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U.S. Nuclear Regulatory Commission  
ATTENTION: Document Control Desk  
Washington, D.C. 20555

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Your ref: Docket No. 52-006  
Our ref: DCP\_NRC\_002531

June 12, 2009

Subject: AP1000 Response to Request for Additional Information (SRP 3)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 3. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI-SRP3.7.1-SEB1-10 R2

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,

A handwritten signature in black ink, appearing to read "R. Sisk" followed by a flourish and the initials "FOR".

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

/Enclosure

1. Response to Request for Additional Information on SRP Section 3

cc:	D. Jaffe	- U.S. NRC	1E
	E. McKenna	- U.S. NRC	1E
	B. Gleaves	- U.S. NRC	1E
	T. Spink	- TVA	1E
	P. Hastings	- Duke Power	1E
	R. Kitchen	- Progress Energy	1E
	A. Monroe	- SCANA	1E
	P. Jacobs	- Florida Power & Light	1E
	C. Pierce	- Southern Company	1E
	E. Schmiech	- Westinghouse	1E
	G. Zinke	- NuStart/Entergy	1E
	R. Grumbir	- NuStart	1E
	D. Lindgren	- Westinghouse	1E

ENCLOSURE 1

Response to Request for Additional Information on SRP Section 3

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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

Revision: 2

### **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.

### **Additional Request by NRC Audit during April 13<sup>th</sup> to 17th (Revision 2):**

Perform additional calculations using EPRI model and rectangular foundation and AP1000 on hard rock foundation.

### **Westinghouse Response (Revision 0 and 1):**

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.

In response to the question raised by the NRC during May 19-23, 2008, Westinghouse has provided the response spectra for the HRHF broadened NI20 model with coherent and incoherent considerations in Figure RAI-SRP3.7.1-SEB1-10-1 to RAI-SRP3.7.1-SEB1-10-21 (5% damping).

### **Westinghouse Response (Revision 2):**

In Figures RAI-SRP3.7.1-SEB1-10-1 to RAI-SRP3.7.1-SEB1-10-21 some of the reductions ratios (defined as Incoherent response / coherent response) are shown to be less than 0.5 in some cases. Analyses have been performed using the EPRI model to provide the staff with additional results needed to conduct an evaluation of the effect of incoherency. The results show that the size and shape of the basemat has a significant effect on the reductions obtained from incoherence.



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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The following three cases using the EPRI Stick model have been analyzed:

1. EPRI AP1000 stick model with EPRI soil profile (Shear wave velocity,  $V_s$ , from 3300 fps to 8500 fps at depth of 130 ft) and EPRI input time history.
2. EPRI AP1000 stick model with EPRI soil profile and HRHF input time history.
3. EPRI AP1000 stick model (basemat size 158' by 254') with HRHF soil profile (Average  $V_s=8000$  fps below grade) and HRHF input time history.

Four Locations are selected for comparison:

- A. Nuclear Island foundation at elevation 60.5' (Node 1).
- B. Top of Containment Internal Structure Mass Center at elevation 169' (Node 129).
- C. Top of Steel Containment Vessel at elevation 281.9' (Node 45).
- D. Top of Shield Building at elevation 333.3' (node 18).

The 5% damping floor response spectra of four nodes and the reduction factors (Coh/Incoh) are shown in Figures RAI-SRP3.7.1-SEB1-10-22 to RAI-SRP3.7.1-SEB1-10-33. The Nuclear Island foundation results at elevation 60.5' (Node 1) show that the larger foundation will have larger reduction in response due to incoherency effects. The results for Top of Containment Internal Structure Mass Center at elevation 169' (Node 129), show reductions of the magnitude seen in the NI20 results. The top of the steel containment vessel and the top of the shield building also show similar results.

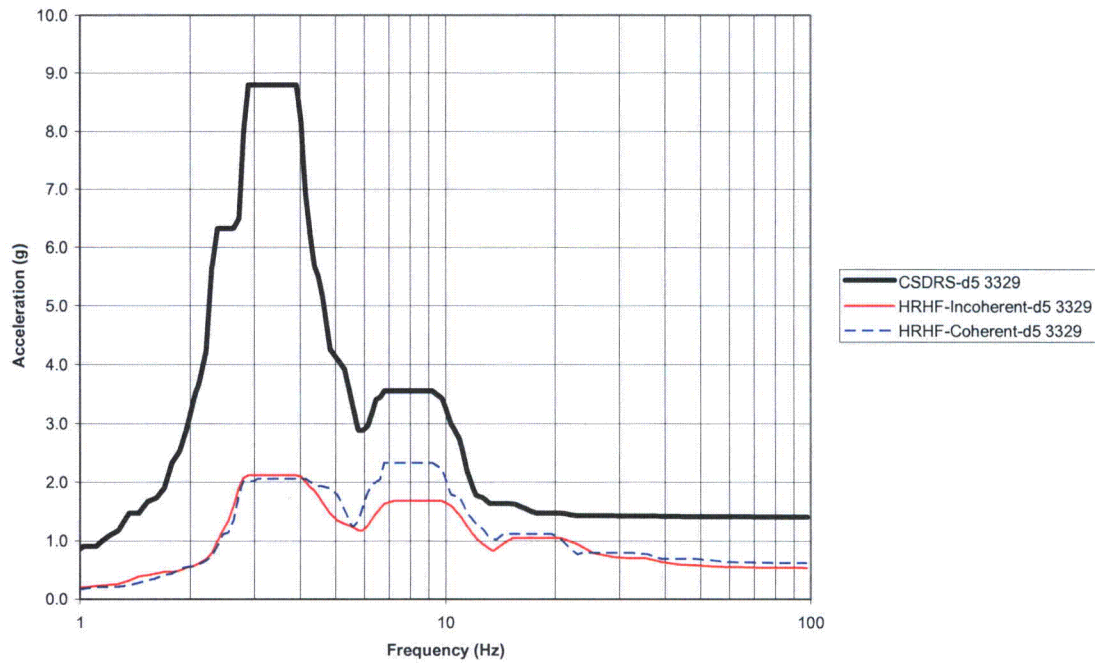
Finally, Figures RAI-SRP3.7.1-SEB1-10-34 to RAI-SRP3.7.1-SEB1-10-36 show a comparison of basemat response at the center (node 1 and 1153) and edges (node 230 and 1047) of the basemat of the EPRI and NI20 models. As can be seen the reductions are similar.

Thus, in conclusion the NI20 achieves similar reductions as the EPRI model for the same size foundation. The good comparisons show that the validated EPRI incoherent SSI methodology (Abrahamson, 2007 Hard-Rock Coherency Functions, Reference 1) was implemented correctly to the NI20 model ACS SASSI analyses.

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison X Direction

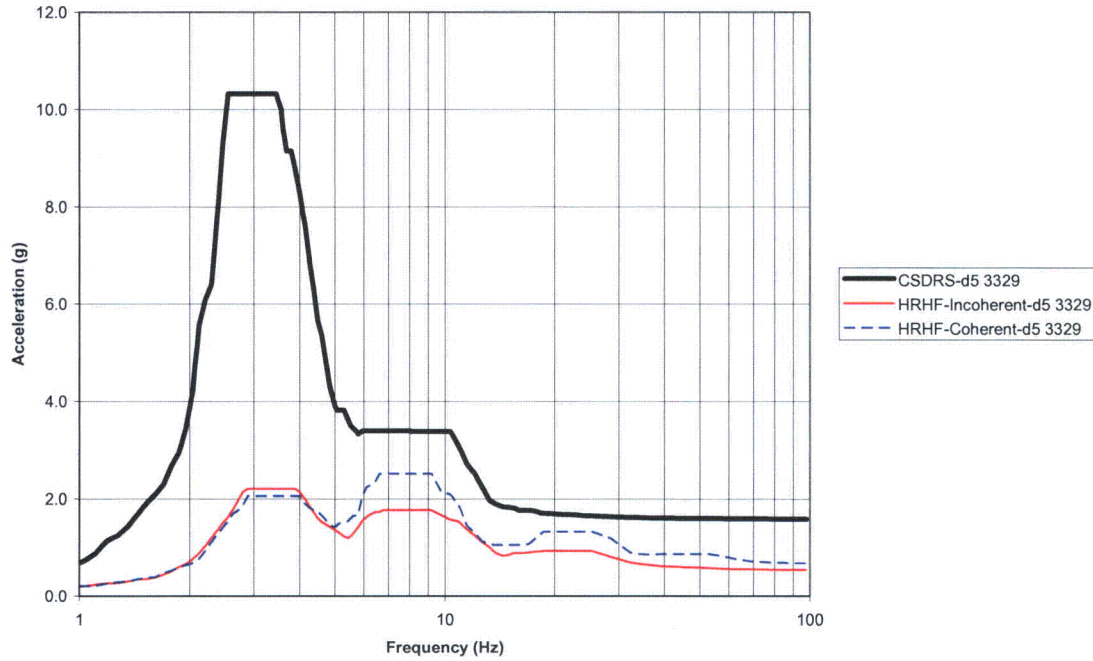


RAI-SRP3.7.1-SEB1-10-1: ASB at Elevation 327.4' X-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Y Direction

