

## ArevaEPRDCPEm Resource

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**From:** BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]  
**Sent:** Tuesday, August 31, 2010 5:07 PM  
**To:** Tesfaye, Getachew  
**Cc:** DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); CORNELL Veronica (EXTERNAL AREVA)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 5  
**Attachments:** RAI 371 Supplement 5 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments. AREVA NP submitted Supplement 4 to the response on July 29, 2010, to provide INTERIM responses to question 03.07.02-66 through question 03.07.02-68.

The attached file, "RAI 371 Supplement 5 Response US EPR DC.pdf" provides technically correct and complete FINAL responses to 3 of the remaining 9 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 371 Supplement 5 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371 — 03.07.02-70	2	3
RAI 371 — 03.07.02-71	4	10
RAI 371 — 03.07.02-72	11	11

The schedule for a technically correct and complete response to the remaining questions is unchanged and is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	September 17, 2010
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 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](mailto:Martin.Bryan.ext@areva.com)

**From:** BRYAN Martin (EXT)  
**Sent:** Thursday, July 29, 2010 8:08 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 4 - Interim

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a revised schedule for question 03.07.01-29. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities. AREVA NP provided Supplement 3 to the response on July 8, 2010, to provide a revised date for submittal of a FINAL response to question 03.07.01-29 to allow time to address NRC comments.

The attached file, "RAI 371 Supplement 4 Response US EPR DC.pdf" provides technically correct and complete INTERIM responses to 3 of the remaining 10 questions, as committed.

The following table indicates the respective pages in the response document, "RAI 371 Supplement 4 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371 — 03.07.02-66	2	2
RAI 371 — 03.07.02-67	3	3
RAI 371 — 03.07.02-68	4	8

The schedule for an interim response and the technically correct and complete response to these questions is unchanged and is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	September 17, 2010
RAI 371-03.07.02-66	July 29, 2010 (Actual)	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010 (Actual)	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011
RAI 371-03.07.02-70	N/A	September 3, 2010
RAI 371-03.07.02-71	N/A	September 3, 2010
RAI 371-03.07.02-72	N/A	September 3, 2010

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**From:** BRYAN Martin (EXT)  
**Sent:** Thursday, July 08, 2010 4:02 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the 9 questions of RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 on June 7, 2010, to provide a revised date for 1 of the questions (03.07.01-29) on June 7, 2010. On June 24, 2010, AREVA provided a revised response schedule in Supplement 2 for the other 8 questions based on the information presented at the June 9, 2010 public meeting on civil/structural replanning activities.

To provide for further interaction with the NRC on the response for question 03.07.01-29, a revised schedule is provided below. Dates for the other 8 questions remain unchanged.

The revised schedule for the technically correct and complete response to these questions has been changed and is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	September 17, 2010
RAI 371-03.07.02-66	July 29, 2010	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011
RAI 371-03.07.02-70	N/A	September 3, 2010
RAI 371-03.07.02-71	N/A	September 3, 2010
RAI 371-03.07.02-72	N/A	September 3, 2010

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**From:** BRYAN Martin (EXT)  
**Sent:** Thursday, June 24, 2010 12:58 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT); RYAN Tom (AREVA NP INC); GARDNER George Darrell (AREVA NP INC)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010. AREVA NP submitted Supplement 1 to the response on June 7, 2010, to provide a

schedule for the remaining 9 questions, 8 of which were affected by the work underway to address NRC comments from the April 26, 2010, audit.

Based upon the civil/structural re-planning activities and revised RAI response schedule presented to the NRC during the June 9, 2010, Public Meeting, and to allow time to interact with the NRC on the responses, the schedule has been changed. The schedule for 03.07.01-29 remains unchanged.

Prior to submittal of the final RAI response, AREVA NP will provide an interim RAI response that includes:

- (1) a description of the technical work (e.g., methodology)
- (2) U.S. EPR FSAR revised pages, as applicable

The revised schedule for an interim response and the technically correct and complete response to these questions is provided below.

Question #	Interim Response Date	Response Date
RAI 371-03.07.01-28	N/A	November 12, 2010
RAI 371-03.07.01-29	N/A	July 8, 2010
RAI 371-03.07.02-66	July 29, 2010	February 17, 2011
RAI 371-03.07.02-67	July 29, 2010	January 20, 2011
RAI 371-03.07.02-68	July 29, 2010	January 20, 2011
RAI 371-03.07.02-69	October 18, 2010	January 20, 2011
RAI 371-03.07.02-70	N/A	September 3, 2010
RAI 371-03.07.02-71	N/A	September 3, 2010
RAI 371-03.07.02-72	N/A	September 3, 2010

Sincerely,

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**From:** BRYAN Martin (EXT)  
**Sent:** Monday, June 07, 2010 5:07 PM  
**To:** 'Tesfaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); CORNELL Veronica (EXT); VAN NOY Mark (EXT)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to RAI No. 371 on April 26, 2010.

As agreed with NRC, AREVA NP is providing a revised date for RAI 371 Supplement 1 Question 03.07.01-29 to allow time to interact with the NRC on the response.

