RG 1.1 and RG 1.82.

AREVA responded to a RAI 212, Question 6.03-6 – related to NPSH) and stated the following:

> AREVA NP elected to use the saturation pressure corresponding to the peak calculated IRWST temperature, instead of the containment pressure prior to the postulated accident as recommended by RG 1.82. This is justified since the containment pressure prior to the postulated accident (atmospheric) is not realistic for the peak calculated IRWST temperature of 230F. The realistic pressure above the IRWST is the saturation pressure corresponding to the peak IRWST temperature.

To conform to the referenced guidance it is necessary that the proper performance of emergency core cooling and containment heat removal systems be independent of calculated increases in containment pressure caused by postulated loss of coolant accidents.

The alternative approach described by AREVA (use of saturation pressure in NPSH analysis) is inconsistent with the US EPR DCD commitment to follow RG 1.1 and RG 1.82, Revision 3, and SRP 6.2.2 criteria (e.g., use of atmospheric pressure in NPSH analysis). AREVAs alternative approach did not address the basic premise behind the regulatory criteria and did not evaluate how their alternative to the SRP (RG) criteria provides an acceptable method of complying with NRC regulations. Additional information is needed to complete a safety finding that is clearly tied to 10CFR 50.46(b)(5). Therefore, NRC staff request that AREVA justify why the selected approach, use of containment accident pressure (CAP) to support ECCS NPSH analysis, is acceptable.

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Response to Question 06.03-15:

A. ECCS NPSH Evaluation Methodology

AREVA NP did not use the containment accident pressure (CAP) in its ECCS NPSH analysis. However, the vapor pressure corresponding with the peak calculated in-containment refueling water storage tank (IRWST) temperature was used. The containment accident pressure will be greater than the partial water vapor pressure. As stated in the Response to RAI 212, Question 06-03-6, the use of pre-accident containment pressure and peak calculated IRWST temperature above 212°F is not physical. Using the vapor pressure corresponding with peak calculated IRWST temperature represents the minimum physical value above the IRWST water level is justified in the ECCS NPSH evaluation. The following applies to conforming to RG 1.1 and RG 1.82:

1. The temperature/pressure combination suggested by RG 1.1 and RG 1.82 is not physical for IRWST temperature above 212°F. Instead, a conservative containment pressure for IRWST temperature above 212°F is the vapor pressure corresponding with the IRWST temperature. The CAP is greater than the partial vapor pressure and was not used in the ECCS NPSH evaluation.
2. In the Safety Evaluation of NEI 04-07, it is stated that "typically for PWRs that do not credit containment overpressure in the design basis analyses, the basic assumption is to conservatively assume that containment pressure equals the vapor pressure of the liquid in the sump." The ECCS NPSH evaluation conforms with this conservative assumption. The NEI guidance document (04-07), with an NRC SE, is based on RG 1.82, Rev. 3 and endorses the use of vapor pressure at the IRWST temperature.

To confirm that the ECCS NPSH evaluation adequately covers the complete range of IRWST temperatures above 212°F, additional analyses were performed at IRWST temperatures from 122 to 245°F, to supplement the existing results at 212°F and analyze the peak calculated IRWST temperature of 245°F. In each case, the containment pressure is conservatively taken as the vapor pressure. The results demonstrate adequate NPSH margin for the entire temperature range of 122 to 245°F.

B. Supplemental Information

The following is the additional information requested by the staff:

1. The likelihood of breaching the U.S.EPR containment structure under loss of coolant accident (LOCA) conditions was summarized with a particular emphasis on the pressure boundary integrity. Three breach mechanisms have been considered: rupture, leakage, and isolation failure and their impact on the U.S.EPR containment structure:

    a) Rupture - The accident pressure resulting from the accident scenario (previously described) and plotted in Figure 06.03-15-1 shows a maximum pressure of ~ 65 psia or 45 psig. This pressure is well below the 62 psig design pressure of the U.S.EPR design and consequently results in a negligible probability of containment rupture (much less than 10^{-8} at design pressure).

    b) Leakage - As defined in the U.S. EPR Level 2 containment evaluation, leakage failure modes only include those small containment failures for which rapid

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depressurization of containment does not occur, otherwise the failure mode is considered as a rupture. Therefore, leakage failure modes do not challenge the pressure boundary of the containment.

c) Isolation Failure -: The total conditional probability of containment isolation failure of any size where a LOCA accident has occurred is evaluated to be small ~ 1.5×10^{-5}.

