ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Friday, July 08, 2011 9:12 AM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 130, FSAR Ch 3, Supplement 4
Attachments: RAI 130 Supplement 4 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for the responses to 52 questions of RAI No. 130 on December 08, 2008. AREVA NP submitted Supplement 1 to RAI No. 130 on February 20, 2009 which provided responses to 20 of the 52 questions. On April 17, 2009, AREVA NP submitted Supplement 2 to RAI 130 to provide final responses to the remaining 32 questions. On June 23, 2011, AREVA NP submitted Supplement 3 to RAI 130 to proved revised responses to 8 questions (Questions 03.07.02-03, 03.07.02-05, 03.07.02-06, 03.07.02-09, 03.07.02-13, 03.07.02-15, 03.07.02-16, and 03.07.02-18).

The responses to 15 additional questions (Questions 03.07.01-11, 03.07.02-01, 03.07.02-2, 03.07.02-4, 03.07.02-7, 03.07.02-8, 03.07.02-14, 03.07.02-20, 03.07.02-21, 03.07.02-22, 03.07.02-24, 03.07.02-25, 03.07.02-26, 03.07.02-28, and 03.07.02-34) are superseded by the response to RAI 320 Question 03.07.02-63. The attached file, "RAI 130 Supplement 4 Response US EPR DC.pdf" provides the revised responses.

The following table indicates the respective pages in the response document, "RAI 130 Supplement 4 Response US EPR.pdf," that contain AREVA NP's revised responses to the subject questions.

Question #	Start Page	End Page
RAI 130 — 03.07.01-11	2	2
RAI 130 — 03.07.02-01	3	3
RAI 130 — 03.07.02-02	4	4
RAI 130 — 03.07.02-04	5	5
RAI 130 — 03.07.02-07	6	6
RAI 130 — 03.07.02-08	7	7
RAI 130 — 03.07.02-14	8	8
RAI 130 — 03.07.02-20	9	9
RAI 130 — 03.07.02-21	10	10
RAI 130 — 03.07.02-22	11	11
RAI 130 — 03.07.02-24	12	12
RAI 130 — 03.07.02-25	13	13
RAI 130 — 03.07.02-26	14	14
RAI 130 — 03.07.02-28	15	15
RAI 130 — 03.07.02-34	16	16

This concludes the formal AREVA NP response to RAI 130, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

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: Thursday, June 23, 2011 4:20 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); CORNELL Veronica (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 130, FSAR Ch 3, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for the responses to 52 questions of RAI No. 130 on December 08, 2008. AREVA NP submitted Supplement 1 to RAI No. 130 on February 20, 2009 which provided responses to 20 of the 52 questions. On April 17, 2009, AREVA NP submitted Supplement 2 to RAI 130 to provide final responses to 32 of the 52 questions.

The responses to Questions 03.07.02-03, 03.07.02-05, 03.07.02-06, 03.07.02-09, 03.07.02-13, 03.07.02-15, 03.07.02-16, and 03.07.02-18 are superseded by the response to RAI 320 Question 03.07.02-63. The attached file, "RAI 130 Supplement 3 Response US EPR DC.pdf" provides the revised responses.

The following table indicates the respective pages in the response document, "RAI 130 Supplement 3 Response US EPR.pdf," that contain AREVA NP's revised responses to the subject questions.

Question #	Start Page	End Page
RAI 130 — 03.07.02-03	2	2
RAI 130 — 03.07.02-05	3	3
RAI 130 — 03.07.02-06	4	4
RAI 130 — 03.07.02-09	5	5
RAI 130 — 03.07.02-13	6	6
RAI 130 — 03.07.02-15	7	7
RAI 130 — 03.07.02-16	8	8
RAI 130 — 03.07.02-18	9	9

Sincerely,

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: WELLS Russell D (AREVA NP INC)
Sent: Friday, April 17, 2009 10:39 PM
To: 'Getachew Tesfaye'

Cc: Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 130, FSAR Ch 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for the responses to 52 questions of RAI No. 130 on December 08, 2008. AREVA NP submitted Supplement 1 to RAI No. 130 on February 20, 2009 which provided responses to 20 of the 52 questions. The attached file, "RAI 130 Supplement 2 Response US EPR DC-SUNSI.pdf" provides technically correct and complete responses to the remaining 32 questions, as committed.