The schedule for technically correct and complete responses to the remaining question has been changed and is provided below. The dates for questions 03.07.02-66 through 03.03.02-69 will be revised based on the information that will be presented at the June 9, 2010 public meeting and subsequent NRC feedback.

Question #	Response Date
RAI 371-03.07.01-28	August 3, 2010
RAI 371-03.07.01-29	July 8, 2010
RAI 371-03.07.02-66	July 27, 2010
RAI 371-03.07.02-67	July 27, 2010
RAI 371-03.07.02-68	August 3, 2010
RAI 371-03.07.02-69	August 3, 2010
RAI 371-03.07.02-70	August 3, 2010
RAI 371-03.07.02-71	August 3, 2010
RAI 371-03.07.02-72	August 3, 2010

Sincerely,

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**From:** BRYAN Martin (EXT)  
**Sent:** Monday, April 26, 2010 12:45 PM  
**To:** 'Tefsaye, Getachew'  
**Cc:** DELANO Karen V (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); ROMINE Judy (AREVA NP INC); VAN NOY Mark (EXT); RYAN Tom (AREVA NP INC)  
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 371 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 9 questions is not provided.

The following table indicates the respective pages in the response document, "RAI 371 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 371-03.07.01-28	2	3
RAI 371-03.07.01-29	4	4
RAI 371-03.07.02-66	5	5
RAI 371-03.07.02-67	6	6
RAI 371-03.07.02-68	7	7
RAI 371-03.07.02-69	8	9
RAI 371-03.07.02-70	10	10
RAI 371-03.07.02-71	11	11
RAI 371-03.07.02-72	12	12

A complete answer is not provided for 9 of the 9 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 371-03.07.01-28	August 3, 2010
RAI 371-03.07.01-29	June 7, 2010
RAI 371-03.07.02-66	July 27, 2010
RAI 371-03.07.02-67	July 27, 2010
RAI 371-03.07.02-68	August 3, 2010
RAI 371-03.07.02-69	August 3, 2010
RAI 371-03.07.02-70	August 3, 2010
RAI 371-03.07.02-71	August 3, 2010
RAI 371-03.07.02-72	August 3, 2010

Sincerely,

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---

**From:** Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]  
**Sent:** Thursday, March 25, 2010 2:05 PM  
**To:** ZZ-DL-A-USEPR-DL  
**Cc:** Chakravorty, Manas; Hawkins, Kimberly; Miernicki, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource  
**Subject:** U.S. EPR Design Certification Application RAI No. 371 (4273,4271,4280), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on February 25, 2010, and on March 24, 2010, 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:** 1928

**Mail Envelope Properties** (BC417D9255991046A37DD56CF597DB7107665BA5)

**Subject:** Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 5  
**Sent Date:** 8/31/2010 5:06:47 PM  
**Received Date:** 8/31/2010 5:06:50 PM  
**From:** BRYAN Martin (EXTERNAL AREVA)

**Created By:** Martin.Bryan.ext@areva.com

**Recipients:**

"DELANO Karen (AREVA)" <Karen.Delano@areva.com>

Tracking Status: None

"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>

Tracking Status: None

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Tracking Status: None

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Tracking Status: None

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Tracking Status: None

**Post Office:** AUSLYNCMX02.adom.ad.corp

<b>Files</b>	<b>Size</b>	<b>Date &amp; Time</b>
MESSAGE	13667	8/31/2010 5:06:50 PM
RAI 371 Supplement 5 Response US EPR DC.pdf		271128

**Options**

**Priority:** Standard

**Return Notification:** No

**Reply Requested:** No

**Sensitivity:** Normal

**Expiration Date:**

**Recipients Received:**

**Response to  
Request for Additional Information No. 371, Supplement 5**

**3/25/2010**

**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 Section: 03.07**

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

**Question 03.07.02-70:****Follow Up to RAI 248, Question 03.07.02-43**

1. Some of the figures for Problem 2 show differences in the magnitudes of transfer function, particularly at higher frequencies. In addition, the plots extend to only 25 Hz. As the AREVA CSDRS will now include the Bell Bend Response Spectra which has a cutoff frequency higher than 50 Hz, please provide comparisons of transfer functions to 50 Hz and comment on the cause of any differences noted and the impact these differences have on the computed seismic response of EPR structures.
2. Figure 3.7.2-43-7 indicates a spike in the interpolated transfer function at about 22 Hz from the SASSI 2000 computation, but not in the AREVA version. As the spike may indicate instability in the solution which may cause errors in the computed seismic response, the applicant is requested to describe on the cause of this spike and whether or not it affects the seismic results.
3. When benchmarking various versions of SASSI and to meet 10CFR50, Appendix B quality assurance requirements for design control it is common practice to perform computations for multiple problems to ensure that the code is operating properly on a given machine, under a given FORTRAN compiler. Please provide information on the problems considered to benchmark AREVA SASSI Version 4.2PC.
4. As AREVA ported SASSI, Version 4.1B to the Windows Personal Computer (PC) platform as AREVA SASSI, Version 4.2PC, the applicant is requested to update the FSAR to capture this change.