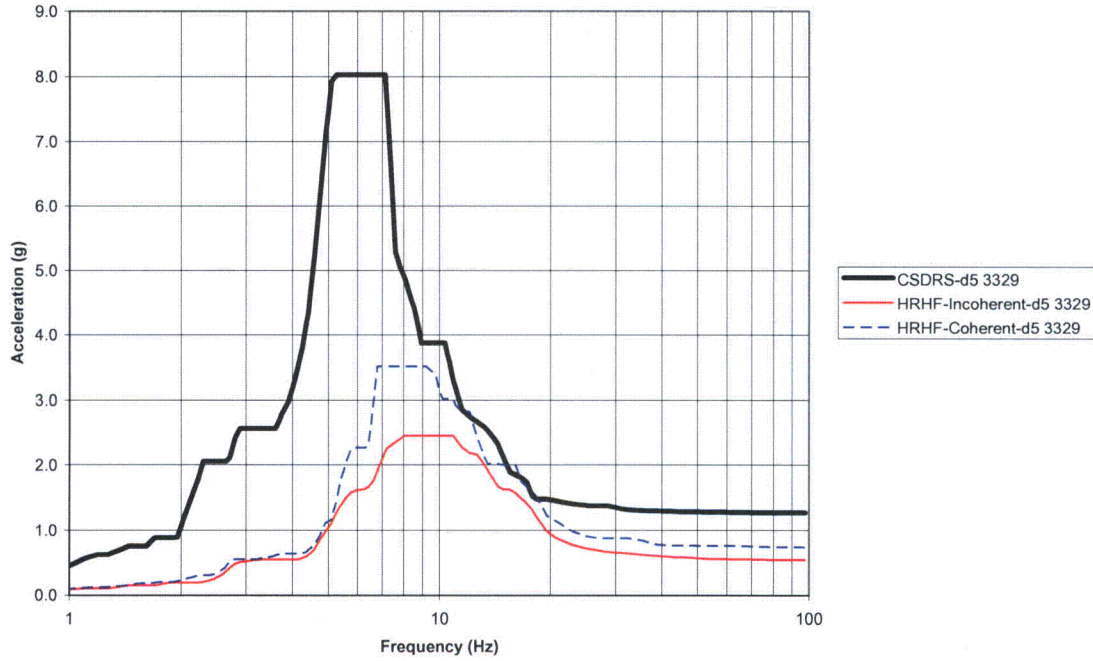


RAI-SRP3.7.1-SEB1-10-2: ASB at Elevation 327.4' Y-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Z Direction

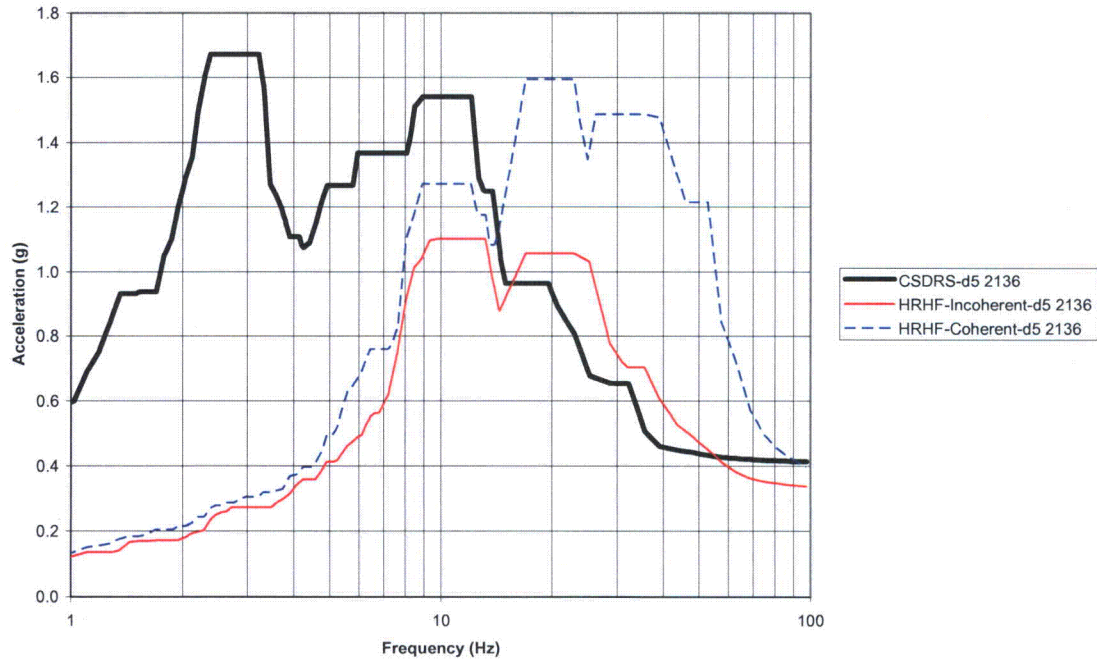


RAI-SRP3.7.1-SEB1-10-3: ASB at Elevation 327.4' Z-Directions

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison X Direction

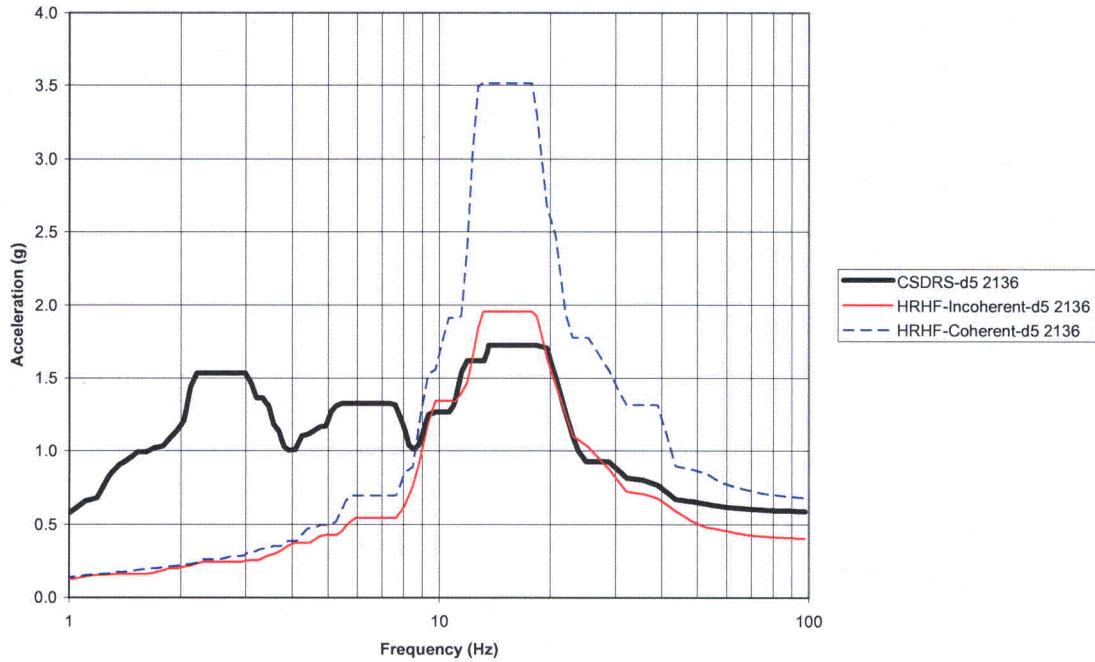


RAI-SRP3.7.1-SEB1-10-4: East Side Containment Operating Floor (Elevation 134.25') X-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Y Direction



