PMSTPCOL PEmails

From: Tai, Tom
Sent: Tuesday, December 20, 2011 3:06 PM
To: Chakrabarti, Samir; Chakravorty, Manas
Cc: STPCOL
Subject: FW: Transmittal of Letter U7-C-NINA-NRC-110148
Attachments: U7-C-NINA-NRC-110148.pdf

Samir, Manas,

Attached for your review is NINA's latest RAI response (hopefully final) addressing section cuts.

Regards

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From: Elton, Loree [mailto:leelton@STPEGS.COM]
Sent: Monday, December 19, 2011 5:07 PM
To: Casto, Chuck; Wunder, George; Eudy, Michael; Foster, Rocky; Joseph, Stacy; Tai, Tom
Subject: Transmittal of Letter U7-C-NINA-NRC-110148

Please find attached a courtesy copy of letter number U7-C-NINA-NRC-110148, which provides a supplemental response to NRC staff question 03.07.01-29 included in the Request for Additional Information (RAI) letter number 378 related to the Combined License Application (COLA) Part 2, Tier 2, Section 3.7 and a revised response to NRC Staff question included in RAI 03.07.02-32 letter number 381 related to the COLA Part 2, Tier 2, Section 3.7.

The official version of this correspondence will be placed in the mail. Please call John Price at 972-754-8221 if you have any questions concerning this letter.

Loree Elton
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Email Number: 3240

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From: Tai, Tom

Created By: Tom.Tai@nrc.gov

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December 19, 2011
U7-C-NINA-NRC-110148

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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Rockville MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Revised Response to Request for Additional Information

Attachment 1 provides a supplemental response to NRC staff question 03.07.01-29 included in the Request for Additional Information (RAI) letter number 378 related to the Combined License Application (COLA) Part 2, Tier 2, Section 3.7. During the audit of September 27-30, 2011, the NRC Staff requested that Nuclear Innovation North America LLC (NINA) provide additional information to support the review of the COLA pertaining to the Benchmark and Mesh Refinement studies performed for the Ultimate Heat Sink/Reactor Service Water Pump House.

Attachment 2 provides a revised response to NRC Staff question included in RAI 03.07.02-32 letter number 381 related to the COLA Part 2, Tier 2, Section 3.7. During the audit of September 27-30, 2011 and subsequent phone conversations, the NRC Staff requested that NINA provide additional information to support the review of the COLA pertaining to Seismic II/I Interactions.

This submittal completes the actions requested by the NRC Staff.

Where there are COLA markups, they will be made at the first routine COLA update following NRC acceptance of the RAI response.

There are no commitments in this letter.

If you have any questions regarding these responses, please contact me at (361) 972-7136 or Bill Mookhoek at (361) 972-7274.

STI 33172195

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 12/19/11

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

jep

Attachments:

1. RAI 03.07.01-29, Supplement 2
2. RAI 03.07.02-32, Revision 1

cc: w/o attachment except*
(paper copy)

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RAI 03.07.01-29, Supplement 2

QUESTION:

The Defense Nuclear Facilities Safety Board (DNFSB) has identified a technical issue in SASSI that when subtraction method is used to analyze embedded structures, the results may be non-conservative. Because the subtraction method has been used for the STP Units 3&4 SSI/SSSI analyses, NINA is requested to demonstrate the acceptability of the subtraction method and the results, or provide a plan and schedule to ensure that the SSCs are designed to meet the requirements of GDC 2. Therefore, the applicant is requested to address the following:

1. For all STP Units 3&4 Seismic Category I structures, compare the In-Structure Response Spectra (ISRS), structural loads, and any other design response quantities developed by using the subtraction method with those using the direct method or modified subtraction method and evaluate the differences.
2. Demonstrate and justify that the differences identified in Item 1 either have no impact on the design of Seismic Category I structures, or revise the design to address the differences.
3. If the modified subtraction method is used to validate the subtraction method, provide a validation program for the modified subtraction method.
4. Provide FSAR mark-up, if any, in the response to document actions taken to address the resolution of the DNFSB's issues with SASSI versions used by STP Units 3&4 analyses.

The staff needs this information to ensure that the STP design basis loads and ISRS will envelop the corresponding ISRS generated from either the direct method or the modified subtraction method.

SUPPLEMENTAL RESPONSE:

The Supplement 1, Revision 1 response to this RAI was submitted with Nuclear Innovation North America LLC (NINA) letter U7-C-NINA-NRC-110143, dated November 28, 2011. This second supplement provides the results of Benchmark and Mesh Refinement studies for the Ultimate Heat Sink (UHS)/Reactor Service Water (RSW) Pump House section cut forces that were discussed in Section D.1.4 of the Supplement 1, Revision 1 response.

When addressing the adequacy of the walls and slabs of the UHS/RSW Pump House for the cumulative effect of change in the maximum accelerations due to use of Modified Subtraction Method (MSM) of analysis, for 19 section cuts of the UHS/RSW Pump House, the percent (%) difference in the soil structure interaction (SSI) forces from Subtraction Method (SM) and MSM analyses were determined and compared to the available margin in the section cut forces due to use of conservative equivalent static method. In order to provide additional confidence in section cut forces obtained from the SSI analysis, two additional confirmatory studies as described below were performed.

Benchmark Study:

The purpose of the benchmark study was to show that the section cut forces from the SSI analysis using SASSI2000 program were accurate or conservative. As noted in the Supplement 1, Revision 1 response, in order to benchmark the calculation of section cut forces from SASSI2000, a dynamic analysis performed in SASSI2000 was repeated using the SAP2000 program with an identical input and nearly identical model. The structural mesh of the models were identical to the so-called coarse mesh (also referred to as original mesh) model used for the SSI analysis of the UHS/RSW Pump House. The SAP2000 model was run as fixed base. Since fixed base is not an option for SASSI2000, fixed base analysis in SASSI2000 was simulated by modifying the SSI model as follows:

- The soil under the UHS basin, from bottom of the UHS basin mudmat down to the bottom of the RSW Pump House mudmat, was replaced with concrete using massless solid elements, see Figure 03.07.01-29 S2.1. In order to avoid fixing the RSW Pump House south wall, as shown in Figure 03.07.01-29 S2.2 the massless concrete elements were not connected to the RSW Pump House south wall.
- The grade elevation was set at the bottom of the RSW Pump House mudmat.
- The soil properties below the grade (i.e. bottom of Pump House) were modified to represent a rigid base through the use of high shear wave velocity of 20000 ft/sec.

The SAP2000 model was identical to the SASSI2000 model that is shown in Figure 03.07.01-29 S2.1 except for the absence of the below grade soil. Nodes identified as the interaction nodes in the SASSI2000 analysis were fixed in the SAP2000 model. The SAP2000 analysis was performed as a linear modal time history analysis utilizing Ritz modal analysis considering 1000 modes. The input ground motions were the site-specific Safe Shutdown Earthquake (SSE), the results from the three seismic excitations were combined using square root of the sum of the squares (SRSS), and only the full basin case was considered.

Table 03.07.01-29 S2.1 provides the comparison of the section cut forces for the 19 section cuts from the SASSI2000 and SAP2000 fixed base analyses. Based on this comparison, the following are noted:

1. In great majority of cases (88 out of 95 force components), the SASSI2000 results are higher than the corresponding SAP2000 results. In these cases, for large force components, the SASSI2000 results are within 15% of those from SAP2000. For relatively small force components, in some cases the percentage difference is higher.
2. For 7 out of the 95 force components, the SAP2000 results are higher. For 5 of these 7 cases the SASSI2000 results are within 6% of the SAP2000 results. For the remaining two cases (namely out-of-plane moments for Sections 68 and 70), the difference of 15% and 24% are for relatively small moments of 273 kip-ft and 114 kip-ft, respectively.

It should be noted that although every attempt is made to make the SASSI2000 and SAP2000 models identical, the models are not quite identical due to presence of below grade soil in the SASSI2000 model. Also note that the SASSI2000 analysis is based on frequency domain analysis and the SAP2000 analysis is based on linear modal time history analysis. Due to these differences, minor differences between the results from the two analyses are expected with higher percentage differences for the force components with relatively low values. Considering this and the comparison results discussed above, it is concluded the section cut forces from the SASSI2000 analysis are conservative and reliable.

Mesh Refinement Study:

The MSM analysis of the UHS/RSW Pump House was performed using the original mesh (also called coarse mesh) that was used in the SM analysis. To examine the impact of mesh refinement on the SSI section cut forces, the fixed base SSI model described in the benchmark study (see Figures 03.07.01-29 S2.1 and 03.07.01-29 S2.2) was refined to best approximate the more refined mesh used in the SAP2000 design model using the equivalent static method. The SSI fixed base model with the refined mesh is shown in Figures 03.07.01-29 S2.3 and 03.07.01-29 S2.4.

The fixed base SSI models with the original mesh and refined mesh were both analyzed for the site-specific SSE ground motions considering both the full and empty basin cases and the results from the three seismic excitations were combined using SRSS to determine section cut forces along the 19 section cuts. Tables 03.07.01-29 S2.2 and 03.07.01-29 S2.3 provide comparison of the section cut forces for the full and empty basin cases, respectively. These comparisons show that in majority of the cases the section cut forces from the two meshes are with ±10%, however there are some cases with higher percent (%) differences.

In order to account for the difference in the section cut forces due to use of refined SSI mesh, the percent (%) difference in the SSI section cut forces from the MSM analysis were increased by the percent (%) difference in the section cut forces due to use of refined mesh to obtain the total increase in the section cut forces due to use of MSM prior to comparing them to the available margins in the design section cut forces due to use of conservative equivalent static method. Tables 03.07.01-29 S2.4 and 03.07.01-29 S2.5 provide the results of this comparison for the full and empty basin cases, respectively. Note that in these comparisons, no credit was taken for any reduction in the section cut forces due to use of MSM analysis and/or refined mesh. Also note that Tables 03.07.01-29 S2.4 and 03.07.01-29 S2.5 of this supplemental response supersede Tables 03.07.01-29 S1.16 and 03.07.01-29 S1.17 provided in Supplement 1, Revision 1 of this response.

Based on the comparisons presented in Tables 03.07.01-29 S2.4 and 03.07.01-29 S2.5, the following are concluded:

- In the majority of the cases, the individual force components from the Modified Subtraction Method of analysis along a section cut are lower than the respective force components from the Subtraction Method of analysis.

- With the exception of one case (discussed in the following bullet), for all those cases where an individual force component from the Modified Subtraction Method of analysis along a section cut exceeds the corresponding force from the Subtraction Method of analysis, the increase is bounded by the available margin in the design forces due to use of conservative equivalent static method.

- For section cut 61 of the full basin case, the percent (%) increase in the in-plane moment is 58.3%. This exceeds the 57% available margin in the design in-plane moment. This difference of 1.3% is of no consequence for the following reasons:

    1. This deficit is only applicable to the in-plane moment. For the remaining force components (i.e. axial force, in-plane shear, out-of-plane shear, and out-of-plane moment), the Modified Subtraction Method yields lower force components.
    2. The design of wall reinforcement is a function of four force components, namely axial force, in-plane shear, in-plane moment, and out-of-plane moment. The minimum margins for the axial force, in-plane shear and out-of-plane moment used for the design are 60%, 124%, and 134%, respectively.
    3. The available margins noted in these tables are conservative because they are only based on the applied loads and do not consider any additional margin based on provided reinforcement vs. calculated required reinforcement. Generally, provided reinforcement is about 5 to 10% more than the calculated required reinforcement.

Table 03.07.01-29 S2.6 provides one additional comparison for the UHS/RSW Pump House full basin case for which the benchmark study was performed. This comparison is similar to the comparison in Table 03.07.01-29 S2.4 except the section cut forces are further modified by an additional factor to reflect the results of benchmark study. Where the SAP2000 results were higher than the SASSI2000, the section cut forces are increased by the percentage difference. The results of this comparison are similar to those shown in Table 03.07.01-29 S2.4 and the above observations noted for Tables 03.07.01-29 S2.4 and 03.07.01-29 S2.5 remain unchanged.

Based on the above and the evaluation results for the UHS basin beams and columns discussed in Section D.1.4 of the Supplement 1, Revision 1 response, all of the UHS/RSW Pump House basin beams, basin columns, wall panels and slabs that were designed based on the SSI analysis results using the Subtraction Method of analysis are adequate for the resulting forces due to use of the Modified Subtraction Method of analysis.

No COLA revisions are required as a result of this response.

Table 03.07.01-29 S2.1: Comparison of Section Cut Forces from SASSI2000 and SAP2000 – Benchmark Study (UHS/RSW Pump House with Full Basin, Simulated Fixed Base Condition)

Full Basin, Benchmark Study (SASSI2000 vs. SAP2000)															
	% Change (SASSI2000/SAP2000)					Output Values (Units: Kips, Kip-ft)									
						SASSI2000					SAP2000				
Section Cut	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment
55	14%	10%	9%	10%	6%	909	1,462	221	26,494	4,945	800	1,326	204	24,052	4,687
56	12%	10%	5%	5%	7%	1,229	1,505	698	45,735	3,096	1,099	1,369	663	43,656	2,895
57	6%	7%	10%	12%	7%	1,521	820	543	21,741	4,031	1,434	769	494	19,428	3,751
58	12%	5%	16%	7%	12%	2,269	3,215	871	46,952	6,937	2,022	3,076	754	43,720	6,195
59	12%	11%	1%	11%	14%	8,344	2,292	701	10,091	9,173	7,472	2,065	696	9,081	8,081
60	14%	5%	14%	8%	12%	2,248	3,179	780	45,736	6,613	1,975	3,030	681	42,515	5,879
61	11%	12%	2%	12%	13%	8,755	2,230	669	14,446	9,179	7,858	1,992	656	12,948	8,114
62	4%	10%	14%	12%	16%	1,121	12,212	587	27,483	10,144	1,073	11,125	514	24,507	8,758
63	12%	14%	2%	-1%	17%	11,017	4,193	190	82,994	1,585	9,824	3,667	187	83,487	1,350
64	8%	4%	17%	0%	14%	3,119	11,968	458	97,595	6,357	2,887	11,473	391	97,374	5,580
65	7%	9%	10%	-5%	13%	11,181	3,952	255	85,446	2,345	10,423	3,631	232	89,844	2,070
66	10%	5%	15%	15%	11%	1,953	5,349	1,376	22,201	15,492	1,776	5,099	1,192	19,333	13,998
67	7%	4%	-2%	13%	9%	10,547	2,094	975	9,778	12,021	9,835	2,008	998	8,642	10,988
68	9%	3%	62%	7%	-15%	197	906	33	1,046	231	180	878	20	981	273
69	7%	7%	18%	-2%	27%	582	726	107	438	592	545	678	91	445	465
70	5%	8%	14%	-6%	-24%	80	296	73	461	86	76	275	64	490	114
71	4%	10%	4%	3%	25%	1,022	667	103	1,162	483	983	605	99	1,126	387
72	10%	9%	21%	9%	23%	338	538	93	849	409	309	493	77	781	334
73	5%	10%	0%	10%	5%	718	911	95	1,210	165	684	826	95	1,099	158

Table 03.07.01-29 S2.2: Comparison of SASSI2000 Section Cut Forces – Refined Mesh Study (UHS/RSW Pump House with Full Basin, Simulated Fixed Base Condition)