**Response to Question 03.07.02-70:**

1. The magnitudes of transfer functions for Problem 2 are different because the two Emergency Power Generating Building (EPGB) models used in the comparison are not identical. Beam end moment releases for some of the beams elements are included in Bechtel SASSI Version 3.1, but are not included in the AREVA NP SASSI Version 4.2PC. Despite the differences, there is good agreement between the transfer functions generated by the SASSI codes. Because AREVA SASSI Version 4.2PC is no longer used in the U.S. EPR soil-structure interaction (SSI) analyses, comparisons of transfer functions to 50 Hz are not provided. AREVA NP will provide a summary of the review of transfer functions up to 50 Hz for SSI analyses with high frequency inputs, such as those for Bell Bend, in the Response to RAI 412, question 03.07.02-73.
2. The AREVA NP and Bechtel SASSI codes transfer functions were computed at the same frequencies. As described in Part 1, there were differences in the two analyses. The transfer function interpolation routine used in SASSI has evolved with the SASSI code. In the Response to RAI 248, question 03.07.02-43, the amplitude of the transfer function spike in Figure 03.07.02-43-7 at about 22 Hz is approximately 25 percent higher and is caused by the interpolation routine as opposed to instability in the solution. The spike does not affect the in-structure response spectra value at 22Hz.
3. AREVA NP SASSI Version 4.2PC has been replaced by the MTR/SASSI code. MTR/SASSI meets the software quality assurance requirements in Topical Report ANP-10266, "AREVA NP Inc. Quality Assurance Plan (QAP) for Design Certification of the U.S. EPR."

The benchmarking for MTR/SASSI is available for NRC inspection.

4. Although AREVA NP ported SASSI Version 4.1B to the PC platform (Version 4.2PC), SASSI Version 4.2PC will not be used in U.S. EPR SSI analysis. SASSI Version 4.1B will be replaced by MTR/SASSI code. The Response to RAI 320, question 03.07.02-63 will include a description of MTR/SASSI analysis, and the U.S. EPR FSAR revisions that will replace AREVA NP SASSI Version 4.1B with MTR/SASSI to reflect the change in analysis software for the SSI analysis of the embedded finite element model. References to AREVA NP SASSI Version 4.1B used for generating inputs to the reactor coolant system (RCS) seismic analysis will remain in the U.S. EPR FSAR until the results from the new codes are incorporated in the RCS seismic analysis.

**FSAR Impact:**

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

**Question 03.07.02-71:****Follow Up to RAI 248, Question 03.07.02-47:**

Regarding the request in **Question 03.07.02-47** to demonstrate that the seismic models for the EPGB and ESWB are sufficiently detailed so that they provide accurate results for the seismic analysis for each of these structures, the applicant has demonstrated this at only one elevation in one direction for one of the structures (the EPGB). The information provided is insufficient to conclude that the models are sufficiently detailed to provide accurate results and meet the guidance of SRP 3.7.2, Acceptance Criteria 3.C.ii. The applicant is requested to provide additional examples for the EPGB as well as examples for the ESWB at several elevations for all three directions of seismic excitation (x,y,z).

**Response to Question 03.07.02-71:**

The Essential Service Water Building (ESWB) and the Emergency Power Generating Building (EPGB) finite element models were analyzed. The length, mass, and thickness of the floor spans and the number and size of the finite elements used to discretize the spans were considered to examine the quality of the mesh for the models. The EPGB has a less refined mesh compared to the ESWB, and was selected for the mesh accuracy study. Two simplified models of the EPGB were generated. The first model used the existing EPGB mesh and the second model used a refined mesh that was half the size of the existing mesh.

The EPGB in-structure response spectra (ISRS) were plotted for several key locations at different elevations and in all three directions. The responses are the result of two input motions, which were derived from the European Utility Requirements and Bell Bend motions. The responses consider approximate structure-soil-structure interaction effects between the Nuclear Island (NI) and the EPGB, and are characterized by dominant low and high frequency contents, respectively. Figure 03.07.02-71-1 through Figure 03.07.02-71-6 show a match between the current and refined mesh results in the frequency range. Node 654 is located at the center of the internal shear wall. Node 684 is located at the center of a roof slab.

