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U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
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Your ref: Docket No. 52-006
Our ref: DCP/NRC2125

April 25, 2008

Subject: AP1000 COL Responses to Requests for Additional Information (SRP3.7.1)

Westinghouse is submitting responses to the NRC requests for additional information (RAIs) on Standard Review Plan (SRP) Section 3.7.1. These RAI responses are submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the responses is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Responses are provided for RAI-SRP3.7.1-SEB1-02 through -14 as sent in an email from Mike Miernicki to Sam Adams dated March 19, 2008. These responses complete all requests received to date for SRP Section 3.7.1. A response to RAI-SRP3.7.1-SEB1-01 was submitted under letter DCP/NRC2096 dated March 4, 2008.

Pursuant to 10 CFR 50.30(b), the responses to the requests for additional information on SRP Section 3.7.1, is submitted as Enclosure 1 under the attached Oath of Affirmation.

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

D. A. Lindgren /for

Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

D063
NRO

00365psa.doc

/Attachment

1. "Oath of Affirmation," dated April 25, 2008

/Enclosure

1. Responses to Request for Additional Information on SRP Section 3.7.1

cc:	M. Miernicki	-	U.S. NRC	1E	1A
	E. McKenna	-	U.S. NRC	1E	1A
	P. Ray	-	TVA	1E	1A
	P. Hastings	-	Duke Power	1E	1A
	R. Kitchen	-	Progress Energy	1E	1A
	A. Monroe	-	SCANA	1E	1A
	J. Wilkinson	-	Florida Power & Light	1E	1A
	C. Pierce	-	Southern Company	1E	1A
	G. Zinke	-	NuStart/Entergy	1E	1A
	R. Grumbir	-	NuStart	1E	1A
	E. Schmiech	-	Westinghouse	1E	1A
	B. LaPay	-	Westinghouse	1E	1A

ATTACHMENT 1

"Oath of Affirmation"

ATTACHMENT 1

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of:)

AP1000 Design Certification Amendment Application)

NRC Docket Number 52-006)

APPLICATION FOR REVIEW OF
"AP1000 GENERAL INFORMATION"
FOR DESIGN CERTIFICATION AMENDMENT APPLICATION REVIEW

W. E. Cummins, being duly sworn, states that he is Vice President, Regulatory Affairs & Standardization, for Westinghouse Electric Company; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission this document; that all statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

W. E. Cummins
Vice President
Regulatory Affairs & Standardization

Subscribed and sworn to
before me this 25th day
of April 2008.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Patricia S. Aston, Notary Public
Murrysville Boro, Westmoreland County
My Commission Expires July 11, 2011
Member, Pennsylvania Association of Notaries

Notary Public

ENCLOSURE 1

Responses to Requests for Additional Information on SRP Section 3.7.1

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-02
Revision: 0

Question:

Quoting the first paragraph of the TR-115 Introduction:

> "The purpose of this report is two fold: (1) to confirm that high frequency seismic input is not damaging to equipment and structures qualified by analysis for the AP 1000 Certified Seismic Design Response Spectra (CSDRS); and (2) to demonstrate that normal design practices result in an AP 1000 design that is safer and more conservative than that which would result if designed for the high frequency input."

The purpose of the report is incorrectly stated, and may lead a reader to an incorrect conclusion. (1) and (2) above apply at best to the HRHFRS that Westinghouse has defined in this report (as further revised in TR-144), which supposedly envelope the 3 currently proposed CEUS hard rock sites. As stated above, a reader may reach the conclusion that Westinghouse's two-fold purpose applies generically to "high frequency seismic input". The staff requests that Westinghouse accurately state the purpose of TR-115.

Quoting the last paragraph of the Introduction:

> "This report describes the methodology and criteria used in the evaluation to confirm that high frequency input is not damaging to equipment and structures qualified by analysis for the AP1000 CSDRS. This report also demonstrates that the AP1000 envelopes any requirements that HF would impose. Thus, HF does not need to be considered explicitly in the design. It provides supplemental criteria for selection and testing of equipment whose function might be sensitive to high frequency. This report provides a summary of the analysis and applicable test results."

This paragraph is also misleading, and may lead a reader to an incorrect conclusion. The staff requests that Westinghouse accurately state what has been specifically demonstrated in TR-115.

Westinghouse Response:

Westinghouse does not believe that the purpose as defined in the first paragraph of TR-115 could be misleading applying to all high frequency input. Westinghouse will however clarify TR-115 to provide more clarity regarding its purpose. The conclusions reached in TR-115 apply only to those sites whose site GMRS are enveloped by the HRHF seismic response that was used for the evaluation as clarified in TR-144. In TR-144 under Section III, DCD Mark-UP, Tier 1, Table 5.0-1 Site Parameters, Seismic SSE it is stated: "The HRHF GMRS provide an alternate set of spectra for evaluation of site specific GMRS. A site is acceptable if its site

specific GMRS fall within the AP1000 HRHF GMRS." Therefore, a site cannot be considered acceptable if it does not fall within Figures 5.0-3 and 5.0-4 as given in TR-144.

The last paragraph of the introduction is also not misleading. The high frequency input that is referred to is the one that is used in the evaluation. This high frequency input seismic response spectra envelopes the AP1000 HRHF GMRS given in TR-144 shown in Figures 5.0-3 and 5.0-4.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

To be consistent with TR-144 the following changes will be made to TR-115.

Modify the 1st paragraph of the introduction to:

> The purpose of this report is two fold: (1) to confirm that high frequency seismic input evaluated is not damaging to equipment and structures qualified by analysis for the AP 1000 Certified Seismic Design Response Spectra (CSDRS); and (2) to demonstrate that normal design practices result in an AP 1000 design that is safer and more conservative than that which would result if designed for the high frequency input evaluated.

Modify the last paragraph of the introduction to:

> This report describes the methodology and criteria used in the evaluation to confirm that high frequency input is not damaging to equipment and structures qualified by analysis for the AP1000 CSDRS. This report also demonstrates that the AP1000 envelopes any requirements that HF would impose. Thus, HF does not need to be considered explicitly in the design. It provides supplemental criteria for selection and testing of equipment whose function might be sensitive to high frequency. The HRHF GMRS provide an alternate set of spectra for evaluation of site specific GMRS. A site is acceptable if its site specific GMRS falls within the AP1000 HRHF GMRS. Therefore, a site is not considered acceptable without additional analyses if it does not fall within Figures 1.0-1 and 1.0-2. This report provides a summary of the analysis and applicable test results.

Modify Figures 1.0-1 and 1.0-2 to be consistent with Figures 5.0-3 and 5.0-4 given in TR-144.

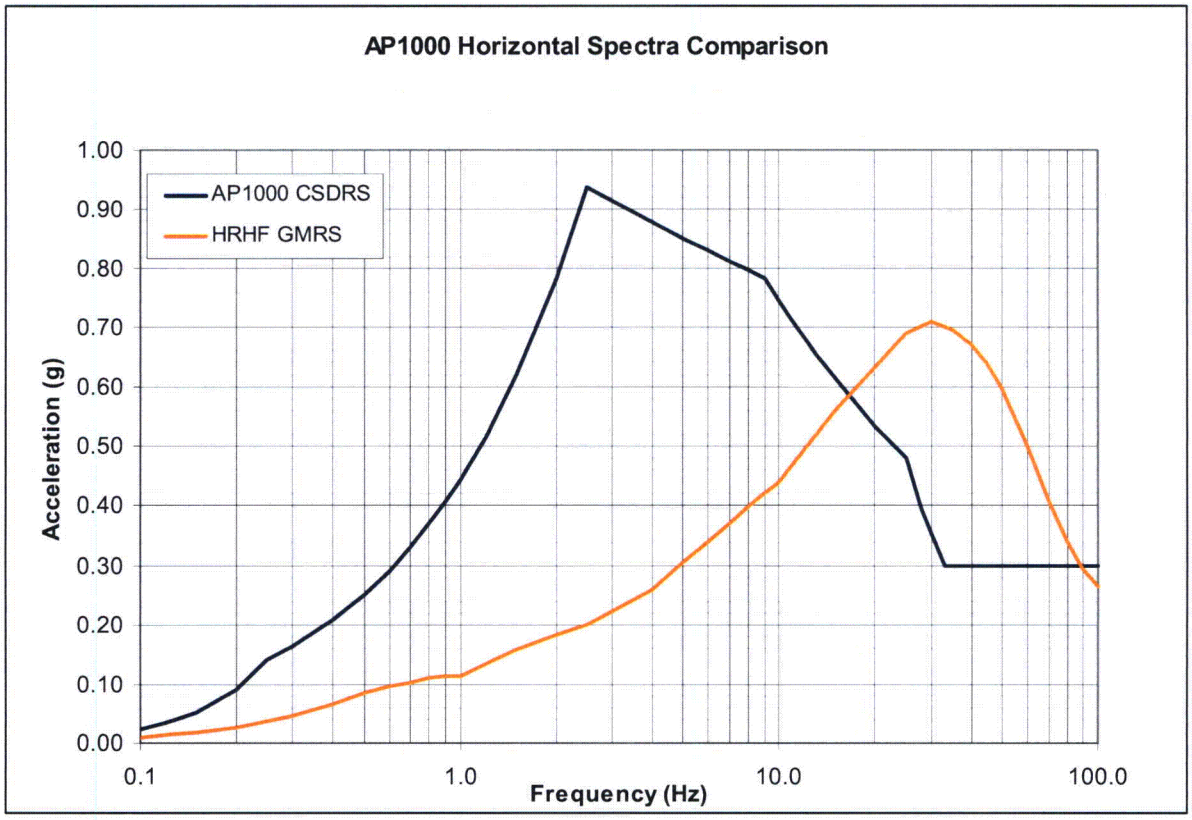


Figure 1.0-1: Comparison of the HRHF horizontal input spectra to the CSDRS

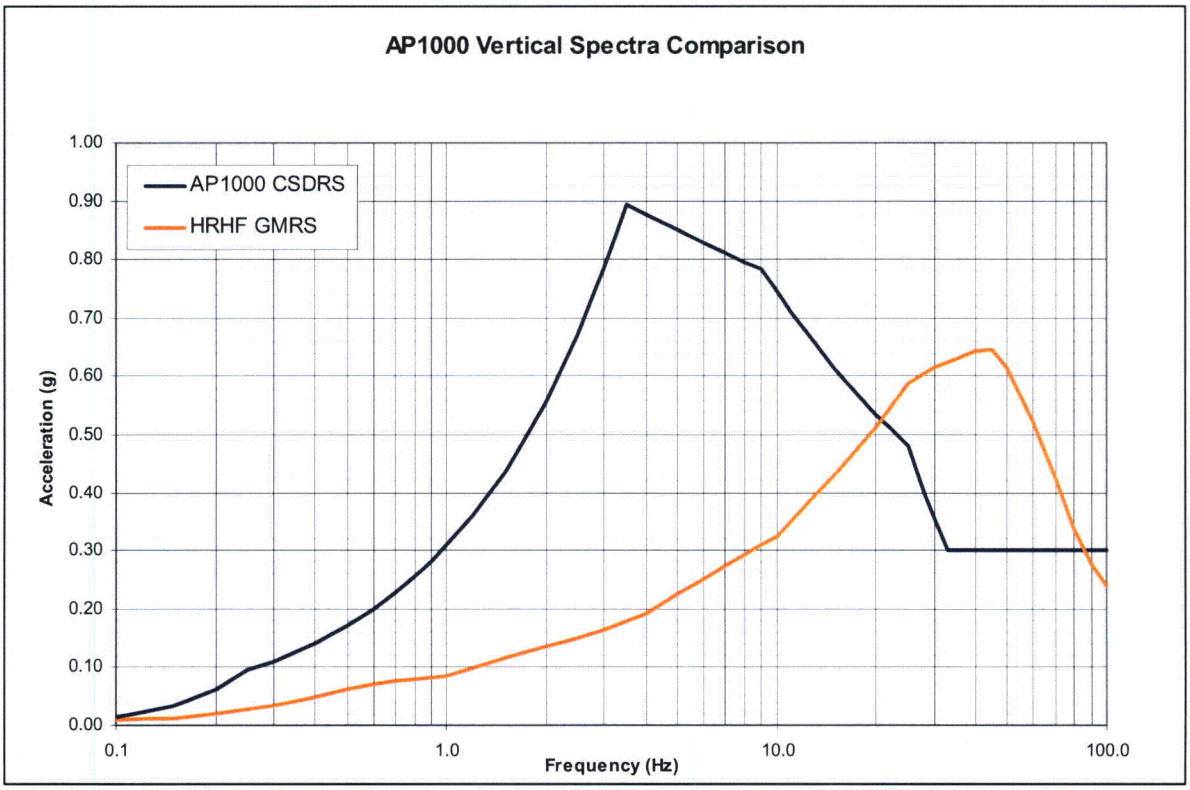


Figure 1.0-2: Comparison of the HRHF vertical input spectra to the CSDRS

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-03
Revision: 0

Question:

The staff reviewed the qualitative description of "Evaluation Methodology" in TR-115, Section 3.0, and concluded that the approach described is an acceptable method for evaluating the effects of incoherency. The staff noted that it is consistent with the presentation made to the staff by Dan Ghiocel at the October 8-12, 2007 audit at Westinghouse's offices in Monroeville, PA. However, TR-115 does not include any of the quantitative information presented at the audit, which demonstrated the implementation of the approach. Consequently, the staff requests that Westinghouse make available for audit, a detailed report of numerical results that demonstrate the implementation of the evaluation method specifically for AP1000.