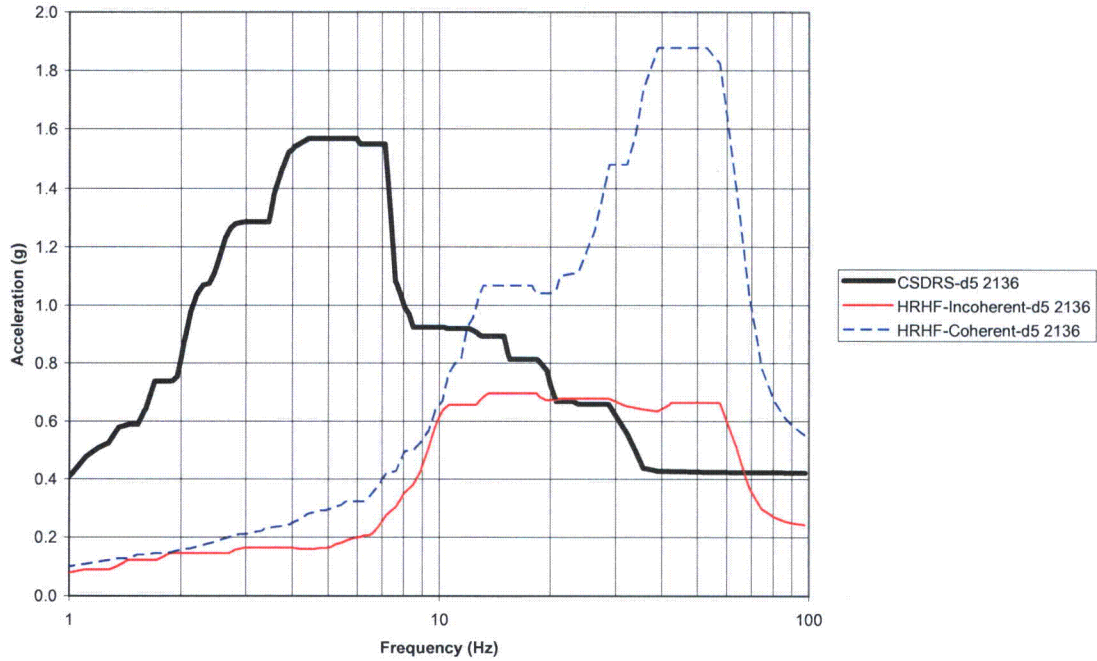
RAI-SRP3.7.1-SEB1-10-5: East Side Containment Operating Floor (Elevation 134.25') Y-Direction



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Z Direction

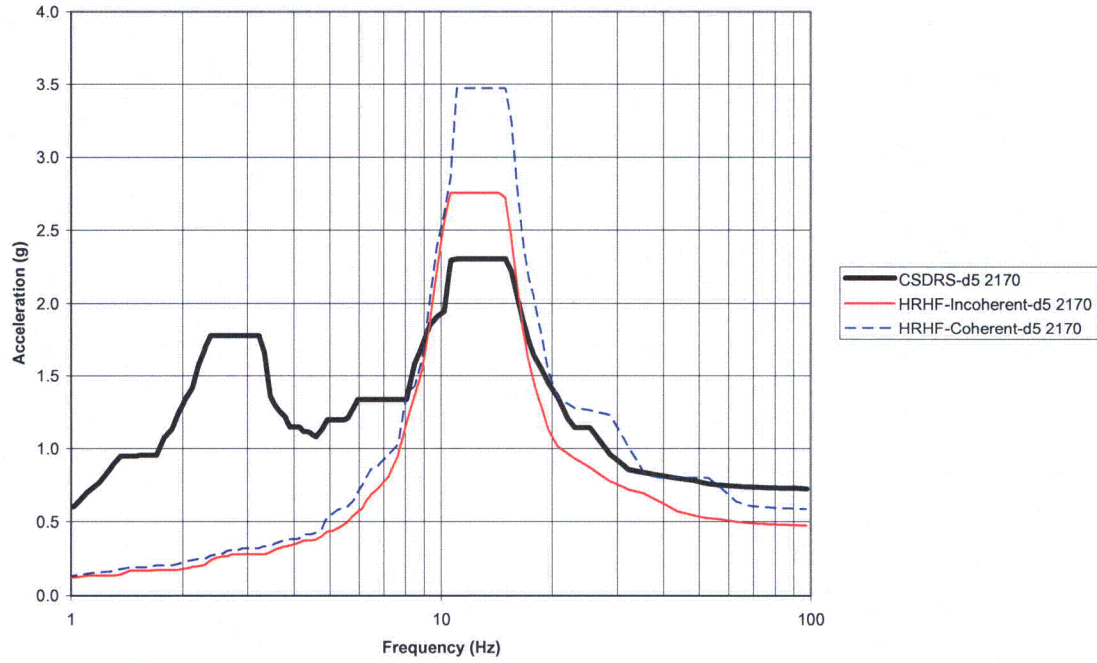


RAI-SRP3.7.1-SEB1-10-6: East Side Containment Operating Floor (Elevation 134.25') Z-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison X Direction



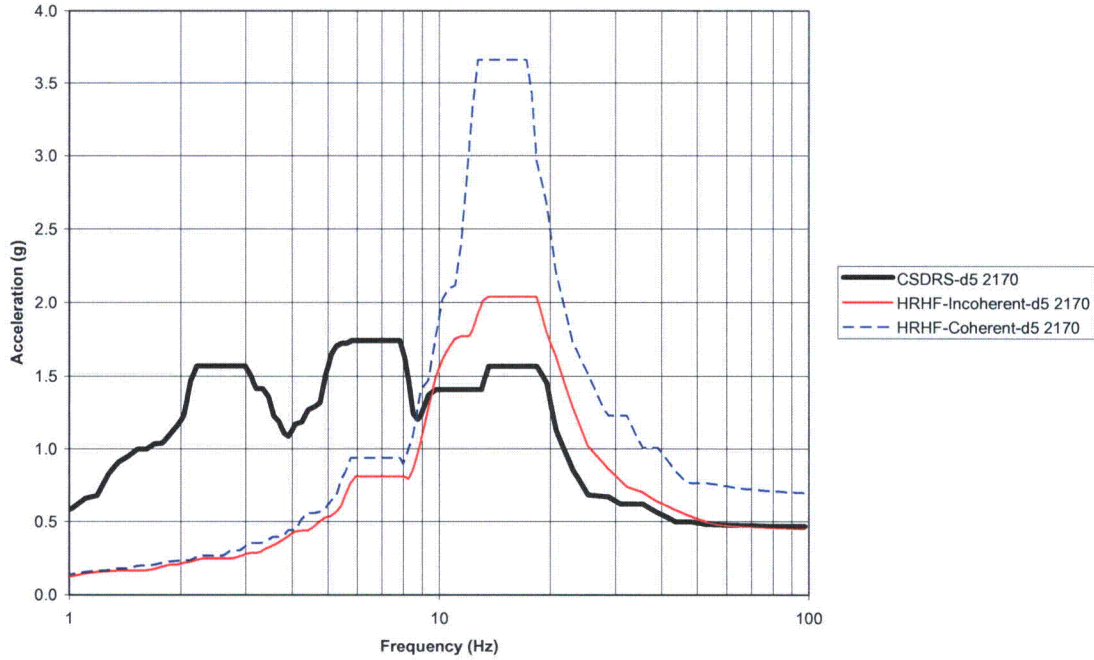
RAI-SRP3.7.1-SEB1-10-7: West Side Containment Operating Floor (Elevation 134.25') X-Direction