Full Basin, Refined Mesh Study															
	% Change (Refined Mesh/Original Mesh)					Output Values (Units: Kips, Kip-ft)									
						Original Mesh					Refined Mesh				
Section Cut	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment
55	-9%	1%	-30%	-12%	-15%	909	1,462	221	26,494	4,945	823	1,471	154	23,305	4,194
56	-3%	-1%	-11%	2%	9%	1,229	1,505	698	45,735	3,096	1,196	1,491	622	46,552	3,374
57	-2%	3%	9%	2%	8%	1,521	820	543	21,741	4,031	1,488	842	591	22,132	4,342
58	3%	5%	-3%	8%	4%	2,269	3,215	871	46,952	6,937	2,335	3,365	845	50,864	7,183
59	1%	2%	-2%	3%	1%	8,344	2,292	701	10,091	9,173	8,457	2,346	687	10,406	9,249
60	3%	5%	-2%	8%	1%	2,248	3,179	780	45,736	6,613	2,314	3,349	762	49,333	6,667
61	2%	2%	-3%	0.4%	2%	8,755	2,230	669	14,446	9,179	8,954	2,264	646	14,503	9,337
62	0%	2%	6%	-32%	11%	1,121	12,212	587	27,483	10,144	1,119	12,430	620	18,726	11,278
63	2%	-1%	-8%	5%	-7%	11,017	4,193	190	82,994	1,585	11,277	4,167	175	87,227	1,474
64	-3%	0%	0.5%	16%	6%	3,119	11,968	458	97,595	6,357	3,020	11,912	460	113,661	6,737
65	-1%	-2%	-5%	2%	-9%	11,181	3,952	255	85,446	2,345	11,100	3,889	241	87,390	2,139
66	-1%	2%	4%	4%	-7%	1,953	5,349	1,376	22,201	15,492	1,924	5,438	1,433	23,062	14,386
67	0.3%	2%	5%	-3%	-3%	10,547	2,094	975	9,778	12,021	10,578	2,130	1,026	9,447	11,648
68	7%	-5%	-51%	7%	-68%	197	906	33	1,046	231	210	860	16	1,115	73
69	6%	-3%	-18%	17%	-6%	582	726	107	438	592	615	704	88	511	559
70	-16%	-3%	24%	5%	24%	80	296	73	461	86	67	286	90	485	108
71	-3%	0%	-6%	1%	5%	1,022	667	103	1,162	483	990	667	97	1,171	505
72	-2%	-6%	-1%	-11%	17%	338	538	93	849	409	330	507	93	752	480
73	-4%	-4%	-18%	3%	-5%	718	911	95	1,210	165	689	871	78	1,244	157

Table 03.07.01-29 S2.3: Comparison of SASSI2000 Section Cut Forces – Refined Mesh Study (UHS/RSW Pump House with Empty Basin, Simulated Fixed Base Condition)

Empty Basin, Refined Mesh Study															
	% Change (Refined Mesh/Original Mesh)					Output Values (Units: Kips, Kip-ft)									
						Original Mesh					Refined Mesh				
Section Cut	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment	Axial	In-Plane Shear	Out-Of-Plane Shear	In-Plane Moment	Out-of-Plane Moment
55	-5%	9%	-34%	-8%	-17%	536	1,155	200	15,948	4,319	511	1,256	132	14,716	3,592
56	2%	12%	-11%	7%	7%	811	1,153	605	33,934	2,735	826	1,292	540	36,358	2,930
57	-3%	2%	-3%	-3%	3%	1,421	747	564	20,294	3,894	1,383	761	545	19,671	4,003
58	-3%	-5%	-7%	4%	4%	1,644	2,666	357	39,130	5,694	1,599	2,543	333	40,583	5,946
59	-10%	-5%	-9%	-8%	-10%	6,204	1,837	380	8,000	6,287	5,606	1,750	346	7,340	5,641
60	-1%	0%	-6%	4%	5%	1,586	2,501	331	38,835	5,404	1,573	2,492	312	40,283	5,691
61	-9%	-1%	-7%	-1%	-10%	6,505	1,619	363	9,993	6,315	5,906	1,610	339	9,934	5,668
62	0.3%	-7%	4%	-44%	5%	539	8,596	593	21,457	9,274	540	8,012	616	11,960	9,756
63	-6%	-8%	-10%	-4%	-7%	7,853	2,454	141	58,467	1,149	7,344	2,264	127	56,253	1,069
64	-1%	1%	4%	18%	7%	2,314	10,083	468	86,385	6,614	2,294	10,159	485	102,077	7,069
65	1%	-1%	-5%	4%	-4%	9,508	2,898	184	72,172	1,856	9,559	2,877	175	74,800	1,781
66	2%	5%	2%	11%	-2%	1,694	4,909	641	14,113	13,329	1,735	5,135	654	15,665	13,114
67	1%	-1%	4%	0%	1%	9,148	1,980	577	7,374	9,451	9,252	1,963	600	7,349	9,534
68	4%	-7%	-57%	4%	-74%	172	772	36	997	237	179	720	15	1,041	62
69	1%	-5%	-19%	20%	-4%	549	635	114	388	621	554	603	93	467	595
70	-27%	-7%	22%	-5%	21%	62	239	50	337	65	45	223	61	320	79
71	1%	-6%	-6%	-9%	9%	747	577	93	783	335	755	543	88	712	364
72	-1%	-5%	1%	-6%	13%	240	530	98	694	409	238	503	99	651	463
73	-1%	0.4%	-13%	-2%	-2%	552	923	88	1,011	142	549	927	77	990	139

Table 03.07.01-29 S2.4: Comparison of % Increase in Section Cut Forces Due to MSM and Refined Mesh vs. Design Margin – Full Basin Condition

FULL BASIN CONDITION			Axial Force				In-plane Shear				Out-of-plane Shear				In-plane Moment				Out-of-plane Moment			
Cut #	Cut Location	Direction of Cut	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI
55	Cooling Tower NS Wall Panel 3	Vert.	1.001	1.000	0.1	259.0	1.000	1.006	0.6	28.0	1.000	1.000	0.0	79.0	1.009	1.000	0.9	235.0	1.023	1.000	2.3	59.0
56	Cooling Tower NS Wall Panel 3	Vert.	1.017	1.000	1.7	164.0	1.000	1.000	0.0	29.0	1.019	1.000	1.9	36.0	1.000	1.018	1.8	140.0	1.014	1.090	10.5	150.0
57	Cooling Tower South Wall Panel 5	Vert.	1.000	1.000	0.0	2.4	1.034	1.027	6.2	84.0	1.000	1.088	8.8	43.0	1.009	1.018	2.7	52.0	1.019	1.077	9.7	96.0
58	Basin North Wall Panel 5	Vert.	1.001	1.029	3.0	110.0	1.000	1.047	4.7	197.0	1.029	1.000	2.9	188.0	1.020	1.083	10.5	108.0	1.000	1.035	3.5	112.0
59	Basin North Wall Panel 5	Horiz.	1.000	1.014	1.4	74.0	1.000	1.023	2.3	217.0	1.000	1.000	0.0	273.0	1.662	1.031	71.4	145.0	1.000	1.008	0.8	180.0
60	Basin South Wall Panel 5	Vert.	1.000	1.029	2.9	152.0	1.000	1.053	5.3	125.0	1.000	1.000	0.0	215.0	1.000	1.079	7.9	108.0	1.000	1.008	0.8	103.0
61	Basin South Wall Panel 5	Horiz.	1.000	1.023	2.3	60.0	1.000	1.015	1.5	124.0	1.000	1.000	0.0	240.0	1.577	1.004	58.3	57.0	1.000	1.017	1.7	134.0
62	Basin North Buttress 4	Vert.	1.000	1.000	0.0	171.0	1.000	1.018	1.8	75.0	1.000	1.056	5.6	272.0	1.000	1.000	0.0	47.0	1.000	1.112	11.2	307.0
63	Basin North Buttress 4	Horiz.	1.001	1.024	2.5	45.0	1.000	1.000	0.0	95.0	1.000	1.000	0.0	278.0	1.008	1.051	5.9	86.0	1.000	1.000	0.0	379.0
64	Basin East Buttress 1	Vert.	1.551	1.000	55.1	125.0	1.010	1.000	1.0	109.0	1.000	1.005	0.5	293.0	1.307	1.165	52.3	175.0	1.000	1.060	6.0	394.0
65	Basin East Buttress 1	Horiz.	1.000	1.000	0.0	26.0	1.000	1.000	0.0	58.0	1.000	1.000	0.0	132.0	1.000	1.023	2.3	20.0	1.000	1.000	0.0	117.0
66	Basin West Wall Panel 2	Vert.	1.000	1.000	0.0	174.0	1.003	1.017	2.0	147.0	1.000	1.042	4.2	224.0	1.050	1.039	9.1	101.0	1.000	1.000	0.0	86.0
67	Basin West Wall Panel 2	Horiz.	1.060	1.003	6.3	22.0	1.041	1.017	5.9	192.0	1.000	1.053	5.3	148.0	3.647	1.000	264.7	587.0	1.000	1.000	0.0	113.0
68	Pump House West Wall Panel 2	Vert.	1.026	1.069	9.7	525.0	1.000	1.000	0.0	61.0	1.000	1.000	0.0	3906.0	1.060	1.066	13.0	1681.0	1.000	1.000	0.0	613.0
69	Pump House West Wall Panel 2	Horiz.	1.000	1.057	5.7	74.0	1.000	1.000	0.0	49.0	1.000	1.000	0.0	715.0	1.000	1.165	16.5	550.0	1.013	1.000	1.3	991.0
70	Pump House South Wall Panel 3	Vert.	1.086	1.000	8.6	246.0	1.000	1.000	0.0	33.0	1.012	1.240	25.5	1375.0	1.062	1.052	11.7	165.0	1.011	1.245	25.9	2018.0
71	Pump House South Wall Panel 3	Horiz.	1.000	1.000	0.0	56.0	1.000	1.000	0.0	77.0	1.016	1.000	1.6	1258.0	1.000	1.008	0.8	592.0	1.011	1.047	5.9	660.0
72	Pump House North Wall Panel 2	Vert.	1.000	1.000	0.0	1215.0	1.000	1.000	0.0	116.0	1.000	1.000	0.0	1364.0	1.000	1.000	0.0	642.0	1.000	1.174	17.4	2408.0
73	Pump House North Wall Panel 2	Horiz.	1.008	1.000	0.8	229.0	1.000	1.000	0.0	72.0	1.000	1.000	0.0	2556.0	1.000	1.028	2.8	276.0	1.019	1.000	1.9	989.0

Table 03.07.01-29 S2.5: Comparison of % Increase in Section Cut Forces Due to MSM and Refined Mesh vs. Design Margin – Empty Basin Condition

EMPTY BASIN CONDITION																						
			Axial Force				In-plane Shear				Out-of-plane Shear				In-plane Moment				Out-of-plane Moment			
Cut #	Cut Location	Direction of Cut	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Total % Increase in Section Cut Forces ((CF1 x CF2) - 1) x 100	% Margin in Section Forces for Design vs. SSI
55	Cooling Tower NS Wall Panel 3	Vert.	1.000	1.000	0.0	322.0	1.000	1.087	8.7	27.0	1.000	1.000	0.0	61.0	1.000	1.000	0.0	264.0	1.010	1.000	1.0	42.0
56	Cooling Tower NS Wall Panel 3	Vert.	1.004	1.018	2.2	190.0	1.000	1.121	12.1	31.0	1.018	1.000	1.8	29.0	1.000	1.071	7.1	151.0	1.026	1.072	10.0	146.0
57	Cooling Tower South Wall Panel 5	Vert.	1.000	1.000	0.0	10.0	1.000	1.018	1.8	73.0	1.000	1.000	0.0	35.0	1.000	1.000	0.0	58.0	1.000	1.028	2.8	78.0
58	Basin North Wall Panel 5	Vert.	1.000	1.000	0.0	126.0	1.000	1.000	0.0	252.0	1.000	1.000	0.0	584.0	1.016	1.037	5.4	113.0	1.000	1.044	4.4	207.0
59	Basin North Wall Panel 5	Horiz.	1.032	1.000	3.2	85.0	1.000	1.000	0.0	243.0	1.000	1.000	0.0	605.0	1.707	1.000	70.7	201.0	1.000	1.000	0.0	155.0
60	Basin South Wall Panel 5	Vert.	1.000	1.000	0.0	179.0	1.000	1.000	0.0	145.0	1.000	1.000	0.0	612.0	1.000	1.037	3.7	93.0	1.000	1.053	5.3	158.0
61	Basin South Wall Panel 5	Horiz.	1.027	1.000	2.7	65.0	1.016	1.000	1.6	105.0	1.000	1.000	0.0	704.0	1.592	1.000	59.2	70.0	1.000	1.000	0.0	128.0
62	Basin North Buttress 4	Vert.	1.000	1.003	0.3	242.0	1.000	1.000	0.0	90.0	1.000	1.038	3.8	133.0	1.000	1.000	0.0	229.0	1.000	1.052	5.2	266.0
63	Basin North Buttress 4	Horiz.	1.020	1.000	2.0	69.0	1.000	1.000	0.0	206.0	1.000	1.000	0.0	246.0	1.022	1.000	2.2	90.0	1.000	1.000	0.0	354.0
64	Basin East Buttress 1	Vert.	1.000	1.000	0.0	158.0	1.005	1.008	1.3	104.0	1.000	1.037	3.7	92.0	1.000	1.182	18.2	266.0	1.000	1.069	6.9	261.0
65	Basin East Buttress 1	Horiz.	1.002	1.005	0.7	22.0	1.000	1.000	0.0	80.0	1.000	1.000	0.0	87.0	1.003	1.036	3.9	19.0	1.000	1.000	0.0	71.0
66	Basin West Wall Panel 2	Vert.	1.000	1.024	2.4	246.0	1.000	1.046	4.6	91.0	1.000	1.021	2.1	255.0	1.000	1.110	11.0	113.0	1.000	1.000	0.0	85.0
67	Basin West Wall Panel 2	Horiz.	1.000	1.011	1.1	33.0	1.009	1.000	0.9	169.0	1.000	1.040	4.0	529.0	1.290	1.000	29.0	378.0	1.002	1.009	1.1	93.0
68	Pump House West Wall Panel 2	Vert.	1.000	1.042	4.2	598.0	1.000	1.000	0.0	29.0	1.000	1.000	0.0	2175.0	1.115	1.045	16.5	1456.0	1.000	1.000	0.0	379.0
69	Pump House West Wall Panel 2	Horiz.	1.000	1.009	0.9	65.0	1.003	1.000	0.3	17.0	1.000	1.000	0.0	615.0	1.000	1.204	20.4	490.0	1.000	1.000	0.0	939.0
70	Pump House South Wall Panel 3	Vert.	1.007	1.000	0.7	267.0	1.000	1.000	0.0	46.0	1.000	1.224	22.4	1425.0	1.000	1.000	0.0	147.0	1.000	1.209	20.9	2173.0
71	Pump House South Wall Panel 3	Horiz.	1.000	1.010	1.0	115.0	1.000	1.000	0.0	109.0	1.000	1.000	0.0	1306.0	1.000	1.000	0.0	578.0	1.000	1.087	8.7	766.0
72	Pump House North Wall Panel 2	Vert.	1.000	1.000	0.0	975.0	1.000	1.000	0.0	175.0	1.000	1.012	1.2	1003.0	1.028	1.000	2.8	604.0	1.000	1.132	13.2	1854.0
73	Pump House North Wall Panel 2	Horiz.	1.000	1.000	0.0	141.0	1.000	1.004	0.4	99.0	1.000	1.000	0.0	883.0	1.000	1.000	0.0	223.0	1.039	1.000	3.9	1207.0

Table 03.07.01-29 S2.6: Comparison of % Increase in Section Cut Forces Due to MSM, Refined Mesh and Benchmark vs. Design Margin – Full Basin Condition

