ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Thursday, July 29, 2010 8:08 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); VAN NOY Mark (EXTERNAL AREVA); CORNELL Veronica (EXTERNAL AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 4 - Interim
Attachments: RAI 371 Supplement 4 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.

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: 'Tesfaye, 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: 1760

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB71070A9351)

Subject: Response to U.S. EPR Design Certification Application RAI No. 371, FSAR Ch. 3, Supplement 4 - Interim
Sent Date: 7/29/2010 8:08:25 PM
Received Date: 7/29/2010 8:09:16 PM
From: BRYAN Martin (EXTERNAL AREVA)

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Files	**Size**	**Date & Time**
MESSAGE	11150	7/29/2010 8:09:16 PM
RAI 371 Supplement 4 Response US EPR DC.pdf		132440

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

Response to

Request for Additional Information No. 371, Supplement 4

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 03.07.02-66:

RAI from Public Meeting 12/14-15, 2009

The new FEM is composed entirely of plate and shell elements (all nodes having 6 DOF) with no brick elements (all nodes having 3 DOF), particularly for the basemat/wall elements of the model. Therefore, there is no issue associated with this model concerning connections between adjoining nodes having different DOFs. These elements, however, have effectively zero thickness leading to the following two problems:

a. When a plate element of a section of the basemat of one thickness is connected to an adjacent element of a different thickness, the centerlines of the adjacent elements are connected continuously in a single plane. However, the actual basemat is typically poured with the bottom of the basemat at one elevation. If the basemat has a varying thickness, the actual centerline does not lie in a single plane but its location changes as the thickness of the mat changes. As this has the potential to introduce non-conservative errors in the design loads for the basemat, the staff requests that the applicant evaluate the impact of the analysis simplification regarding the location of the basemat centerline on the bending evaluation of the basemat and the use of the analysis results for the design of the mat.

b. In embedding the model into the foundation, the basemat can be located with its centerline at the elevation of the nominal bottom of the basemat in which case the length of the attached walls must be increased affecting their frequency response or the centerline can be located at its actual elevation somewhat above the foundation bottom. This latter method leaves the effective lengths of attached walls approximately correct but the seismic input to the model is at an incorrect elevation. In either case the assumptions used can lead to non-conservative structural accelerations and an under prediction of seismic loads acting on the structure. The staff requests that the applicant describe the details of the placement of the embedded model into the foundation material using these plate elements and its potential effect on the accuracy of the analysis results and the impact on the building's seismic design loads.

Response to Question 03.07.02-66:

a. AREVA NP will develop a new basemat analysis model for the design of the Nuclear Island (NI) basemat. Elements representing elevations and varying thicknesses of the basemat in the new model will be studied for mesh sensitivity and behavior and their ability to capture accurate forces and moments for design use will be determined.

b. In the dynamic finite element model (FEM) that is used to conduct soil-structure interaction analysis, the NI basemat consists entirely of shell elements. Basemat shell elements are located with their centerline at the elevation of the nominal bottom of the basemat, which is appropriate for input of ground motions. To compensate for longer walls that result from using the nominal basemat elevation, wall elements are modeled as rigid from below the top of the mat through its thickness. The basemat FEM described in (a.) will be used to develop forces and moments for design.

FSAR Impact:

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

Question 03.07.02-67:

RAI from Public Meeting 12/14-15, 2009

A new large finite element model of the Nuclear Island Common Basemat Structures was developed using the ANSYS Code. This model is too large to be directly input into the MTR/SASSI Code. Therefore, the model used for the dynamic response analysis has been reduced in size. If these models are not dynamically equivalent, non-conservative errors could be introduced in the results of the dynamic analysis. As the ANSYS model serves as the basis for the SASSI model, the applicant is requested to demonstrate and describe the process that was used to ensure that the two models (ANSYS model vs SASSI model) are dynamically equivalent and include this information in the FSAR. The staff needs this information to conclude that an adequate dynamic model was used in the analysis.