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Y Direction

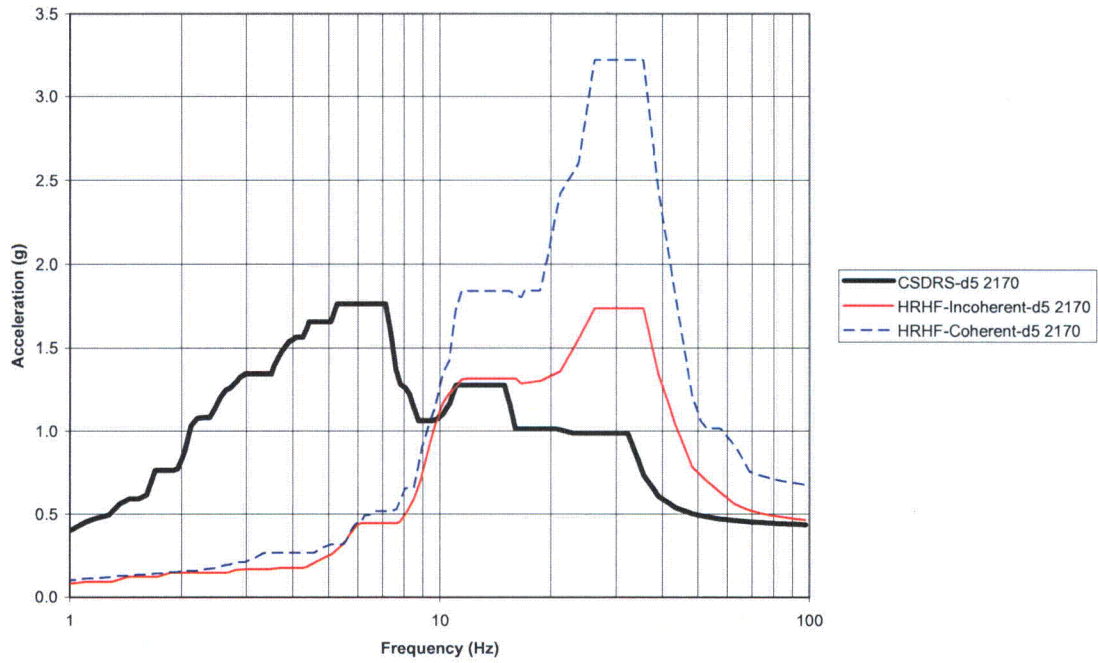


RAI-SRP3.7.1-SEB1-10-8: West Side Containment Operating Floor (Elevation 134.25') Y-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Z Direction

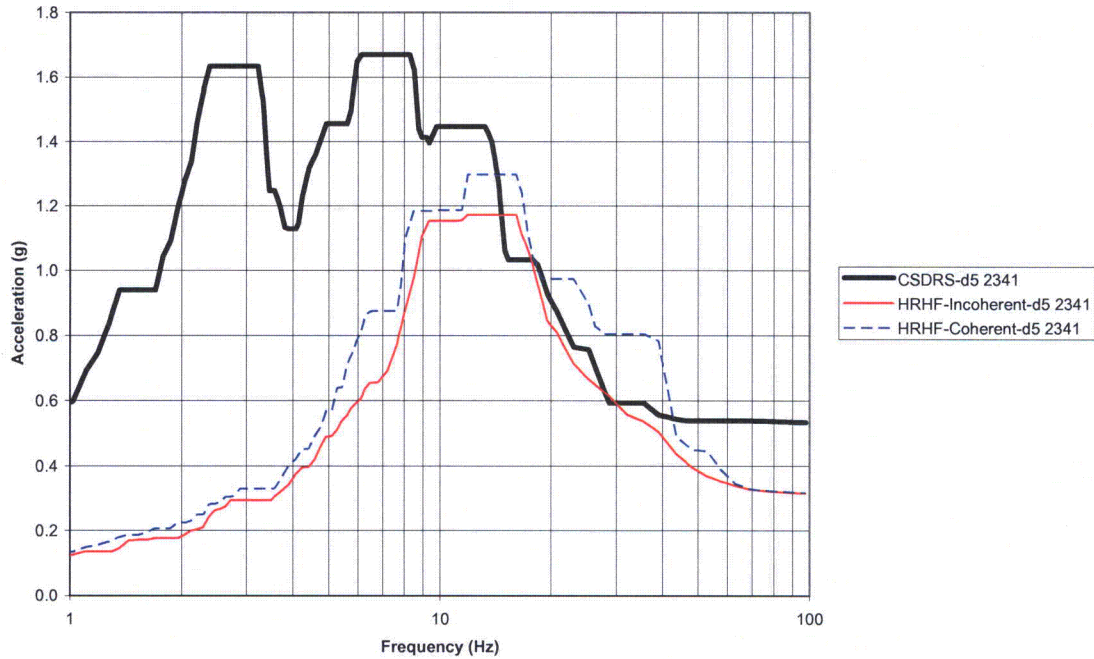


RAI-SRP3.7.1-SEB1-10-9: West Side Containment Operating Floor (Elevation 134.25') Z-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison X Direction

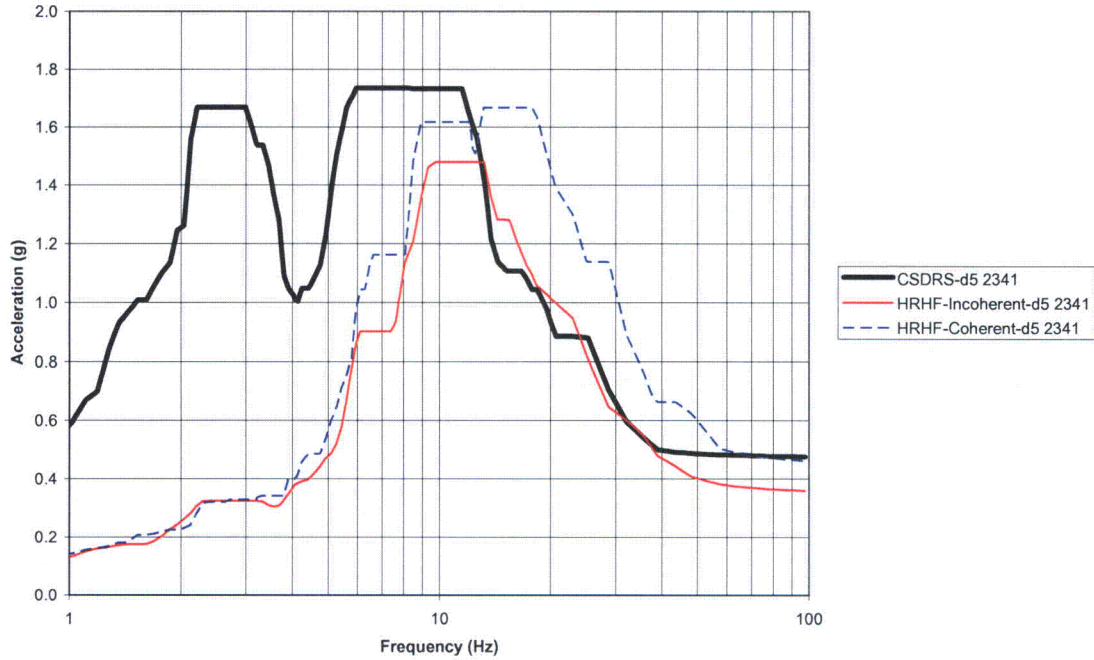


RAI-SRP3.7.1-SEB1-10-10: ASB at Northeast Corner (Elevation 134.5') X-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Y Direction