FULL BASIN CONDITION			Axial Force					In-plane Shear					Out-of-plane Shear					In-plane Moment					Out-of-plane Moment				
Cut #	Cut Location	Direction of Cut	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Correction Factor 3 - CF3 (Based on % Difference in Section Cut Forces for SSI model vs. SAP2000 model)	Total % Increase in Section Cut Forces ((CF1 x CF2 x CF3) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Correction Factor 3 - CF3 (Based on % Difference in Section Cut Forces for SSI model vs. SAP2000 model)	Total % Increase in Section Cut Forces ((CF1 x CF2 x CF3) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Correction Factor 3 - CF3 (Based on % Difference in Section Cut Forces for SSI model vs. SAP2000 model)	Total % Increase in Section Cut Forces ((CF1 x CF2 x CF3) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Correction Factor 3 - CF3 (Based on % Difference in Section Cut Forces for SSI model vs. SAP2000 model)	Total % Increase in Section Cut Forces ((CF1 x CF2 x CF3) - 1) x 100	% Margin in Section Forces for Design vs. SSI	Correction Factor 1 - CF1 (Based on % Increase in Section Cut Forces for Modified Subtraction Method vs. Subtraction Method)	Correction Factor 2 - CF2 (Based on % Increase in Section Cut Forces for Refined Mesh vs. Original Mesh)	Correction Factor 3 - CF3 (Based on % Difference in Section Cut Forces for SSI model vs. SAP2000 model)	Total % Increase in Section Cut Forces ((CF1 x CF2 x CF3) - 1) x 100	% Margin in Section Forces for Design vs. SSI
55	Cooling Tower NS Wall Panel 3	Vert.	1.001	1.000	1.000	0.1	259.0	1.000	1.006	1.000	0.6	28.0	1.000	1.000	1.000	0.0	79.0	1.009	1.000	1.000	0.9	235.0	1.023	1.000	1.000	2.3	59.0
56	Cooling Tower NS Wall Panel 3	Vert.	1.017	1.000	1.000	1.7	164.0	1.000	1.000	1.000	0.0	29.0	1.019	1.000	1.000	1.9	36.0	1.000	1.018	1.000	1.8	140.0	1.014	1.090	1.000	10.5	150.0
57	Cooling Tower South Wall Panel 5	Vert.	1.000	1.000	1.000	0.0	2.4	1.034	1.027	1.000	6.2	84.0	1.000	1.088	1.000	8.8	43.0	1.009	1.018	1.000	2.7	52.0	1.019	1.077	1.000	9.7	96.0
58	Basin North Wall Panel 5	Vert.	1.001	1.029	1.000	3.0	110.0	1.000	1.047	1.000	4.7	197.0	1.029	1.000	1.000	2.9	188.0	1.020	1.083	1.000	10.5	108.0	1.000	1.035	1.000	3.5	112.0
59	Basin North Wall Panel 5	Horiz.	1.000	1.014	1.000	1.4	74.0	1.000	1.023	1.000	2.3	217.0	1.000	1.000	1.000	0.0	273.0	1.662	1.031	1.000	71.4	145.0	1.000	1.008	1.000	0.8	180.0
60	Basin South Wall Panel 5	Vert.	1.000	1.029	1.000	2.9	152.0	1.000	1.053	1.000	5.3	125.0	1.000	1.000	1.000	0.0	215.0	1.000	1.079	1.000	7.9	108.0	1.000	1.008	1.000	0.8	103.0
61	Basin South Wall Panel 5	Horiz.	1.000	1.023	1.000	2.3	60.0	1.000	1.015	1.000	1.5	124.0	1.000	1.000	1.000	0.0	240.0	1.577	1.004	1.000	58.3	57.0	1.000	1.017	1.000	1.7	134.0
62	Basin North Buttress 4	Vert.	1.000	1.000	1.000	0.0	171.0	1.000	1.018	1.000	1.8	75.0	1.000	1.056	1.000	5.6	272.0	1.000	1.000	1.000	0.0	47.0	1.000	1.112	1.000	11.2	307.0
63	Basin North Buttress 4	Horiz.	1.001	1.024	1.000	2.5	45.0	1.000	1.000	1.000	0.0	95.0	1.000	1.000	1.000	0.0	278.0	1.008	1.051	1.006	6.6	86.0	1.000	1.000	1.000	0.0	379.0
64	Basin East Buttress 1	Vert.	1.551	1.000	1.000	55.1	125.0	1.010	1.000	1.000	1.0	109.0	1.000	1.005	1.000	0.5	293.0	1.307	1.165	1.000	52.3	175.0	1.000	1.060	1.000	6.0	394.0
65	Basin East Buttress 1	Horiz.	1.000	1.000	1.000	0.0	26.0	1.000	1.000	1.000	0.0	58.0	1.000	1.000	1.000	0.0	132.0	1.000	1.023	1.049	7.3	20.0	1.000	1.000	1.000	0.0	117.0
66	Basin West Wall Panel 2	Vert.	1.000	1.000	1.000	0.0	174.0	1.003	1.017	1.000	2.0	147.0	1.000	1.042	1.000	4.2	224.0	1.050	1.039	1.000	9.1	101.0	1.000	1.000	1.000	0.0	86.0
67	Basin West Wall Panel 2	Horiz.	1.060	1.003	1.000	6.3	22.0	1.041	1.017	1.000	5.9	192.0	1.000	1.053	1.023	7.7	148.0	3.647	1.000	1.000	264.7	587.0	1.000	1.000	1.000	0.0	113.0
68	Pump House West Wall Panel 2	Vert.	1.026	1.069	1.000	9.7	525.0	1.000	1.000	1.000	0.0	61.0	1.000	1.000	1.000	0.0	3906.0	1.060	1.066	1.000	13.0	1681.0	1.000	1.000	1.151	15.1	613.0
69	Pump House West Wall Panel 2	Horiz.	1.000	1.057	1.000	5.7	74.0	1.000	1.000	1.000	0.0	49.0	1.000	1.000	1.000	0.0	715.0	1.000	1.165	1.015	18.3	550.0	1.013	1.000	1.000	1.3	991.0
70	Pump House South Wall Panel 3	Vert.	1.086	1.000	1.000	8.6	246.0	1.000	1.000	1.000	0.0	33.0	1.012	1.240	1.000	25.5	1375.0	1.062	1.052	1.059	18.4	165.0	1.011	1.245	1.244	56.5	2018.0
71	Pump House South Wall Panel 3	Horiz.	1.000	1.000	1.000	0.0	56.0	1.000	1.000	1.000	0.0	77.0	1.016	1.000	1.000	1.6	1258.0	1.000	1.008	1.000	0.8	592.0	1.011	1.047	1.000	5.9	660.0
72	Pump House North Wall Panel 2	Vert.	1.000	1.000	1.000	0.0	1215.0	1.000	1.000	1.000	0.0	116.0	1.000	1.000	1.000	0.0	1364.0	1.000	1.000	1.000	0.0	642.0	1.000	1.174	1.000	17.4	2408.0
73	Pump House North Wall Panel 2	Horiz.	1.008	1.000	1.000	0.8	229.0	1.000	1.000	1.000	0.0	72.0	1.000	1.000	1.000	0.0	2556.0	1.000	1.028	1.000	2.8	276.0	1.019	1.000	1.000	1.9	989.0

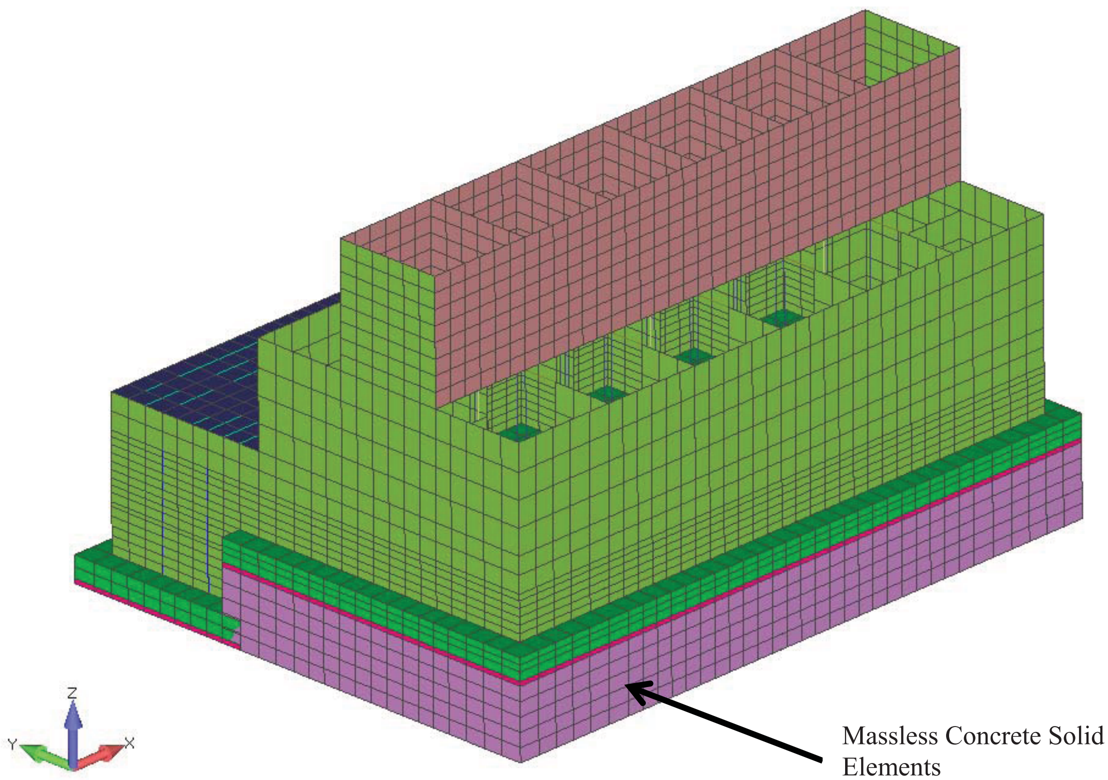

Figure 03.07.01-29 S2.1: Isometric View of the Fixed Base SSI Model of UHS/RSW Pump House – Using Original SSI Mesh

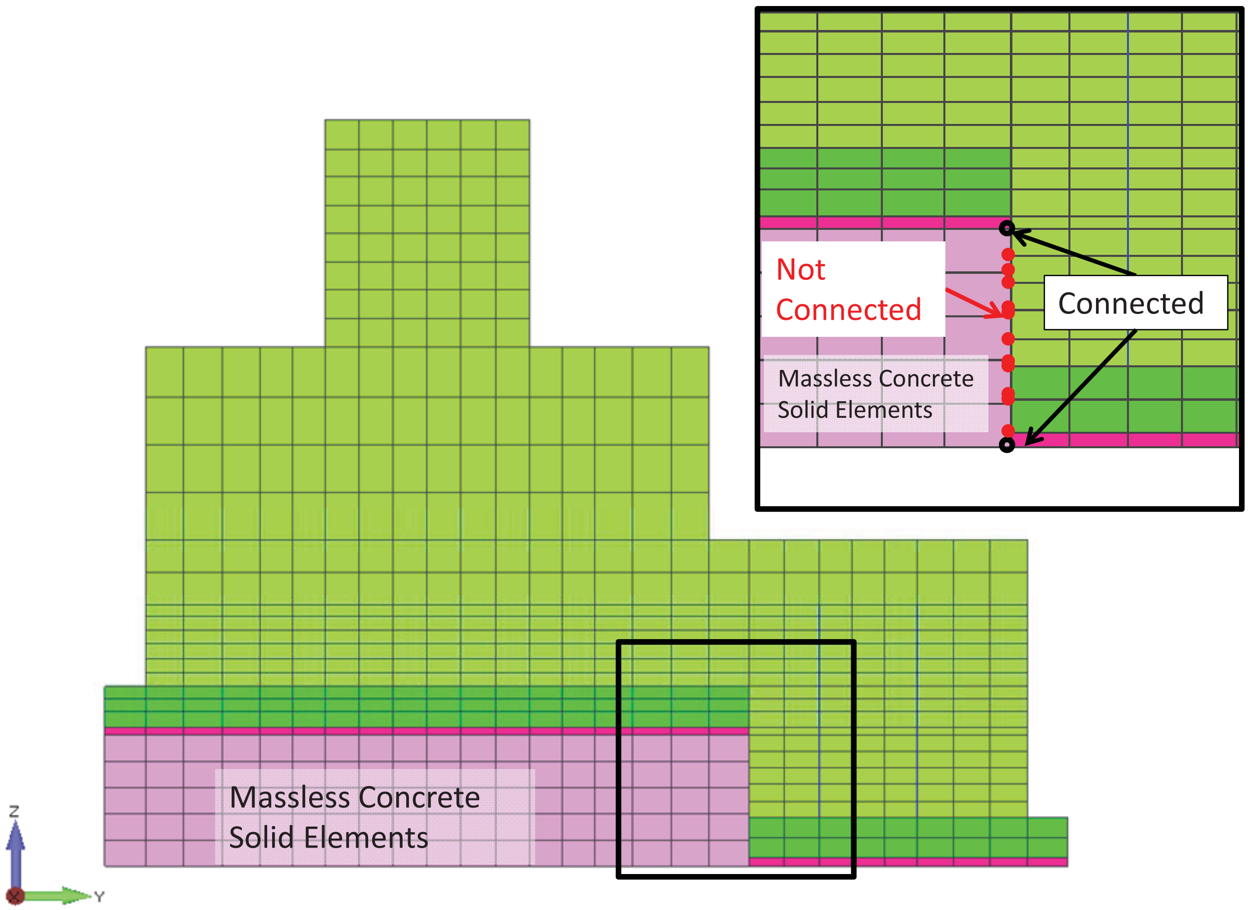

Figure 03.07.01-29 S2.2: Detail of Connectivity Near Stiff Concrete Fill and RSW Pump House (Fixed Base SSI Model of UHS/RSW Pump House – Using Original SSI Mesh)

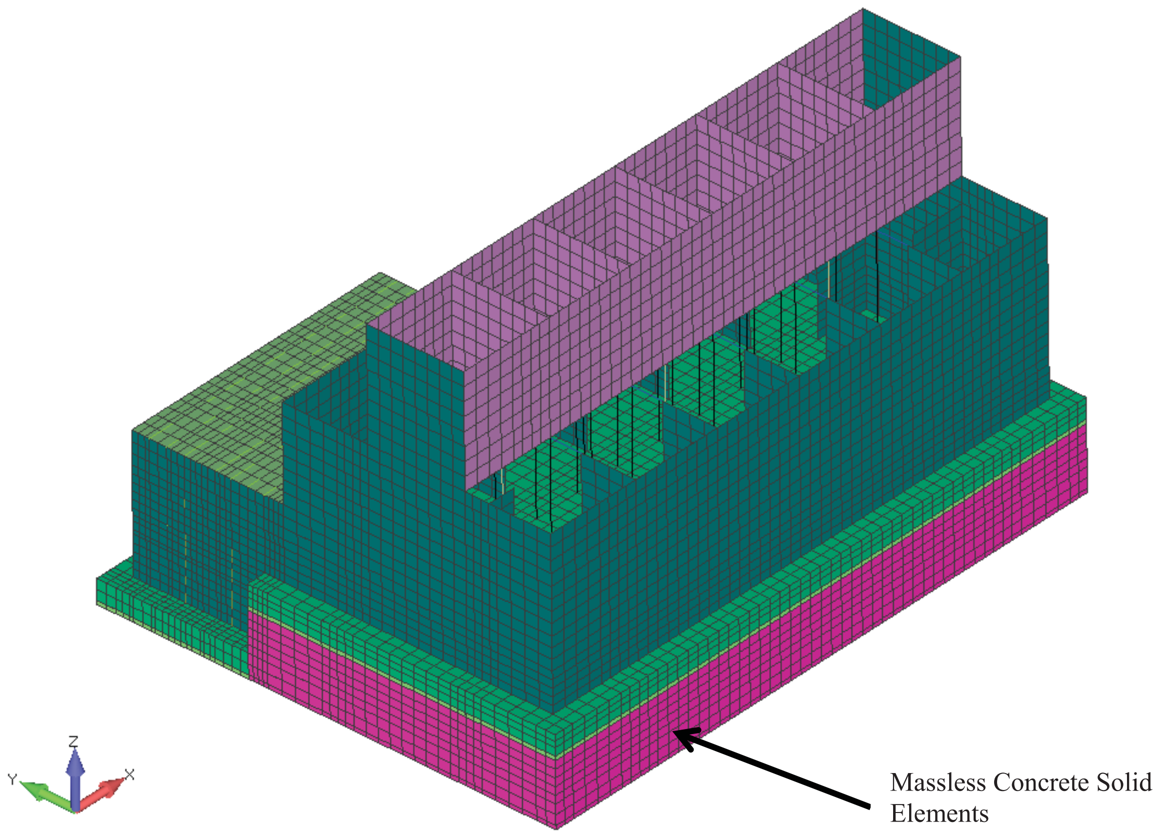

Figure 03.07.01-29 S2.3: Isometric View of the Fixed Base SSI Model of UHS/RSW Pump House – Using Refined SSI Mesh