Response to Question 03.07.02-67:

Fixed-base modal time-history analyses will be performed on the two models and in-structure response spectra at selected locations will be compared to confirm adequacy of the dynamic model used in the soil-structure interaction analysis. The U.S. EPR FSAR will be revised to incorporate these comparisons 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 03.07.02-68:

RAI from Public Meeting 12/14-15, 2009

The frequency transmission characteristics of the Nuclear Island seismic model using a finite element model to represent the common basemat structures needs to be evaluated. The criterion of DC/COL-ISG-1 (Seismic Issues of High Frequency Ground Motion) states that information should be provided to demonstrate that the SSI and structural models are of adequate refinement to assure that the high frequency components of the horizontal and vertical GMRS/FIRS of interest are properly transmitted through both segments of the computer model. For the soft soil case(s), the transmission characteristics are limited by the transmission capability of the site soils, which are softer than the concrete structural elements. The applicant is requested to describe how the problems used for SSI analyses were modeled such that the subgrade is capable of transmitting the highest frequency of interest for each of the CSDRS time histories and to present the results of any sensitivity studies that were performed to assure that the seismic models meet the frequency criterion of the ISG and include this information in the FSAR. If sensitivity studies were not performed, the applicant should provide technical justification as to why this was not done.

Response to Question 03.07.02-68:

AREVA NP performed sensitivity studies to verify the ability of the Nuclear Island (NI) model to transmit high frequency ground motion. The structure chosen for these studies was a simplified finite element model of the Essential Service Water Building (ESWB) with a mesh size and soil layering equivalent to that of the NI model. Stick models with multiple single-degree-of-freedom oscillators were added to the simplified ESWB models to represent a wider range of dynamic behavior. Two mesh sizes were used to examine the ability of the subgrade to transmit the highest frequency of interest with the finer mesh being half the size of the coarser mesh. The following paragraphs discuss preliminary results. Final results will be provided in the FINAL response to this question.

Soil element frequency transmission ability is based on $f_{max} = V_s/(5L_e)$. Table 3.7.2-68-1 shows soil passing frequencies for design certification. Soil cases 1n2u, 1n5a, and Bell Bend (lower bound) are the soil cases with the lowest passing frequencies and were selected for this study.

In-structure response spectra at various locations were used to compare results from the coarse and refined meshes. Soil cases 1n2u and 1n5a input motions are characterized by low frequency content using modified European utility requirements curves. Figure 3.7.2-68-1 to Figure 3.7.2-68-3 demonstrate close agreement between the fine and course mesh curves observed for these soil cases throughout the frequency range up to 100 Hz with a soil passing frequency as low as 19 Hz. Soil case Bell Bend LB input motion contains high frequency content up to 25 Hz. For this soil case, Figure 3.7.2-68-4 to Figure 3.7.2-68-6 show close agreement between the coarse and refined mesh results up to the soil passing frequency shown in Table 3.7.2-68-1. These results indicate that the Bell Bend lower bound (LB) and best estimate (BE) soil cases require refinement in the embedded portion of the mesh for the NI FEM to meet DC/COL-ISG-1 requirements. Mesh refinement will be used to model the embedded portion of the structure and described in the FINAL response to this question.

U.S. EPR FSAR, Tier 2, Section 3.7.2 will be revised accordingly in response to RAI 320 Question 03.07.02-63.

Table 3.7.2-68-1—Calculated Soil Passing Frequencies for U.S. EPR Soil Cases

Soil Case	Location	Shear Wave Velocity	Element Length	Passing Frequency
		(m/s)	(m)	(Hz)
1n2u	Backfill	213.4	2.250	19
	Soil	435.0	2.000	44
1n5a	Backfill	213.4	2.250	19
	Soil	2012..0	1.000	402
2sn4u	Backfill	500.0	2.250	44
	Soil	500.0	0.950	105
4u	Backfill	1200.0	2.250	107
	Soil	1200.0	1.000	240
5a	Backfill	4000.0	2.250	356
	Soil	4000.0	1.013	790
Bell Bend BE	Backfill	176.3	1.500	24
	Soil	2926.0	4.570	128
Bell Bend LB	Backfill	143.3	1.5	19
	Soil	2389.0	4.570	105
Bell Bend UB	Backfill	429.3	1.925	45
	Soil	3584.0	4.570	157

Figure 3.7.2-68-1—ISRS-Comparison, ESWB Simplified FE-Model, Node 26623, X-Dir, Soil Case 1n2u

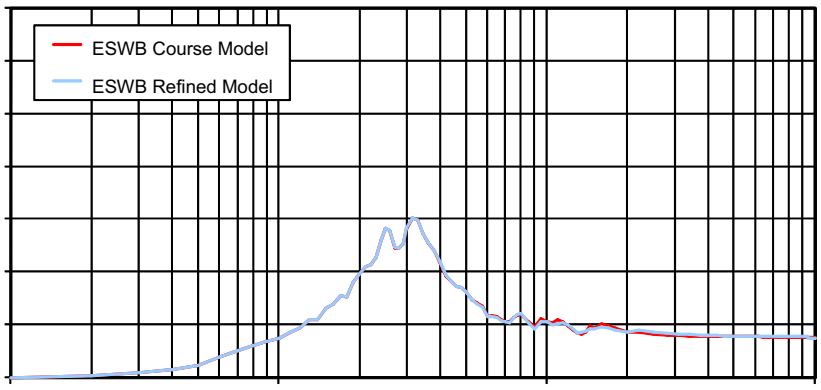


Figure 3.7.2-68-2—ISRS-Comparison, ESWB Simplified FE-Model, Node 26623, Y-Dir, Soil Case 1n2u