Westinghouse Response:

Westinghouse will make available to the NRC for audit the calculations that were prepared in support to TR-115.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-04
Revision: 0

Question:

In Section 4.0 of TR-115, Westinghouse lists the four (4) screening criteria used to select systems, structures, and components (SSC) for detailed evaluation:

- Select systems, structures, and components based on their importance to safety. This includes the review of component safety function for the Safe Shutdown Earthquake (SSE) event and its potential failure modes due to an SSE. Those components whose failure modes do not impact the ability to achieve safe shutdown are excluded.

- Select systems, structures, and components that are located in areas of the plant that are susceptible to large high frequency seismic inputs.

- Select systems, structures, and components that have significant modal response within the region of high frequency amplification. Significance is defined by such items as: modal mass, participation factor, stress and/or deflection.

- Select systems, structures, and components that have significant total stress as compared to allowable, when considering load combinations that include seismic.

Based on the Westinghouse screening criteria, it is not clear to the staff why the Containment Structure is not identified for detailed comparison of the CSDRS response and the HRHFRS response. The staff requests that Westinghouse either include a detailed comparison for the Containment Structure in Section 6.1, or describe in detail its technical basis for excluding the Containment Structure.

Westinghouse Response:

The steel containment structure was not chosen for evaluation since it does not meet the 3rd bullet of the general screening criteria:

- Select systems, structures, and components that have significant modal response within the region of high frequency amplification. Significance is defined by such items as: modal mass, participation factor, stress and/or deflection.

Shown below are the dominant frequencies with modal mass associated with the steel containment vessel with polar crane. The dominant modes for horizontal response are below 10 hertz, and the dominant mode in the vertical direction is below 20 hertz. The dominant modes are not in the region where the HRHF exceeds the AP1000 CSDRS. Further, over 75 %

of the mass is participating prior to the exceedance of the AP1000 CSDRS by the HRHF. Therefore, the Steel Containment Structure was excluded from the evaluation.

Direction	Frequency (hertz)	Effective Mass Participation (kip-sec^2/ft)	Percent of Mass Participation
X (North-South)	5.090	151.499	60.578
	8.109	32.009	75.306
	17.546	31.095	88.628
Y (East-West)	3.240	31.480	12.709
	6.095	156.933	76.062
	18.947	40.003	93.161
Z (Vertical)	6.692	22.140	9.057
	16.376	166.317	77.236
	27.318	18.628	90.367

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-05
Revision: 0

Question:

The staff needs additional information describing how the screening criteria in TR-115 Section 4.0 were applied in the selection of the locations that are compared in Section 6.1. The staff requests that Westinghouse include in Section 4.0 the specific evaluation against these criteria for each selected location. As an alternative, Westinghouse may include all locations addressed in TR-03, in Section 6.1.

Westinghouse Response:

Section 4.0 provides the general selection screening criteria. Specific evaluations against these criteria are discussed in the individual sections where structures and equipment evaluations are presented. In Section 6.1 the selection criteria for the building structures are presented. Representative locations were chosen that are susceptible to high frequency response to demonstrate that the forces and moments from the HRHF input is non-damaging and do not exceed the values from the CSDRS response. The Nuclear Island building structure locations identified in Section 6.1 were selected based on the screening criteria given in the second bullet in Section 4.0 that states:

- Select systems, structures, and components that are located in areas of the plant that are susceptible to large high frequency seismic inputs.

As stated in Section 6.1 of TR-115 the locations are selected based on the areas that can experience high seismic shear and moment loads due to the high frequency input. As stated in Section 6.1:

- Three locations in the Auxiliary Building subject to high frequency at the bottom of a wall, a location on the wall near the vicinity of a floor, and a corner intersection of walls.

- Eight locations on the lower elevations of the Shield Building were chosen that are located on the east, west, north, and south sides.

- Three areas within the Containment Internal Structures were chosen that would be representative of a portion of the structures associated with the refueling canal, steam generator compartments, and IRWST.

These representative locations were chosen since it is not necessary to evaluate the Nuclear Island (NI) building structures in total. This number of locations is considered sufficient by Westinghouse for evaluation since no CSDRS member forces were exceeded, and it is not expected that NI building structures will be subject to high stresses because of the small

displacements that the NI building structures will experience due to the HRHF input. Westinghouse considers that there is sufficient information in Section 6.1 describing why these locations were selected using the screening criteria given in Section 4.0.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-06
Revision: 0

Question:

Westinghouse's calculation in TR-115 indicates 4 points per wavelength for 80 Hz. This is the bare minimum to represent a full cycle of sinusoidal displacement variation. The staff requests that Westinghouse include in Section 5.1 a comparison of frequencies and mode shapes between the NI10 and NI20 models, as an alternate way to demonstrate the adequacy of the NI20 model to accurately predict high frequency modes (up to 80 Hz).

Westinghouse Response:

At the December 20, 2007 meeting between the U.S. NRC staff and industry related to the high frequency seismic events, it was agreed that a maximum analysis frequency of 50 hertz would be sufficient to transmit the high frequency response through the model. Using this frequency and the formulas given in Section 5.1 the acceptable mesh size is determined.

Shortest wavelength = $\lambda = Vs / f_{max}$

Vs = 6900 ft/sec (given in Section 5.1)
f_{max} = 50 hertz

$\lambda = 6900 / 50 = 138'$

Using the NI20 model (mesh size of 20'), and the shortest wavelength of 138', then close to 7 nodes per wavelength are obtained to transmit the high frequency through the finite elements. This is sufficient accuracy in the building structure model to transmit the high frequency through the finite elements in the NI20 model. Therefore, it is not necessary to include in Section 5.1 a comparison of frequencies and mode shapes between the NI10 and NI20 models.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

Section 5.1 is revised to reflect the 50 hertz requirement on the dynamic models.

5.1 Adequacy of CSDRS and HRHF Response Spectra

The adequacy of the NI20 model is demonstrated by:

1. Mesh size is adequate to transmit the high frequency through the finite elements
2. Close comparison to NI10 results

The NI20 (~20' finite element mesh size) model is used to develop the HRHF response spectra using the finite element program SASSI. For a concrete of 4000 psi with a poisson's ratio (υ) of approximately 0.17, the shear modulus of elasticity (G) is 221,846 ksf.

$$G = \frac{57400\sqrt{fc'}}{2(1+\nu)}$$ Where fc' is Concrete stress in psi

The shear wave velocity (V_s) is 6900 ft/sec for the concrete density of 0.15 ksf.

$$V_s = \sqrt{\frac{G}{\rho}}$$ ρ is mass density

For a maximum analysis frequency (f_{max}) of 50 Hz which must transmit through the finite elements, the shortest wavelength (λ) is 138 ft.

$$\lambda = \frac{V_s}{f_{\max}}$$

Approximately 7 (6.9) nodes per wavelength are available for a mesh size of 20', and this is adequate to transmit the high frequency through the finite elements in the NI20 model. ~~Therefore, the mesh size of 20 ft (i.e. NI20) is adequate for the Auxiliary and Shield Building (ASB).~~ The portion of the NI20 model has an element mesh size of ~ 10' for the Containment and Internal Structure (CIS).

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-07
Revision: 0

Question:

The spectral comparisons in TR-115 Figures 5.1-1 through 5.1-3, between NI10 results and NI20 results, are insufficiently described. The staff requests that Westinghouse identify what seismic input to the buildings produced these in-structure response spectra.

The staff notes that if the CSDRS synthetic time histories were used, the comparison is of questionable value, because the CSDRS do not have amplification at high frequency. To clearly show the adequacy or inadequacy of the NI20 model for analysis of the HRHFRS, the staff requests that Westinghouse perform NI10 and NI20 fixed base analyses, using the un-modified HRHFRS synthetic time histories as input, without any reduction for incoherency or other considerations, and present the comparison of results.

Westinghouse Response:

The spectral comparison in TR-115 Figures 5.1-1 through 5.1-3, between NI10 and NI20 results, use a fixed base analysis. An interim high frequency synthetic time history without any reduction for incoherency was used. This time history was created earlier than the HRHF time histories used to evaluate structures and equipment in TR-115 (see RAI-SRP3.7.1-SEB1-01). As seen in Figures RAI-SRP3.7.1-SEB1-07-01 and RAI-SRP3.7.1-SEB1-07-02 the seismic response is higher than that associated with the time histories used for evaluation and documented in TR-115.

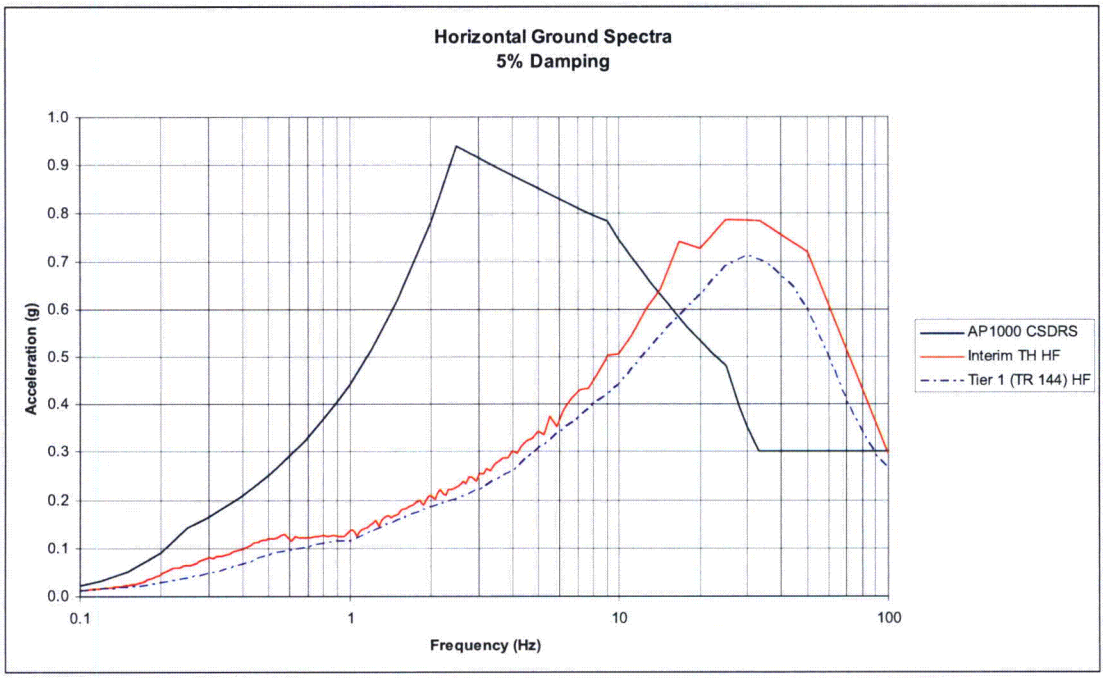


Figure RAI-SRP3.7.1-SEB1-07-01: Comparison of Horizontal Response Spectra

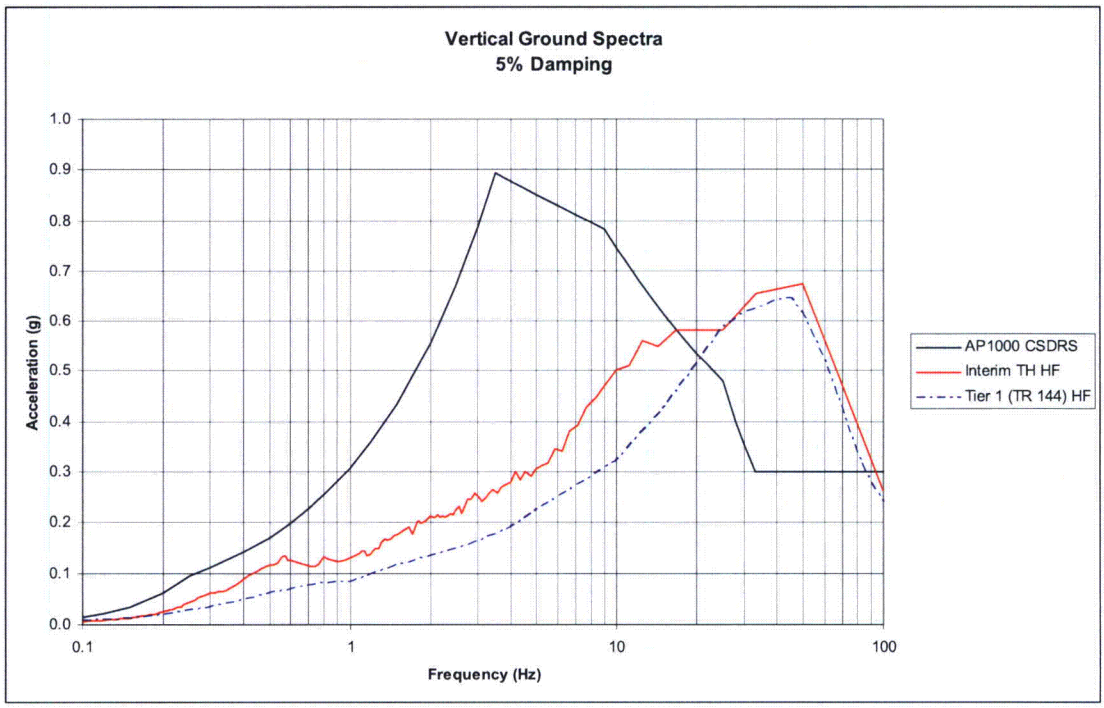


Figure RAI-SRP3.7.1-SEB1-07-02: Comparison of Vertical Response Spectra

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-08
Revision: 0

Question:

The staff also noted that there are an insufficient number of comparisons presented in TR-115 Section 5.1. The NI10 results presented show no significant amplification in the higher frequency range on any of the figures. The staff requests that Westinghouse include in Section 5.1, NI10 vs. NI20 comparisons at locations/directions where there is significant amplification at higher frequency.