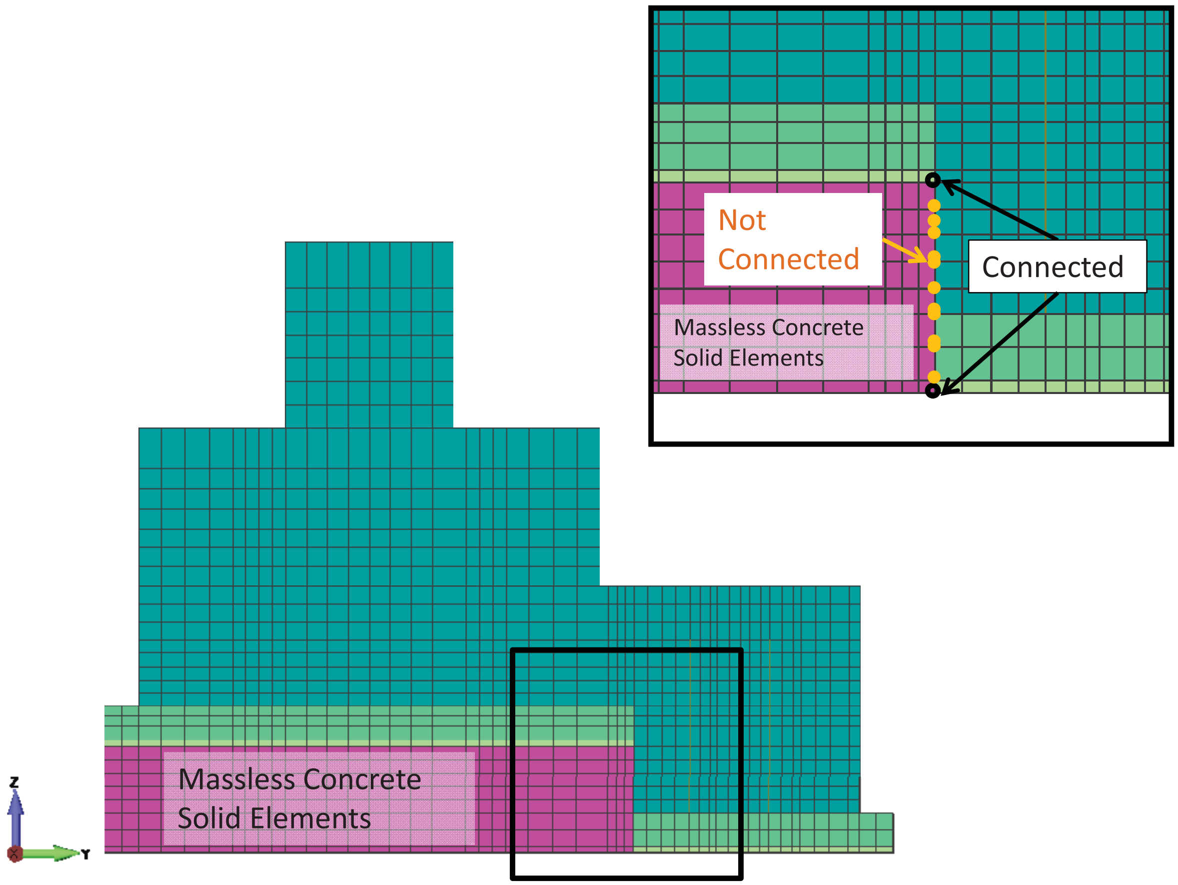

Figure 03.07.01-29 S2.4: Detail of Connectivity Near Stiff Concrete Fill and RSW Pump House (Fixed Base SSI Model of UHS/RSW Pump House – Using Refined SSI Mesh)

RAI 03.07.02-32, Revision 1

QUESTION:

RAI for Interaction of Non-Seismic Category I Structures, Systems and Components with Seismic Category I Structures, Systems and Components

In FSAR Section 3.7.2.8, the applicant stated that the non-category I structures that can interact with seismic category I structures include the turbine building (TB), radwaste building (RWB), service building (SB), control building annex (CBA), and the stack on reactor building roof. The applicant also provided the seismic input motions for design of the above five non-category I structures and included the sliding and overturning factors of safety under site-specific SSE for TB, RWB, SB, and CBA. The applicant further stated that for each non-category I structure, either: (1) it is determined that the collapse of the non-category I structure will not cause the non-category I structure to strike a category I structure; or (2) the non-category I structure will be analyzed and designed to prevent its failure under SSE conditions in a manner such that the margin of safety of the structure is equivalent to that of seismic category I structures. The above description for analysis and design of non-category I structures included in the FSAR only states the guidance provided in SRP 3.7.2 for analysis and design of these structures, and does not provide any information for review by the staff if analysis and design of these structures meet the guidance provided in SRP 3.7.2. Further, the FSAR does not clearly describe how seismic demand and restoring forces were determined for calculation of sliding and overturning factors of safety. Therefore, in order for the staff to conclude that there is no potential for any unacceptable interaction between non-category I structures and seismic category I structures during an SSE, and to address the COL action stated in Section 3.7.5.4 of ABWR DCD, the applicant is requested to provide the following information, and update the FSAR, as necessary:

1. Clearly describe in the FSAR the criterion used to determine that collapse of a non-category I structure will not cause the non-category I structure to strike a category I structure. Also, clarify in the FSAR that non-category I structures that are not identified in the FSAR as structures that can interact with category I structures, meet this criterion.

2. Describe in the FSAR the analysis and design of each non-category I structure that can interact with category I structures, to demonstrate that it is analyzed and designed to prevent its failure under SSE conditions in a manner such that the margin of safety of the structure is equivalent to that of seismic category I structures. Also, include site-specific ITAAC for each structure to confirm that the as-built structure is analyzed and designed as described in the FSAR.

3. For each non-category I structure, describe in the FSAR the stability evaluation procedure including how seismic demand and restoring forces for stability evaluation are determined.

REVISED RESPONSE:

The original response to this RAI was submitted with NINA letter U7-C-NINA-NRC-110114, dated August 30, 2011. This revised response is being submitted based on discussions with NRC during the audit performed during the week of September 26, 2011, and further discussions with NRC during the weekly telecons. The revisions to the original response are marked by revision bars.

This response also includes the response to the following requests by the NRC staff on the December 7, 2011 weekly phone call:

- Provide seismic input motions figures for II/I evaluation of all structures requiring seismic II/I evaluation.
- In COLA Section 3.8, provide a pointer for Diesel Generator Fuel Oil Tunnels (DGFOT) details in Section 3H.7.
- Revise COLA Table 3.4-1 to include Diesel Generator Fuel Oil Storage Vaults (DGFOSV).

1. A specific criterion will be added in the COLA Part 2, Tier 2 Section 3.7.2.8 that if the above grade height of the non-Category I structure is less than the shortest horizontal distance between the non-Category I structure and the closest Category I structure, collapse of the non-Category I structure will not cause the non-Category I structure to strike a Category I structure. The COLA will also be revised to reflect that non-Category I structures that are not identified in the FSAR as structures that can interact with Category I structures, meet this criterion.

2. The analysis and design of non-Category I structures that can interact with Category I structures, except for the stack on the Reactor Building roof, are included in the COLA mark-up provided for Sections 3.7.2.8 and 3.7.3.16 in RAI 03.07.02-13 Supplement 3, submitted with NINA Letter U7-C-NINA-NRC-110103, dated July 27, 2011. Some additional information has been added in the mark-up to COLA Section 3.7.2.8 included in the Enclosure to complete the information requested in this RAI. The following provides additional details for design of such structures:

    - For the overall design, the procedures described in the International Building Code (IBC-2006) seismic design criteria will be followed. Considering the location of STP 3 & 4, the following seismic parameters are applicable:

        - Occupancy Category IV
        - Importance Factor of 1.5
        - Seismic Design Category A

- The design of the lateral load resisting systems which prevent interaction between non-Category I and Category I structures will meet the following; in addition to meeting the IBC requirements:
  - The lateral load resisting system shall be capable of resisting the entire lateral load assuming that all components of the non-Category I structure, with the exception of siding which may come off during a tornado event, will remain intact during the extreme environmental loading.
  - The lateral load resisting system shall be designed to remain elastic under the extreme environmental loads shown in COLA Table 3H.9-1 using the same loads, load combinations and design codes as those for the adjacent Category I structure.
  - For dual systems (i.e. shear walls with braced steel frame), one of the two systems must be designed to be capable of carrying the entire load.
- The exterior wall of the non-Category I structure that is adjacent to the Category I structure shall be capable of resisting SSE loads using the same loads, load combinations and design codes as those for the adjacent Category I structure. This criterion is also applicable to the elements of the non-Category I structure which meet the following two conditions:
  1. The element is located within a story height of the exterior wall
  2. The element may come in contact with the exterior wall upon its failure under SSE loads.

The lateral load resisting system discussed above, depending on the structure type, may consist of some or all of the following:

- Shear walls
- Horizontal bracing members and their connections
- Vertical bracing members and their connections
- Diaphragm floors
- Beams and their connections required for transfer of lateral loads at each floor to vertical bracing or shear walls
- Foundation

The design of the stack on the Reactor Building roof is covered under the certified design of the Reactor Building.

COLA Table 3H.9-1 is revised as shown in the Enclosure to further clarify II/I evaluations.

Also, new site-specific ITAAC Tables 3.0-21 through 3.0-24 are included in the enclosed COLA mark-up for confirmation that as-built non-Category I structures are analyzed and designed as described in the FSAR

3. The stability evaluation procedure, including how seismic demand and restoring forces for stability evaluation are determined, is also described in the COLA mark-up provided for Sections 3.7.2.8 and 3.7.3.16 in RAI 03.07.02-13 Supplement 3, submitted with NINA Letter U7-C-NINA-NRC-110103, dated July 27, 2011.

4. Seismic Input Motion Figures for II/I Evaluations

   See revised COLA Section 3.7.3.16 and new COLA Figures 3.7-47 through 3.7-55 provided in the Enclosure.

5. Pointer in COLA Section 3.8 for DGFOT

   See the Enclosure for revision of COLA Section 3.8.4.

6. Inclusion of DGFOSV in COLA Table 3.4-1

   See the Enclosure for the revised COLA Table 3.4-1 which includes DGFOSV.

Enclosure 1 provides the COLA mark-up. For ready reference, included in this mark-up is the mark-up provided to Sections 3.7.2.8 and 3.7.3.16 in response to RAI 03.07.02-13 Supplement 3, submitted with NINA Letter U7-C-NINA-NRC-110103, dated July 27, 2011. The mark-up included in the Enclosure 1 supersedes the mark-up for Section 3.7.2.8 provided in this earlier RAI response.

Enclosure 1

3.7.2.8 Interaction of Non-Seismic Category I Structures, Systems and Components with Seismic Category I Structures, Systems and Components

The Category I structures and their physical proximity to nearby non-Category I structures are shown in Figure 3.7-40. None of the non-Category I structures proposed as part of STP Units 3 and 4 is intended to meet Criterion (2) of DCD Section 3.7.2.8. Rather, for each non-Category I structure, either: (1) it is determined that the collapse of the non-Category I structure will not cause the non-Category I structure to strike a Category I structure ; or (2) the non-Category I structure will be analyzed and designed to prevent its failure under SSE conditions in a manner such that the margin of safety of the structure is equivalent to that of Seismic Category I structures. Criterion (1) is met if the above-grade height of the non-Category I structure is less than the shortest horizontal distance between the non-Category I structure and the closest Category I structure. Based on this criterion, Nnon-Category I structures that can interact with Seismic Category I structures include the Turbine Building (TB), Radwaste Building (RWB), Service Building (SB), Control Building Annex (CBA) and the stack on the Reactor Building roof. Other non-Category I structures shown in Figure 3.7-40 meet Criterion (1). Table 3H.6-14 provides sliding and overturning factors of safety under site-specific SSE for TB, RWB, SB, and CBA.

The seismic input motions for the II/I design of the five non-seismic cCategory I structures noted above, except for the stack on the Reactor Building roof, are described in the following. The design of the stack on the Reactor Building roof is covered by the certified design of the Reactor Building.

- TB: 0.3g Regulatory Guide 1.60 spectra.
- RWB: as described in Sections 3.7.3.16 and 3H.3.5.3 and shown in Figures 3.7-4041 through 3.7-4243.
- SB: as described in Section 3.7.3.16.0.3g Regulatory Guide 1.60 spectra.
- CBA: as described in Section 3.7.3.16 and shown in Figures 3.7-38 and 3.7-39.

Stack on the Reactor Building roof: seismic loading at its location, resulting from the SSE analysis of the Reactor Building.
The overall design of non-Category I structures is based on IBC-2006. However, the lateral load resisting system is designed to remain elastic under the extreme environmental loads shown in Table 3H.9-1 using the same loads, load combinations and design codes (i.e. ACI 349 and AISC N690) as those for the adjacent Category I structure. Also, see Section 3.7.3-16 for additional details.

The seismic input motions for II/I stability evaluations of TB, RWB, SB, and CBA are described in more detail in the following:

- TB: site-specific SSE
- RWB: as described in Sections 3.7.3.16 and 3H.3.5.3 and shown in Figures 3.7-44 through 3.7-46
- SB: as described in Section 3.7.3.16
- CBA: as described in Section 3.7.3.16

The restoring forces and moments for sliding and overturning stability evaluations of TB, RWB, SB, and CBA are in accordance with the methodology outlined in Figure 3H.3-52.

Seismic demands along each orthogonal direction for stability evaluation of TB, RWB, and SB are determined using response spectrum analysis of a fixed base stick model representing each of these structures. The input motions for these response spectrum analyses are as described above. The base shears and moments from these response spectrum analyses are adjusted manually to account for the additional shears and moments due to basemat excitation which are calculated considering zero period acceleration (ZPA) of the input motions. The three orthogonal seismic demands of each structure are combined using the 100%-40%-40% rule as outlined in Regulatory Guide 1.92, Revision 2.

Seismic demands along each orthogonal direction for stability evaluation of the CBA are calculated using manual calculation where the CBA is idealized as a single degree of freedom structure. The three orthogonal seismic demands are combined using the 100%-40%-40% rule as outlined in Regulatory Guide 1.92, Revision 2.

Table 3H.6-14 provides sliding and overturning factors of safety under site-specific SSE for TB, RWB, SB, and CBA.

3.7.3.16 Analysis Procedure for Non-Seismic Structures in Lieu of Dynamic Analysis

STD DEP 1.8-1

For overall ~~*the*~~ *design of non-seismic Category I structures, the procedures described in the* ~~*Uniform Building Code (UBC)*~~ International Building Code (IBC) *seismic design criteria shall be followed.* Considering the location of STP 3 & 4, the following seismic parameters are applicable:

- Occupancy Category IV
- Importance Factor of 1.5
- Seismic Design Category A

Where a structure is required to be designed to withstand a SSE, the design of the lateral load resisting system consisting of structural elements required for transfer of lateral loads to the foundation (i.e. shear walls, horizontal bracing members and their connections, vertical bracing members and their connections, diaphragm floors, beams and their connections required for transfer of lateral loads at each floor to vertical bracing or shear walls and the foundation) shall meet *the following* ~~*limitations apply:*~~, in addition to meeting the IBC requirements:

(1) ~~*The seismic zone shall be "Zone 3".*~~ The seismic acceleration shall be per Table 3H.9-1 ~~the SSE ground acceleration~~.

(2) *The* lateral load resisting system shall remain elastic*.* ~~*structure shall be classified as "Essential Facility"; thereby using appropriate importance factors for wind and seismic.*~~

(3) *For dual systems (i.e., shear wall with braced steel frame), one of the two systems must be designed to be capable of carrying all of the seismic or wind loading without collapse. No credit will be given for the other for resisting lateral loads.*

(4) The design codes shall be the same as those for the adjacent Category I structure

(5) The lateral load resisting system shall be capable of resisting the entire lateral load assuming that all components of the non-Category I structure, with the exception of siding which may come off during a tornado event, will remain intact during the extreme environmental loading.

(6) The exterior wall of the non-Category I structure that is adjacent to the Category I structure shall be capable of resisting SSE loads using the same loads, load combinations and design codes as those for the adjacent Category I structure. This criterion is also applicable to the elements of the non-Category I structure which meet the following two conditions:

- The element is located within a story height of the exterior wall.
- The element may come in contact with the exterior wall upon its failure under SSE loads.

For the Control Building Annex (CBA) II/I design, the SSE input at the foundation level (Figures 3.7-38a, 3.7-38b and 3.7-39) is the envelope of 0.3g RG 1.60 response spectra and the induced acceleration response spectra due to site specific SSE that is determined from an SSI analysis which accounts for the impact of the nearby Control Building (CB). In this SSI analysis, five interaction nodes at the depth corresponding to the bottom elevation of the CBA foundation are added to the three dimensional SSI model of the CB. These five interaction nodes correspond to the four corners and the center of the CBA foundation. The average response of these five interaction nodes is enveloped with the 0.3g RG 1.60 spectra to determine the SSE input at the CBA foundation level.

For the stability evaluation of the CBA, the SSE input (see Figures 3.7-47 through 3.7-49) is the envelope of the average response of the five interaction nodes from the site-specific SSI analysis described above and the site specific SSE.