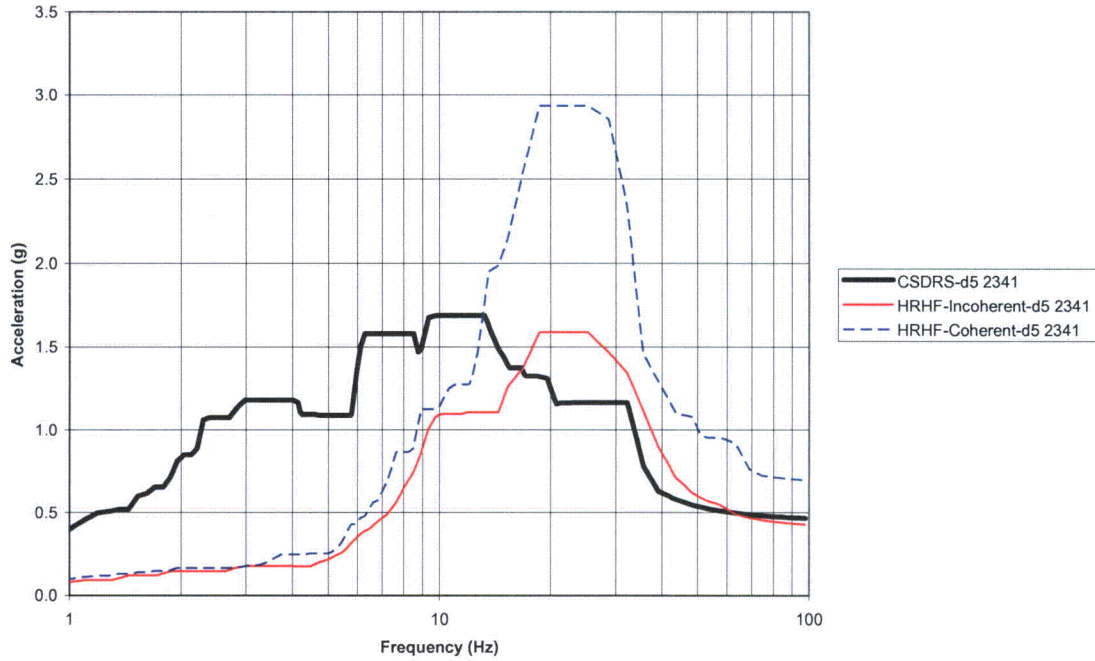


RAI-SRP3.7.1-SEB1-10-11: ASB at Northeast Corner (Elevation 134.5') Y-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Z Direction

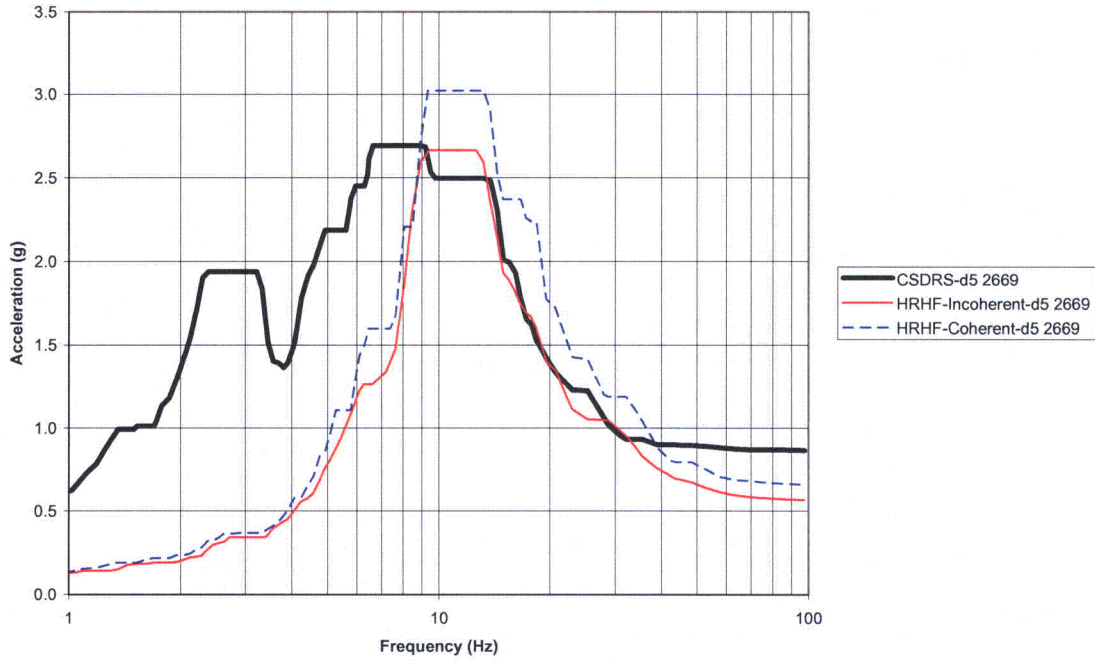


RAI-SRP3.7.1-SEB1-10-12: ASB at Northeast Corner (Elevation 134.5') Z-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison X Direction



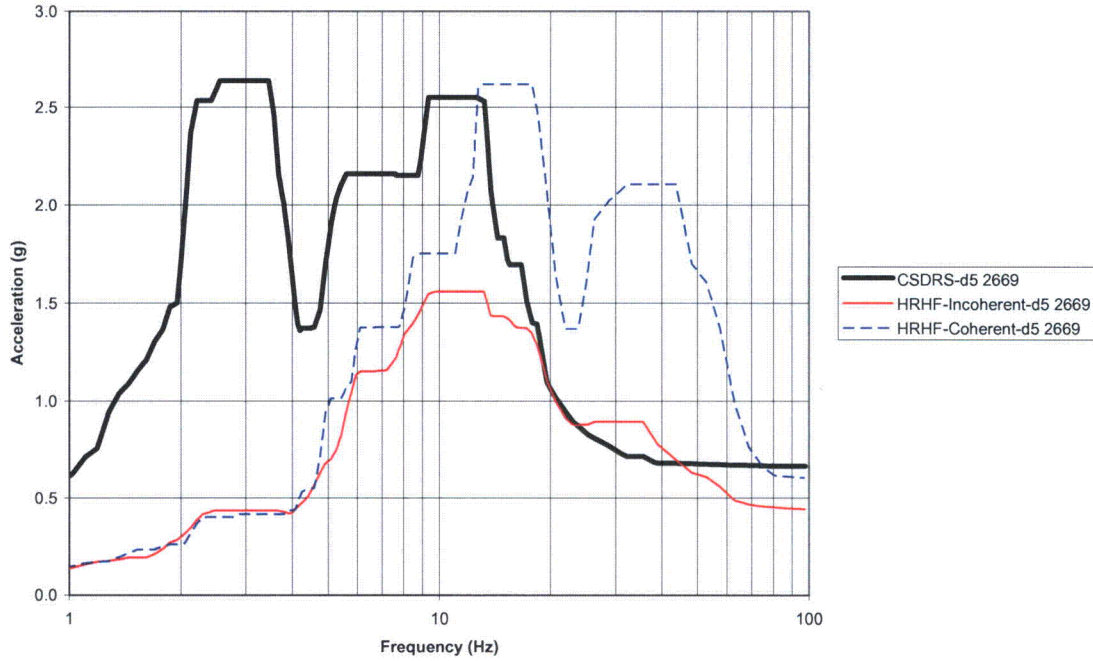
RAI-SRP3.7.1-SEB1-10-13: ASB at Fuel Building Roof (Elevation 179.56') X-Direction



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Y Direction

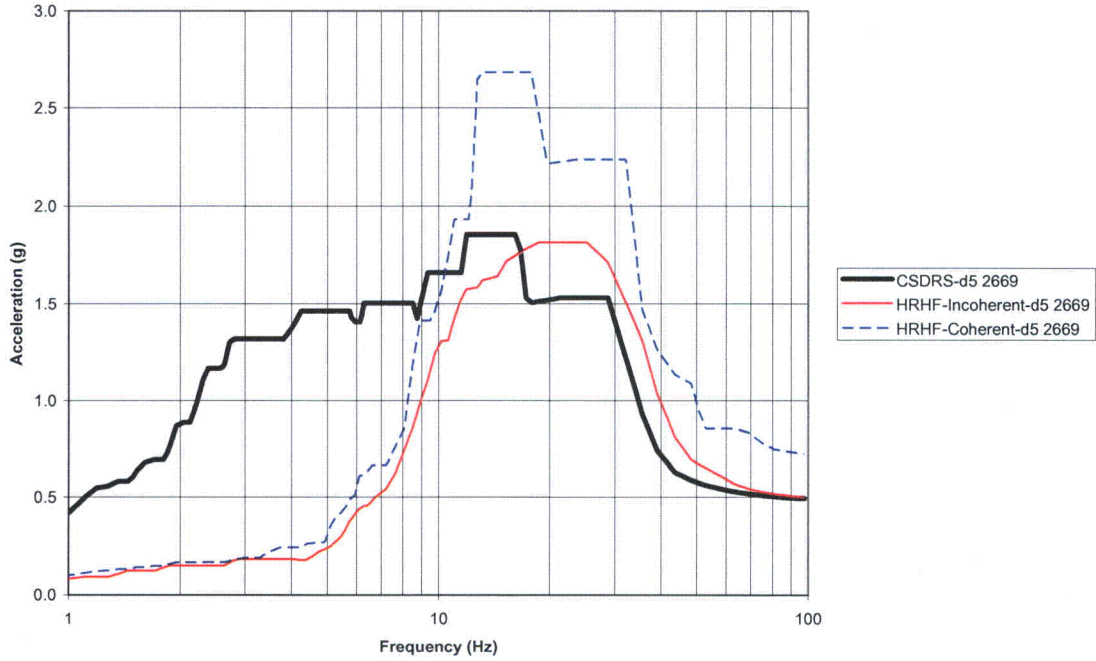


RAI-SRP3.7.1-SEB1-10-14: ASB at Fuel Building Roof (Elevation 179.56') Y-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Z Direction