Since the response file contains security-related sensitive information that should be withheld from public disclosure in accordance with 10 CFR 2.390, a public version is provided with the security-related sensitive information redacted. This email does not contain any security-related information. The unredacted SUNSI version is provided under separate email.

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 130 Questions 03.07.01-05, 03.07.01-06, 03.07.01-07, 03.07.01-17, 03.07.02-19, 03.07.02-23, 03.07.02-25, and 03.07.02-27.

The following table indicates the respective pages in the response document, "RAI 130 Supplement 2 Response US EPR DC-SUNSI.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 130 — 03.07.01-05	2	2
RAI 130 — 03.07.01-06	3	3
RAI 130 — 03.07.01-07	4	4
RAI 130 — 03.07.01-08	5	5
RAI 130 — 03.07.01-10	6	6
RAI 130 — 03.07.01-11	7	7
RAI 130 — 03.07.01-17	8	8
RAI 130 — 03.07.02-01	9	9
RAI 130 — 03.07.02-03	10	10
RAI 130 — 03.07.02-04	11	11
RAI 130 — 03.07.02-05	12	12
RAI 130 — 03.07.02-06	13	13
RAI 130 — 03.07.02-07	14	14
RAI 130 — 03.07.02-09	15	15
RAI 130 — 03.07.02-11	16	16
RAI 130 — 03.07.02-12	17	17
RAI 130 — 03.07.02-13	18	18
RAI 130 — 03.07.02-14	19	19
RAI 130 — 03.07.02-15	20	20
RAI 130 — 03.07.02-16	21	21
RAI 130 — 03.07.02-18	22	22
RAI 130 — 03.07.02-19	23	23
RAI 130 — 03.07.02-20	24	25
RAI 130 — 03.07.02-21	26	26
RAI 130 — 03.07.02-23	27	27
RAI 130 — 03.07.02-25	28	28
RAI 130 — 03.07.02-26	29	29
RAI 130 — 03.07.02-27	30	30
RAI 130 — 03.07.02-28	31	31

RAI 130 — 03.07.02-29	32	32
RAI 130 — 03.07.02-30	33	33
RAI 130 — 03.07.02-31	34	34

This concludes the formal AREVA NP response to RAI 130, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

(Russ Wells on behalf of)

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
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: WELLS Russell D (AREVA NP INC)
Sent: Friday, February 20, 2009 7:31 PM
To: 'Getachew Tesfaye'
Cc: Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); SLIVA Dana (EXT); 'John Rycyna'
Subject: Response to U.S. EPR Design Certification Application RAI No. 130, FSAR Ch 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for the responses to the 52 questions of RAI No. 130 on December 08, 2008. The attached file, "RAI 130 Supplement 1 Response US EPR DC.pdf" provides technically correct and complete responses to 20 of the 52 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 130 Questions 03.07.01-12, 03.07.01-15, 03.07.02-2, 03.07.02-10, 03.07.02-17, and 03.07.02-34.

The following table indicates the respective pages in the response document, "RAI 130 Supplement 1 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 130 — 03.07.01-1	2	2
RAI 130 — 03.07.01-2	3	3
RAI 130 — 03.07.01-3	4	4
RAI 130 — 03.07.01-4	5	5
RAI 130 — 03.07.01-9	6	6
RAI 130 — 03.07.01-12	7	7
RAI 130 — 03.07.01-13	8	8
RAI 130 — 03.07.01-14	9	9
RAI 130 — 03.07.01-15	10	11
RAI 130 — 03.07.01-16	12	12

RAI 130 — 03.07.01-18	13	13
RAI 130 — 03.07.02-2	14	20
RAI 130 — 03.07.02-8	21	21
RAI 130 — 03.07.02-10	22	22
RAI 130 — 03.07.02-17	23	24
RAI 130 — 03.07.02-22	25	26
RAI 130 — 03.07.02-24	26	26
RAI 130 — 03.07.02-32	27	27
RAI 130 — 03.07.02-33	28	28
RAI 130 — 03.07.02-34	29	30