Westinghouse Response:

As stated in RAI-SRP3.7.1-SEB1-06, demonstration of the adequacy of the model used to develop HRHF response is to be based on a maximum analysis frequency of 50 hertz. It was shown in the response to this RAI that the NI20 model has sufficient accuracy in the building structure model. Therefore, further comparison than that given in Section 5.1 is not necessary.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

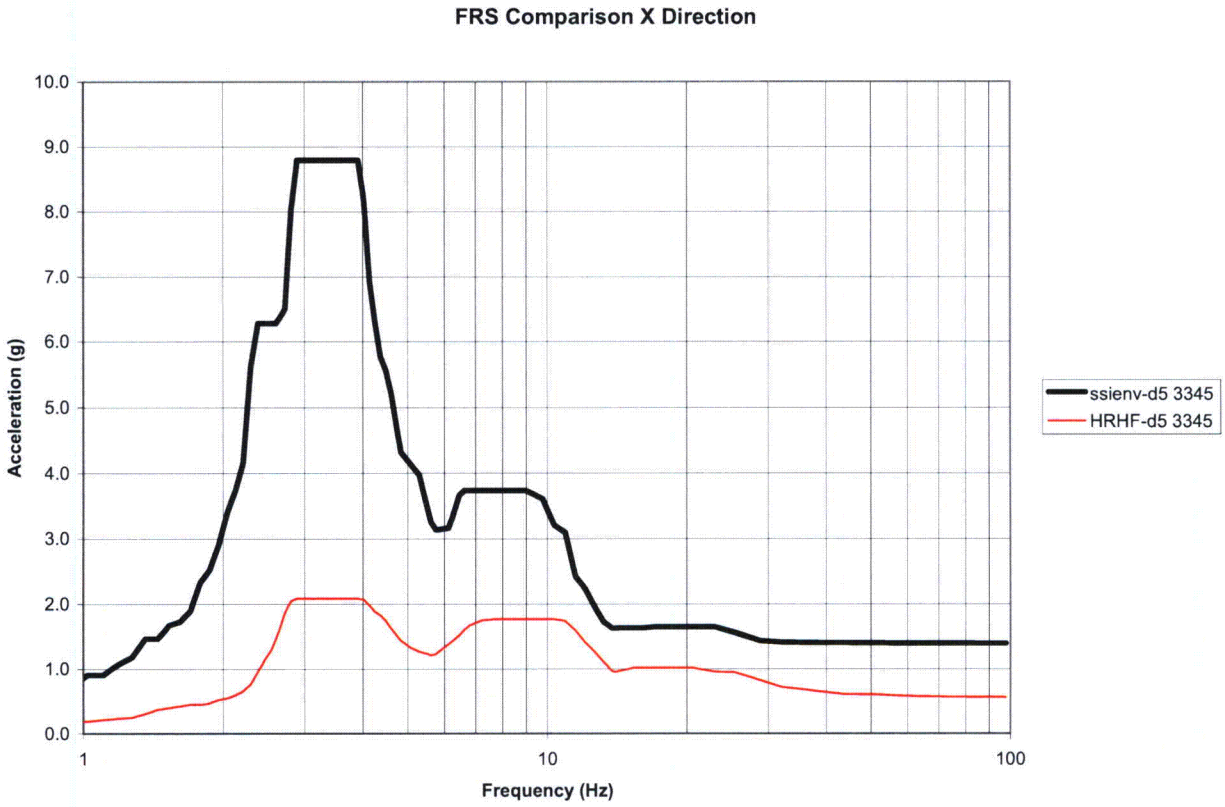
RAI Response Number: RAI-SRP3.7.1-SEB1-09
Revision: 0

Question:

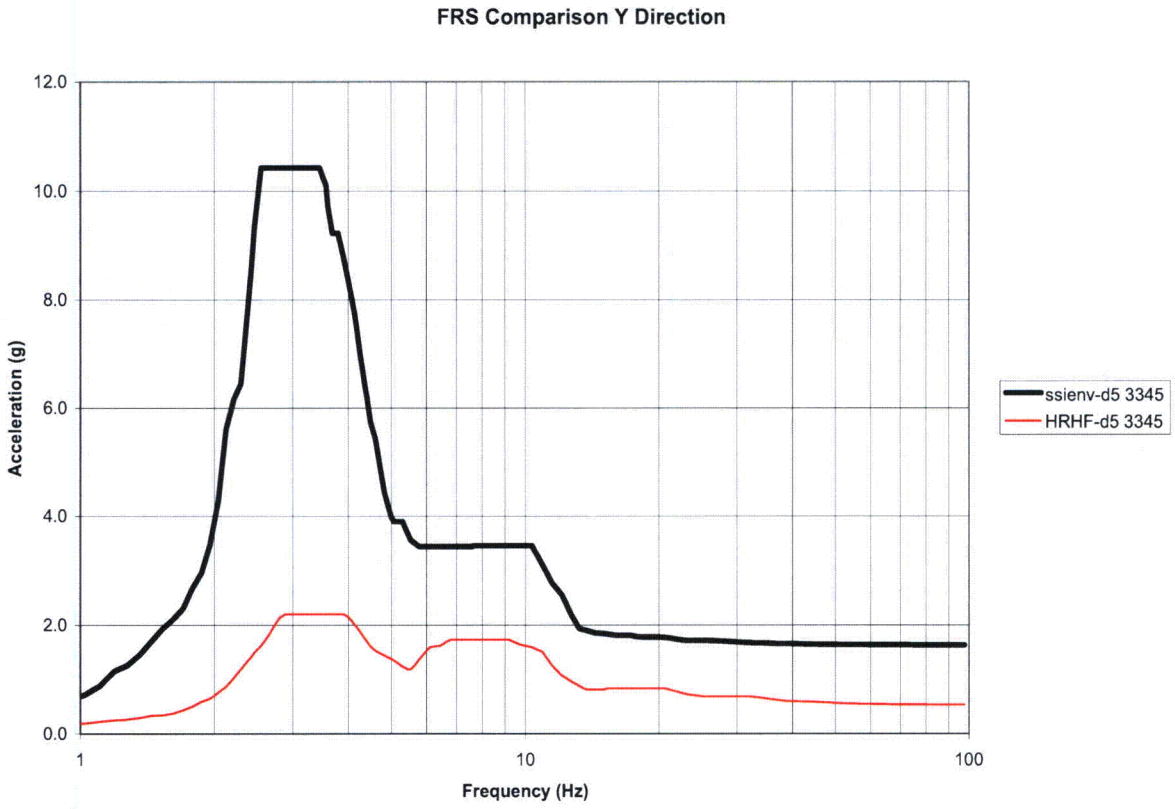
The staff noted that improved, more readable Figures 5.2-1 through 5.2-6 in TR-115 are needed. The ordinate scale and the legend cannot be read even by zooming in the electronic file. High resolution printing makes them barely readable. The staff requests that Westinghouse submit larger, readable copies of Figures 5.2-1 through 5.2-6, to facilitate the staff's evaluation of the information.

Westinghouse Response:

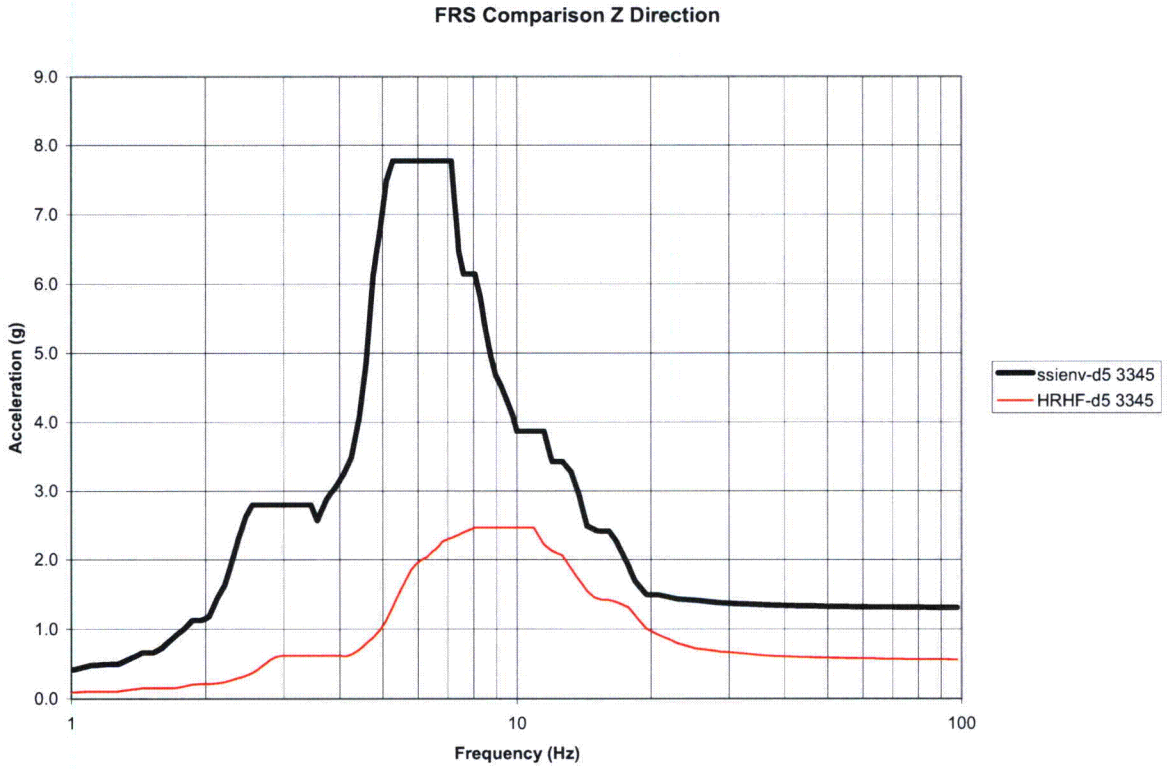
The requested figures are found in Figures RAI-SRP3.7.1-SEB1-09-01a to RAI-SRP3.7.1-SEB1-09-06c.