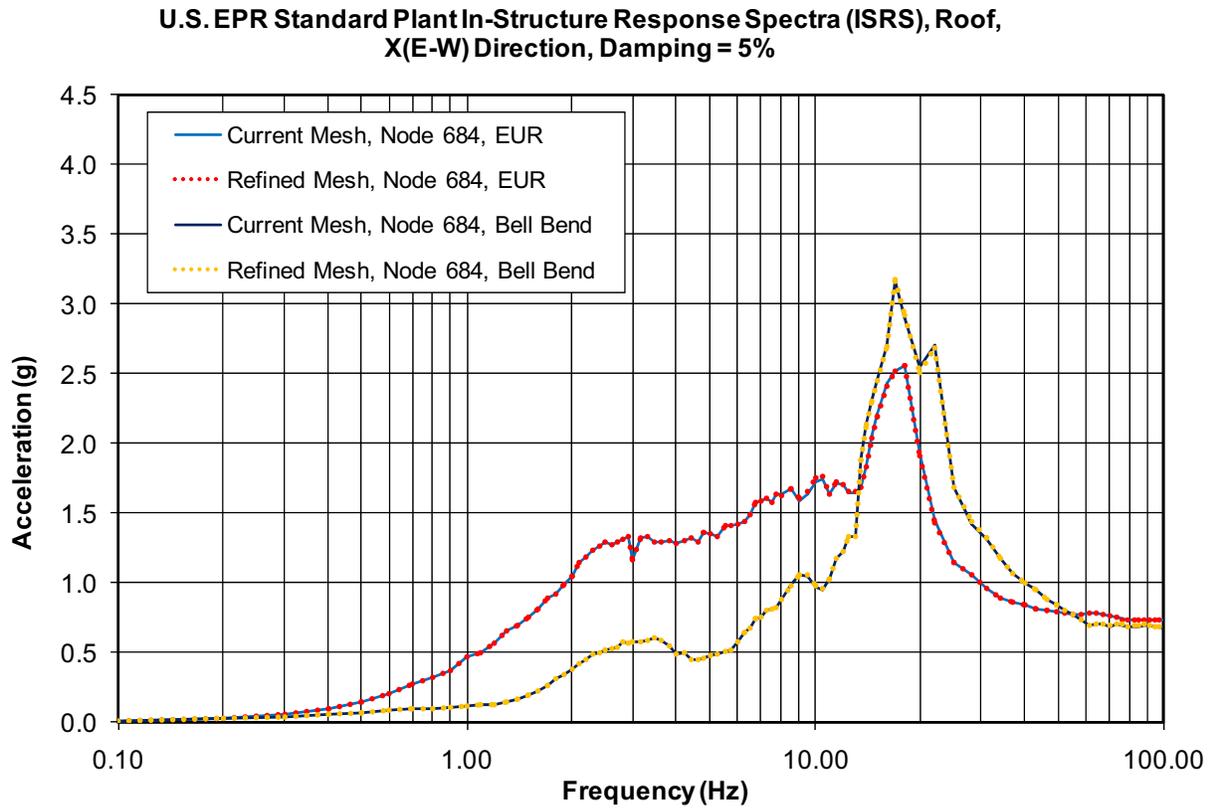
The mass participation ratios for the simplified models discussed above were revised. The participating number of modes was increased from all modes below 100Hz to all modes below 200Hz.

Revised calculations and additional ISRS comparisons showing similar results are available for NRC inspection.