The schedule for technically correct and complete responses to the remaining 32 questions is unchanged and provided below:

Question #	Response Date
RAI 130 — 03.07.01-5	April 17, 2009
RAI 130 — 03.07.01-6	April 17, 2009
RAI 130 — 03.07.01-7	April 17, 2009
RAI 130 — 03.07.01-8	April 17, 2009
RAI 130 — 03.07.01-10	April 17, 2009
RAI 130 — 03.07.01-11	April 17, 2009
RAI 130 — 03.07.01-17	April 17, 2009
RAI 130 — 03.07.02-1	April 17, 2009
RAI 130 — 03.07.02-3	April 17, 2009
RAI 130 — 03.07.02-4	April 17, 2009
RAI 130 — 03.07.02-5	April 17, 2009
RAI 130 — 03.07.02-6	April 17, 2009
RAI 130 — 03.07.02-7	April 17, 2009
RAI 130 — 03.07.02-9	April 17, 2009
RAI 130 — 03.07.02-11	April 17, 2009
RAI 130 — 03.07.02-12	April 17, 2009
RAI 130 — 03.07.02-13	April 17, 2009
RAI 130 — 03.07.02-14	April 17, 2009
RAI 130 — 03.07.02-15	April 17, 2009
RAI 130 — 03.07.02-16	April 17, 2009
RAI 130 — 03.07.02-18	April 17, 2009
RAI 130 — 03.07.02-19	April 17, 2009
RAI 130 — 03.07.02-20	April 17, 2009
RAI 130 — 03.07.02-21	April 17, 2009
RAI 130 — 03.07.02-23	April 17, 2009
RAI 130 — 03.07.02-25	April 17, 2009
RAI 130 — 03.07.02-26	April 17, 2009
RAI 130 — 03.07.02-27	April 17, 2009
RAI 130 — 03.07.02-28	April 17, 2009
RAI 130 — 03.07.02-29	April 17, 2009
RAI 130 — 03.07.02-30	April 17, 2009
RAI 130 — 03.07.02-31	April 17, 2009

Sincerely,

(Russ Wells on behalf of)

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
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: WELLS Russell D (AREVA NP INC)
Sent: Monday, December 08, 2008 7:08 PM
To: 'Getachew Tesfaye'
Cc: 'John Rycyna'; Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 130, FSAR Ch 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 130 Response US EPR DC.pdf" provides technically correct and complete responses to none of the 52 questions.

A complete answer is not provided to any of the 52 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 130 — 03.07.01-1	February 20, 2009
RAI 130 — 03.07.01-2	February 20, 2009
RAI 130 — 03.07.01-3	February 20, 2009
RAI 130 — 03.07.01-4	February 20, 2009
RAI 130 — 03.07.01-5	April 17, 2009
RAI 130 — 03.07.01-6	April 17, 2009
RAI 130 — 03.07.01-7	April 17, 2009
RAI 130 — 03.07.01-8	April 17, 2009
RAI 130 — 03.07.01-9	February 20, 2009
RAI 130 — 03.07.01-10	April 17, 2009
RAI 130 — 03.07.01-11	April 17, 2009
RAI 130 — 03.07.01-12	February 20, 2009
RAI 130 — 03.07.01-13	February 20, 2009
RAI 130 — 03.07.01-14	February 20, 2009
RAI 130 — 03.07.01-15	February 20, 2009
RAI 130 — 03.07.01-16	February 20, 2009
RAI 130 — 03.07.01-17	April 17, 2009
RAI 130 — 03.07.01-18	February 20, 2009
RAI 130 — 03.07.02-1	April 17, 2009
RAI 130 — 03.07.02-2	February 20, 2009
RAI 130 — 03.07.02-3	April 17, 2009
RAI 130 — 03.07.02-4	April 17, 2009
RAI 130 — 03.07.02-5	April 17, 2009
RAI 130 — 03.07.02-6	April 17, 2009
RAI 130 — 03.07.02-7	April 17, 2009
RAI 130 — 03.07.02-8	February 20, 2009