For the Radwaste Building (RWB) II/I design, the SSE input (see Figures 3.7-41 through 3.7-43) ~~at the foundation level~~ is the envelope of 0.3g RG 1.60 response spectrum and the induced acceleration response spectrum due to site-specific SSE that is determined from an SSI analysis which accounts for the impact of the nearby

Reactor Building (RB). In this SSI analysis, five interaction nodes at the ~~depth~~ground surface ~~corresponding to the bottom elevation of the RWB foundation~~ are added to the three dimensional SSI model of the RB. These five interaction nodes correspond to the four corners and the center of the RWB foundation. The average response of these five interaction nodes is enveloped with the 0.3g RG 1.60 spectra to determine the SSE input at the foundation level.

For the stability evaluation of the RWB, the SSE input (see Figures 3.7-44 through 3.7-46) is the envelope of the average response of the five interaction nodes from the site-specific SSI analysis described above and the site specific SSE.

For the Service Building (SB) II/I design, the SSE input (see Figures 3.7-50 through 3.7-52) is the envelope of 0.3g RG 1.60 response spectrum and the induced acceleration response spectrum due to site-specific SSE that is determined from an SSI analysis which accounts for the impact of the nearby CB Building. In this SSI analysis, five interaction nodes at the ground surface are added to the three dimensional SSI model of the CB. These five interaction nodes correspond to the four corners and the center of the SB foundation. The average response of these five interaction nodes is enveloped with the 0.3g RG 1.60 spectra to determine the SSE input at the foundation level.

For the stability evaluation of the SB, the SSE input (see Figures 3.7-53 through 3.7-55) is the envelope of the average response of the five interaction nodes from the site-specific SSI analysis described above and the site specific SSE.

3.8.4 Other Seismic Category I Structures

STD DEP T1 2.15-1

STD DEP 12.3-3

Other Seismic Category I structures which constitute the ABWR Standard Plant are the Reactor Building, ~~and~~ *Control Building, and* Diesel Generator Fuel Oil Tunnels. ~~*Radwaste Building substructure.*~~ *Figure 1.2-1 shows the spatial relationship of these buildings. The* ~~*only other*~~ non-Category I *structure*s which could interact with ~~*in close proximity to*~~ *these structures* ~~*is*~~are the Radwaste Building, Service Building, Control Building Annex, the stack on the Reactor Building roof, and *the Turbine Building.* ~~*It is*~~These structures, except the stack, are *structurally separated from the other ABWR Standard Plant buildings.* The analysis and design of these non-Category I structures are described in Sections 3.7.2.8 and 3.7.3.16.

Details of the Diesel Generator Fuel Oil Tunnels are provided in Section 3H.7

3H.5.5 Structural Analysis Report For The Radwaste Building (Including Radwaste Tunnels) and The Turbine Building

STD DEP 1.8-1

STD DEP T1 2.15-1

The RW/B (including Radwaste Tunnels) and *T/B* ~~*is*~~are *not classified as* ~~*a*~~ *Seismic Category 1 structures.* ~~*However, the buildings*~~ The T/B *is*~~are~~ *designed such that damage to safety-related functions does not occur under seismic loads corresponding to the safe shutdown earthquake (SSE) ground acceleration.* The RW/B (including Radwaste Tunnels) is designed per Regulatory Guide 1.143.

For material properties and dimensions, assess compliance of the as-built structure with design requirements in Section 3.7.3.16, Table 3.2-1 and *the* International Building Code (IBC)~~*Uniform Building Code (UBC)*~~ for the Turbine Building and Regulatory Guide 1.143 for the Radwaste Building (including Radwaste Tunnels). ~~*and in the Table 3.2-1 and paragraph 3.7.3.16.*~~

Construction deviations and design changes will be assessed to determine appropriate disposition.

This disposition will be accepted "as-is," provided the following acceptance criteria are met:

- *The structural design meets the acceptance criteria and load combinations of* Section 3.7.3.16 and *the* ~~*UBC*~~ IBC *code* for the Turbine Building and Regulatory Guide 1.143 for the Radwaste Building (including Radwaste Tunnels).

~~*The* RW/B (including Radwaste Tunnels) and *T/B is*~~are ~~*not classified as*~~ a ~~*Seismic Category 1 structures. However, the buildings is*~~are ~~*designed such that damage to safety-related functions does not occur under seismic loads corresponding to the safe shutdown earthquake (SSE) ground acceleration.*~~

3.0 Site-Specific ITAAC

- Main Turbine System
- Turbine Building- Seismic II/I Interaction
- Service Building- Seismic II/I Interaction
- Radwaste Building- Seismic II/I Interaction
- Control Building Annex- Seismic II/I Interaction

Table 3.0-21 Turbine Building- Seismic II/I Interaction

Design Requirement	Inspections, Tests, Analyses	Acceptance Criteria
The lateral load resisting system in the Turbine Building is designed to remain elastic under the extreme environmental loads to prevent the Building from impacting the adjacent Control Building. The extreme environmental loads include (a) the SSE, tornado wind, and tornado missile parameters described in Tier 1, Table 5.0; and (b) the loads associated with the breach of the Main Cooling Reservoir Embankment	a. A structural analysis will be performed to confirm that the lateral load resisting system of the Turbine Building, as designed and constructed, meets the Design Requirements.	a. A structural analysis report exists which concludes that the lateral load resisting system of the Turbine Building, as designed and constructed, meets the Design Requirements.
	b. Inspection of as-built Turbine Building will be performed to confirm that the configuration is consistent with the design.	b. As-built configuration is consistent with the design.

Table 3.0-22 Service Building- Seismic II/I Interaction

Design Requirement	Inspections, Tests, Analyses	Acceptance Criteria
The lateral load resisting system in the Service Building is designed to remain elastic under the extreme environmental loads to prevent the Building from impacting the adjacent Reactor and Control Buildings. The extreme environmental loads include (a) the SSE, tornado wind, and tornado missile parameters described in Tier 1, Table 5.0; and (b) the loads associated with the breach of the Main Cooling Reservoir Embankment.	a. A structural analysis will be performed to confirm that the lateral load resisting system of the Service Building, as designed and constructed, meets the Design Requirements.	a. A structural analysis report exists which concludes that the lateral load resisting system of the Service Building, as designed and constructed, meets the Design Requirements
	b. Inspection of as-built Service Building will be performed to confirm that the configuration is consistent with the design.	b. As-built configuration is consistent with the design.

Table 3.0-23 Radwaste Building- Seismic II/I Interaction

Design Requirement	Inspections, Tests, Analyses	Acceptance Criteria
The lateral load resisting system in the Radwaste Building is designed to remain elastic under the extreme environmental loads to prevent the Building from impacting the adjacent Reactor Building. The extreme environmental loads include (a) the SSE, tornado wind, and tornado missile parameters described in Tier 1, Table 5.0; and (b) the loads associated with the breach of the Main Cooling Reservoir Embankment.	a. A structural analysis will be performed to confirm that the lateral load resisting system of the Radwaste Building, as designed and constructed, meets the Design Requirements	a. A structural analysis report exists which concludes that the lateral load resisting system of the Radwaste Building, as designed and constructed, meets the Design Requirements
	b. Inspection of as-built Radwaste Building will be performed to confirm that the configuration is consistent with the design.	b. As-built configuration is consistent with the design.

Table 3.0-24 Control Building Annex- Seismic II/I Interaction

Design Requirement	Inspections, Tests, Analyses	Acceptance Criteria
The lateral load resisting system in the Control Building Annex is designed to remain elastic under the extreme environmental loads to prevent the Building from impacting the adjacent Control Building. The extreme environmental loads include (a) the SSE, tornado wind, and tornado missile parameters described in Tier 1, Table 5.0; and (b) the loads associated with the breach of the Main Cooling Reservoir Embankment	a. A structural analysis will be performed to confirm that the lateral load resisting system of the Control Building Annex, as designed and constructed, meets the Design Requirements	a. A structural analysis report exists which concludes that the lateral load resisting system of the Control Building Annex, as designed and constructed, meets the Design Requirements
	b. Inspection of as-built Control Building Annex will be performed to confirm that the configuration is consistent with the design.	b. As-built configuration is consistent with the design.

~~Table 3.0-25 Stack on the Reactor Building Roof- Seismic II/I Interaction~~

Table 3.4-1 Structures, Penetrations, and Access Openings Designed for Flood Protection (Note 9)

Structure	**Reactor Building**	**Service Building**	**Control Building**	**Radwaste Building**	**Turbine Building**	**Ultimate Heat Sink/RSW Pump House (Note 8)**	**Diesel Generator Fuel Oil Storage Vaults**
Design Flood Level ~~(mm)~~	~~11,695~~ **12,192 mm (40.0 ft)**	~~11,695~~ **10058 mm (33 ft) (Note 7)**	~~11,695~~ **12,192 mm (40.0 ft)**	~~11,695~~ **10058 mm (33 ft) (Note 7)**	~~11,695~~ ***10058*** **mm (33 ft) (Note 7)**	**12,192 mm (40.0 ft)**	**12,192 mm (40.0 ft)**
Design Ground Water Level ~~(mm)~~	~~11,390~~ **9,753mm (32 ft)**	~~11,390~~ **9,753 mm (32 ft)**	~~11,390~~ **9,753 mm (32 ft)**	~~11,390~~ **9,753 mm (32 ft)**	~~11,390~~ **9,753 mm (32 ft)**	**8,534 mm (28.0 ft)**	**8,534 mm (28.0 ft)**
Reference Plant Grade ~~(mm)~~	~~12,000~~ **10,363 mm (34ft)**	~~12,000~~ **10,363 mm (34ft)**	~~12,000~~ **10,363 mm (34ft)**	~~12,000~~ **10,363 mm (34ft)**	~~12,000~~ **10,363 mm (34ft)**	**10,363 mm (34 ft)**	**10,363 mm (34 ft)**
Top of Base Slab ~~(mm)~~	~~–8,200~~ **–9,837 mm (-32.27 ft)**	~~–2,150 & 3,500~~ **-3,787 mm (-12.42 ft)**	~~–8,200~~ **–9,837 mm (-32.27 ft)**	~~-1,500~~ **-3,353 mm (-11 ft)**	~~5,300~~ **-4,840 mm (-15.88 ft)**	**4,267 mm (UHS), -5,486 mm (RSW Pump House) (14 ft, UHS) (-18 ft, RSW Pump House)**	**-914 mm (-3 ft)**
Actual Plant Grade ~~(mm)~~	~~12,000~~ **Varies between 9,753 mm (32 ft) and 10,973 mm (36 ft)**	~~12,000~~ **Varies between 9,753 mm (32 ft) and 10,973 mm (36 ft)**	~~12,000~~ **Varies between 9,753 mm (32 ft) and 10,973 mm (36 ft)**	~~12,000~~ **Varies between 9,753 mm (32 ft) and 10,973 mm (36 ft)**	~~12,000~~ **Varies between 9,753 mm (32 ft) and 10,973 mm (36 ft)**	**Varies between 9,753 mm (32 ft) and 10,973 mm (36 ft)**	**Varies between 9,753 mm (32 ft) and 10,973 mm (36 ft)**
~~Building Height (mm)~~	~~49,700~~	~~22,200~~	~~22,200~~	~~28,000~~	~~54,300~~		
Penetrations Below Design Flood Level (Notes 1 through 4)	Refer to Table 6.2-9	None	RCW, RSW and miscellaneous lines, and electrical penetrations	None, except radwaste piping	Radwaste piping	**RSW piping and electric cables**	**Fuel oil transfer piping**

Table 3.4-1 Structures, Penetrations, and Access Openings Designed for Flood Protection (Note 9) (Continued)

Structure	Reactor Building	Service Building	Control Building	Radwaste Building	Turbine Building	Ultimate Heat Sink/RSW Pump House (Note 8)	Diesel Generator Fuel Oil Storage Vaults
Access Openings Below Design Flood Level (Notes 5 and 6)	Access ways **to outside and** from S/B **and C/B (Fig. 1.2-4 through 1.2-8)** @ ~~4,800 mm~~	Access ways from R/B, **C/B and T/B. (Fig. 1.2-17 through 1.2-20)** @ ~~3,500 mm, (Fig. 1.2-18)~~ ~~Area access ways from C/B @-2,150 mm, 3,500 mm, and 7,900 mm (Fig. 1.2-19)~~ ~~Area access way from T/B @ 3,500 mm (Fig. 1.2-24)~~	~~Hx area access from S/B @ -2,150 mm, (Fig. 1.2-15)~~ ~~Area access from S/B @ 3,500 (See Fig. 1.2-18~~ ~~Area access way from S/B @ 7,900 mm, (See Fig. 1.2-15)~~ **Access ways to outside, S/B, R/B, and RW/B (See Fig 1.2-17 through 1.2-20)**	None	Access ways from S/B @ ~~5,300 mm,~~ **(Fig 1.2-18)**	**None**	**Access room door**

Notes:

1 Watertight penetrations will be provided for all Reactor, ~~and~~ Control, Turbine and Radwaste Buildings penetrations that are below ~~grade~~ design flood level.

2 The safety-related and non-safety-related tunnels prevent the lines running through them from being exposed to outside ground flooding.

3 Penetrations below design flood level will be sealed against any hydrostatic head resulting from the design basis flood, or from a moderate energy pipe failure in the tunnel or inside a connecting building.

4 Waterproof sealant applied to the building exterior walls below flood level will also be extended a minimum of 150 mm along the penetration *surfaces.*

5 *Watertight doors (bulkhead type) are provided at all Reactor*, ~~and~~ *Control Building*, and Diesel Generator Fuel Oil Storage Vault *access ways that are below* ~~grade~~ design flood level.

6 The figure shown best depicts the indicated access.

7 The Turbine Building and Service Building shall also meet the flood design requirements of ASCE 7-05. The Radwaste Building shall also meet the flood design requirements of ASCE 7-95.

8 UHS includes safety-related cooling towers and RSW Pump House, which are contiguous to the UHS.

9 All elevations in this table correspond to mean sea level (msl).

~~Table 3H.8-1~~ Extreme Environmental Design Parameters for Seismic Analysis, Design, Stability Evaluation and Seismic Category II/I Design

Structure	Seismic Analysis					Design									Design for II/I (applicable to the design of lateral load resisting system)			
	SSI			SSSI		Structure				Stability								
	Input Motion	Soil Type	Structural Damping for Generation of ISRS	Input Motion	Soil Type	Seismic	Tornado	Tornado Missiles	Flood	Seismic	Tornado	Tornado Missiles	Flotation	Coeff. Of Friction for Waterproofing Membrane	Seismic	Tornado	Tornado Missiles	Flood
Diesel Generator Fuel Oil Tunnels (DGFOT)	Envelope of Amplified[1] Site-Specific SSE & 0.3g RG 1.60	DCD & Site-Specific	4% for all SSI analysis cases	Site-Specific SSE	Site-Specific	Envelope of Amplified[1] Site-Specific SSE & 0.3g RG 1.60 (See Note 4)	DCD Tornado Wind Parameters (As described in Table 5.0 of DCD/Tier 1)	DCD Missile Spectrum 1 as defined in Table 5.0 of DCD/Tier 1	Flood El. 40' MSL, Water Density 63.85 lb/ft3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)	Amplified[1] Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1 (Note 2)	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	NA	NA	NA	NA
UHS/RSW Pump House	Site-Specific SSE	Site-Specific	4% for all SSI analysis cases	Site-Specific SSE	Site-Specific	Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)	Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	NA	NA	NA	NA
RSW Piping Tunnels	Amplified[1] Site-Specific SSE	Site-Specific	4% for all SSI analysis cases Except 7% for Cracked Case	Site-Specific SSE	Site-Specific	Amplified[1] Site-Specific SSE (See Note 4)	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)	Amplified[1] Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	NA	NA	NA	NA
Diesel Generator Fuel Oil Storage Vault (DGFOSV)	Envelope of Amplified[1] Site-Specific SSE & 0.3g RG 1.60	Site-Specific	4% for all SSI analysis cases	Site-Specific SSE	Site-Specific	Envelope of Amplified[1] Site-Specific SSE & 0.3g RG 1.60	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)	Amplified[1] Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	NA	NA	NA	NA
Radwaste Building (RWB)	NA	NA	NA	Site-Specific SSE	Site-Specific	1/2 of 0.3g RG 1.60 SSE for RW-IIa Classification, 4% Damping	Per Table 2 of RG 1.143 Rev. 2 for RW-IIa Classification	Per Table 2 of RG 1.143 Rev. 2 for RW-IIa Classification	Flood El. 33' MSL RW-IIb Classification	Amplified[1] Site-Specific SSE , 7% Damping	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	Envelope of Amplified[1] Site-Specific SSE & 0.3g RG 1.60, 7% Damping	DCD Tornado Wind Parameters (As described in Table 5.0 of DCD/Tier 1)	DCD Missile Spectrum 1 as defined in Table 5.0 of DCD/Tier 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)
Control Bldg. Annex (CBA)	NA	NA	NA	NA	NA	IBC 2006	NA	NA	NA	Amplified[1] Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	Envelope of Amplified[1] Site-Specific SSE & 0.3g RG 1.60	DCD Tornado Wind Parameters (As described in Table 5.0 of DCD/Tier 1)	DCD Missile Spectrum 1 as defined in Table 5.0 of DCD/Tier 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)
Turbine Building (TB)	NA	NA	NA	NA	NA	IBC 2006	NA	NA	NA	Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	0.3g RG 1.60 SSE	DCD Tornado Wind Parameters (As described in Table 5.0 of DCD/Tier 1)	DCD Missile Spectrum 1 as defined in Table 5.0 of DCD/Tier 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)
Service Building (SB)	NA	NA	NA	NA	NA	IBC 2006	NA	NA	NA	Amplified[1] Site-Specific SSE	Site-Specific Tornado Wind Parameters (Region II, RG 1.76 Rev. 1)	Site-Specific Tornado Missile Spectrum for Region II as shown in Table 2 of RG 1.76 Rev. 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade)	Site-Specific	Envelope of Amplified[1] Site-Specific SSE & 0.3g RG 1.60	DCD Tornado Wind Parameters (As described in Table 5.0 of DCD/Tier 1)	DCD Missile Spectrum 1 as defined in Table 5.0 of DCD/Tier 1	Flood El. 40' MSL, Water Density 63.85 lb/ft^3 (above grade) + Drag Effect 44 psf (above grade) + Impact of Floating Debris per COLA Section 3.4.2 + Wind Generated Wave Action per COLA Figure 3.4-1 (only hydrodynamic portion)

~~General~~ Notes:

1) Amplified Site-Specific SSE accounts for the influence of nearby heavy Reactor Building, Control Building, and/or UHS/RSW Pump House.