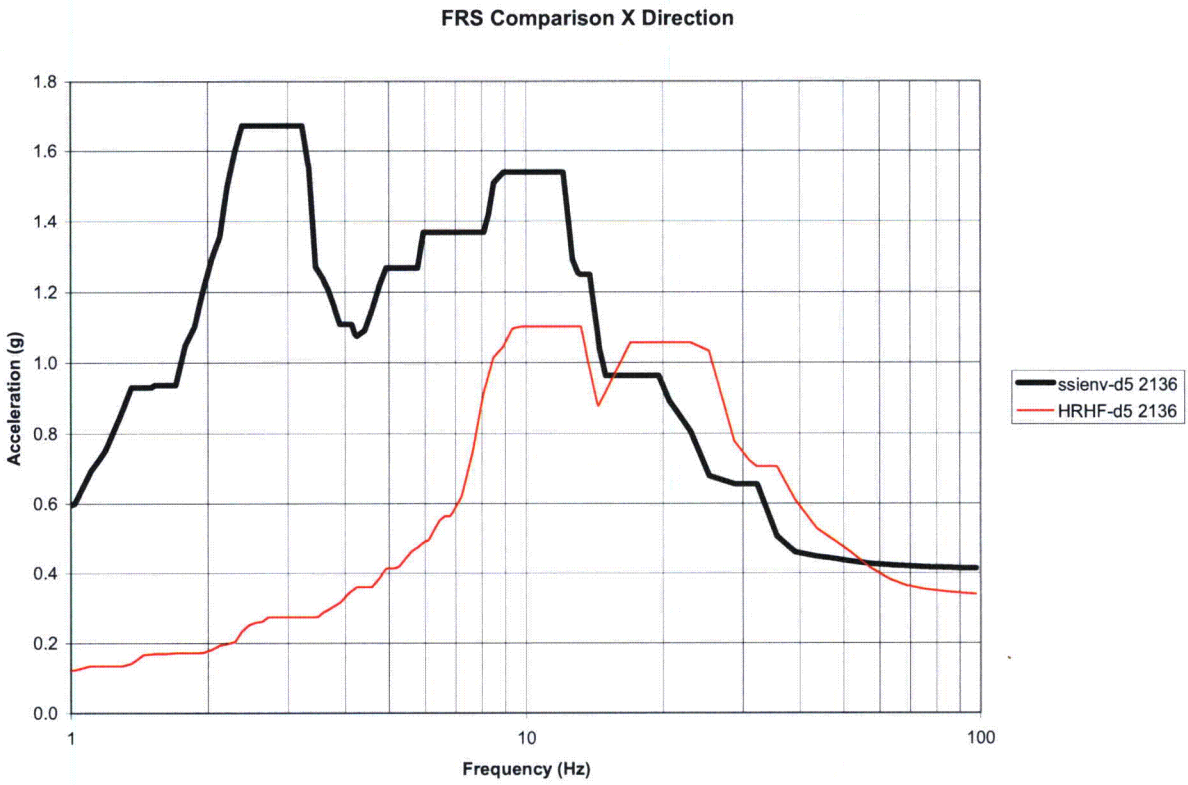
RAI-SRP3.7.1-SEB1-09-01a: ASB at Elevation 327.4' X Direction



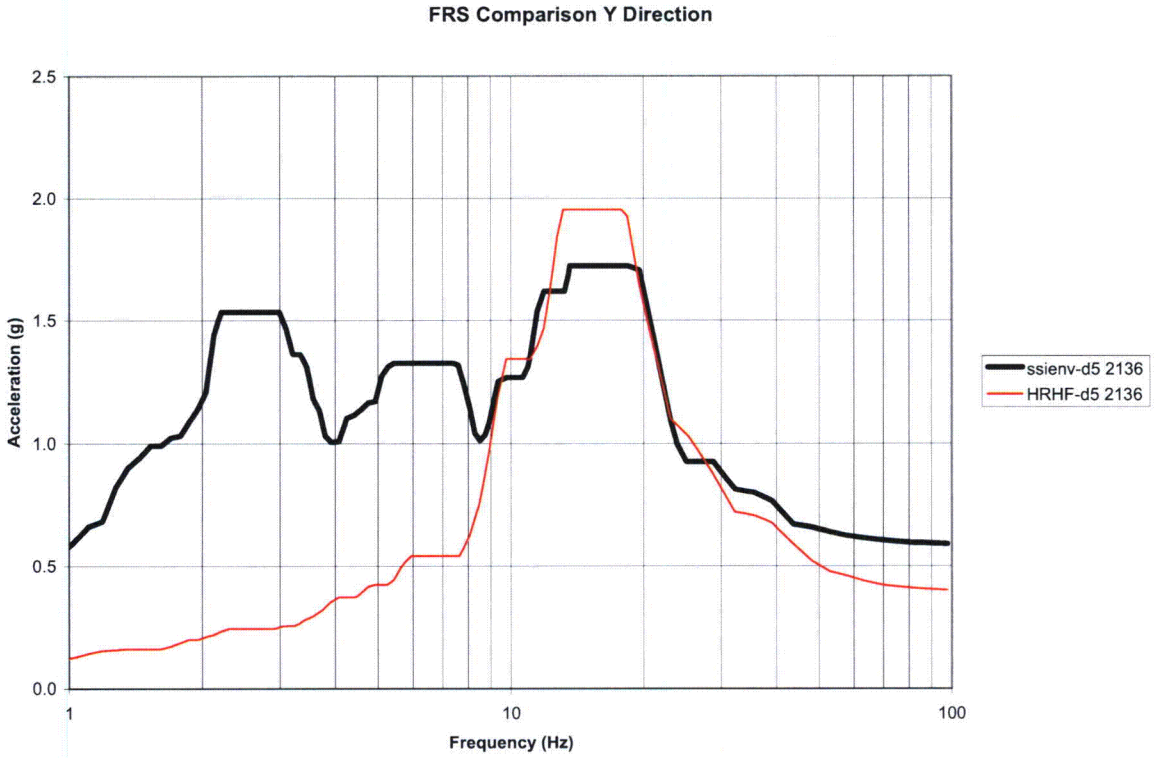
RAI-SRP3.7.1-SEB1-09-01b: ASB at Elevation 327.4' Y Direction



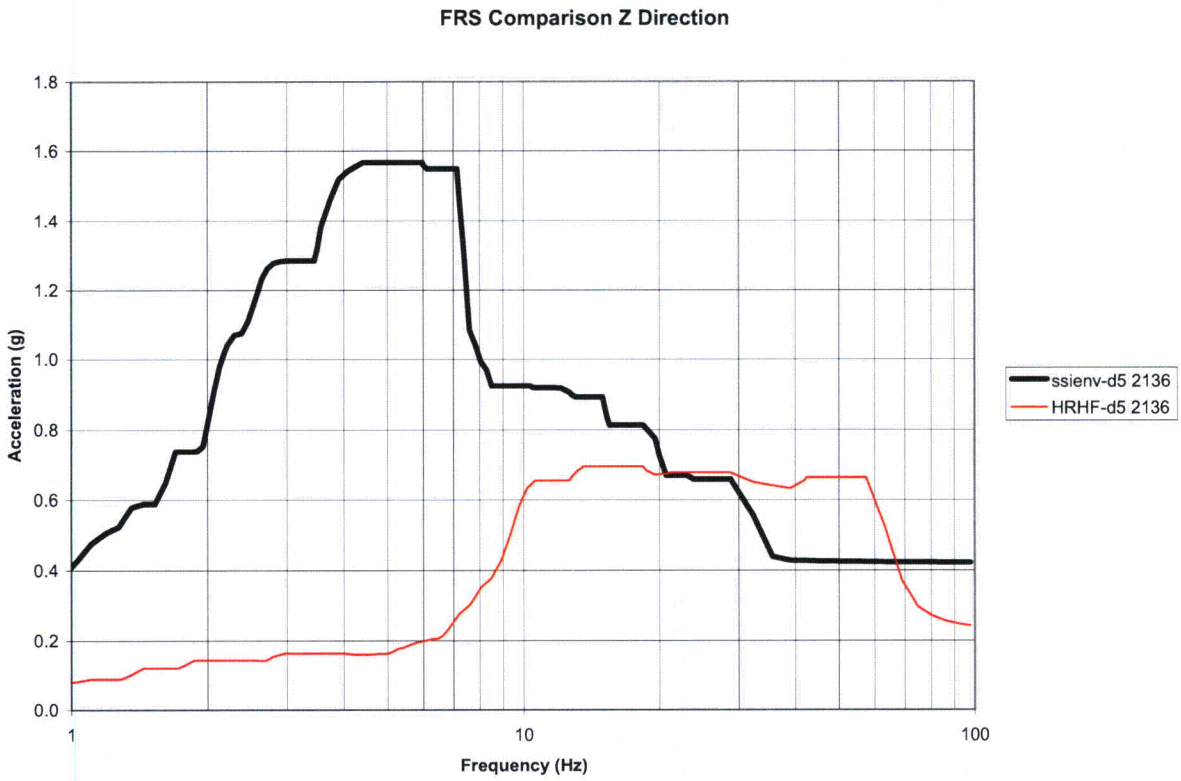
RAI-SRP3.7.1-SEB1-09-01c: ASB at Elevation 327.4' Z Direction



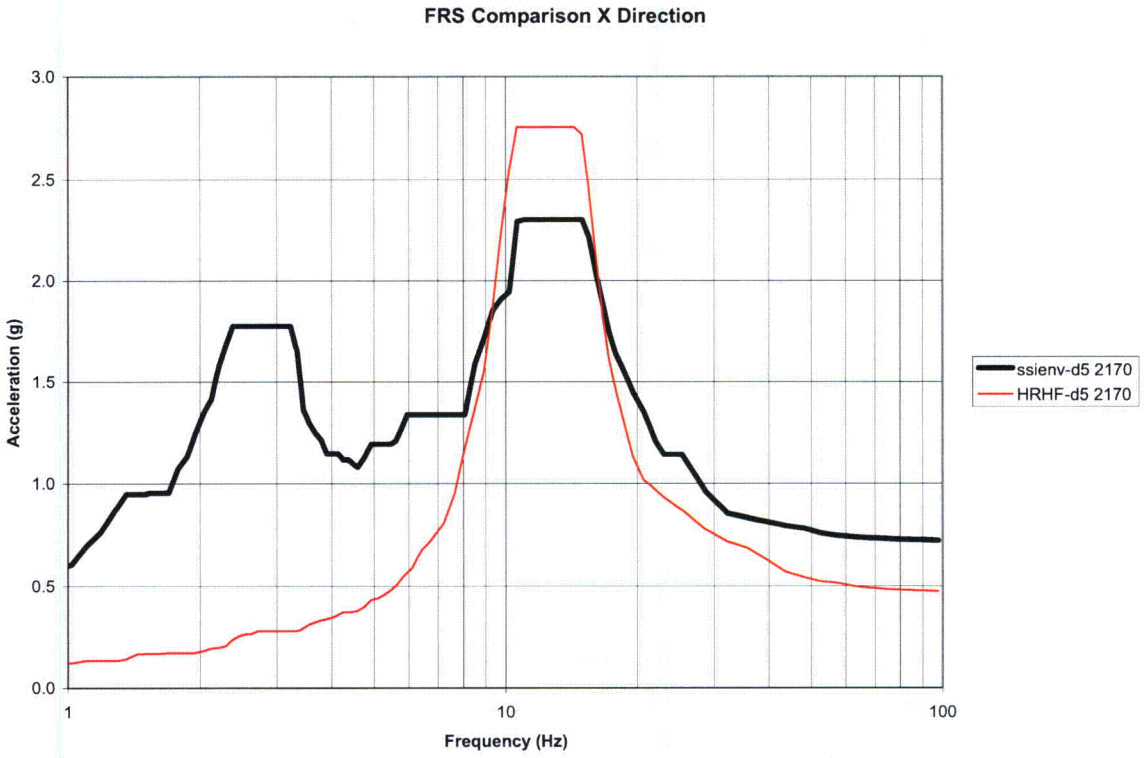
RAI-SRP3.7.1-SEB1-09-02 Ea: Containment Operating Floor (Elevation 134.25') East Side X Direction



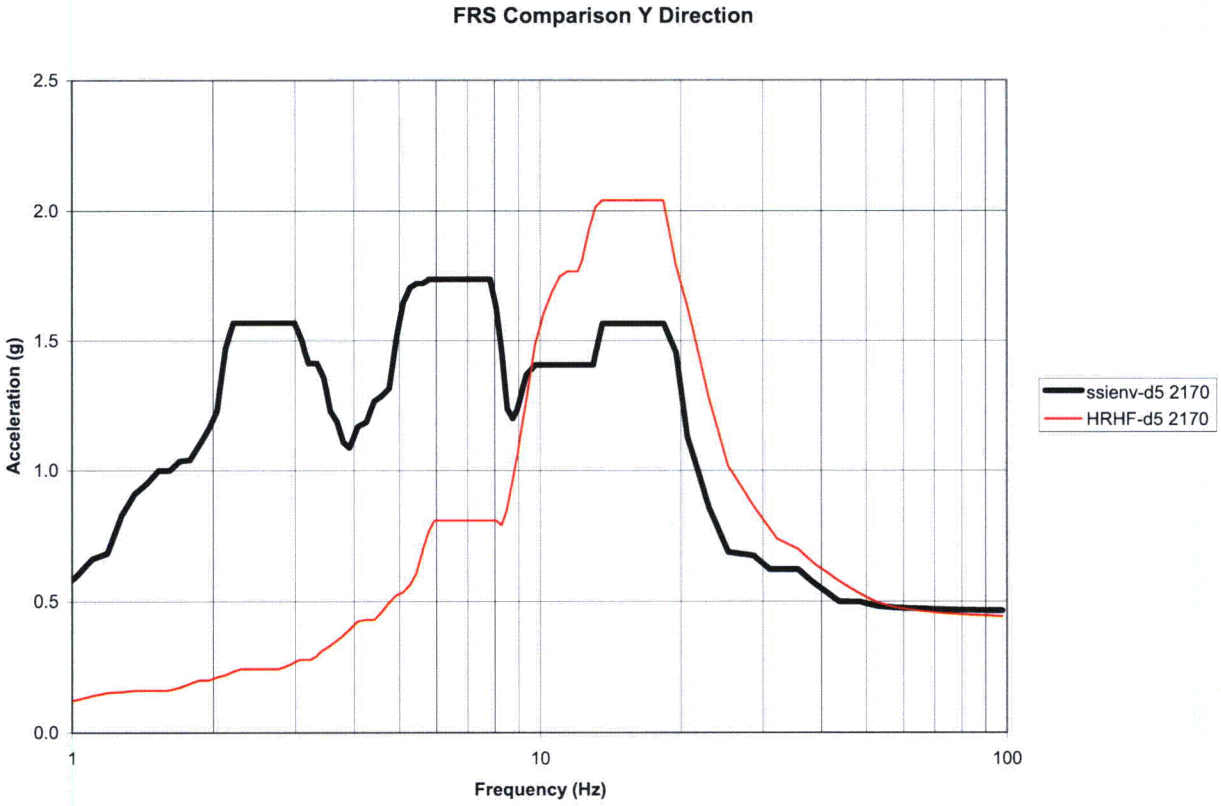
RAI-SRP3.7.1-SEB1-09-02 Eb: Containment Operating Floor (Elevation 134.25') East Side Y Direction