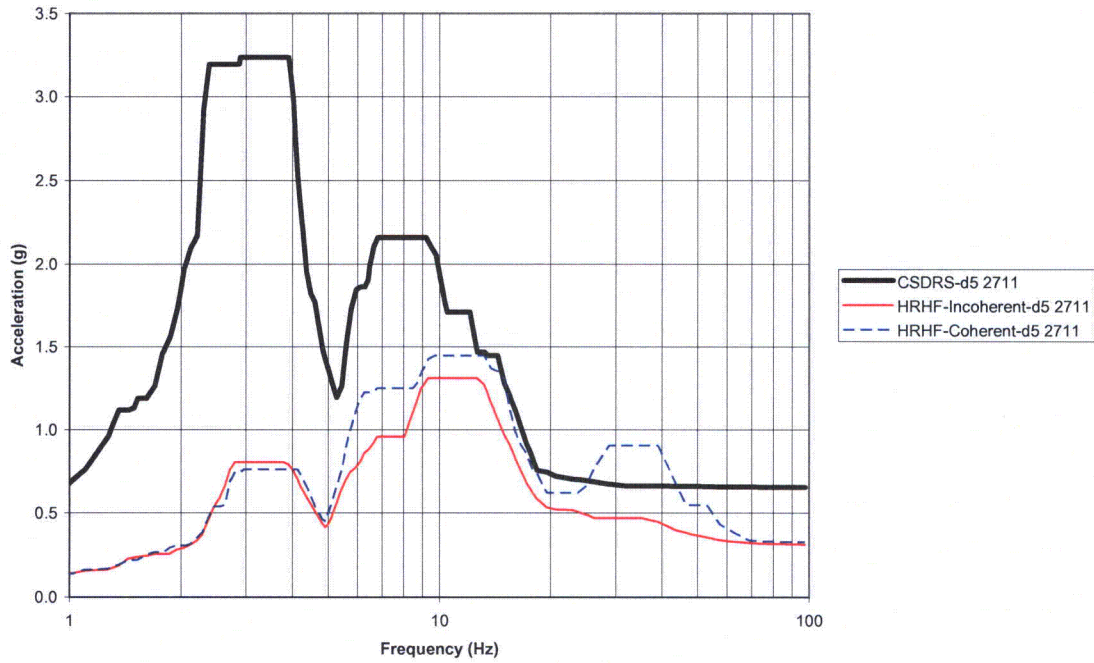
RAI-SRP3.7.1-SEB1-10-15: ASB at Fuel Building Roof (Elevation 179.56') Z-Direction



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison X Direction

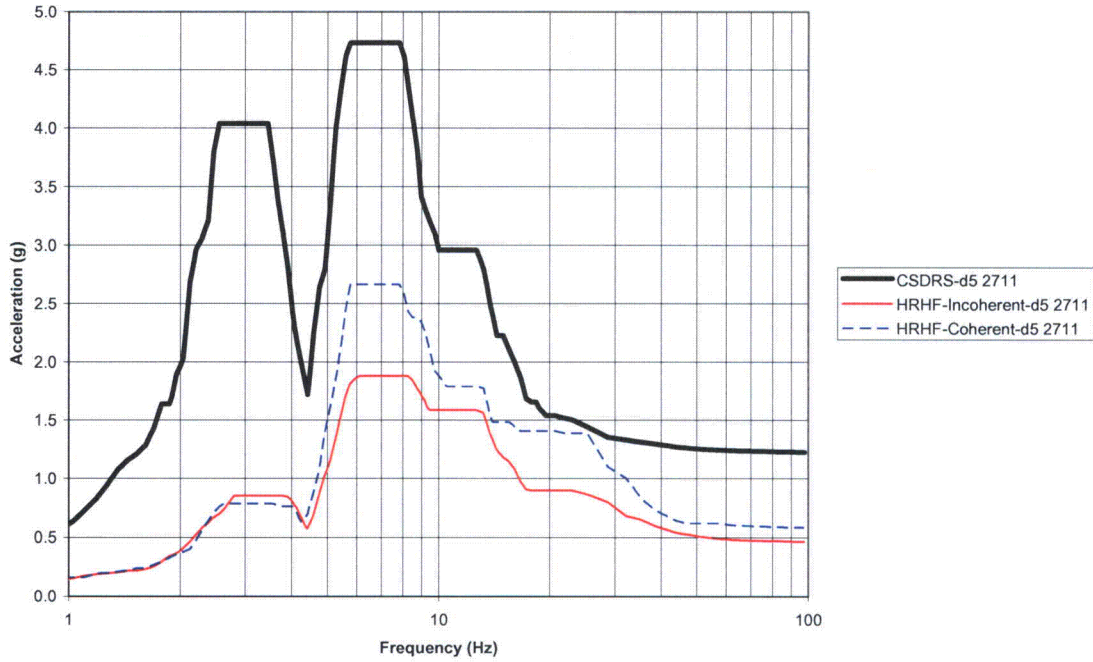


RAI-SRP3.7.1-SEB1-10-16: FRS Nodes – Elevation 180' X-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Y Direction

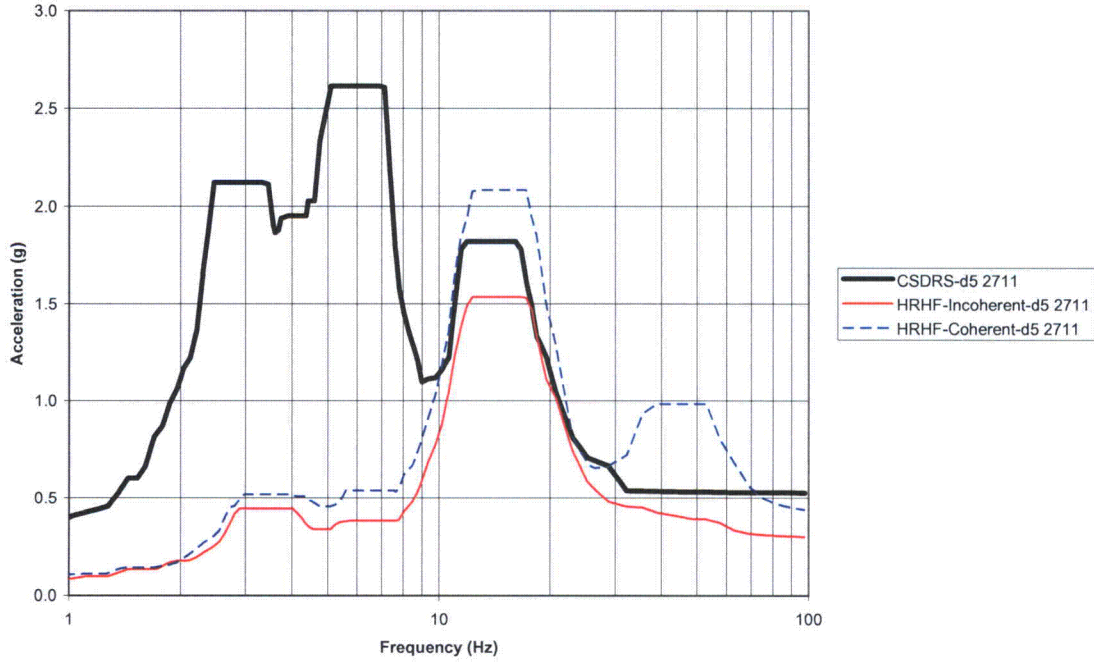


RAI-SRP3.7.1-SEB1-10-17: FRS Nodes – Elevation 180' Y-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Z Direction