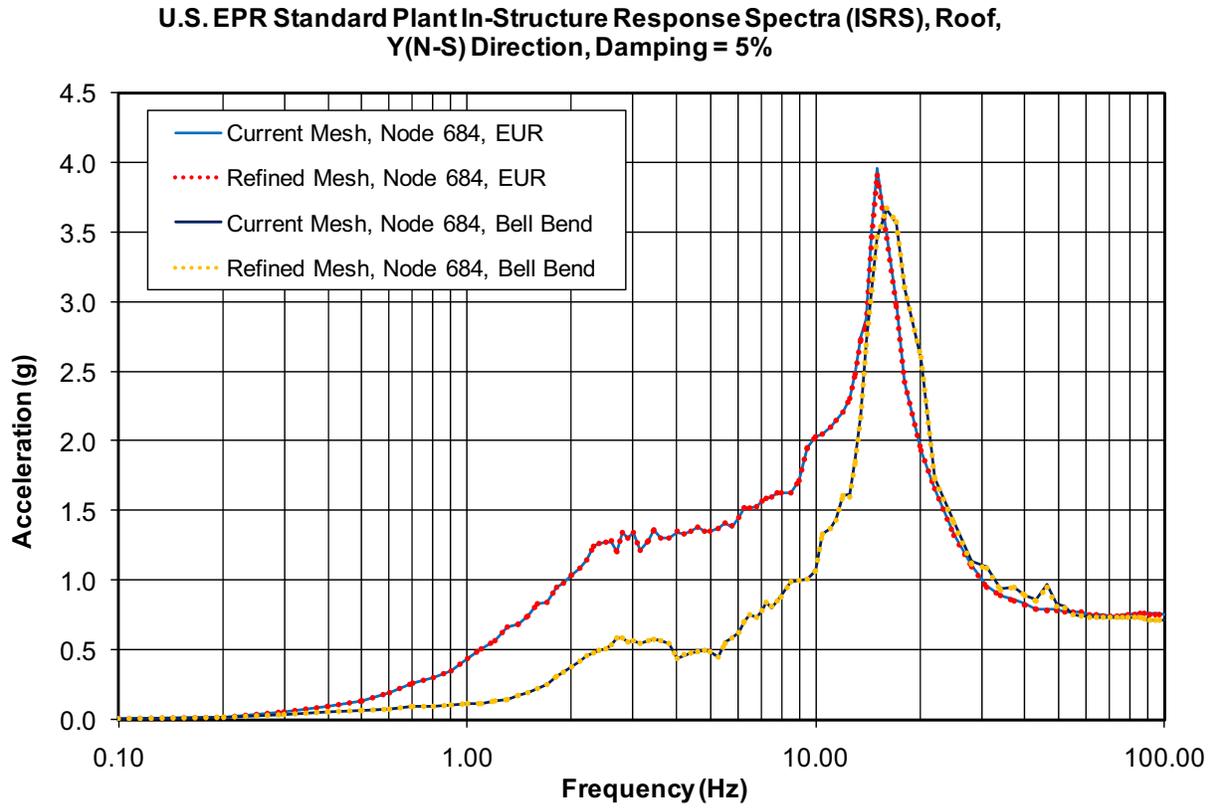
**FSAR Impact:**

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

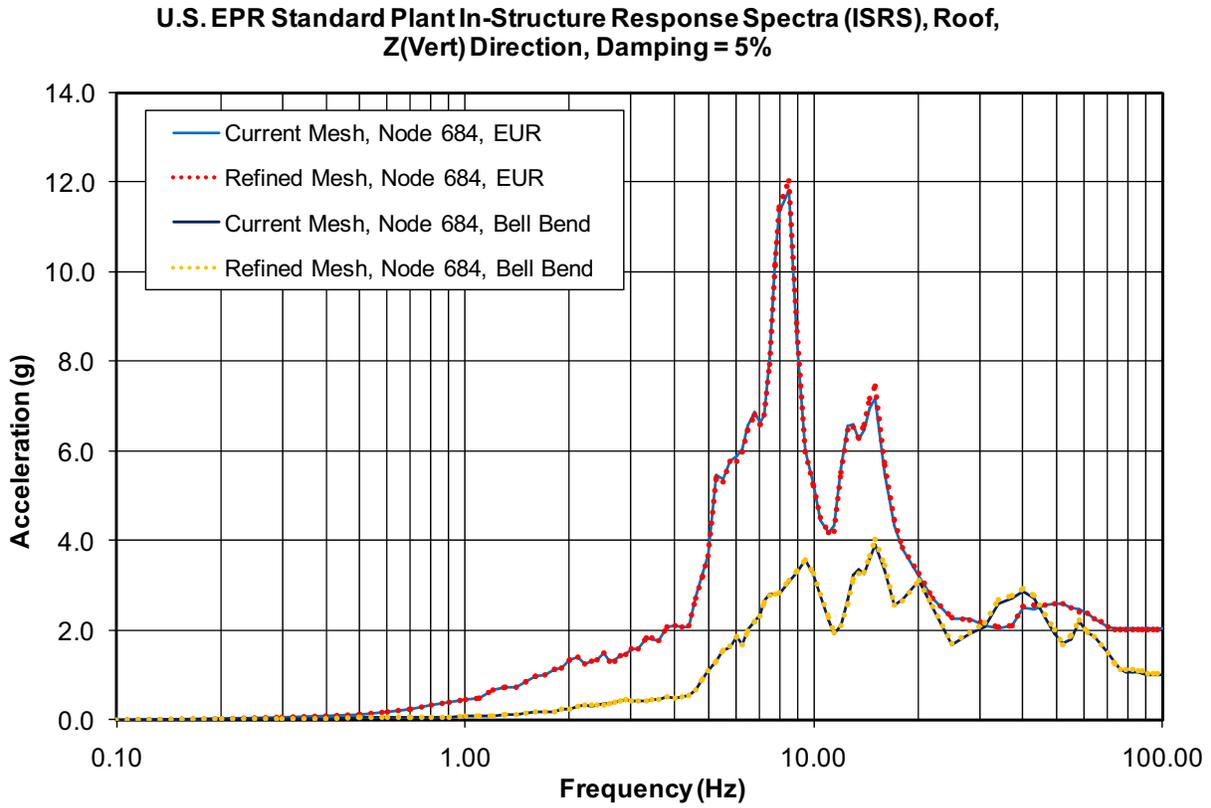
**Figure 03.07.02-71-1—Node 684, X-Dir.**