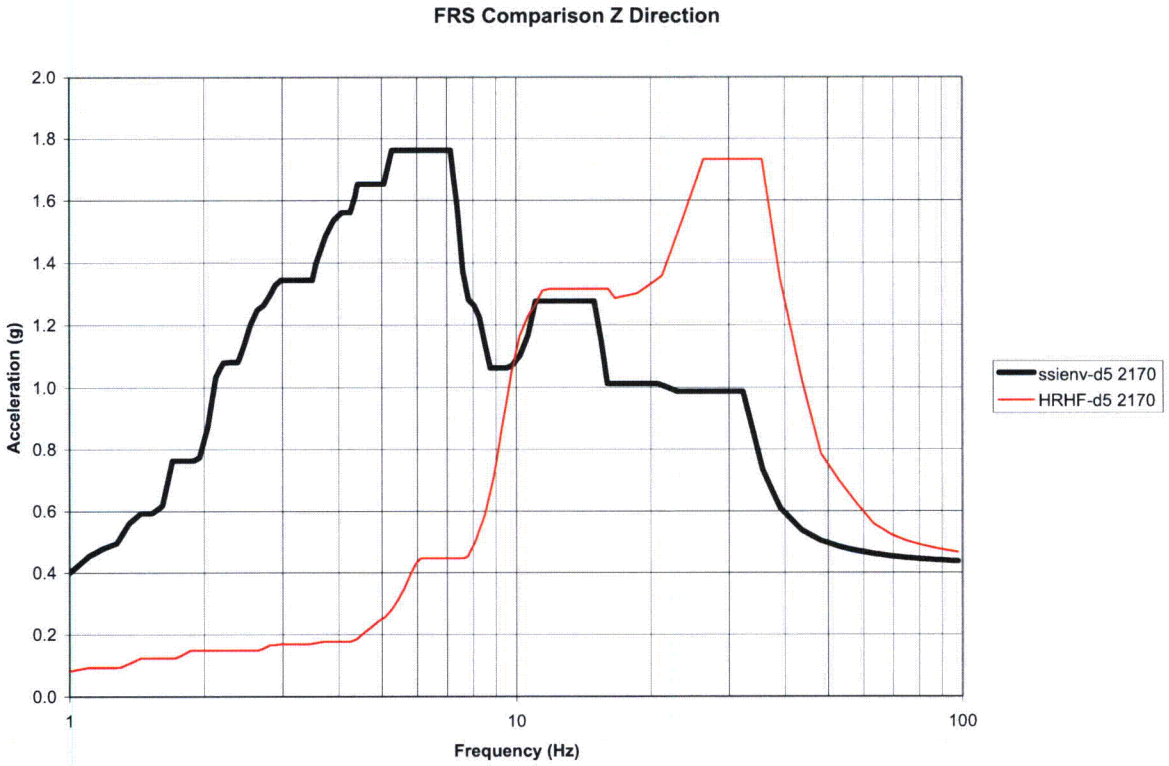
RAI-SRP3.7.1-SEB1-09-02 Ec: Containment Operating Floor (Elevation 134.25')
East Side Z Direction



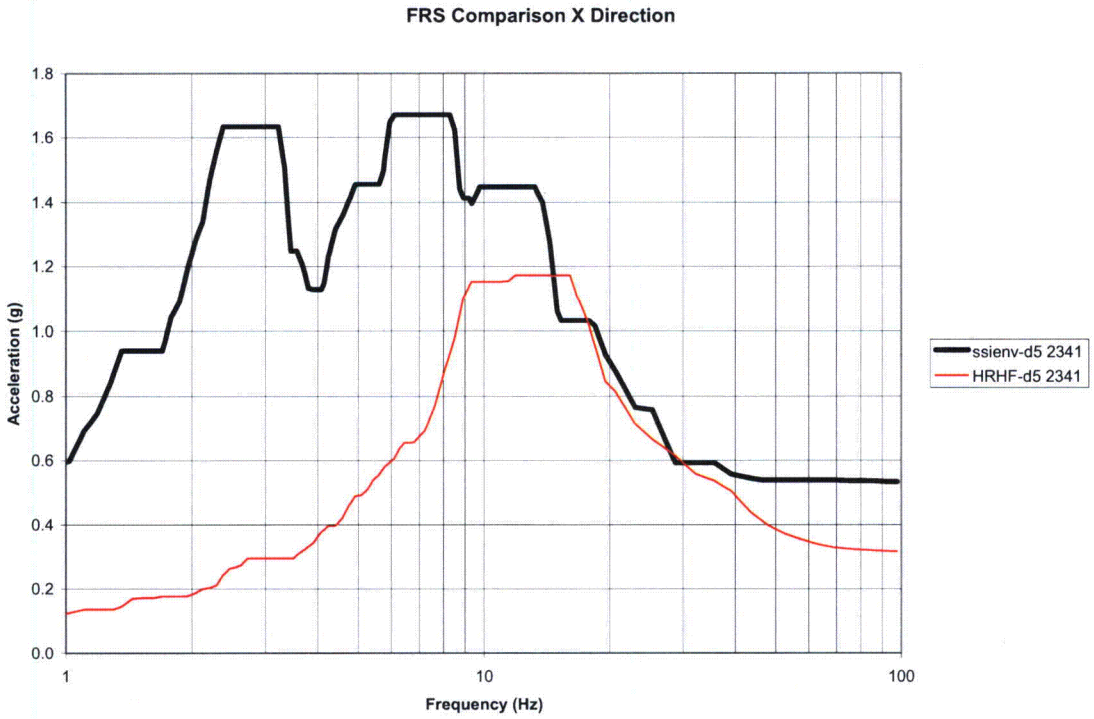
RAI-SRP3.7.1-SEB1-09-02 Wa: Containment Operating Floor (Elevation 134.25')
West Side X Direction



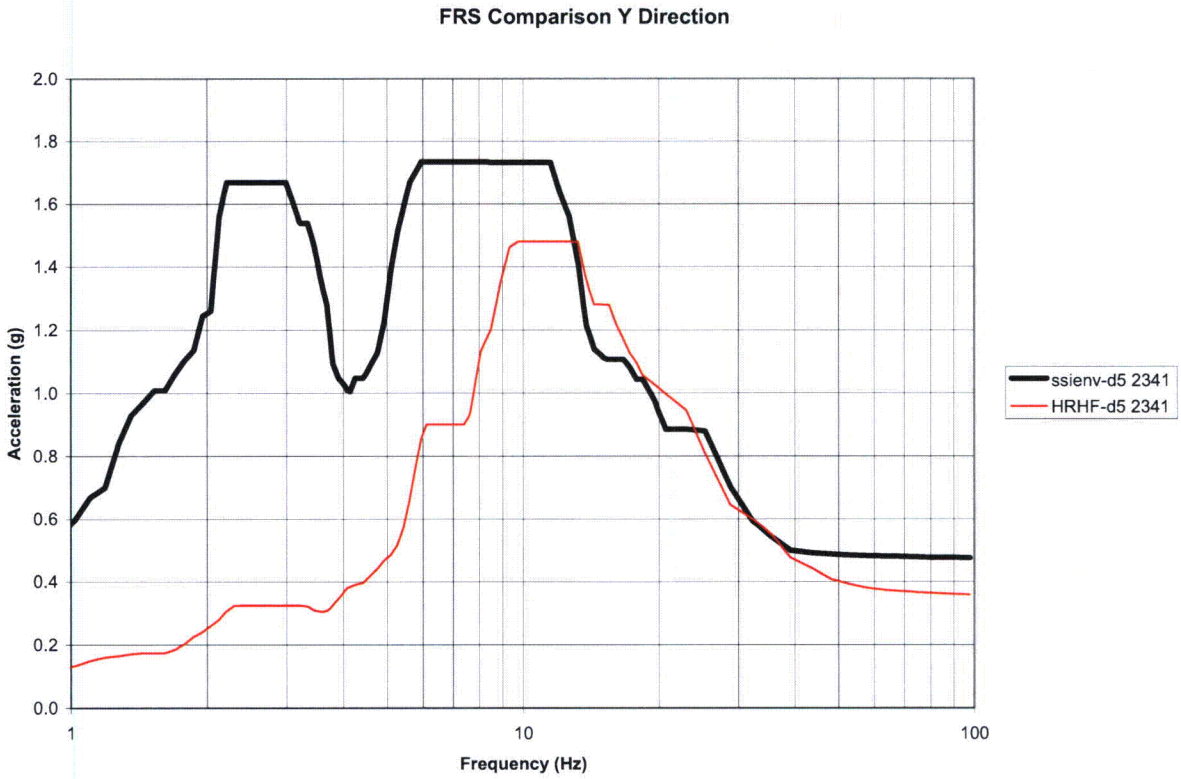
RAI-SRP3.7.1-SEB1-09-02 Wb: Containment Operating Floor (Elevation 134.25') West Side Y Direction



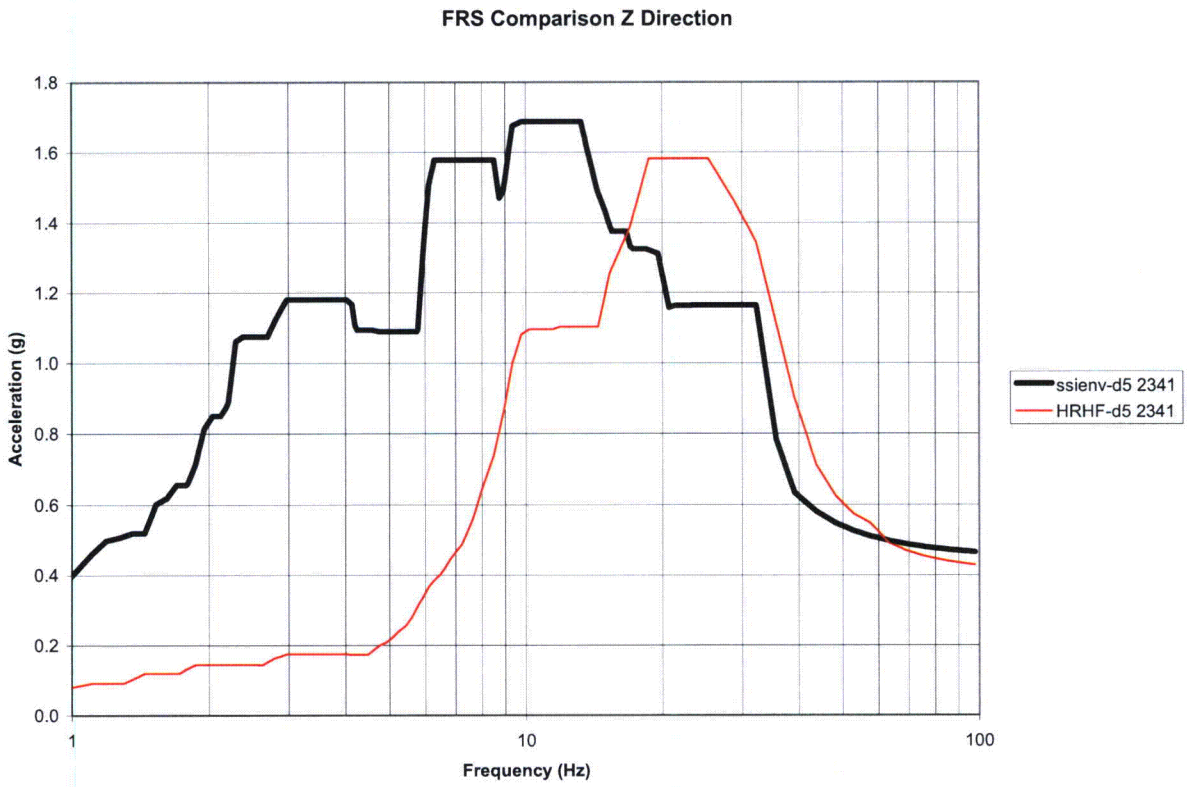
RAI-SRP3.7.1-SEB1-09-02 Wc: Containment Operating Floor (Elevation 134.25')
West Side Z Direction