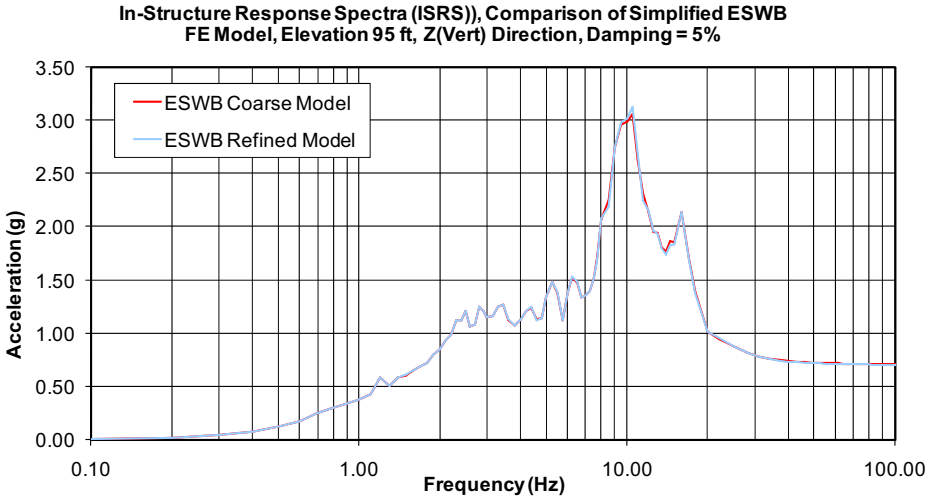


Figure 3.7.2-68-3—ISRS-Comparison, ESWB Simplified FE-Model, Node 26623, Z-Dir, Soil Case 1n2u

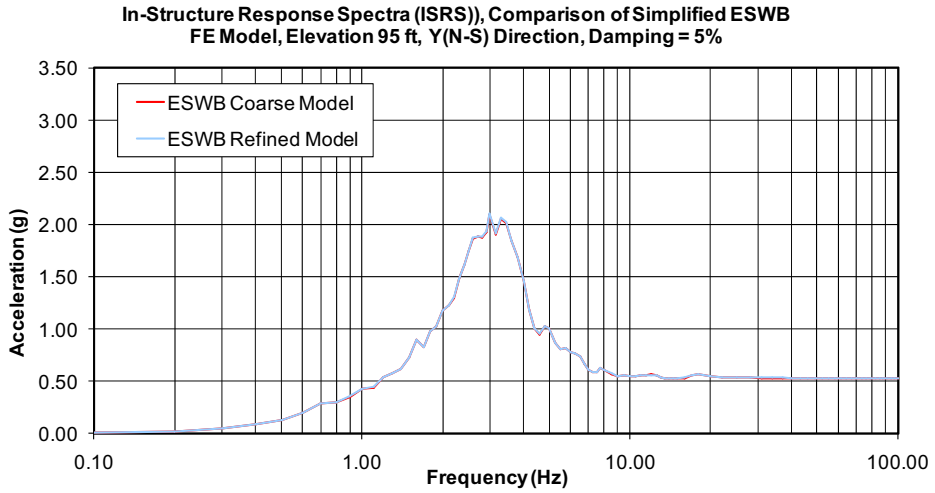


Figure 3.7.2-68-4—ISRS-Comparison, ESWB Simplified FE-Model, Node 26623, X-Dir, Soil Case Bell Bend LB

