From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Monday, July 13, 2009 5:42 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); VAN NOY Mark (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 211, FSAR Ch. 3, Supplement 1
Attachments: RAI 211 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to 6 of the 10 questions of RAI No. 211 on May 26, 2009. The attached file, “RAI 211 Supplement 1 Response US EPR DC.pdf” provides technically correct and complete responses to 3 of the remaining 4 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 responses to RAI 211 Questions 03.03.01-3, and 03.04.02-7.

The following table indicates the respective pages in the response document, “RAI 211 Supplement 1 Response US EPR DC.pdf” that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 211 — 03.03.01-3	2	3
RAI 211 — 03.04.02-7	4	4
RAI 211 — 03.05.03-10	5	5

The schedule for a technically correct and complete response to the remaining 1 question is unchanged and provided below:

Question #	Response Date
RAI 211 — 03.03.02-3	August 26, 2009

Sincerely,

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Pederson Ronda M (AREVA NP INC)
Sent: Tuesday, May 26, 2009 3:09 PM

To: 'Getachew Tesfaye'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); VAN NOY Mark (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 211, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 211 Response US EPR DC.pdf" provides technically correct and complete responses to 6 of the 10 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 211 Questions 03.09.03-21, 03.12-12, 03.12-13, and 03.12-16.

The following table indicates the respective pages in the response document, "RAI 211 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 211 — 03.03.01-3	2	3
RAI 211 — 03.03.02-3	4	6
RAI 211 — 03.04.02-7	7	7
RAI 211 — 03.05.03-10	8	8
RAI 211 — 03.08.01-31	9	10
RAI 211 — 03.09.03-21	11	11
RAI 211 — 03.12-12	12	12
RAI 211 — 03.12-13	13	14
RAI 211 — 03.12-15	15	15
RAI 211 — 03.12-16	16	16

A complete answer is not provided for 4 of the 10 questions. The schedule for technically correct and complete responses to these questions is provided below.

Question #	Response Date
RAI 211 — 03.03.01-3	July 14, 2009
RAI 211 — 03.03.02-3	August 26, 2009
RAI 211 — 03.04.02-7	July 14, 2009
RAI 211 — 03.05.03-10	July 14, 2009

Sincerely,

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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, April 23, 2009 7:46 PM
To: ZZ-DL-A-USEPR-DL
Cc: David Jeng; Jim Xu; Abdul Sheikh; Kaihwa Hsu; Anthony Hsia; Michael Miernicki; Joseph Colaccino; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 211 (2435, 2437,2438, 2439, 2462, 2442, 2376), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on April 7, 2009, and discussed with your staff on April 20, 2009. Draft RAI Question 03.12-14 was deleted 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: 649

Mail Envelope Properties (5CEC4184E98FFE49A383961FAD402D310110EF38)

Subject: Response to U.S. EPR Design Certification Application RAI No. 211, FSAR Ch. 3, Supplement 1
Sent Date: 7/13/2009 5:42:11 PM
Received Date: 7/13/2009 5:42:10 PM
From: Pederson Ronda M (AREVA NP INC)

Created By: Ronda.Pederson@areva.com

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Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

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RAI 211 Supplement 1 Response US EPR DC.pdf	61632	

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Priority: Standard
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Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 211(2435, 2437, 2438, 2439, 2462, 2442, 2376), Supplement 1, Revision 1

4/23/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.03.01 - Wind Loading
SRP Section: 03.03.02 - Tornado Loads
SRP Section: 03.04.02 - Analysis Procedures
SRP Section: 03.05.03 - Barrier Design Procedures
SRP Section: 03.08.01 - Concrete Containment
SRP Section: 03.09.03 - ASME Code Class 1, 2, and 3 Components
SRP Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports

Application Section: FSAR Ch. 3

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)
QUESTIONS for Engineering Mechanics Branch 1 (AP1000/EPR Projects) (EMB1)

Question 03.03.01-3:

The staff in RAI 94, Question 03.03.01-1(b), asked that since AREVA had used the value of K_d from Table 6-4 of ASCE/SEI Standard 7-05, did it also use the load combinations which include wind load from Sections 2.3 and 2.4. The Standard requires these load combinations be used if the value of K_d is based on Table 6-4. In its written response AREVA did not state whether the load combinations in the Standard were the basis of load combinations containing wind load in the FSAR. Section 2.3 and 2.4 of the Standard contain the following load combinations which are to be used when the wind load has been calculated using the values of K_d from Table 6-4.