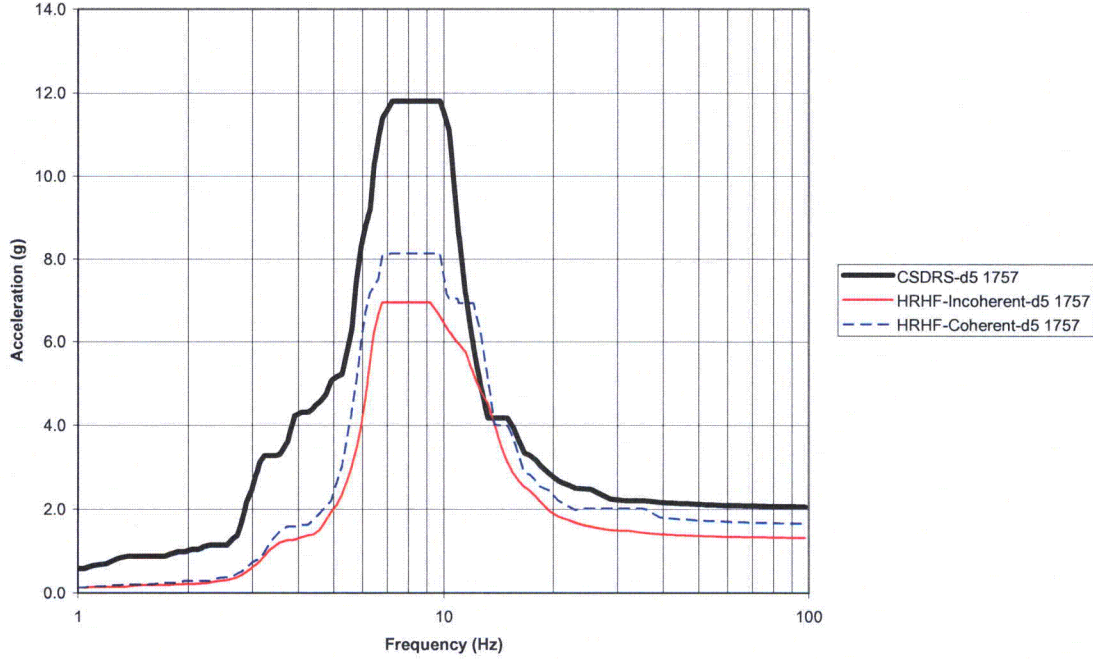


RAI-SRP3.7.1-SEB1-10-18: FRS Nodes – Elevation 180' Z-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison X Direction

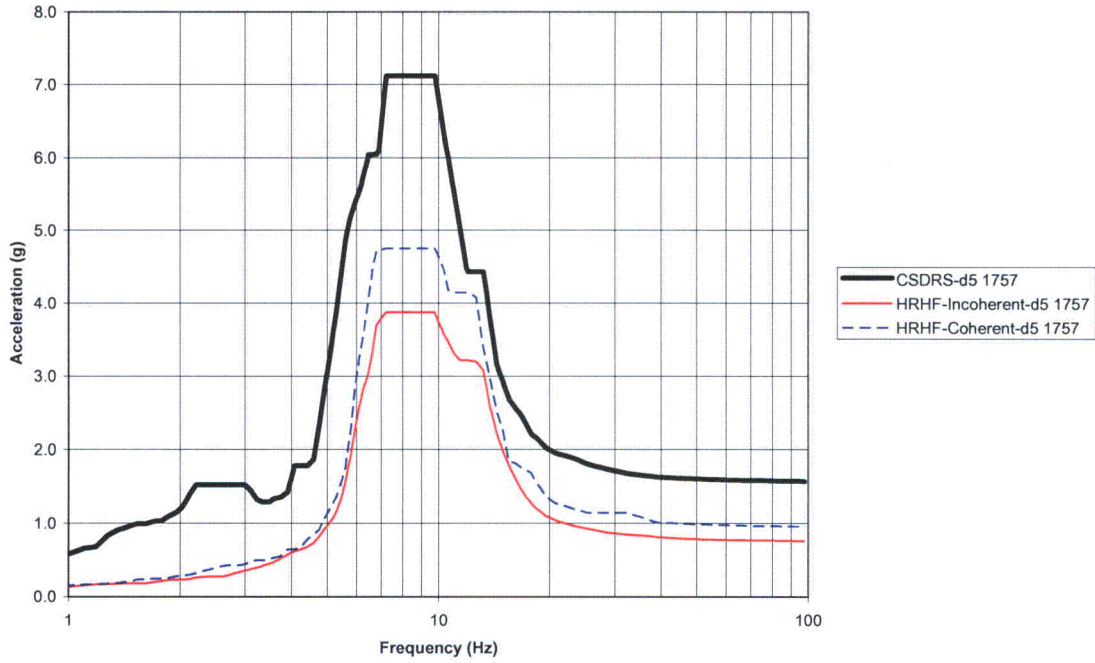


RAI-SRP3.7.1-SEB1-10-19: Reactor Coolant Pump – Elevation 99' X-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Y Direction