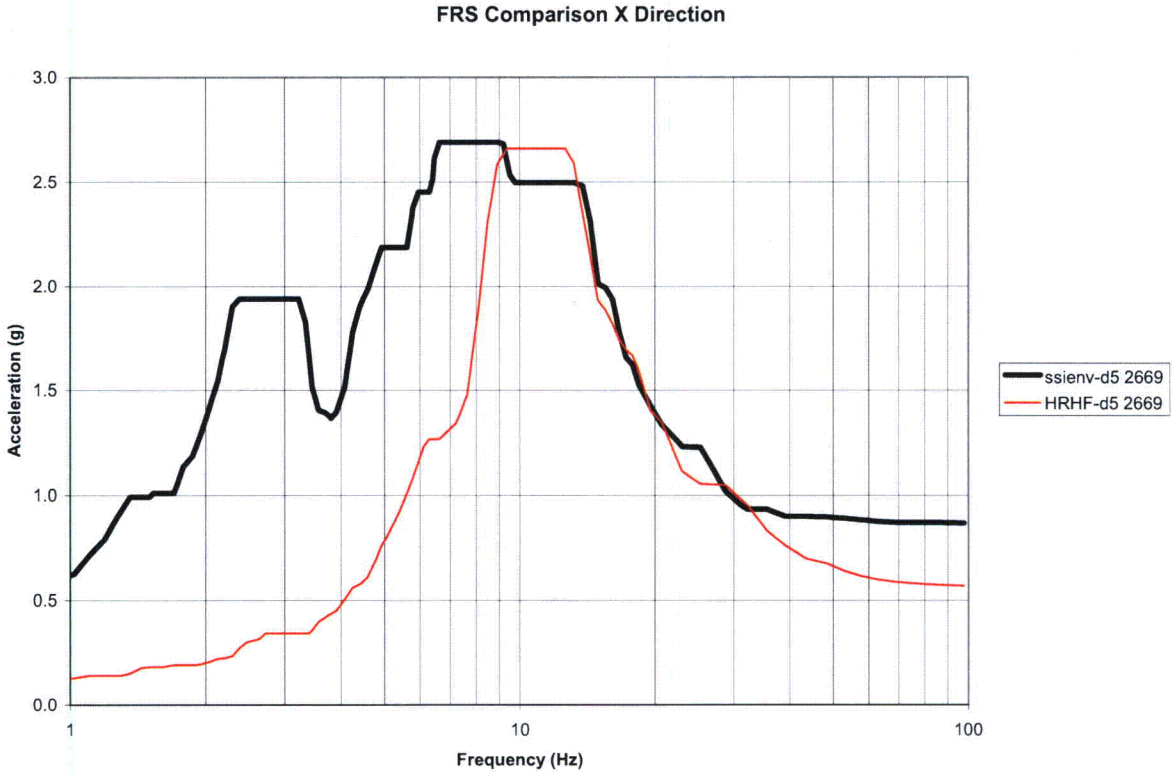
RAI-SRP3.7.1-SEB1-09-03a: ASB at Northeast Corner (Elevation 134.5') X Direction



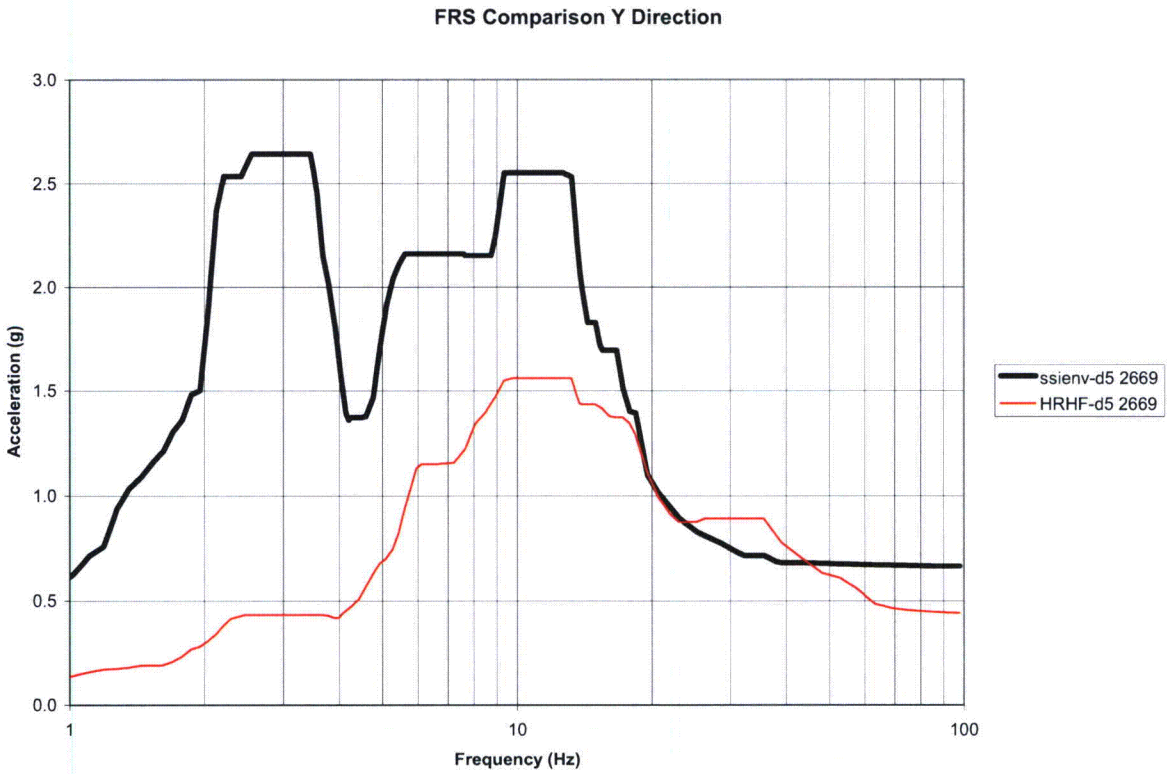
RAI-SRP3.7.1-SEB1-09-03b: ASB at Northeast Corner (Elevation 134.5') Y Direction



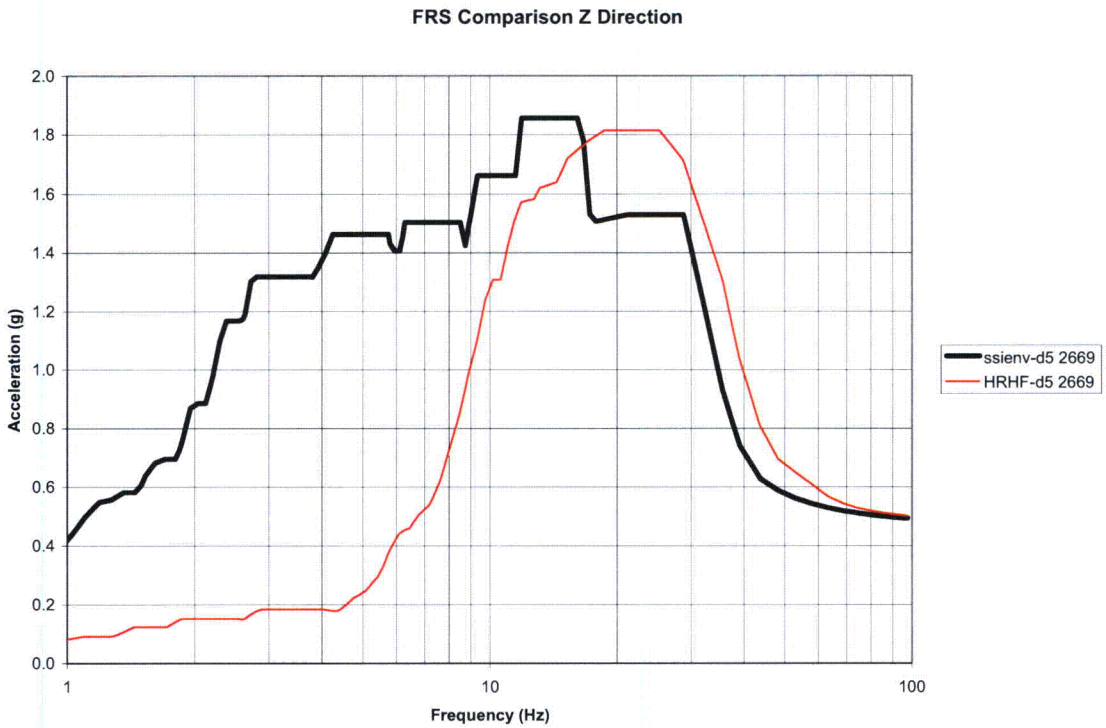
RAI-SRP3.7.1-SEB1-09-03c: ASB at Northeast Corner (Elevation 134.5') Z Direction



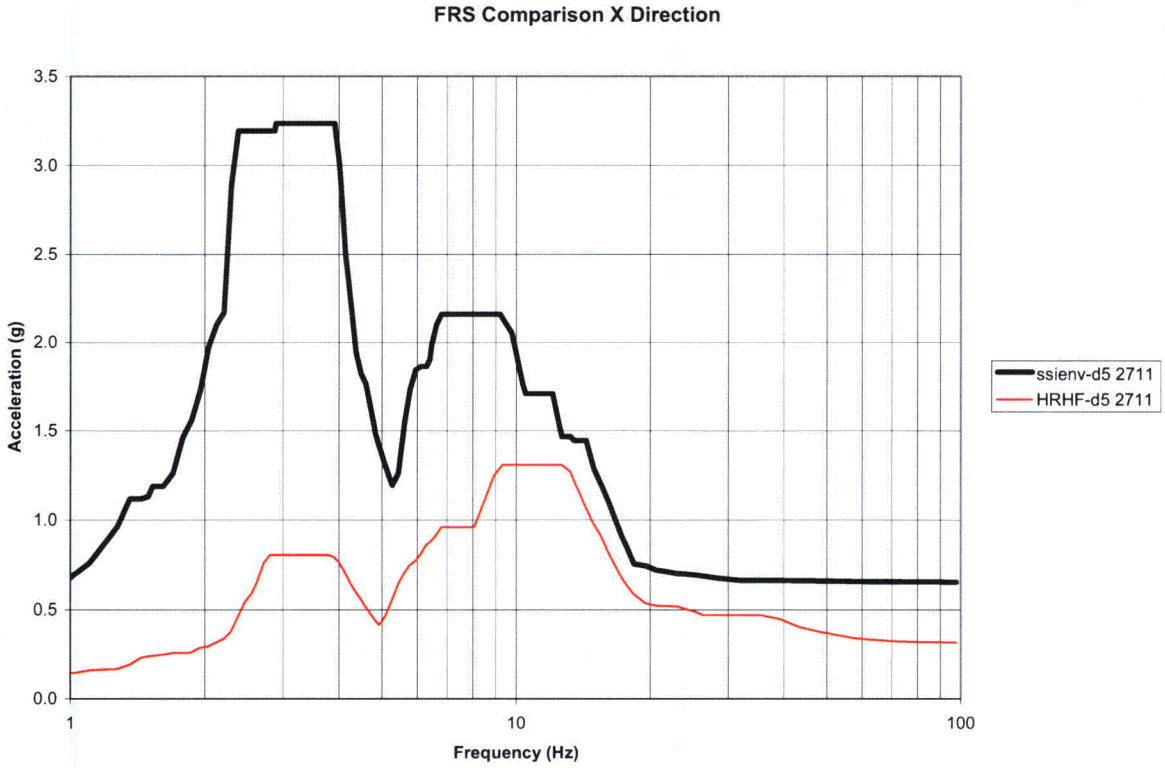
RAI-SRP3.7.1-SEB1-09-04a: ASB at Fuel Building Roof (Elevation 179.56') X Direction



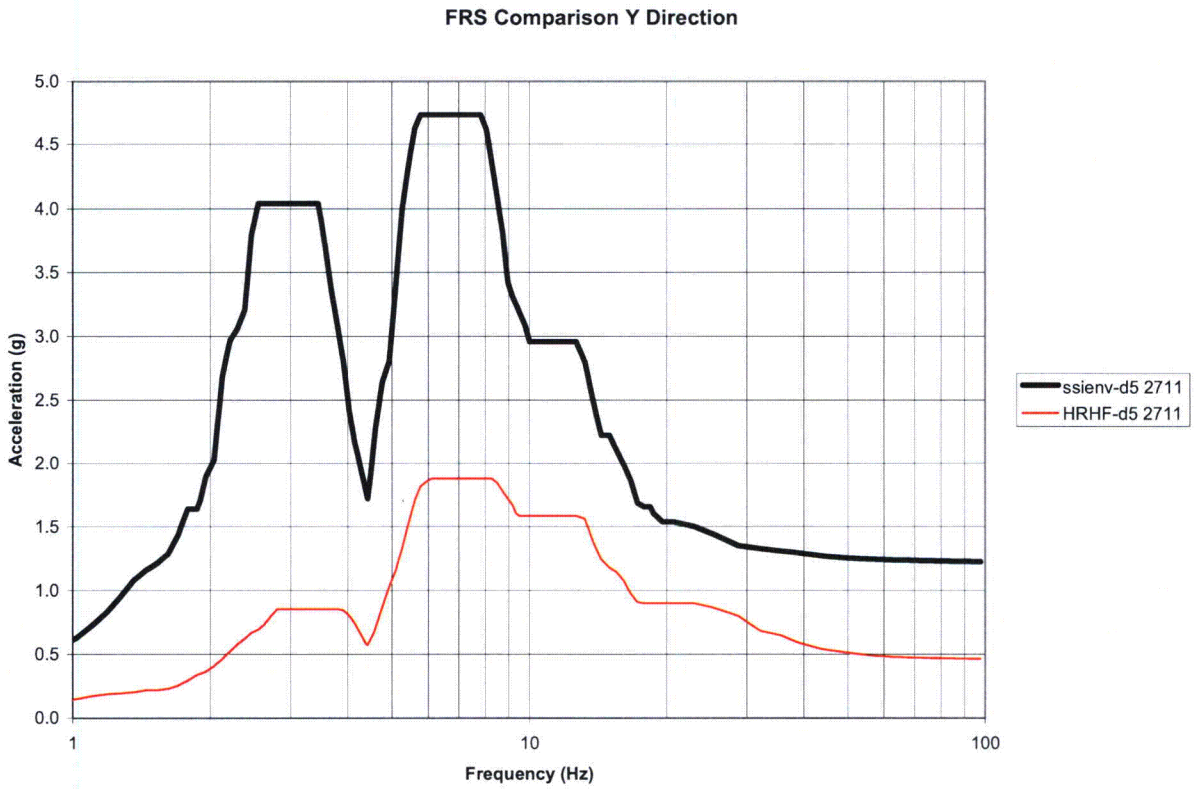
RAI-SRP3.7.1-SEB1-09-04b: ASB at Fuel Building Roof (Elevation 179.56') Y Direction