RAI 130 — 03.07.02-9	April 17, 2009
RAI 130 — 03.07.02-10	February 20, 2009
RAI 130 — 03.07.02-11	April 17, 2009
RAI 130 — 03.07.02-12	April 17, 2009
RAI 130 — 03.07.02-13	April 17, 2009
RAI 130 — 03.07.02-14	April 17, 2009
RAI 130 — 03.07.02-15	April 17, 2009
RAI 130 — 03.07.02-16	April 17, 2009
RAI 130 — 03.07.02-17	February 20, 2009
RAI 130 — 03.07.02-18	April 17, 2009
RAI 130 — 03.07.02-19	April 17, 2009
RAI 130 — 03.07.02-20	April 17, 2009
RAI 130 — 03.07.02-21	April 17, 2009
RAI 130 — 03.07.02-22	February 20, 2009
RAI 130 — 03.07.02-23	April 17, 2009
RAI 130 — 03.07.02-24	February 20, 2009
RAI 130 — 03.07.02-25	April 17, 2009
RAI 130 — 03.07.02-26	April 17, 2009
RAI 130 — 03.07.02-27	April 17, 2009
RAI 130 — 03.07.02-28	April 17, 2009
RAI 130 — 03.07.02-29	April 17, 2009
RAI 130 — 03.07.02-30	April 17, 2009
RAI 130 — 03.07.02-31	April 17, 2009
RAI 130 — 03.07.02-32	February 20, 2009
RAI 130 — 03.07.02-33	February 20, 2009
RAI 130 — 03.07.02-34	February 20, 2009

Sincerely,

(Russ Wells on behalf of)

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
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: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, November 12, 2008 7:33 PM
To: ZZ-DL-A-USEPR-DL
Cc: Manas Chakravorty; Sujit Samaddar; Michael Miernicki; Joseph Colaccino; John Rycyna
Subject: U.S. EPR Design Certification Application RAI No. 130 (1430,1461),FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on October 27, 2008, and on November 12, 2008, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. 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: 3203

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D47AF8B2)

Subject: Response to U.S. EPR Design Certification Application RAI No. 130, FSAR Ch 3, Supplement 4
Sent Date: 7/8/2011 9:11:53 AM
Received Date: 7/8/2011 9:11:57 AM
From: WILLIFORD Dennis (AREVA)

Created By: Dennis.Williford@areva.com

Recipients:
"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>
Tracking Status: None
"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: auscharmx02.adom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	15775	7/8/2011 9:11:57 AM
RAI 130 Supplement 4 Response US EPR DC.pdf	109699	

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

Response to

Request for Additional Information No. 130, Supplement 4 (1430, 1461), Revision 0

11/12/2008

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.07.01 - Seismic Design Parameters
SRP Section: 03.07.02 - Seismic System Analysis
Application FSAR Section: 03.07

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)

Question 03.07.01-11:

In Section 3.7.1.2 of the FSAR (first paragraph on pg 3.7-11), it states that in-structure response spectra (ISRS) for the NI common basemat structures are generated using SSE damping values. RG 1.61 requires that the damping values used need to be consistent with the level of stress. Provide the computed stress level (attributed to load combinations using the SSE) for major load carrying members such as walls, columns, floors, etc. of the NI common basemat structures to justify the use of SSE structural damping for the development ISRS.

Response to Question 03.07.01-11:

Calculated critical section stress for load combinations using the safe shutdown earthquake (SSE) are reviewed for consistency with the stress levels associated with SSE damping and RG 1.61 Rev. 1 guidelines. Review the Response to RAI 370, Question 03.07.01-27.