For strength design (Section 2.3):

1.2D + 1.6W + L + 0.5(Lr or S or R)
0.9D + 1.6W + 1.6H
1.2D + 1.6(Lr or S or R) + (L or .8W)

Where: Lr=roof load
S=snow load
R=rain load
D=dead load
W=wind load
E=earthquake load
L=live load
H=lateral earth pressure load

For allowable stress design (Section 2.4):

D + H + F + (W or 0.7E)
D + H + F + 0.75(W or 0.7E) + 0.75L +0.75(Lr or S or R)
0.6D + W + H

The load combinations in ACI 349-06 for strength design which contain wind load are:

1.2(D + F +Ro) + 1.6(L + H + W)
0.9D + 1.6L + 1.6W

Where: Ro=normal pipe reaction loads
F=fluid loads

These load combinations are very similar to those in the ASCE Standard with the factor on the wind load the same in both sets of load combinations. The ACI code also allows alternate load combinations which are the same as those found in the FSAR Section 3.8.4.3.2. For concrete structures what has been provided in the FSAR for load combinations containing wind load is therefore acceptable. AREVA is requested to perform a similar review of the FSAR load combinations that apply to steel structures and demonstrate they meet the requirements of the ASCE/SEI Standard when wind load is included or, alternatively, provide justification for the load combinations that are used.

Response to Question 03.03.01-3:

In conformance with regulatory guidance, AREVA NP is revising U.S. EPR FSAR Tier 2, Section 3.3.1.2 to remove the current values for K_z, K_{zt} and K_d and replace them with NUREG-0800, SRP Section 3.3.recommended values.

U.S. EPR FSAR Tier 2, Section 3.3.1.2 will be revised to show:

K_z = velocity pressure exposure coefficient at height “z” for Exposure Category C, which is determined in conformance with Reference 1, Table 6-3, but not less than 0.87.

K_{zt} = topographic factor = 1.0 for U.S. EPR standard plant design.

K_d = wind directionality factor = 1.0 for U.S. EPR standard plant design.

U.S. EPR FSAR Tier 2, Section 3.3.1.2.1 will be deleted in its entirety.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.3.1.2 and Section 3.3.1.2.1 will be revised as described in the response and indicated on the enclosed markup.

Question 03.04.02-7:

In the U.S. EPR FSAR it isn't apparent that the depth of embedment defined by the distance between the finished grade and the bottom of the foundation mat is explicitly defined for each of the structures. This dimension is important as it could impact earth pressure loads as well as a structure's seismic analysis if a different embedment depth is used by the COL applicant. AREVA is requested to provide this information in a table or figure of the FSAR for each in-scope U.S. EPR structure and include a COL requirement in the FSAR for the applicant to verify the depths of embedment for U.S. EPR structures, i.e. the foundation depth from finished grade to the bottom of each foundation mat, so that it meets the design basis of the U.S. EPR standard design.

Response to Question 03.04.02-7:

In this response, the term "supporting soil" refers to the soil in which the subject structure is embedded. Elevations are relative to each structure. Elevation 0 (zero) is the elevation of the threshold of the lowest personnel access penetration through which flood water might gain access. "Plant grade" is the finished top of the supporting soil. Elevation 0 is approximately one foot above plant grade where the soil meets the structure. U.S. EPR structural foundations are discussed in U.S. EPR FSAR Tier 2, Section 3.8.5.

U.S. EPR FSAR Tier 2, Section 3.8.5.1.2 states that the Emergency Power Generating Building (EPGB) is embedded approximately five feet into the supporting soil, or that the bottom of its foundation is five feet below plant grade.

U.S. EPR FSAR Tier 2, Section 3.8.5.1.3 states that the Essential Service Water Building (ESWB) is embedded approximately 22 feet into the supporting soil.

U.S. EPR FSAR Tier 2, Section 3.8.5.1.1 will be revised to clarify that the Nuclear Island (NI) common basemat structure is "embedded approximately 40 feet into the supporting soil." There is approximately 40 feet of soil between the bottom of the basemat and plant grade.

A COL applicant who references the certified U.S. EPR design must construct U.S. EPR structures in accordance with U.S. EPR FSAR design specifications or justify deviations. Thus, it is unnecessary to provide a new COL item for verifying embedment depths of U.S. EPR structures.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.8.5.1.1 will be revised as described in the response and indicated on the enclosed markup.

Question 03.05.03-10:

In FSAR Section 3.5.2 on page 3.5-11 it states that missile protection for openings and penetrations in structures is provided by enclosures, missile-resistant doors and covers, labyrinth structures or physical protection features. For the U.S. EPR Category I structures, AREVA is requested to provide specific examples of each of these protective features, including the method of analysis used for the missile barrier and the external missile for which the barrier is being designed.