2) For stability under tornado loading with tornado missile, restraints are required at top of DGFOT access regions.

3) NA: Not Applicable

4) Seismic wave propagation for DGFOT and RSW Piping Tunnels is based on site-specific SSE because their layouts are site-specific.

Table 3H.9-1 Extreme Environmental Design Parameters for Seismic Analysis, Design, Stability Evaluation and Seismic Category II/I Design

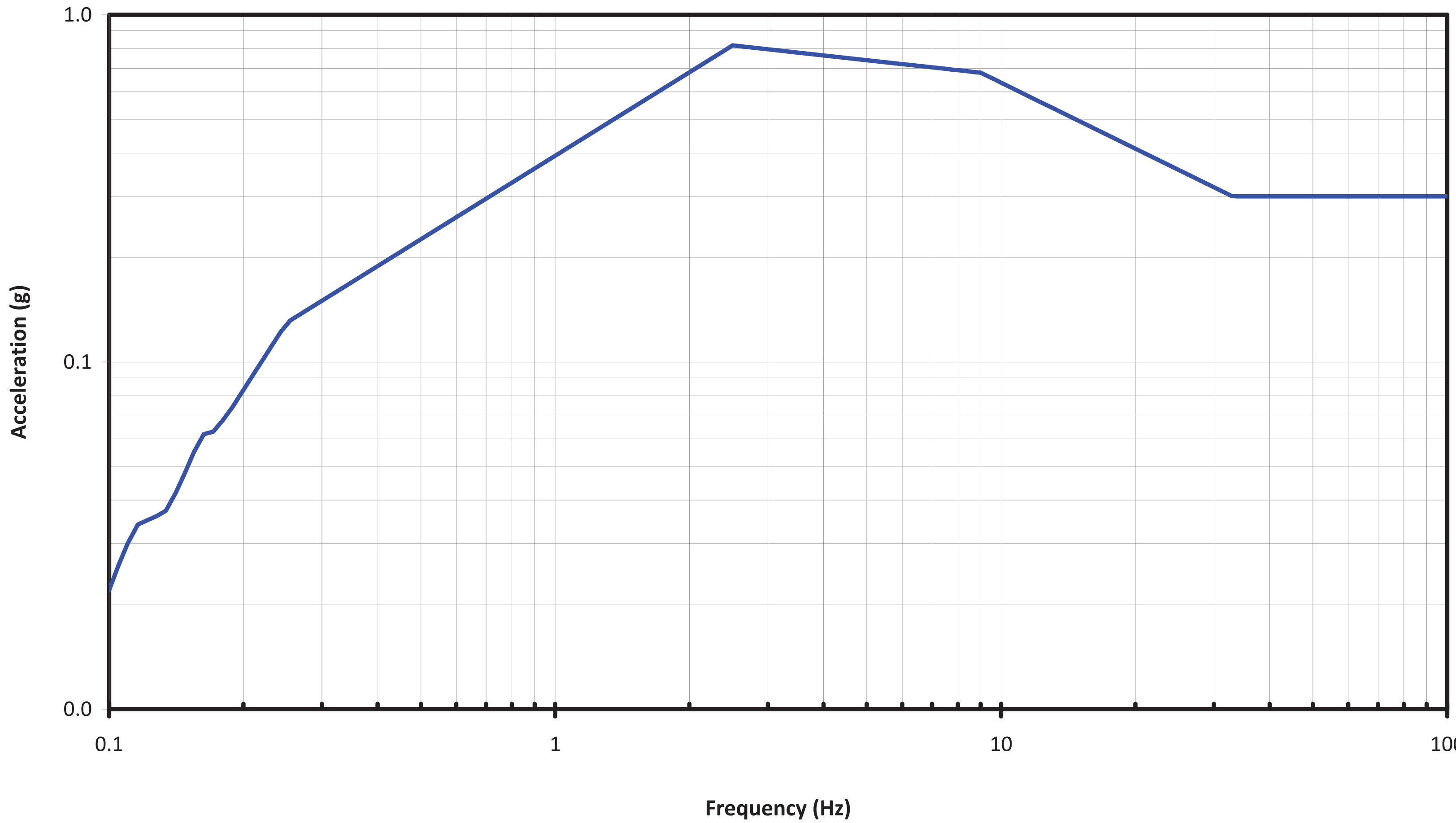

Figure 3.7- 38a Horizontal (N-S) Control Building Annex Input Motion for II/I Design (7% Damping)

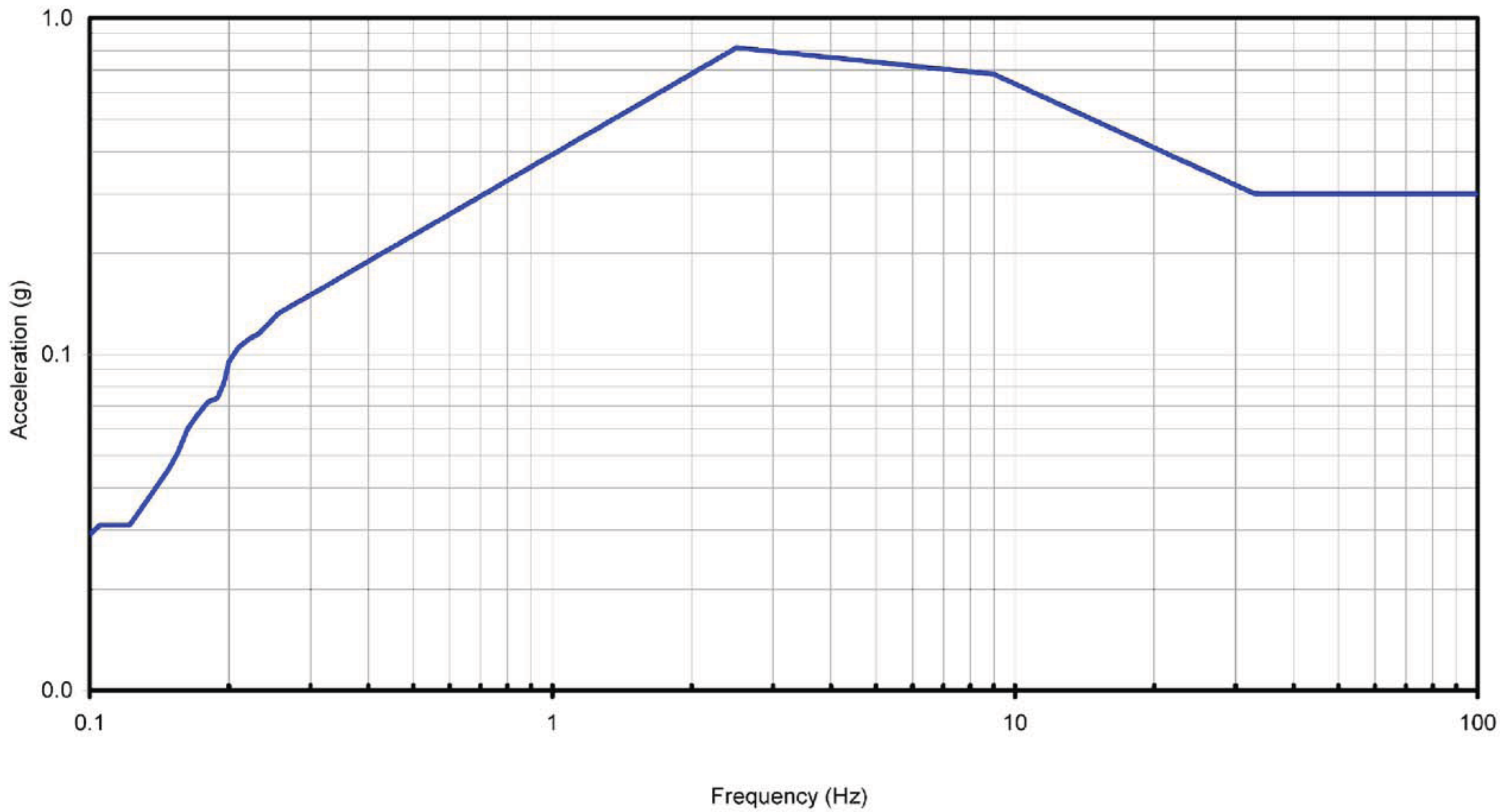

Figure 3.7-38b Horizontal (E-W) Control Building Annex Input Motion for II/I Design ~~Mat Foundation Response Spectrum~~ (7% Damping)

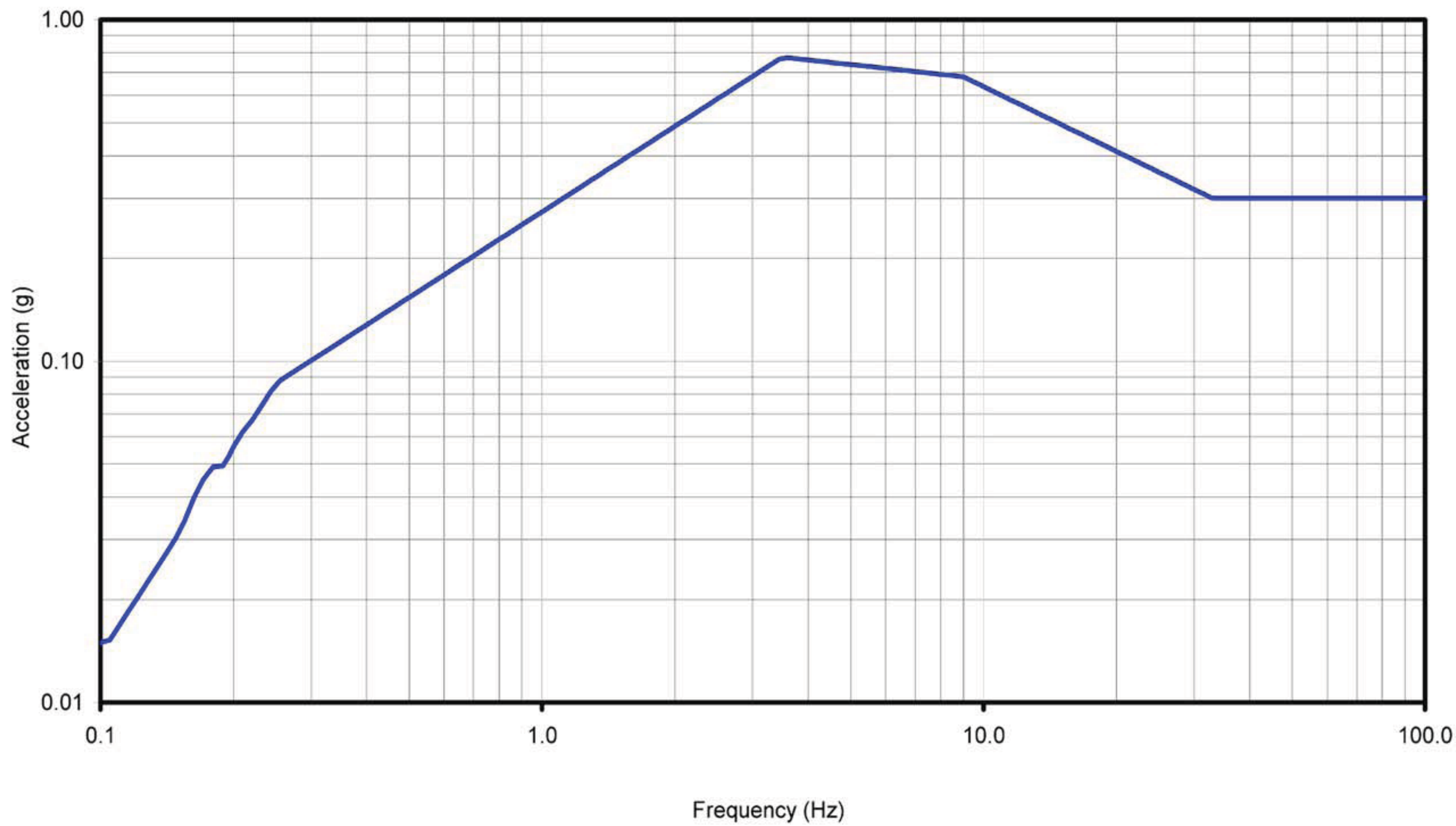

Figure 3.7-39 Vertical Control Building Annex Input Motion for II/I Design ~~Mat Foundation Response Spectrum~~ (7% Damping)

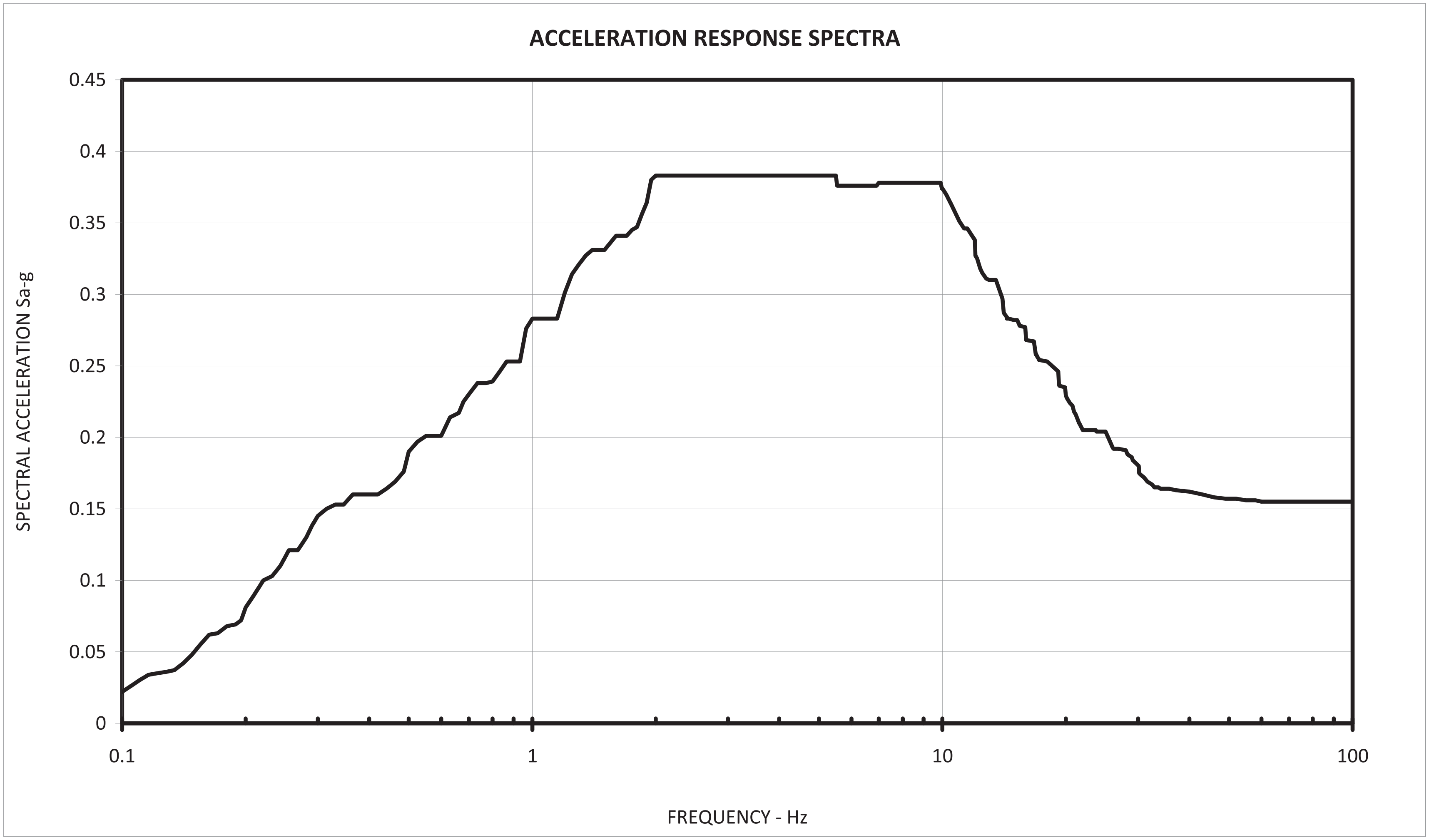

Figure 3.7-47: Control Building Annex North-South Input Motion for Stability Evaluations (7% Damping)