FSAR Impact:

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

Question 03.07.02-1:

In FSAR Section 3.7.2.1.3 (pg 3.7-69, 2nd paragraph), it indicates that the complex frequency response analysis method is used in the seismic SSI analysis of all Seismic Category I structures. AREVA computer code SASSI, Version 4.1B, is used in the SSI analysis of the NI common basemat structures and NAB. Bechtel computer code SASSI 2000, Version 3.1, is used in the SSI analysis of the EPGBs and ESWBs. Describe the differences between these two versions of the SASSI Code, the reason for implementing two versions of the code and provide a comparison of results from a building seismic analysis using each version of the code.

Response to Question 03.07.02-1:

MTR/SASSI version 8.3 has been used for the SSI analyses of U.S. EPR NI Common Basemat Structures and EPGB as described in response to RAI 320, Question 03.07.02-63 and RAI 376, Question 03.08.05-31, respectively. The MTR/SASSI computer code will also be used for the SSI analysis of the ESWB and will be described in the final response to RAI 376, Question 03.08.05-31.

FSAR Impact:

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

Question 03.07.02-2:

In FSAR Section 3.7.2.1.3 (pg 3.7-69, 4th paragraph), it indicates that the complex frequency response analysis method is also used in the soil column analysis using Bechtel computer code SHAKE2000, Version 1.1, to compute the free-field "in-ground" motion at the foundation level of ESWBs, for use as the input motion to the SSI analysis. This is indicated to be needed to incorporate the effects of embedment in the SSI analysis of the ESWBs. The input ground motion specified in Section 3.7.1 corresponds to a hypothetical free-field "outcrop" motion at the foundation level of ESWB. Bechtel code SASSI 2000 requires that the input motion, when specified at the foundation level, must be an "in-ground" motion converted from the "outcrop" motion through a soil column analysis. Please indicate if, in generating "outcrop" motions using the SHAKE Code whether the soil column above the foundation level (a depth of about 6.7 m (*22* ft)) below grade) is removed from the soil column as required by both the SRP and the ISG. The "outcrop" must be defined assuming no soil above the level of the "outcrop" depth and all potential effects of down-coming waves need to be removed from the computation. Provide analytic modeling, outcrop and in-ground spectra, FIRS, soil conditions and numerical results to indicate how the SHAKE computations are performed.

Response to Question 03.07.02-2:

Refer to the Response to RAI 376, Question 03.08.05-31.

FSAR Impact:

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

Question 03.07.02-4:

In FSAR Section 3.7.2.3.1 (pg 3.7-71), it indicates that the SASSI SSI model is performed assuming a rigid basemat model. Even with a thick basemat, the flexibility of the mat as well as that of the connecting walls can have an impact on local SSI pressure distributions as well as on moment and shear development in the exterior structural elements. What is the impact of this simplifying assumption on the calculation of seismic design loads, as well as on the generation of in-structure response spectra, particularly at higher frequencies?

Response to Question 03.07.02-4:

In the U.S. EPR FEM model used for the SSI analysis, the actual basemat thickness is modeled using plate elements. The seismic design loads and in-structure response spectra calculated from the FEM SSI analyses do incorporate the effects, if any, of the basemat flexibility. This is described in response to RAI 320, Question 03.07.02-63.

FSAR Impact:

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

Question 03.07.02-7:

In FSAR Section 3.7.2 (pg 3.7-66), it states that the impact of changes to the design during the detailed design phase are evaluated and that the combined deviations are acceptable if the amplitudes of the in-structure response spectra increase by less than 10 percent. Provide the technical basis for these statements to include the impact on code allowables, and provide justification for not performing reanalysis under the conditions described.

Response to Question 03.07.02-7:

Refer to the Response to RAI 371, Question 03.07.02-72, Supplement 5.

FSAR Impact:

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

Question 03.07.02-8:

In FSAR Section 3.7.2.1.1 (pg 3.7-67), it states that when nonlinearities occur in the stiffness matrix or damping matrix, the direct integration technique is used. It states that this technique is used for the time history analysis of the NI common basemat structures to determine their stability against seismic sliding or overturning and their potential for seismic structural interaction.

a. Provide the basis and values used for the stiffness and damping matrices.
b. Describe the design motion time histories that are used in the nonlinear structural analysis and the basis for their selection.
c. Describe how the soil springs are modeled in this analysis.
d. Provide the relationship between this analysis and the seismic analysis conducted to determine structural loads and ISRS.