Response to Question 03.05.03-10:

U.S. EPR missile barrier design employs the same methodology for both internally and externally generated missiles, although their respective sources and geometry are appropriate to the missiles postulated for each. Based on the missile under consideration and its corresponding geometry, the appropriate flat nosed, blunt, sharp nosed, etc., shape factor is selected for use in missile barrier design calculations. Postulated missiles are discussed in U.S. EPR FSAR Tier 2, Section 3.5.1, “Missile Selection and Description.”

U.S. EPR FSAR Tier 2, Section 3.5.3 discusses design procedures for concrete and steel missile barriers. Specific examples of U.S. EPR Seismic Category I structure missile barriers are:

- Physical Protection Features: Four trains of safeguards equipment are located in separate buildings, which protects their design basis safety functions from postulated missiles.
- Missile Resistant Doors: See U.S. EPR FSAR Tier 2, Appendix 3B, Figure 3B-43—Safeguard Buildings 2 and 3 Dimensional Plan Elevation 0 m (0 ft). The opening on the west side of the building along grid line 15, between grid lines V and W is protected from postulated missiles by a concrete door-barrier.
- Missile Resistant Covers: See U.S. EPR FSAR Tier 2, Appendix 3B, Figure 3B-76—Essential Service Water Building Dimensional Section B-B. Grid line 3, elevation 24.99 m (81.99 ft) shows that the cooling tower fans are protected from postulated missiles by a concrete cover or slab.
- Labyrinth structures: See U.S. EPR FSAR Tier 2, Appendix 3B, Figure 3B-43—Safeguard Buildings 2 and 3 Dimensional Plan Elevation 0 m (0 ft). The opening on the west side of the building along grid line 15, between grid lines X and Y is protected from postulated missiles by a concrete labyrinth structure.
- Enclosures: The Reactor Containment Building, Safeguard Buildings 2 and 3, and the Fuel Building are protected from postulated missiles by hardened concrete enclosures designed to withstand beyond design basis aircraft hazards.

FSAR Impact:

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

U.S. EPR Final Safety Analysis Report Markups

3.3 Wind and Tornado Loadings

Seismic Category I structures are designed to withstand the effects of wind and tornado loadings. A combined license (COL) applicant that references the U.S. EPR design certification will determine site-specific wind and tornado design parameters and compare these to the standard plant criteria. If the site-specific wind and tornado parameters are not bounded, then the COL applicant will evaluate the design for site-specific wind and tornado events and demonstrate that these loadings will not adversely affect the ability of safety-related structures to perform their safety functions during or after such events.

3.3.1 Wind Loadings

The U.S. EPR wind pressure loads are determined in conformance with ASCE/SEI Standard 7-05, "Minimum Design Loads for Buildings and Other Structures" (Reference 1). A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for wind loads, will not affect the ability of other structures to perform their intended safety functions.

3.3.1.1 Design Wind Velocity

The design basic wind speed is a 3-second gust speed at 33 feet above ground. The basic wind speed (V) is 145 mph in open terrain, exposure category C associated with a 50-year mean recurrence interval. The basic wind speed is increased by an importance factor of 1.15 to obtain a 100-year mean recurrence interval for the design of safety-related and quality-related structures.

3.3.1.2 Determination of Applied Wind Forces

Wind velocity is converted into an effective pressure to be applied to surfaces of structures in conformance with Reference 1.

Effective wind design velocity pressure (q_z) on structural elements is calculated in conformance with Reference 1, Equation 6-15, as follows:

$$q_z = 0.00256\, K_z\, K_{zt}\, K_d\, V^2\, I\ (lb/ft^2),$$

Where:

q_z = velocity pressure in pounds per square foot at height "z".

K_z = velocity pressure exposure coefficient at height "z" for Exposure Category C, which is determined in conformance with Reference 1,Table 6-3, but not less than 0.87.

03.03.01-3

(SRP Section 3.3.1 sets a lower limit of 0.87 for K_z, whereas this value could be as low as 0.85 per Reference 1,Table 6-3 for Exposure C.)

03.03.01-3

K_{zt} = topographic factor = 1.21.0 for U.S. EPR standard plant design.

(This is more conservative than the value of K_{dt} = 1.0 recommended in SRP Section 3.3.1)

K_d = wind directionality factor = 1.0 for U.S. EPR standard plant design., which is determined in conformance with Reference 1, Table 6-4.