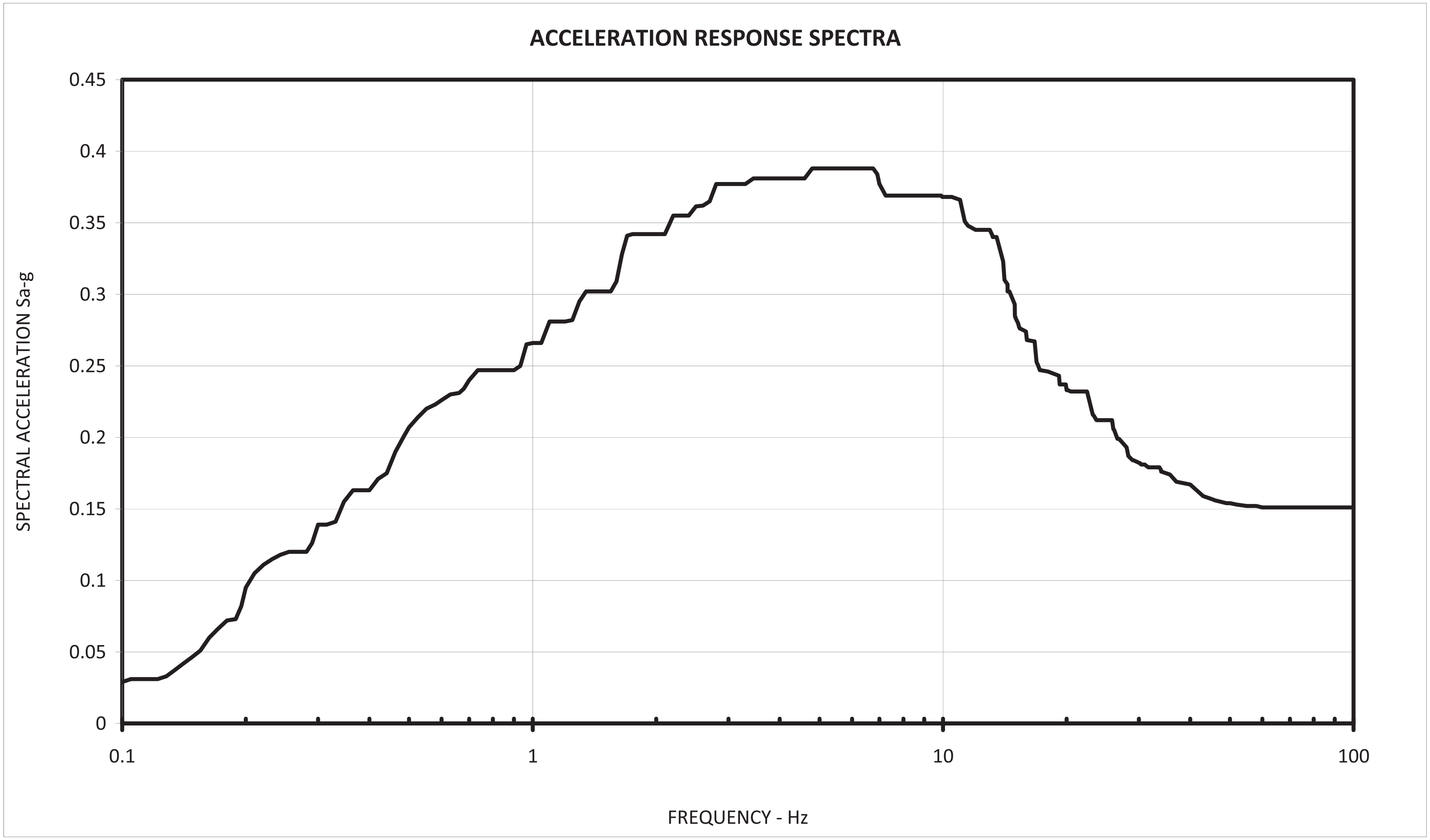

Figure 3.7-48: Control Building Annex East-West Input Motion for Stability Evaluations (7% Damping)

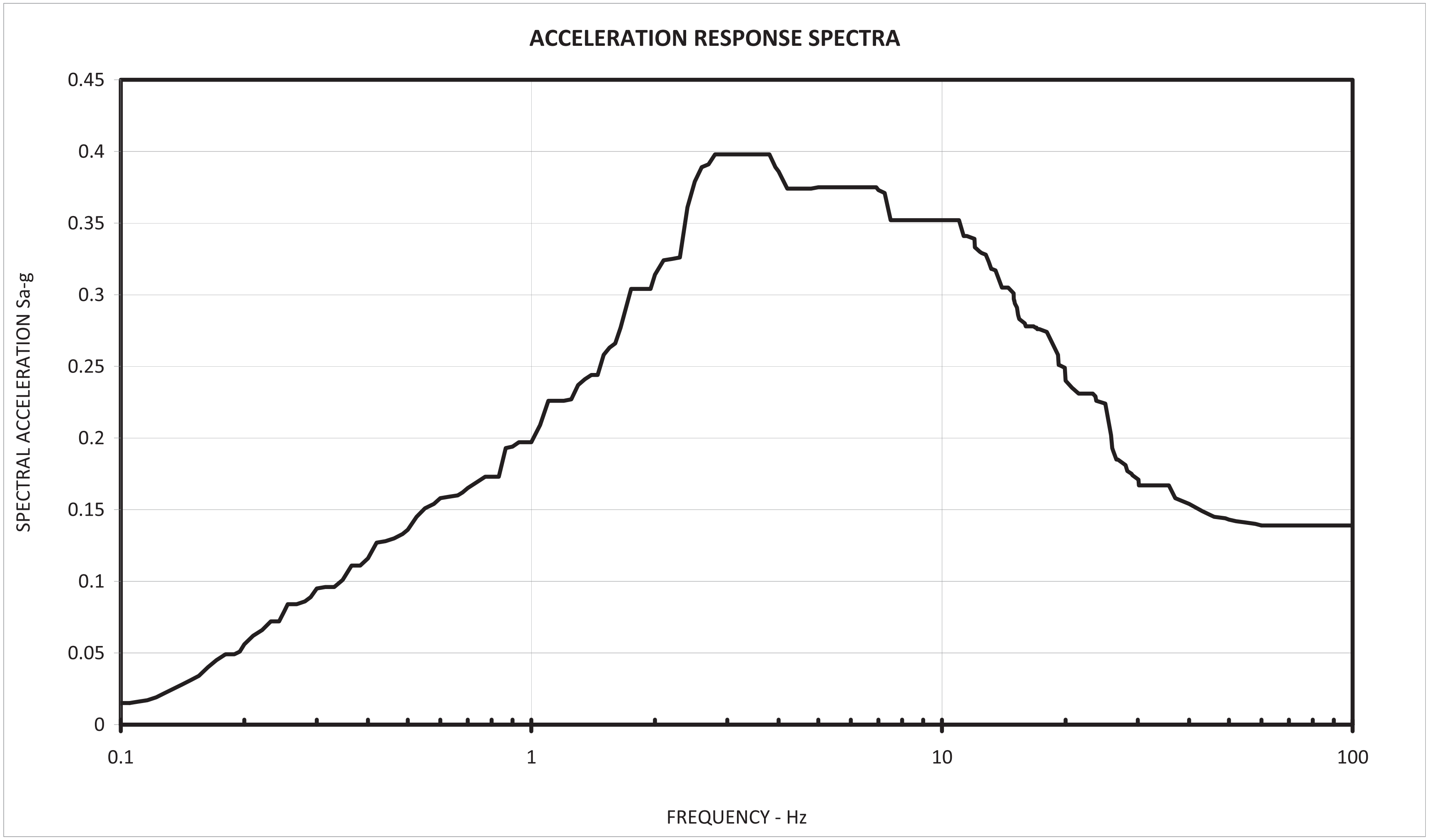

Figure 3.7-49: Control Building Annex Vertical Input Motion for Stability Evaluations (7% Damping)

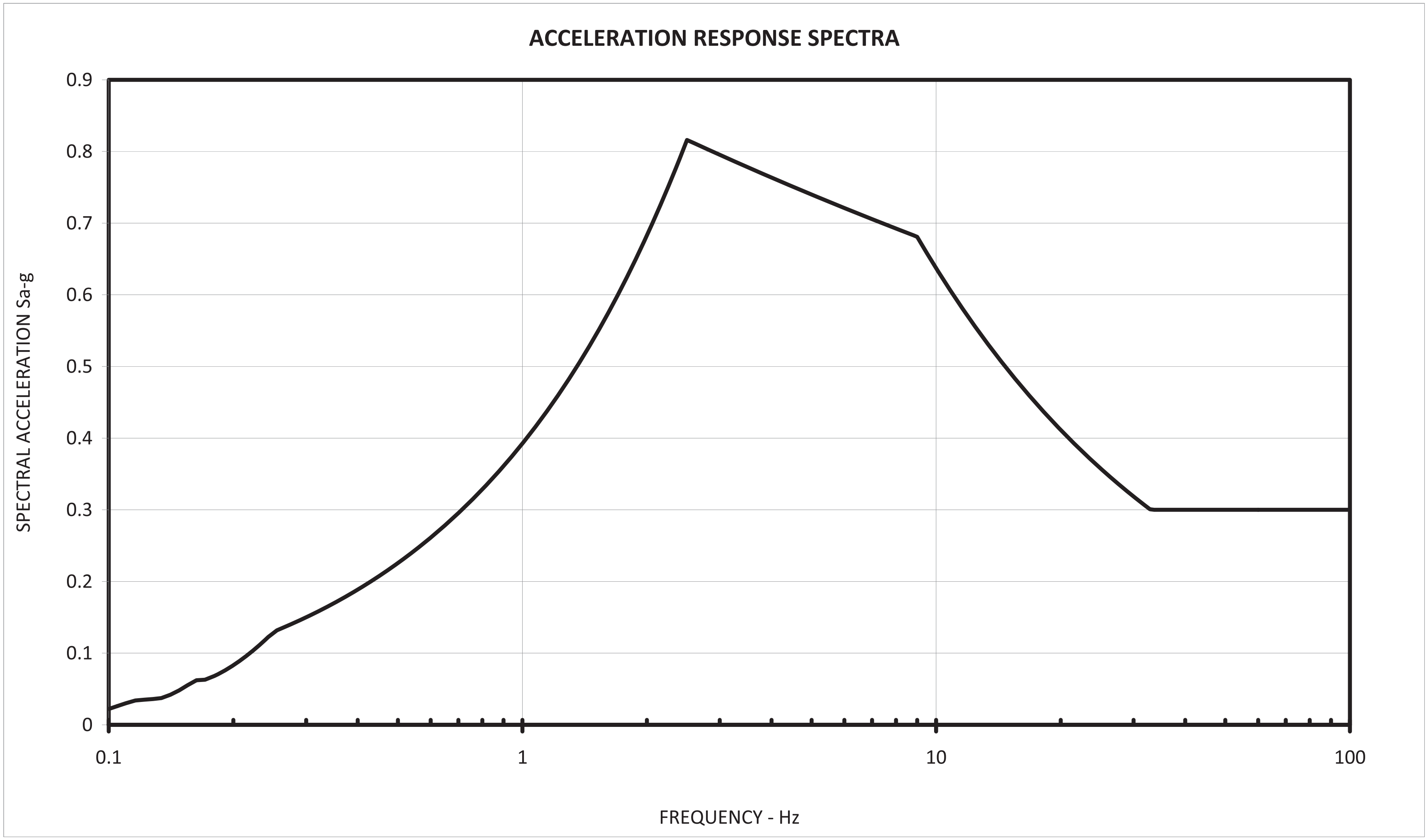

Figure 3.7-50: Service Building North-South Input Motion for II/I Design (7% Damping)

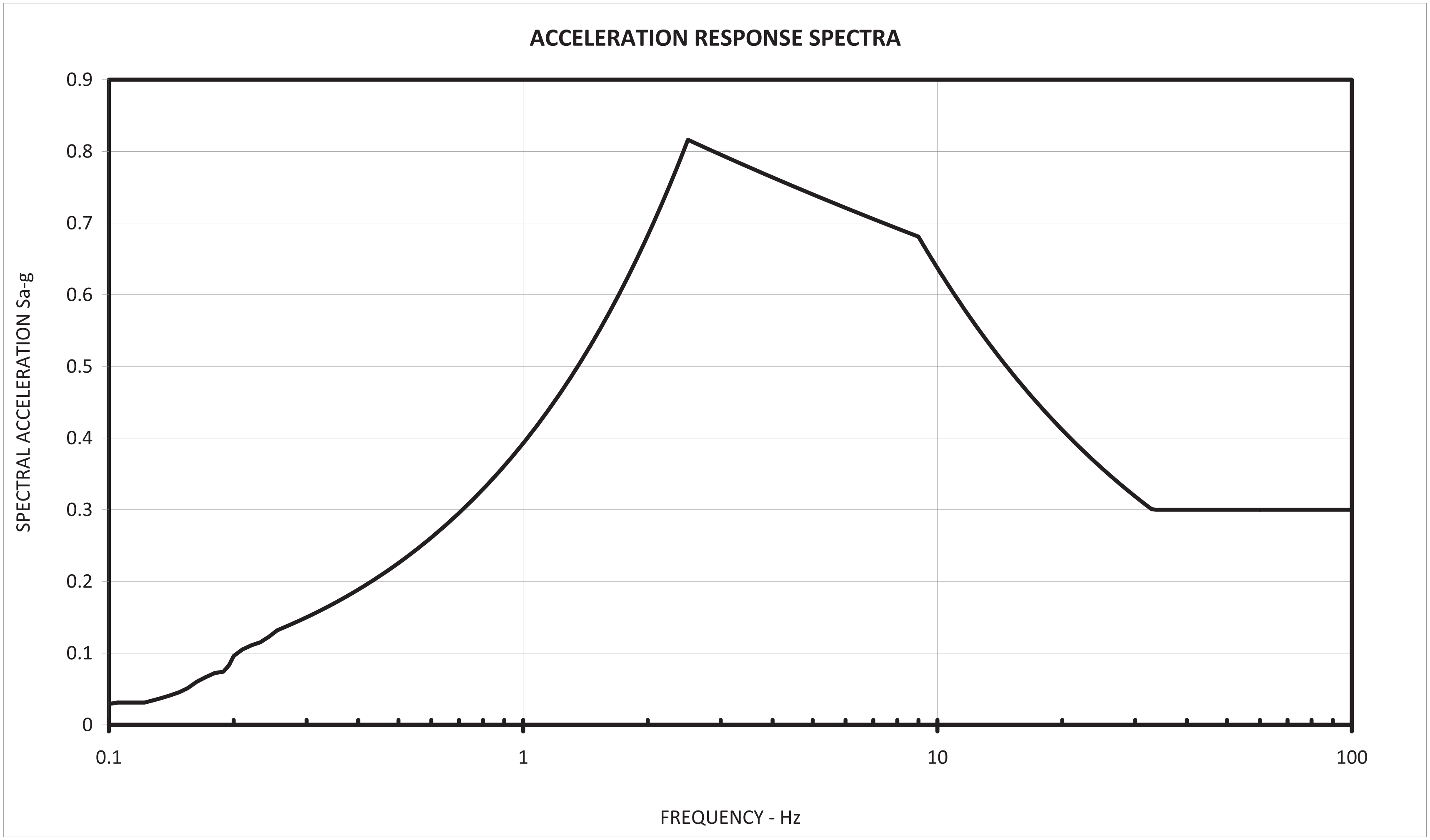

Figure 3.7-51: Service Building East-West Input Motion for II/I Design (7% Damping)