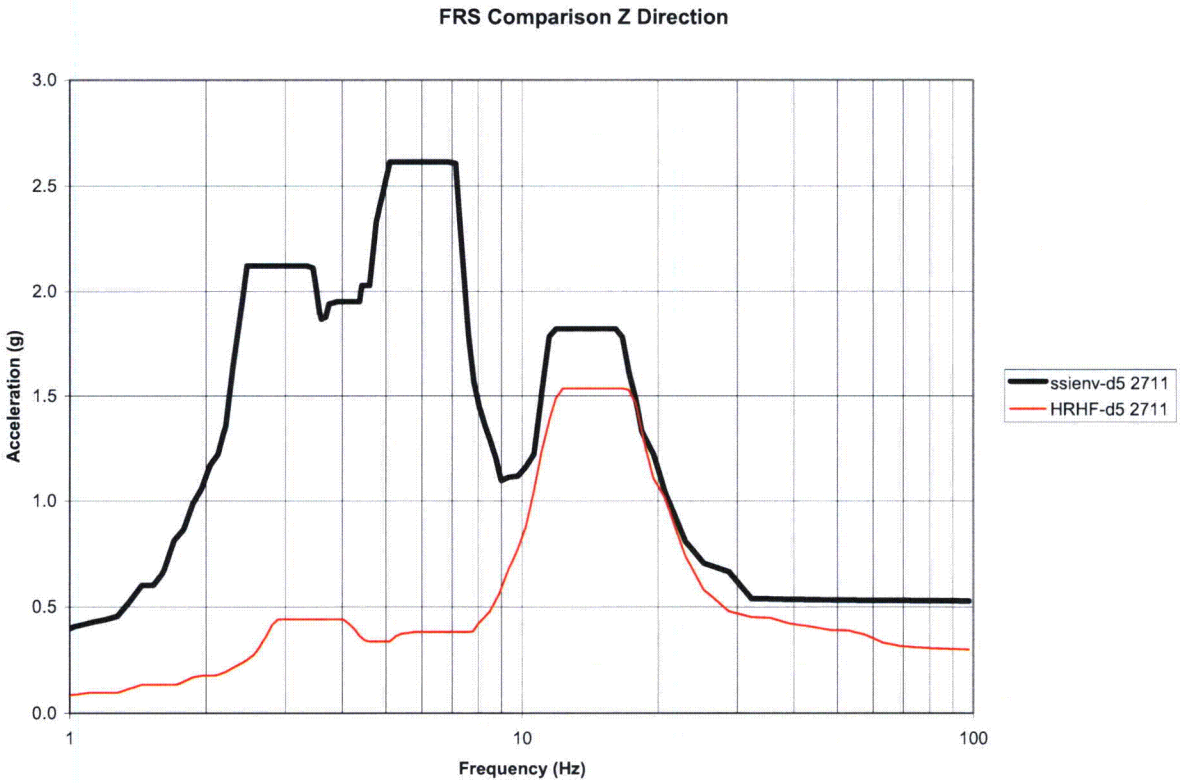
RAI-SRP3.7.1-SEB1-09-04c: ASB at Fuel Building Roof (Elevation 179.56') Z Direction



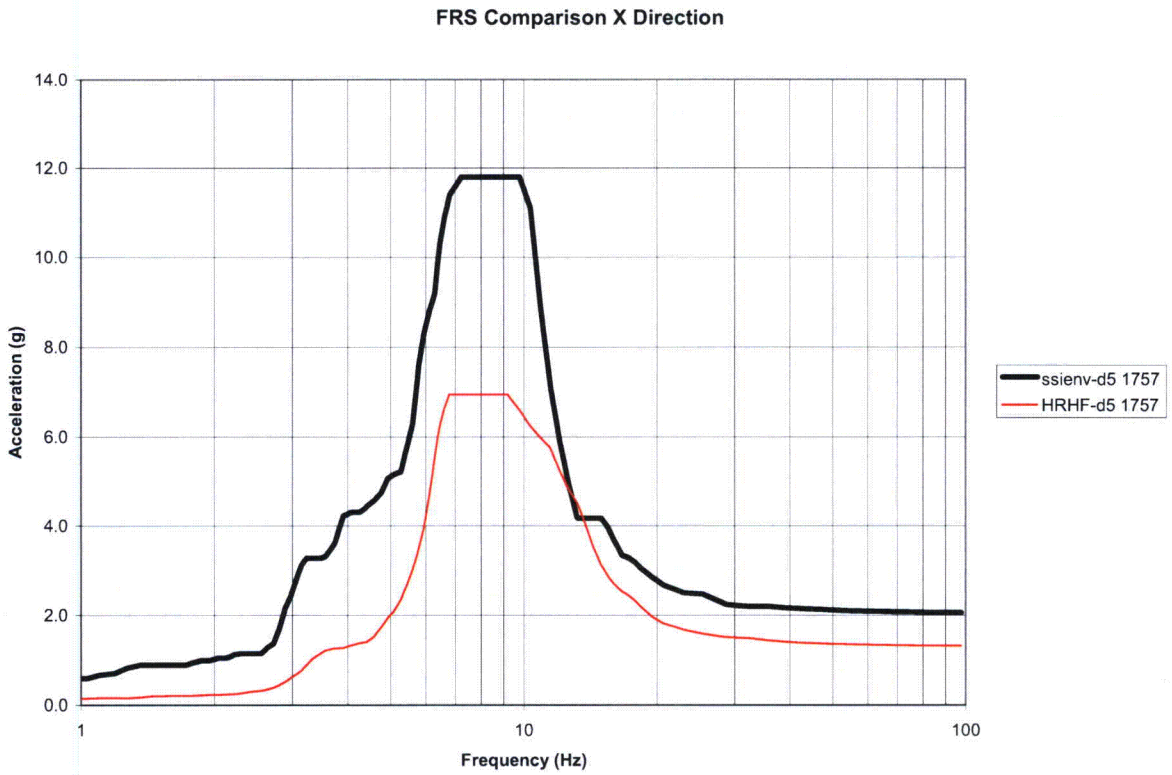
RAI-SRP3.7.1-SEB1-09-05a: ASB Shield Building (Elevation 180') X Direction



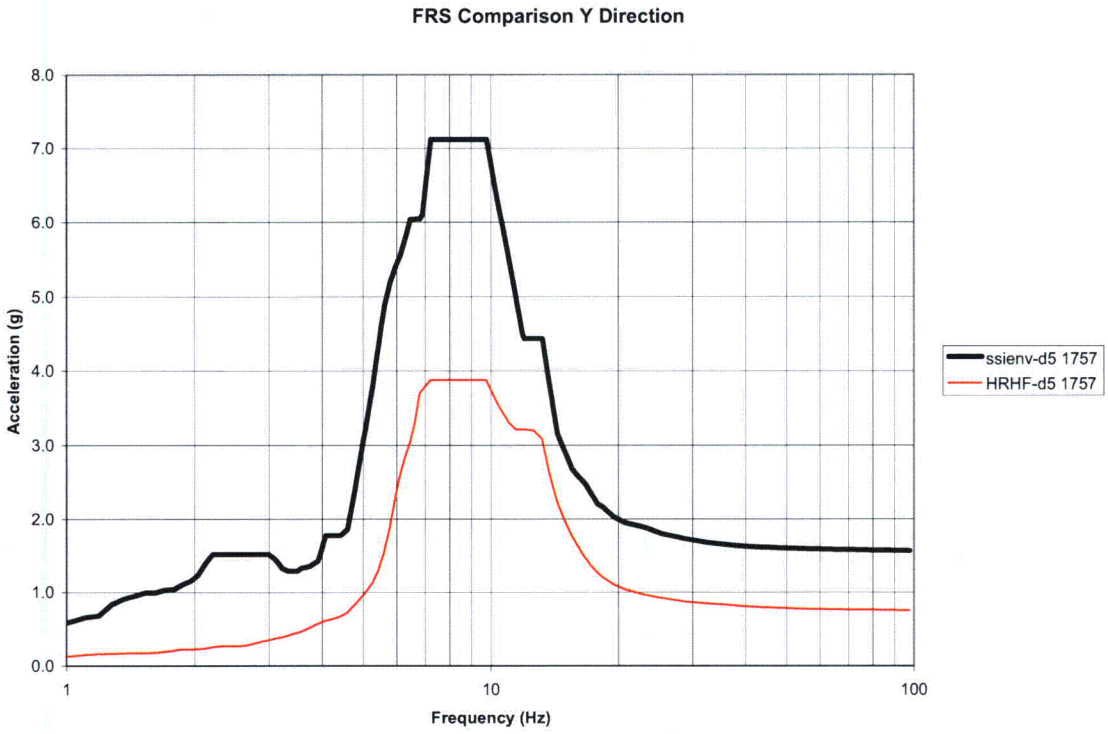
RAI-SRP3.7.1-SEB1-09-05b: ASB Shield Building (Elevation 180') Y Direction



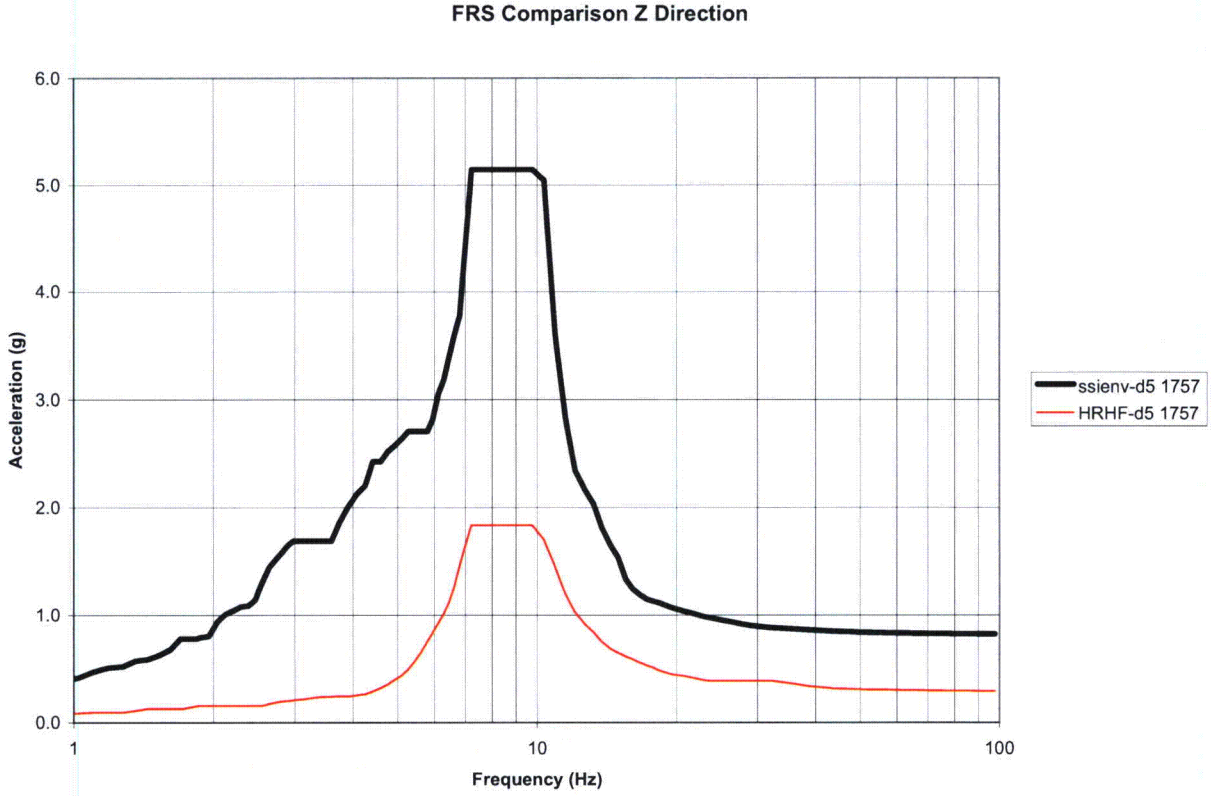
RAI-SRP3.7.1-SEB1-09-05c: ASB Shield Building (Elevation 180') Z Direction



RAI-SRP3.7.1-SEB1-09-06a: Reactor Coolant Pump X Direction



RAI-SRP3.7.1-SEB1-09-06b: Reactor Coolant Pump Y Direction



RAI-SRP3.7.1-SEB1-09-06c: Reactor Coolant Pump Z Direction

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-10
Revision: 0

Question:

The staff requests that Westinghouse augment Figures 5.2-1 through 5.2-6 in TR-115, by adding the HRHF broadened spectra from the NI20 fixed base analysis, without any reduction for incoherency or other considerations. This will provide the staff with results needed to conduct an evaluation of the effect of incoherency.