Response to Question 03.07.02-8:

Stability of Seismic Category I structures against seismic sliding or overturning are evaluated using the methodology described in the response to RAI 371, Question 03.07.02-69.

FSAR Impact:

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

Question 03.07.02-14:

In FSAR Section 3.7.2.4.4 (pg 3.7-86), it states that the NAB is embedded only on its south side and therefore, for the purposes of seismic analysis, it is sufficient to take the NAB as a surface grounded structure. As SRP 3.7.2 requires that embedment effects be considered in an SSI analysis, the basis for this conclusion should be provided.

Response to Question 03.07.02-14:

As addressed in the Response to RAI 320, Question 03.07.02-63, the Nuclear Auxiliary Building (NAB) included in the Nuclear Island soil-structure interaction (SSI) model and embedment on the south side of the NAB, is now considered.

FSAR Impact:

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

Question 03.07.02-20:

In FSAR Section 3.7.2.8 (pg 3.7-95), it discusses the interaction of non seismic with seismic Category I Structures.

a. For the NAB, it states that a reduction in forces is taken for critical structural elements. Are these forces taken from the seismic analysis of the full stick model of the NAB? What is the reduction that is taken?

b. Since the NAB is designed not to collapse on a seismic Category I structure, SRP 3.7.2-SAC-8 states that the non-Category I structure will be analyzed and designed to prevent its failure under SSE conditions, such that the margin of safety is equivalent to that of Category I structure. Describe how the method proposed meets this requirement.

c. Describe the development of the non linear models for the NAB and NI common basemat structures used to determine the potential for seismic interaction and provide the results of the analysis. Identify the elements that are considered to be nonlinear and provide the basis for determining the non-linearity. Since the NAB and NI common basemat structures were analyzed using full stick models, describe why it is now necessary to use a nonlinear analysis employing finite element models with reduced degrees of freedom?

In this same FSAR Section on page 3.7-98, it also states that the NAB shields the NI common basemat structures from collapse of the Radioactive Waste Processing Building (RWPB). However, it does not appear that the NAB is designed to withstand a collapse of the RWPB. Section 3.7.2.8 states that the NAB is designed to allow distortion short of collapse under an SSE event. The basis for stating that the NAB shields the NI common basemat structures from collapse of the RWPB needs to be justified.

Response to Question 03.07.02-20:

Refer to the Response to RAI 371, Question 03.07.02-64.

FSAR Impact

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

Question 03.07.02-21:

Because a number of computer codes are discussed in FSAR Section 3.7.2, the staff is requesting that all computer codes used in the seismic analysis of seismic Category I structures be identified including those used in soil-structure interaction analysis, in developing ISRS, and in determining seismic loads on structures. In addition, descriptions of the programs, program validation, and the extent of application of the programs should be provided. This information should also be included in the FSAR.

Response to Question 03.07.02-21:

Refer to response RAI 155 Supplement 1, Question 03.08.01-13 for the list of computer codes used in the seismic analysis of seismic Category I structures.

FSAR Impact:

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

Question 03.07.02-22:

In FSAR Section 3.7.2.14 (pg 3.7-100), it states that the overturning of the common basemat of the NI structures due to a seismic event does not occur due to its inherent stability. In this regard, describe the analytical model for assessing building stability during a seismic event and provide the corresponding factors of safety against potential sliding (including maximum absolute displacement of NI common basemat structure) and overturning during the design basis seismic event. Also, what is the assumed minimum coefficient of friction used for evaluation of the translational stability of the NI structures? Is there a requirement for a COL applicant to meet a minimum coefficient of friction to be available at the soil/basemat interface? If so, specify this information in Table 2.1-1 of the FSAR. Similar information should be provided for the EPGBs and the ESWBs.