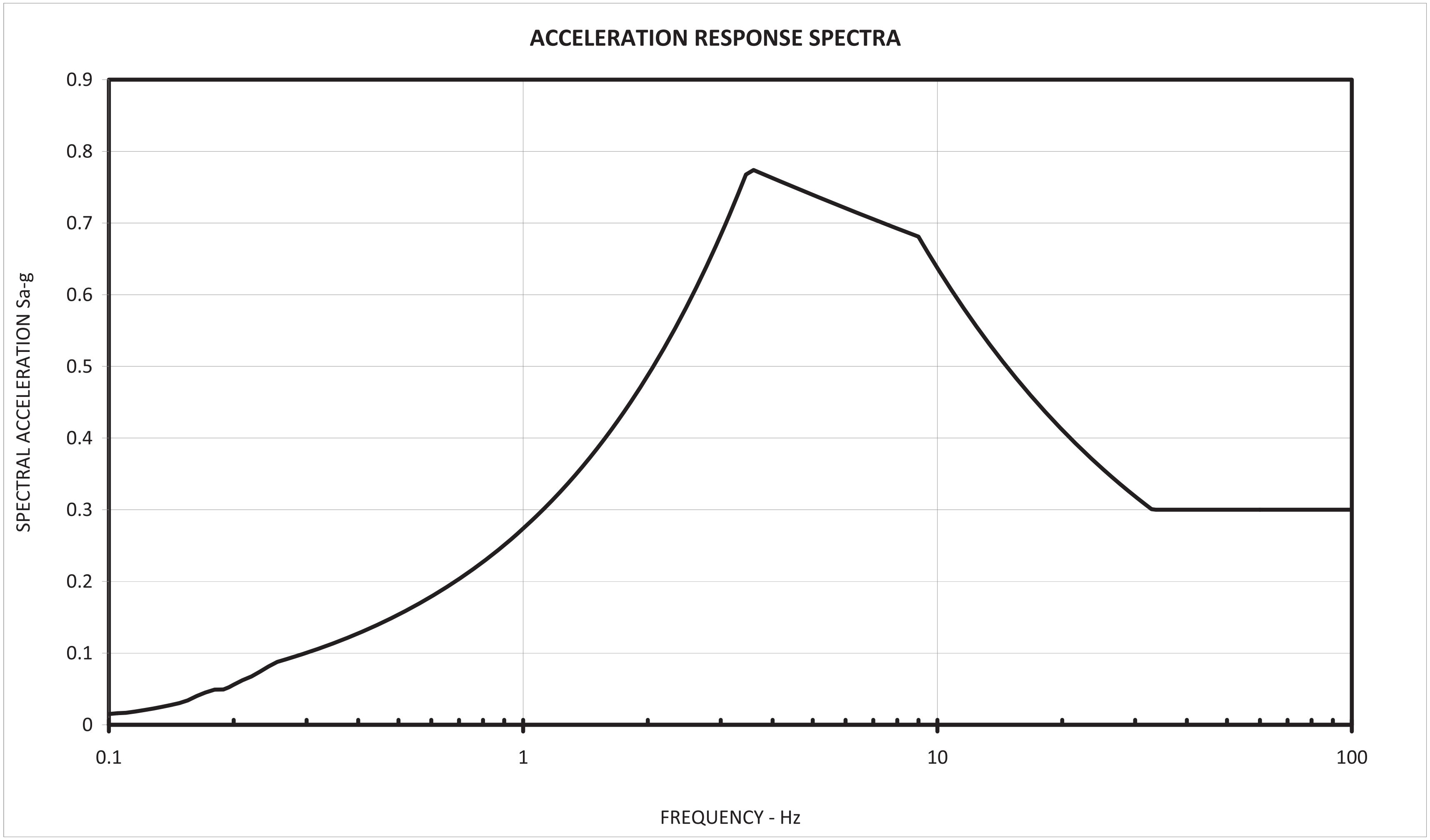

Figure 3.7-52: Service Building Vertical Input Motion for II/I Design (7% Damping)

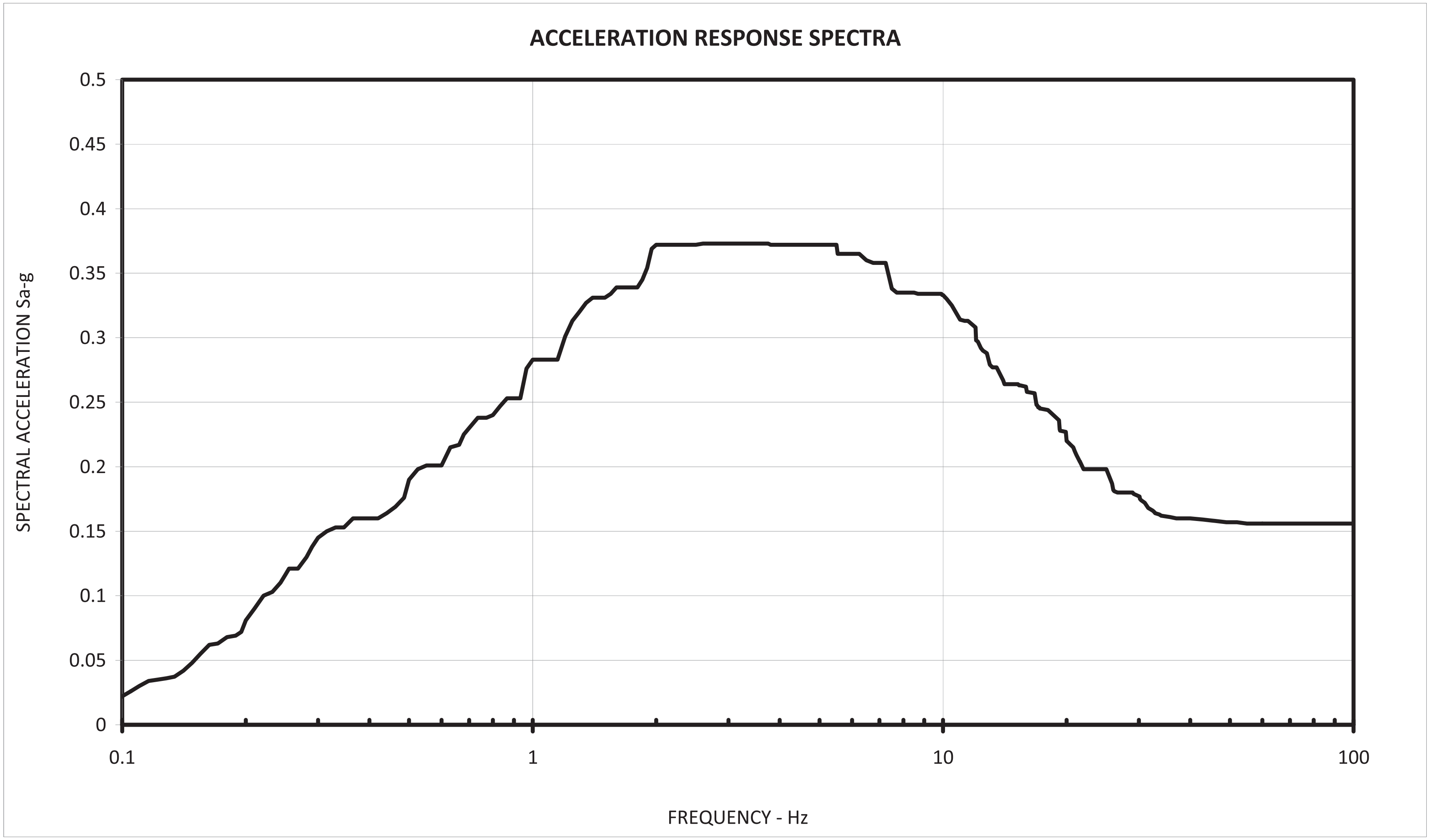

Figure 3.7-53: Service Building North-South Input Motion for Stability Evaluations (7% Damping)

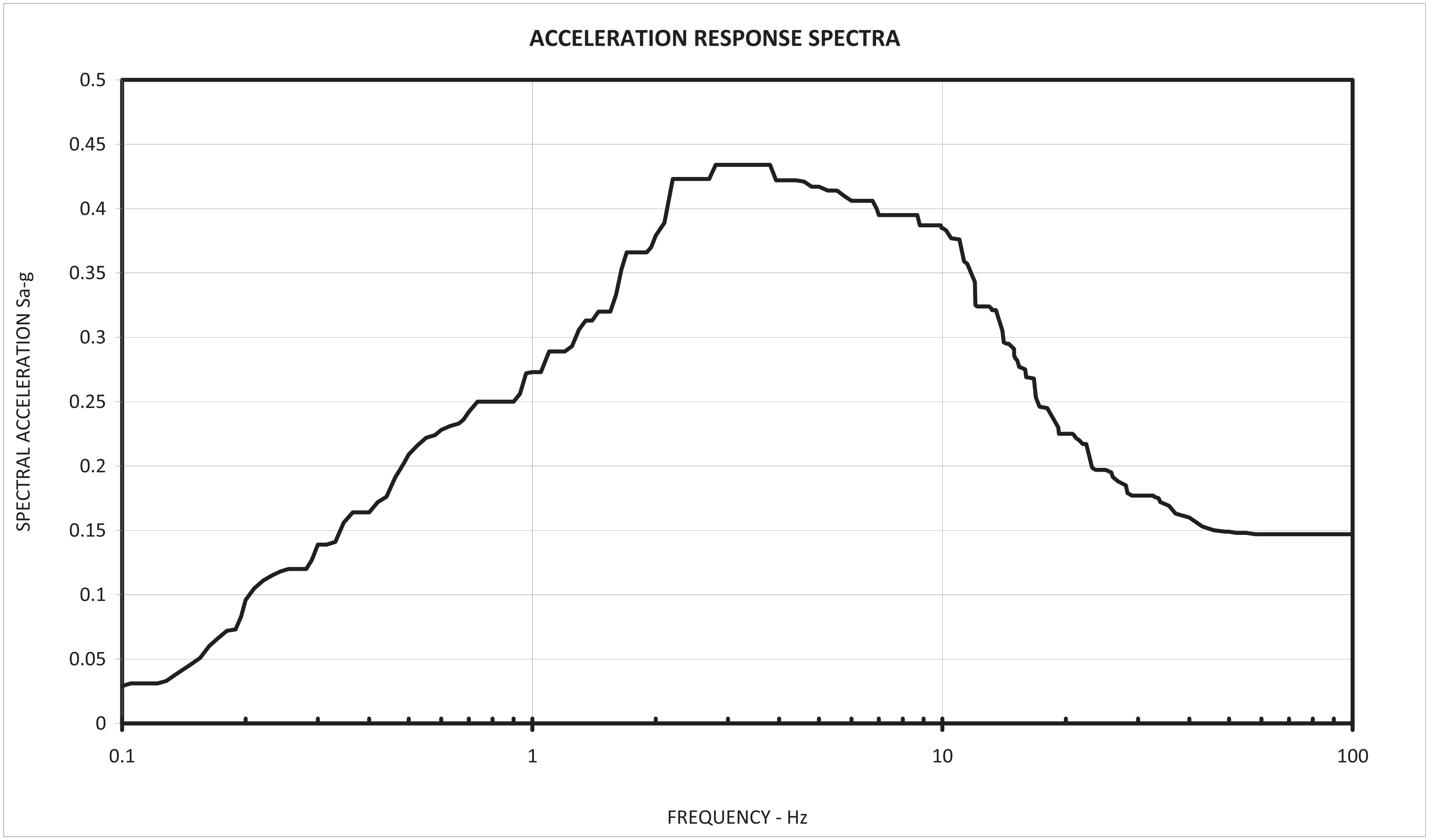

Figure 3.7-54: Service Building East-West Input Motion for Stability Evaluations (7% Damping)

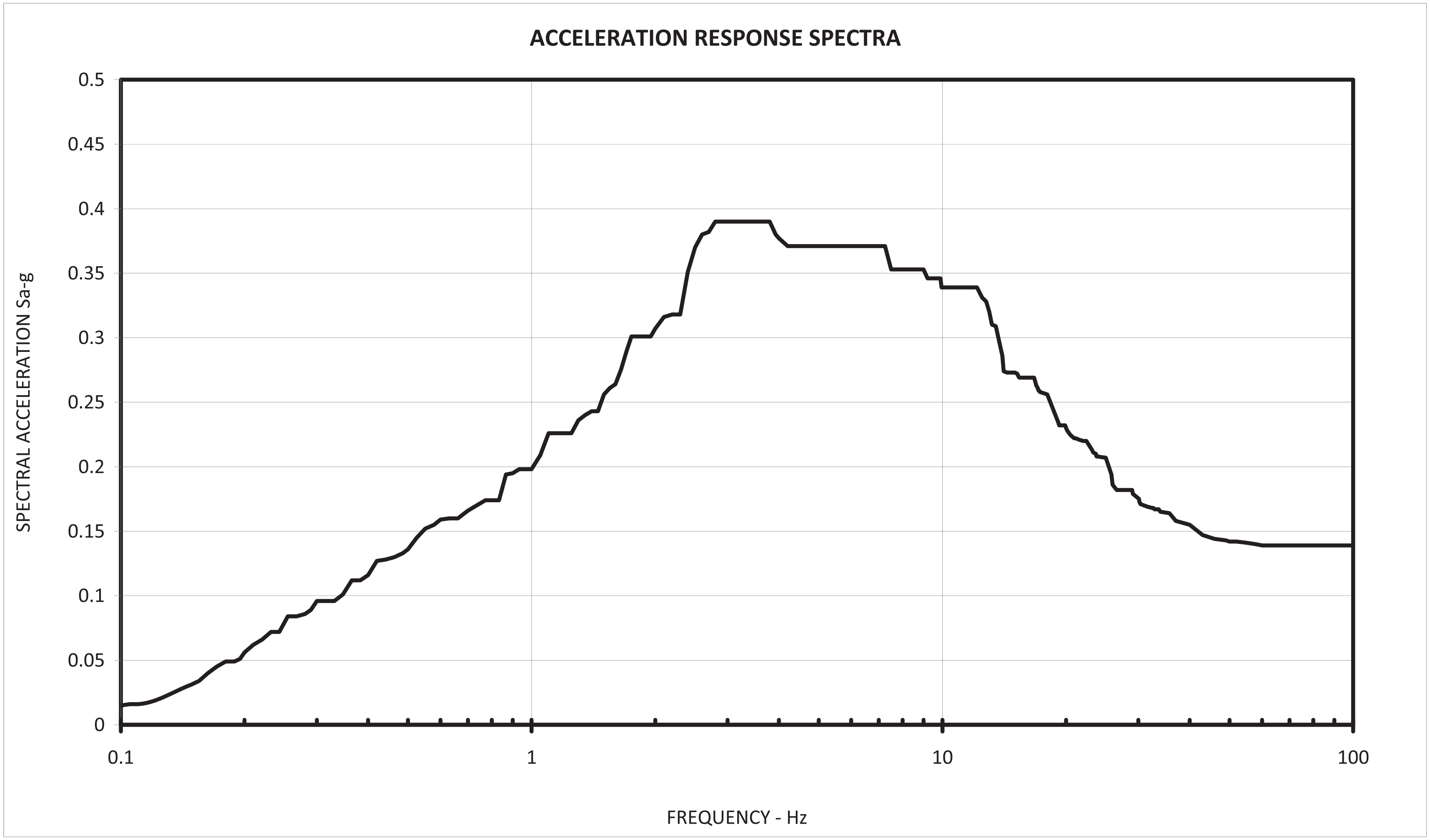

Figure 3.7-55: Service Building Vertical Input Motion for Stability Evaluations (7% Damping)