Westinghouse Response:

It Is noted that Westinghouse uses the NEI recommended coherency function that reduces high frequency ground motions by accounting for special seismic wave incoherency. The rock-based coherency function that is being used was developed by Dr. Norman A. Abrahamson. This function is consistent with the requirements of the "Common Understanding" developed by the NRC staff and industry representatives during the December 20-21, 2006 public meeting. Since Westinghouse is using the coherency function that is consistent with the "Common Understanding" between the NRC and industry, it is not considered necessary to provide this information. There is nothing unique in the Westinghouse application of the coherency function.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-11
Revision: 0

Question:

The staff requests that Westinghouse provide additional figures in Section 5.2 TR-115, to include all location/direction combinations presented in the Section 5.1 figures, and to provide a cross-reference between the corresponding 5.1 and 5.2 figures.

Westinghouse Response:

The figures provided in Section 5.1 are for comparison of NI10 and NI20 models. The time histories are different from that used in the HRHF evaluation documented in TR-115 as discussed in the Westinghouse response to RAI-SRP3.7.1-SEB01-07. No reduction for incoherency was considered. A representative group of HRHF floor response spectra were developed at locations considered susceptible to the high frequency response for comparison to the CSDRS floor response spectra. Some of these locations are the same or close to those given in Section 5.1. It would not be useful to add additional figures in Section 5.2 since the locations chosen are considered sufficient for comparison. A cross-reference between corresponding 5.1 and 5.2 figures cannot be given since different time histories are used.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-12
Revision: 0

Question:

The staff's understanding, from Westinghouse's initial presentation of the structural response comparisons in April 2007 at the Westinghouse offices, was that Westinghouse used the HRHFRS without considering reduction for incoherency. The staff specifically sought this clarification from Westinghouse at that time. TR-115 Section 6.1 does not specifically identify that the structures comparisons are based on use of the HRHFRS without considering reduction for incoherency. The staff requests that Westinghouse clearly define how it calculated the HRHFRS structural loads used in Tables 6.1-1 through 6.1-6.

Westinghouse Response:

The HRHF member forces that are provided in Tables 6.1-1 through 6.1-6 are based on incoherency. The incoherent member forces are averaged from 25 independent Monte Carlo runs done with SASSI and multiplied by the element thickness to form the member forces presented.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-13
Revision: 0

Question:

If the tabulated results in Tables 6.1-1 through 6.1-6 in TR-115 are based on use of the HRHFRS including reduction for incoherency, the staff requests that Westinghouse provide additional comparison results in these tables, based on use of the HRHFRS without considering reduction for incoherency, similar to the results presented in April 2007.

Westinghouse Response:

As requested, provided in Tables RAI-SRP3.7.1-SEB1-13-1 to RAI-SRP3.7.1-SEB1-13-01-6 is the requested comparison of HRHF coherent and incoherent comparisons. Note: Inconsistencies were identified in the HRHF incoherent results tabulated in TR115, refer to RAI-SRP3.7.1-SEB1-14.

Table RAI-SRP3.7.1-SEB1-13-1: Auxiliary Building Time History Member Force Comparison

	HRHF Coherent (kips/ft)			HRHF Incoherent (kips/ft)		
Element #	**TX**	**TY**	**TXY**	**TX**	**TY**	**TXY**
132	10.0	21.0	11.6	9.2	16.5	10.3
167	2.9	38.7	36.5	2.4	40.1	34.9
1342	9.9	44.3	21.2	27.0	50.2	32.0

Table RAI-SRP3.7.1-SEB1-13-2: Shield Building Time History Member Force Comparison

	HRHF Coherent (kips/ft)			HRHF Incoherent (kips/ft)		
Element #	**TX**	**TY**	**TXY**	**TX**	**TY**	**TXY**
585	8.0	59.4	59.9	8.2	53.2	46.1
597	23.0	84.6	62.7	23.7	69.8	49.4
602	23.0	137.6	55.5	18.5	120.4	59.1
1602	12.8	92.0	24.3	13.1	75.6	23.0

Table RAI-SRP3.7.1-SEB1-13-3: Shield Building Time History Member Force Comparison

	HRHF Coherent (kips/ft)			HRHF Incoherent (kips/ft)		
Element #	**TX**	**TY**	**TXY**	**TX**	**TY**	**TXY**
2951	19.1	56.1	43.2	14.9	49.9	43.8
2975	17.5	62.7	43.6	13.2	45.9	49.2
2982	24.2	64.5	49.9	18.4	55.8	45.3
3005	22.0	64.7	33.8	14.6	49.9	33.4

Table RAI-SRP3.7.1-SEB1-13-4: Refueling Wall Time History Member Force Comparison

	HRHF Coherent (kips/ft)			HRHF Incoherent (kips/ft)		
Element #	**TX**	**TY**	**TXY**	**TX**	**TY**	**TXY**
845	5.4	10.8	25.6	4.5	7.5	19.4
846	5.1	6.8	16.6	4.2	4.9	14.4
851	8.4	15.2	33.7	7.7	10.2	23.6
852	5.2	21.8	28.0	4.1	14.4	20.4
861	12.0	39.1	36.2	11.5	27.8	26.5
862	11.1	17.8	34.6	10.9	12.7	24.2

Table RAI-SRP3.7.1-SEB1-13-5: SW Steam Generator Wall Time History Member Force Comparison

	HRHF Coherent (kips/ft)			HRHF Incoherent (kips/ft)		
Element #	**TX**	**TY**	**TXY**	**TX**	**TY**	**TXY**
819	4.8	38.3	25.2	3.9	30.8	18.8
820	6.9	12.9	32.6	6.0	9.8	25.0
821	14.1	15.3	20.5	12.0	11.2	17.1
822	20.7	61.8	33.3	15.2	50.0	22.8
3193-3195	20.2	32.4	17.8	14.9	27.3	13.9
3196-3198	9.3	18.5	19.1	7.3	14.5	16.7
3201-3203	12.3	25.4	18.2	11.4	23.7	16.1
3204-3206	27.1	25.0	19.6	21.7	19.7	15.0

Table RAI-SRP3.7.1-SEB1-13-6: CA02 Wall Building Time History Member Force Comparison

	HRHF Coherent (kips/ft)			HRHF Incoherent (kips/ft)		
Element #	**TX**	**TY**	**TXY**	**TX**	**TY**	**TXY**
826	6.3	31.6	18.1	4.9	24.1	14.6
827	4.3	12.4	10.6	3.1	7.4	8.4
828	13.2	52.9	26.1	10.8	45.8	23.4
829	9.0	7.2	21.9	6.4	6.3	17.3
830	9.8	22.0	28.8	8.4	18.0	23.2
831	10.9	26.0	27.3	10.0	19.1	24.2
832	11.9	26.6	31.3	10.2	16.8	24.4
833	9.0	19.9	29.9	8.4	13.6	25.2
834	9.6	19.8	29.8	9.5	14.1	25.9

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

None

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-14
Revision: 0

Question:

The staff's preliminary review of Tables 6.1-1 through 6.1-6 in TR-115 indicates several erratic patterns of differences between the CSDRS results and the HRHFRS results. While these may be the result of enveloping many different analyses to arrive at the CSDRS, they may also be indicative of analysis errors or improper data reduction (e.g., comparing 2 different locations). The staff requests that Westinghouse review the tabulated results in Tables 6.1-1 through 6.1-6, and provide a technical explanation for each pattern of differences that Westinghouse determines to be in need of further review.

Westinghouse Response:

Westinghouse has reviewed the tabulated results in Tables 6.1-1 through 6.1-6 and concluded that there were inconsistencies in the tabulated results. These inconsistencies are corrected and the revised tables are shown below and will be in the next revision to TR-115. The conclusions in Section 6.1 remain unchanged. See Technical Report (TR) Revision section for the revised tables. An Issue Report has been opened related to the inconsistencies found in the Westinghouse Correction Action Process (CAP).

It is still noted that any differences in the pattern between the CSDRS and the HRHF results in the revised table are due to:

- As mentioned in the question, part of the difference is due to enveloping many different analyses to arrive at the CSDRS results. The maximum element force for each TX, TY, and TXY component can be from the hard rock case or a different soil case.

- High frequency content in the HRHF seismic response can excite different modes than the CSDRS time histories. This will change the localized pattern of the forces.

- The locations that are compared can be influenced differently by the HRHF and CSDRS seismic input. For example, the forces within walls on different sides of the ASB, or the ASB roof can portray different patterns when comparing between two areas.

Design Control Document (DCD) Revision:

None

PRA Revision:

None

Technical Report (TR) Revision:

Tables 6.1-1 to 6.1-6 are revised as shown below.

Table 6.1-1: Auxiliary Building Time History Member Force Comparison

	HRHF (kips/ft)			CSDRS (kips/ft)		
Element #	TX	TY	TXY	TX	TY	TXY
132	9.2	16.5	10.3	18.8	35.8	26.7
167	2.4	40.1	34.9	4.0	151.4	136.6
1342	27.0	50.2	32.0	68.5	149.6	59.9

Table 6.1-2: Shield Building Time History Member Force Comparison

	HRHF (kips/ft)			CSDRS (kips/ft)		
Element #	TX	TY	TXY	TX	TY	TXY
585	8.2	53.2	46.1	20.9	163.2	136.0
597	23.7	69.8	49.4	63.2	254.1	131.1
602	18.5	120.4	59.1	62.9	448.6	221.3
1602	13.1	75.6	23.0	43.8	281.0	53.2

Table 6.1-3: Shield Building Time History Member Force Comparison

	HRHF (kips/ft)			CSDRS (kips/ft)		
Element #	TX	TY	TXY	TX	TY	TXY
2951	14.9	49.9	43.8	36.8	196.8	150.2
2975	13.2	45.9	49.2	38.4	157.3	157.4
2982	18.4	55.8	45.3	70.5	222.3	157.4
3005	14.6	49.9	33.4	65.5	164.2	115.6

Table 6.1-4: Refueling Wall Time History Member Force Comparison

	HRHF (kips/ft)			CSDRS (kips/ft)		
Element #	TX	TY	TXY	TX	TY	TXY
845	4.5	7.5	19.4	13.4	24.1	44.2
846	4.2	4.9	14.4	17.3	16.1	31.1
851	7.7	10.2	23.6	14.8	23.4	47.0
852	4.1	14.4	20.4	14.7	25.3	38.8
861	11.5	27.8	26.5	28.0	48.6	46.0
862	10.9	12.7	24.2	25.5	33.1	61.1

Table 6.1-5: SW Steam Generator Wall Time History Member Force Comparison

	HRHF (kips/ft)			CSDRS (kips/ft)		
Element #	TX	TY	TXY	TX	TY	TXY
819	3.9	30.8	18.8	15.2	52.9	30.1
820	6.0	9.8	25.0	14.5	12.0	40.3
821	12.0	11.2	17.1	31.1	29.7	40.4
822	15.2	50.0	22.8	34.9	83.9	38.0
3193-3195	14.9	27.3	13.9	34.2	49.2	32.9
3196-3198	7.3	14.5	16.7	83.4	48.5	37.4
3201-3203	11.4	23.7	16.1	58.3	45.8	32.2
3204-3206	21.7	19.7	15.0	32.8	33.8	44.7

Table 6.1-6: CA02 Wall Building Time History Member Force Comparison

	HRHF (kips/ft)			CSDRS (kips/ft)		
Element #	TX	TY	TXY	TX	TY	TXY
826	4.9	24.1	14.6	32.5	49.4	22.9
827	3.1	7.4	8.4	32.0	17.8	22.4
828	10.8	45.8	23.4	29.5	58.9	33.7
829	6.4	6.3	17.3	20.4	17.1	28.2
830	8.4	18.0	23.2	38.0	39.9	38.4
831	10.0	19.1	24.2	24.3	35.2	50.7
832	10.2	16.8	24.4	28.5	19.6	37.6
833	8.4	13.6	25.2	30.7	21.6	41.6
834	9.5	14.1	25.9	16.8	21.4	60.7