Response to Question 03.07.02-22:

For the Nuclear Island, refer to the Response to RAI 376, Question 03.08.05-28, Supplement 23 – Interim for the updated position. For the EPGB, refer to the current response to RAI 376, Question 03.08.05-31. The Essential Service Water Building (ESWB) results will be provided in the final response to RAI 376, Question 03.08.05-31.

FSAR Impact:

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

Question 03.07.02-24:

In FSAR Section 3.7.2.4.4 (Line 7 from bottom of Page 3.7-86), it is stated that the SSI of the NI common basemat structures will have some effect on EPGBs and ESWBs. It states that this effect has been captured by modeling the surrounding footprints on the soil surface along with the NI common basemat SSI model. Accordingly, confirm that the modified CSDRS used for the analysis of the surrounding category I structures represent the envelope of soil surface response spectra calculated from each of ten generic soil profile SSI analyses (NI common base mat and NAB) at the EPGB and ESWB footprints.

Response to Question 03.07.02-24:

The modified certified seismic design response spectra (CSDRS) used for the analysis of the surrounding category I structures are confirmed to represent the envelope of all soil surface response spectra with the exception of case 1n5a, which has a large impedance mismatch between the backfill and underlying rock supporting the NI foundation that results in an unrealistically high demand for standard design purposes. The EUR and HF based input motions and corresponding soil profiles used in the soil–structure interaction (SSI) analyses are described in U.S. EPR FSAR Tier 2, Sections 3.7.2.4.4 and 3.7.2.4.5. See the Response to RAI 376, Question 03.08.05-31.

FSAR Impact:

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

Question 03.07.02-25:

In FSAR Section 3.7.2.5, the methods for developing in-structure response spectra (ISRS) are described. It is stated that these follow the guidance of RG 1.122. SRP 3.7.2-SAC-5.C(2) states that guidance of RG 1.122 is augmented by the following: The 3 Hz frequency increment in the last row of RG 1.1.22, Table 1 applies up to the highest frequency of interest. This typically will be the PGA frequency of the design ground response spectrum, which in some cases may significantly exceed 33 Hz. In FSAR 3.7.2.5 on page 3.7-90, there is a table that shows the frequency increment for sets of frequency ranges at which ISRS acceleration values are computed. From 22 Hz to 40 Hz, the frequency increment is 3 Hz which agrees with the RG. From 40 Hz to 50 Hz, a frequency increment has not been provided. From 50 Hz to 100 Hz, a frequency interval of 50 Hz is indicated. The table should be revised to meet the guidance provided in the SRP acceptance criteria for a 3 Hz increment up to the highest frequency of interest and to also add the frequency increment used from 40 to 50 Hz. Also, the highest frequency of interest should be indicated and the basis for its selection should be provided. FSAR Section 3.7.2.5(2) (pg 3.7-91) describes the development of response spectra for the EPGB and ESWB. It states that response spectra are calculated at a total of 241 frequencies from .2 to 50 Hz with 100 frequencies per decade that are uniformly spaced in the log scale. A table of frequency increments and frequency ranges should be provided similar to that provided for the NI common basemat structures on page 3.7-90 and if different than the requirements of RG 1.122 those differences should be justified.

Response to Question 03.07.02-25:

- For the NI Common Basemat Structures, the 22 to 40 Hz range has been revised to a 22 to 100 Hz range in the U.S. EPR FSAR Tier 2, Section 3.7.2.5 in response to RAI 320, Question 03.07.02-63. The set of frequencies at which response spectra are calculated for the NI Common Basemat Structures is also used for the Emergency Power Generating Building (EPGB) and Essential Service Water Building (ESWB), and will be addressed in response to RAI 376, Question 03.08.05-31.
- The highest frequency of interest for the U.S. EPR Seismic Category I Structures is 50 Hz per ISG-01.