**Figure 03.07.02-71-2— Node 684, Y-Dir.**

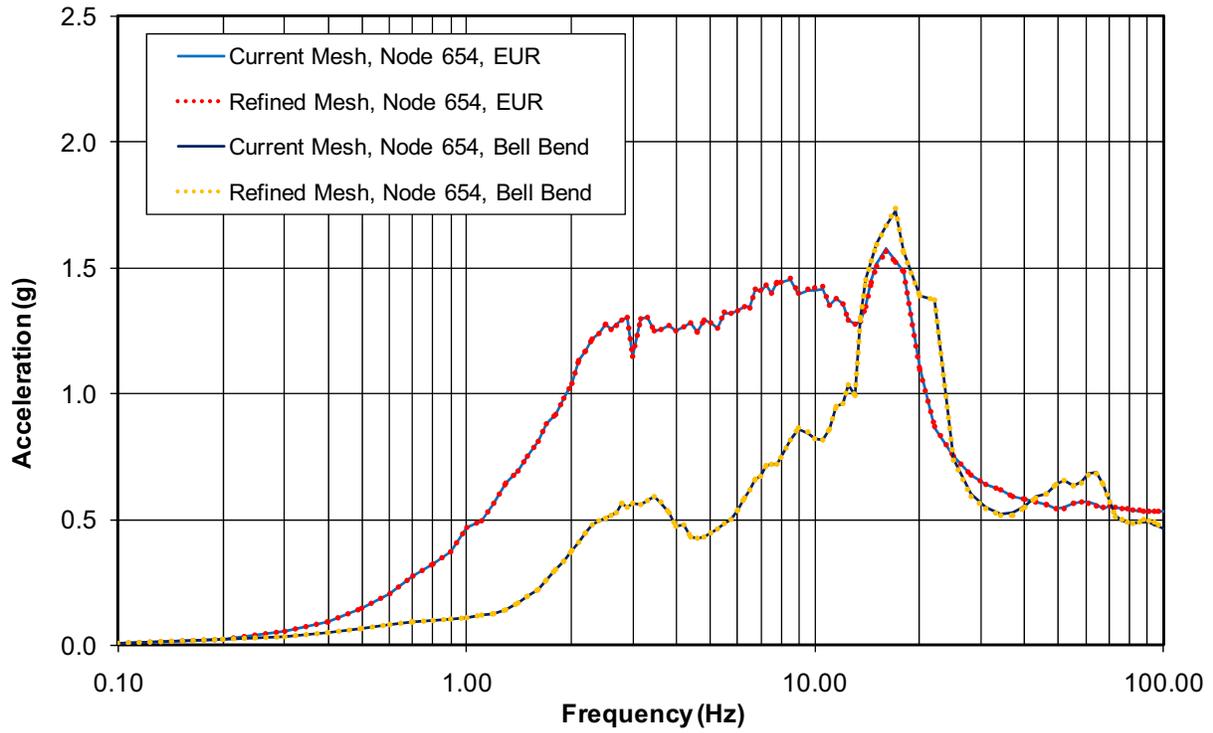


**Figure 03.07.02-71-3—Node 684, Z-Dir.**



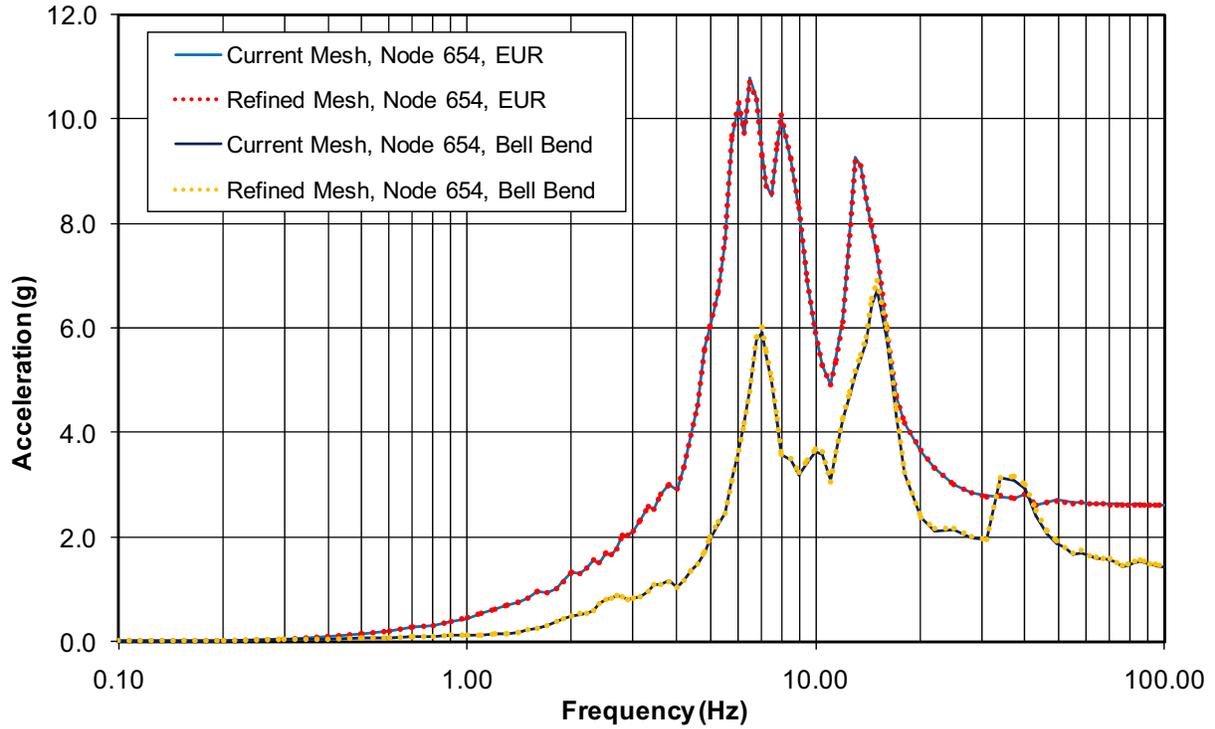
**Figure 03.07.02-71-4—Node 654, X-Dir.**