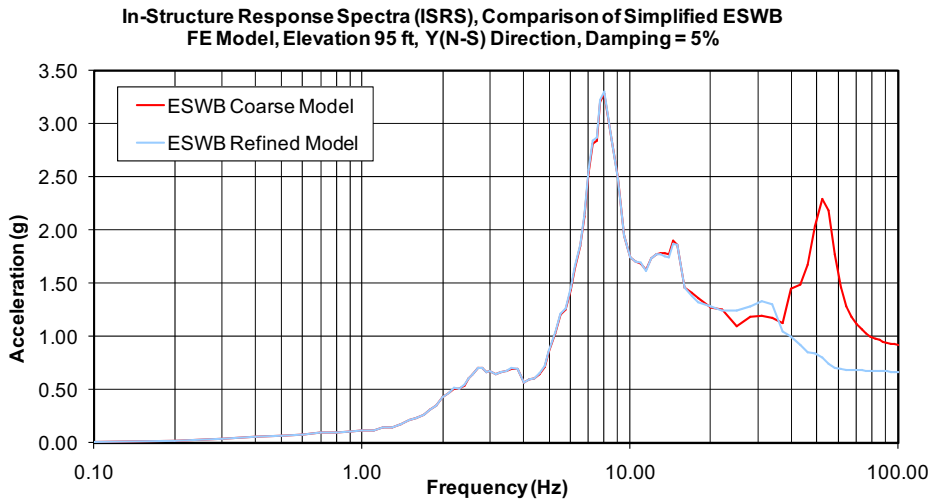


Figure 3.7.2-68-5—ISRS-Comparison, ESWB Simplified FE-Model, Node 26623, Y-Dir, Soil Case Bell Bend LB

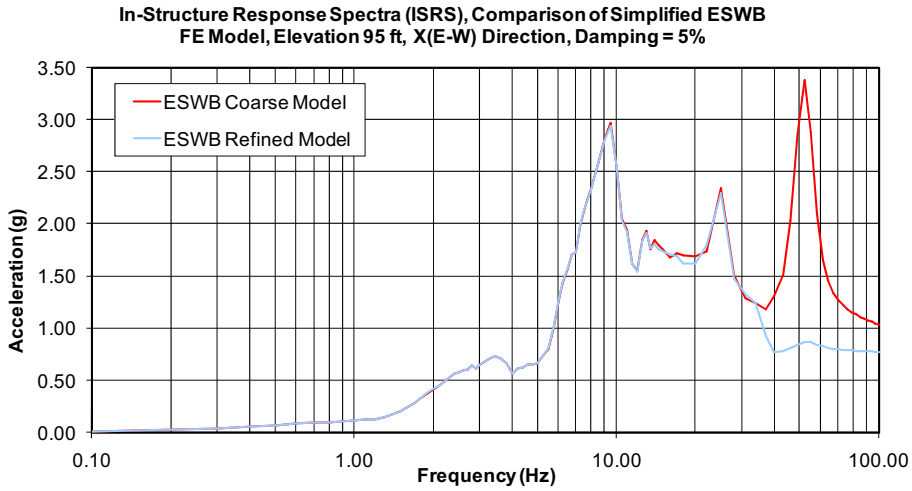
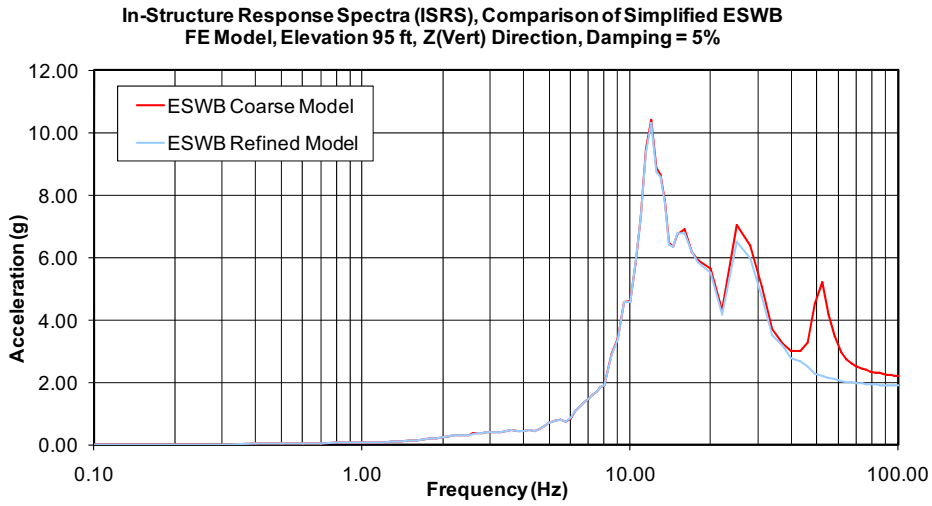


Figure 3.7.2-68-6—ISRS-Comparison, ESWB Simplified FE-Model, Node 26623, Z-Dir, Soil Case Bell Bend LB



FSAR Impact:

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