FSAR Impact:

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

Question 03.07.02-26:

In FSAR Section 3.7.2.6(1) (pg 3.7-94) for the NI common basemat structures, it states that for member forces and moments, the STRESS module of the SASSI code outputs the maximum member force/moment due to each component of earthquake motion. It further states that these member forces and moments are combined by the SRSS. This effectively eliminates the sign of the force (compression or tension) and of the bending moment (positive or negative). In concrete design, the sign or direction of a force or moment is important in properly sizing the member and in determining the correct amount of reinforcement. The amount of shear reinforcement that is required will also be affected by the direction of the axial force and bending moment. Thus, the staff is asking how the method described in the section of the FSAR properly accounts for the sign of the force or moment and how this is used in the design of concrete members. In addition, describe how the multiple sets of input motion time histories are accounted for in determining the maximum member forces and moments. As there are twelve cases analyzed for the NI structures, how the maximum design values are determined should also be described.

Response to Question 03.07.02-26:

Zero period acceleration is used to produce seismic loadings for the superstructure detail design. These forces are combined with those of static loadings per load combinations provided in Section 3.8.4.3.2, and will have positive or negative signs. The worst case combination is used in the design. Refer to U.S. EPR FSAR Tier 2, Section 3.8.4.4.1.

The basemat is designed using the seismic results from a time history analysis. Refer to the response to RAI 371, Question 3.7.2-66. These results carry the correct sign through the analysis. They are combined with the associated static loadings per combinations provided in U.S. EPR FSAR Tier 2, Section 3.8.4.3.2. The worst combination of loadings is used in the design.

FSAR Impact:

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

Question 03.07.02-28:

In FSAR Section 3.7.2.8 (Third Bullet), it is stated that "conventional seismic structures that have the potential to interact with Seismic Category I structures are assessed for collapse potential under SSE and tornado loading (acting independently). Seismic demand for the SSE is computed in accordance with ASCE 4-98, Reference 1 and the methodologies in Section 3.7.2. Seismic load combinations are developed in accordance with ASCE 43-05 …." ASCE 4-98 has not been accepted by the Staff as a guidance document. In addition, SRP acceptance criteria 3.7.2 –SAC-8C requires that "the non-Category I structure will be analyzed and designed to prevent its failure under SSE conditions, such that the margin of safety is equivalent to that of Category I structures." As such, in addition to the NAB which was addressed in RAI 3.7.2-20, demonstrate that non-Category I structures (not analyzed and designed as seismic Category II structures) having the potential of interaction with Category I structures will not slide or overturn during a SSE level earthquake and will have the margin of safety equivalent to that of Category I structures as stated by the acceptance criteria of SRP-SAC-8.C. Address how the NAB, Access Building, Turbine Building, Radioactive Waste Processing Building (RWPB), Fire Protection Storage Tanks and Buildings satisfy the SRP guidance.

Response to Question 03.07.02-28:

Refer to the Response to RAI 370, Question 03.07.02-65.

FSAR Impact:

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

Question 03.07.02-34:

In FSAR Section 3.7.2.6(2) (pg 3.7-94) for the EPGBs and ESWBs, it states that the three components of earthquake motion are combined using the (1.0, .4, .4) rule. This meets the requirements of RG 1.92, revision 2 and is acceptable for determining the response of the structure. In FSAR Section 3.7.2.4.6 on page 3.7-89, it states that for each of the ten generic soil cases, the extracted maximum nodal accelerations are used to compute the weighted average maximum nodal accelerations in each direction due to each ground motion component. The weighting factors are the applicable nodal masses. Then in each direction the averaged maximum nodal accelerations due to the three components of earthquake motion are combined using the (1.0, .4, .4) rule as stated above. Table 3.7.2-27 and 3.7.2-28 show the worst case maximum ZPA accelerations for the EPGBs and the ESWBs, respectively. It is not clear how the maximum ZPA accelerations are used from the ten generic soil cases to determine member forces and moments and how the weighted average maximum nodal acceleration is calculated. The staff requests that the procedure and basis for calculating the weighted average maximum nodal accelerations be provided, as well as how the member forces and moments are determined once the maximum ZPA accelerations have been calculated from the ten soil cases.

Response to Question 03.07.02-34:

Refer to the Response to RAI 371, Question 03.07.02-66 for a description of how zero period acceleration from the SSI analyses are mapped to the static analysis model.

FSAR Impact:

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