**U.S. EPR Standard Plant In-Structure Response Spectra (ISRS),  
Internal Wall, X(E-W) Direction, Damping = 5%**



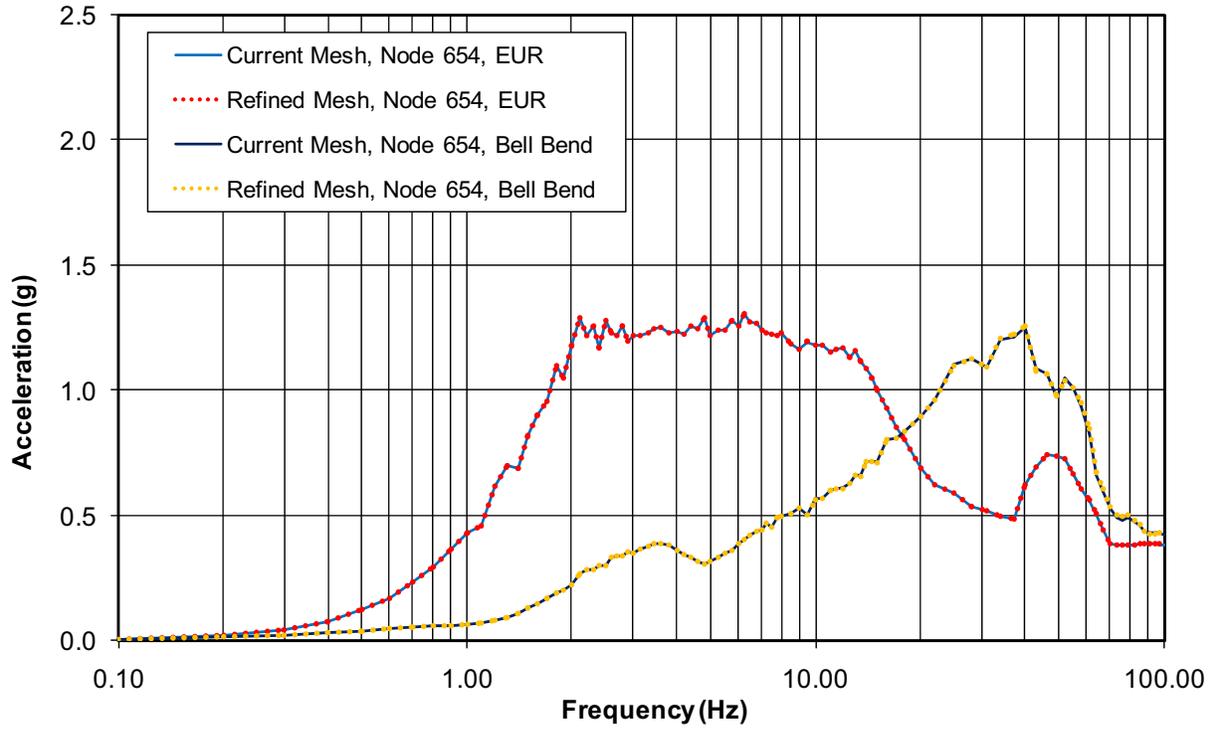
**Figure 03.07.02-71-5— Node 654, Y-Dir.**

**U.S. EPR Standard Plant In-Structure Response Spectra (ISRS),  
Internal Wall, Y(N-S) Direction, Damping = 5%**



**Figure 03.07.02-71-6—Node 654, Z-Dir.**

**U.S. EPR Standard Plant In-Structure Response Spectra (ISRS),  
Internal Wall, Z(Vert) Direction, Damping = 5%**



**Question 03.07.02-72:****Follow Up to RAI 248, Question 03.07.02-48:**

On page 3.7-65 of the FSAR markup, the fourth bullet states that “Changes, either individually or cumulatively, that exceed these thresholds result in the evaluation of the need for reanalysis.” This is referring to the third bullet which previously stated in Revision 1 of the FSAR that deviations in ISRS of less than 10 percent increase were acceptable. As the wording of the third bullet has now been superseded by the words in the FSAR markup, the applicant is requested to change or delete the current wording of the fourth bullet. In addition the applicant has not responded to that part of Question 03.07.02-48 which asked whether the approach of accepting up to a ten percent increase in ISRS was also applicable to an increase in design loads for critical sections. Acceptance of a ten percent increase without proper evaluation could result in code allowable stresses being exceeded and would not meet 10 CFR 50, Appendix B requirements for design control. Therefore, the applicant is requested to provide a response to this question and if the response is that increases of up to 10 percent are acceptable, to provide the technical basis for the applicant’s position.

**Response to Question 03.07.02-72:**

Site-specific in-structure response spectra (ISRS) and design loads that exceed U.S. EPR design require additional evaluation to determine if U.S. EPR safety-related structures, systems, and components will be affected. U.S. EPR FSAR Tier 2, Section 2.5.2.6 and Section 3.7.2 will be revised to remove the reference to the ten percent criterion.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 2.5.2.6 and Section 3.7.2 will be revised as described in the response and indicated on the enclosed markup.