(SRP Section 3.3.1 sets K_d = 1.0, whereas this value could be as low as 0.85 per Reference 1,Table 6-4.)

V = basic wind speed in miles per hour = 145 mph.

I = importance factor = 1.15 for safety-related and quality-related structures, systems and components (SSC). The importance factor is used to adjust the velocity pressure, q_z, to the appropriate 100-year mean recurrence interval for design of safety-related and quality-related SSC.

Effective pressure loads on structural elements and members are determined in conformance with the applicable requirements of Reference 1, Sections 6.5.12 through 6.5.15. Gust factors are applied in accordance with requirements of this standard.

ASCE paper No. 3269, "Wind Forces on Structures" (Reference 2) is used to determine the external pressure coefficients for distribution of wind pressures around the circumferences of the Reactor Shield Building and the vent stack.

3.3.1.2.1 Note on Values Used

03.03.01-3

The use of the values stated previously for K_z = 0.85 or greater, K_{zt} = 1.2, and K_d = 0.85 or greater provides essentially identical results as those recommended in NUREG 0800, SRP Section 3.3.1 for K_z = 0.87, K_{dt} = 1.0, and K_d = 1.0. That is, the product of the U.S. EPR values is 0.85 x 1.2 x 0.85 = 0.867, whereas the product of SRP Section 3.3.1, values is 0.87 x 1.0 x 1.0 = 0.87.

3.3.2 Tornado Loadings

Seismic Category I structures are designed to resist tornado loadings and remain functional during and following a tornado event. In addition, Non-Seismic Category I structures, that have the potential to interact with Seismic Category I structures are evaluated to demonstrate they do not affect Seismic Category I structures under tornado load conditions. Tornado loads are applied to the roofs and exterior walls of such structures. For Radwaste Seismic Structures, classified as RW-IIa per RG 1.143, additional tornado loadings also apply, as specified in RG 1.143.

03.04.02-7 → the NI Common Basemat Structure foundation basemat is founded approximately at elevation -41 feet and is embedded into the supporting soil approximately 40 feet~~below plant grade~~. The NI Common Basemat Structure foundation basemat outline and section views are presented in Figures 3B-1, 3.8-11, 3.8-12, 3.8-13, 3.8-50, 3.8-51, 3.8-52, 3.8-63, 3.8-74, and 3.8-85.

The NI Common Basemat Structure foundation basemat provides anchorage of the vertical post-tensioning tendons in the RCB, which is described in Section 3.8.1. The portion of the NI Common Basemat Structure foundation basemat that is considered to provide support and anchorage for the RCB is the area under the circumference of the outer face of the RSB wall, as shown on Figure 3.8-11, Figure 3.8-12 and Figure 3.8-13. This portion of the NI Common Basemat Structure foundation basemat is designed in accordance with the ASME BPV Code 2004 Edition, Section III, Division 2. A circular gallery is provided beneath the NI Common Basemat Structure foundation basemat for maintenance access to the bottom of the vertical post-tensioning tendons provided in the RCB shell wall. The tendon access gallery is approximately 11 feet wide by 14 feet high, including an approximately 36 inch thick foundation slab under the gallery structure. No credit is taken in the design for the tendon gallery transmitting loads into the soil in vertical or horizontal bearing. Connection of the tendon gallery to the NI Common Basemat Structure foundation basement allows for differential movement between the concrete structures.

Sections 3.8.1 and 3.8.3 describe the interface of the RCB containment liner plate and upper internal basemat above the liner for supporting the RB internal structures. Sections 3.8.4 describes the interface of the RSB, FB, and SBs with the NI Common Basemat Structure foundation basemat. Concrete walls and columns of these NI Common Basemat Structure Seismic Category I structures are anchored into the NI Common Basemat Structure foundation basemat with reinforcing bars to transmit vertical, horizontal, and bending moment loads into the basemat and to enhance the rigidity of the basemat.

Horizontal shear loads are transferred from the NI Common Basemat Structure foundation basemat to the underlying soil by friction between the bottom of the basemat, mud mat (or both), and the soil, and by passive earth pressure on the below-grade walls of the NI Common Basemat Structure Seismic Category I structures; shear keys are not used. Section 2.5.4.2 describes the friction coefficient properties of soil addressed for the U.S. EPR.

Buildings adjacent to the NI Common Basemat Structure are separated from the NI Common Basemat Structure foundation basemat to allow for differential seismic movements between buildings. Refer to Figure 3B-1, which illustrates the gaps between buildings.