Based on these results it is concluded that containment breach leading to a pressure boundary failure following a LOCA initiator is a low probability event ($< 5 \times 10^{-5}$).

2. The impact of non-safety grade equipment has been considered in the calculation of the peak IRWST temperature. In the analysis the severe accident heat removal system (SAHRS) containment sprays and the HVAC system were considered.

   SAHRS includes a manually actuated containment spray system dedicated to severe accident mitigation. Because the SAHRS must be manually aligned and actuated, it is not subject to a single failure that could cause inadvertent actuation of containment spray, thereby eliminating the need to analyze its impact on the IRWST temperature.

   In the event that the HVAC system is not isolated following the LOCA, the steam removed by the non-safety HVAC system is collected by the vent and drain system and will not return to the IRWST.

3. Figure 06.03-15-1 shows a comparison of the IRWST water saturation pressure versus time and the containment accident pressure (CAP) for a typical hot leg LBLOCA. As can be seen, the CAP is greater than the IRWST water saturation pressure for the entire transient. Because it has been demonstrated that NPSH margin exists for the entire range of IRWST temperature above 212°F, and that the minimum margin occurs at 212°F, it is immaterial whether the hot leg LOCA case presented in Figure 06.03-15-1 represents the most limiting IRWST water saturation pressure. In other words, should the most limiting IRWST water temperature be higher than the calculated 245°F, it will not adversely impact the conclusion with respect to NPSH margin. Likewise, it is immaterial whether the hot leg LOCA case presented in Figure 06.03-15-1 represents the most limiting lower bound containment accident pressure, because it is not used in the ECCS NPSH evaluation. Therefore, should the most limiting CAP be lower than that shown in Figure 06.03-15-1, it will have no impact on the conclusion with respect to NPSH margin.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

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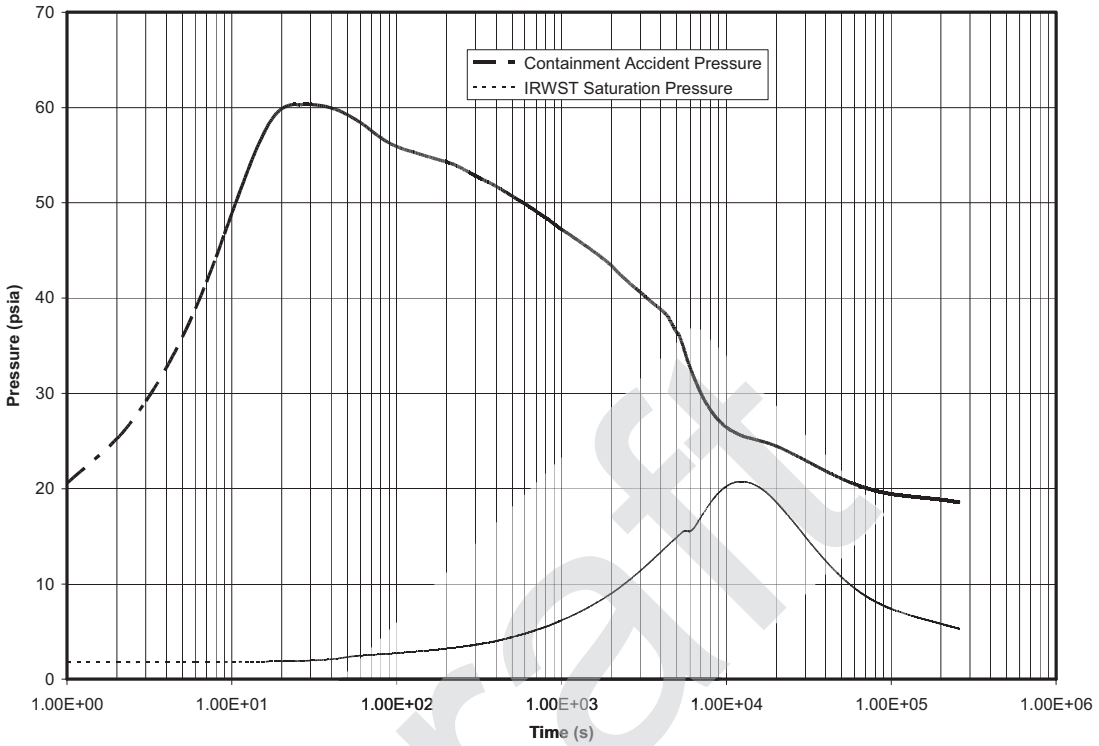
Figure 06.03-15-1—Containment and IRWST Water Saturation Pressure for Hot Leg LOCA



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