# U.S. EPR Final Safety Analysis Report Markups

performed in accordance with the methodologies described in Section 3.7.1 and Section 3.7.2. Results from this comparison will be acceptable if the amplitude of the site-specific ISRS do not exceed the ISRS for the U.S. EPR ~~by greater than 10 percent on a location-by-location basis~~. Comparisons will be made at the following key locations, defined in Section 3.7.2:

03.07.02-72 →

- A. Reactor Building Internal Structures (RBIS)—Reactor Vessel Support at elevation +16 ft, 10-3/4 in (Figures 3.7.2-74, 3.7.2-75, and 3.7.2-76) and steam generator supports at elevation +63 ft, 11-3/4 in (Figures 3.7.2-77, 3.7.2-78, and 3.7.2-79).
- B. Safeguards Building (SB) 1—elevation +26 ft, 7 in (Figures 3.7.2-80, 3.7.2-81, and 3.7.2-82) and +68 ft, 10-3/4 in (Figures 3.7.2-83, 3.7.2-84, and 3.7.2-85).
- C. SBs 2/3—elevation +26 ft, 7 in (Figures 3.7.2-86, 3.7.2-87, and 3.7.2-88) and +50 ft, 6-1/4 in (Figures 3.7.2-89, 3.7.2-90, and 3.7.2-91).
- D. SB 4—elevation +68 ft, 10-3/4 in (Figures 3.7.2-92, 3.7.2-93, and 3.7.2-94).
- E. Reactor Containment Building (RCB)—Polar crane support at elevation +123 ft, 4-1/4 in (Figures 3.7.2-95, 3.7.2-96, and 3.7.2-97) and top-of-dome at elevation +190 ft, 3-1/2 in (Figures 3.7.2-98, 3.7.2-99, and 3.7.2-100).
- F. Fuel Building (FB)—elevation + 12 ft, 1-2/3 in.
- G. Emergency Power Generator Building (EPGB)—basemat elevation. +0 ft, 0 in at Node 1172 (Figures 3.7.2-101, 3.7.2-102, and 3.7.2-103) and +51 ft, 6 in.
- H. Essential Service Water Building (ESWB)—Node 10385 on elevation +14 ft, 0 in (Figures 3.7.2-107, 3.7.2-108, and 3.7.2-109) and Node 12733 on elevation +63 ft, 0 in (Figures 3.7.2-104, 3.7.2-105, and 3.7.2-106).

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9. Exceedances ~~in excess of the limits discussed in step 8~~ will require additional evaluation to determine if safety-related structures, systems, and components of the U.S. EPR at the location(s) in question will be affected.

As a result of the reconciliation process described above, the applicant may redesign selected features of the U.S. EPR, as required. Redesigned features will be identified as exceptions to the FSAR and addressed by the COL applicant.

### 2.5.3 Surface Faulting

No surface faulting is considered to be present under foundations for Seismic Category I structures in the U.S. EPR (GDC 2).

A COL applicant that references the U.S. EPR design certification will investigate site-specific surface and subsurface geologic, seismic, geophysical, and geotechnical aspects within 25 miles around the site and evaluate any impact to the design. The COL applicant will demonstrate that no capable faults exist at the site in accordance with

EPR structures is defined in Section 3.2. These seismic analyses meet the requirements of 10 CFR 50, GDC 2 and 10 CFR 50, Appendix S, with respect to the capability of the structures to withstand the effects of earthquakes. Application of the criteria in Section 3.7 to the seismic analysis and design of the U.S. EPR results in a robust design with significant seismic margin, as demonstrated in the seismic margin assessment of Section 19.1. A COL applicant that references the U.S. EPR design certification will confirm that the site-specific seismic response is within the parameters of Section 3.7 of the U.S. EPR standard design. The impact of changes to the standard design at the detailed design stage is evaluated using the following criteria.

- The effects of deviations are evaluated using methods that are consistent with those of Section 3.7 as used for the certified design.
- The evaluation considers the combined effect of such deviations.
- The combined deviations ~~are acceptable if the amplitudes of the in-structure response spectra increase by less than 10 percent~~ in amplitude of the in-structure response spectra will be evaluated on a case-by-case basis.
- ~~Changes, either individually or cumulatively, that exceed these thresholds result in the evaluation of the need for reanalysis.~~

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### 3.7.2.1

#### Seismic Analysis Methods

The response of a multi degree-of-freedom system subjected to seismic excitation may be represented by the differential equations of motion in the following general form:

Equation 1

$$[M]\{\ddot{X}\} + [C]\{\dot{X}\} + [K]\{X\} = -[M]\{\ddot{u}_g\}$$

Where:

$[M]$  = mass matrix (n x n)

$[C]$  = viscous damping matrix (n x n)

$[K]$  = stiffness matrix (n x n)

$\{X\}$  = column vector of relative displacements (n x 1)

$\{\dot{X}\}$  = column vector of relative velocities (n x 1)

$\{\ddot{X}\}$  = column vector of relative accelerations (n x 1)

$n$  = number of degrees of freedom