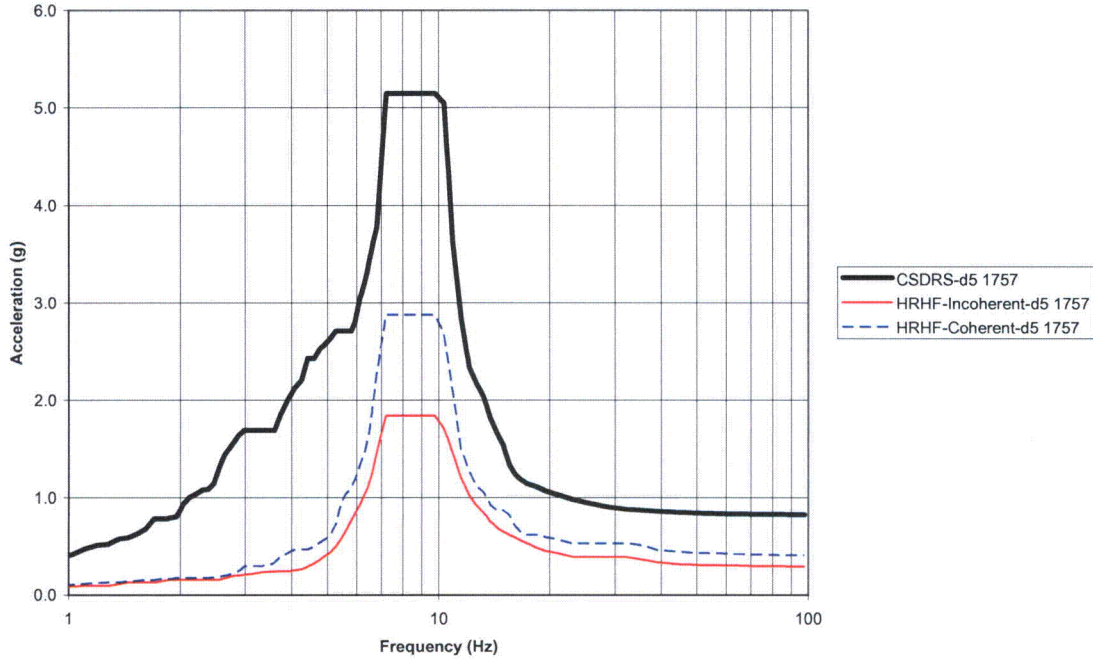


RAI-SRP3.7.1-SEB1-10-20: Reactor Coolant Pump – Elevation 99' Y-Direction

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

FRS Comparison Z Direction

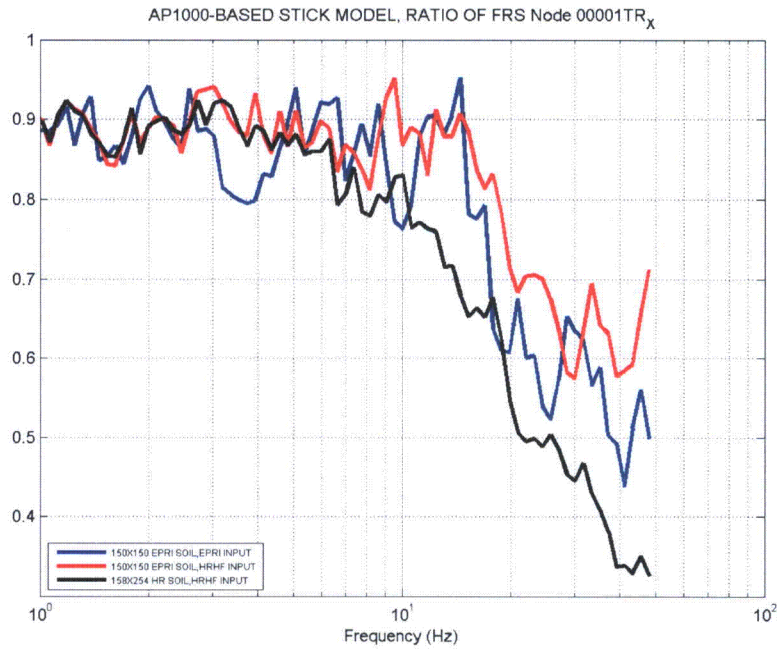
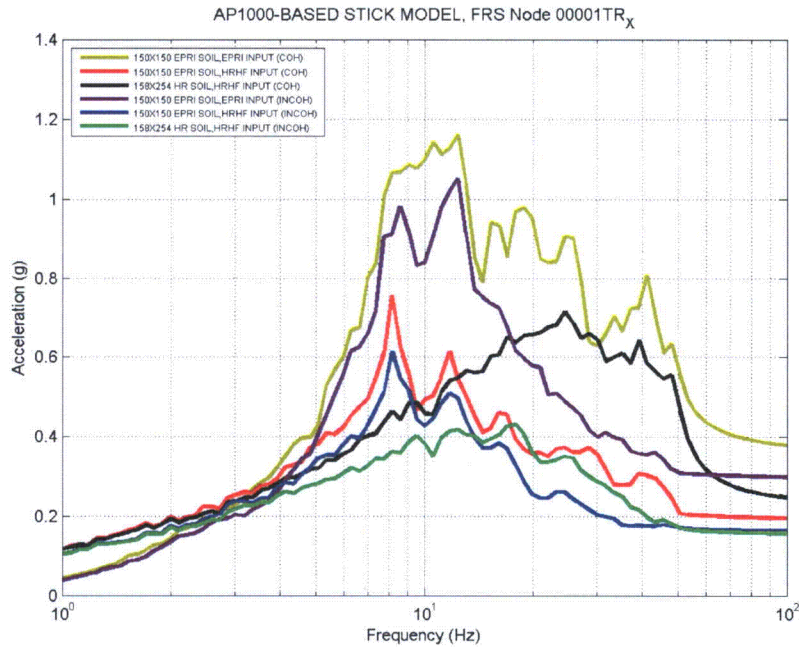


RAI-SRP3.7.1-SEB1-10-21: Reactor Coolant Pump – Elevation 99' Z-Direction



# AP1000 TECHNICAL REPORT REVIEW

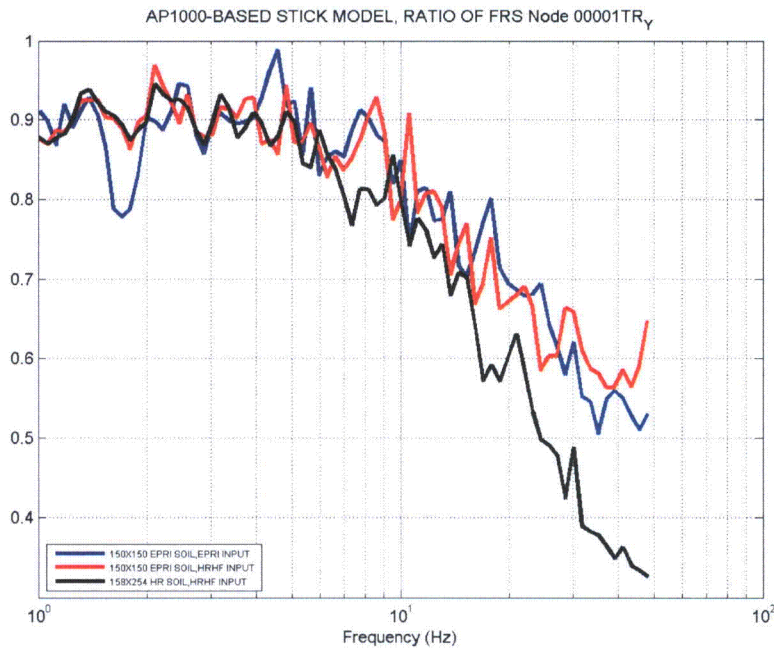
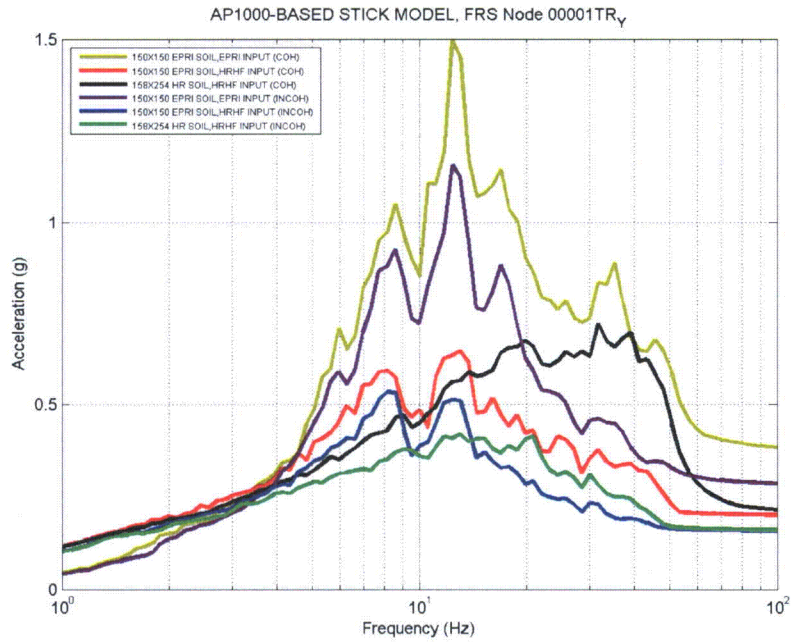
## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-22: Foundation of Auxiliary Shield Building – Elevation 60.5' X-Direction**

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

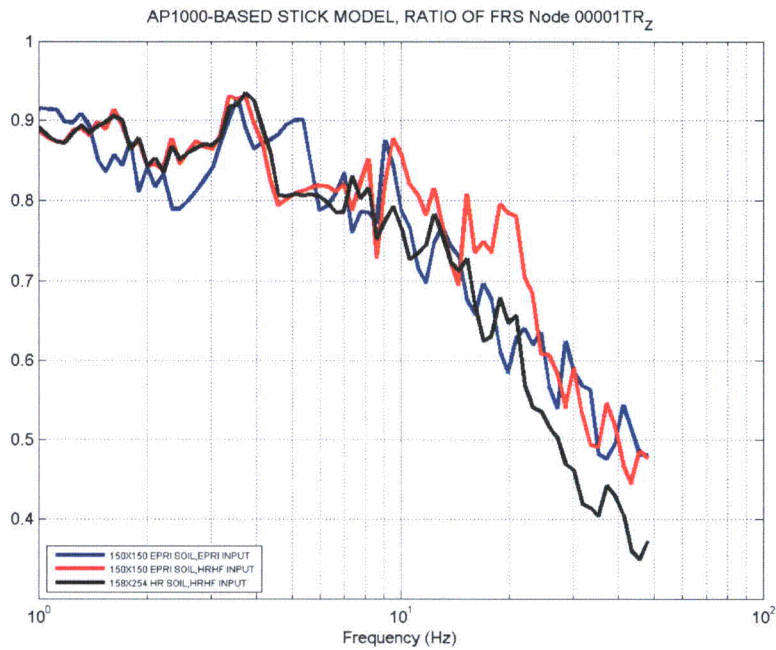
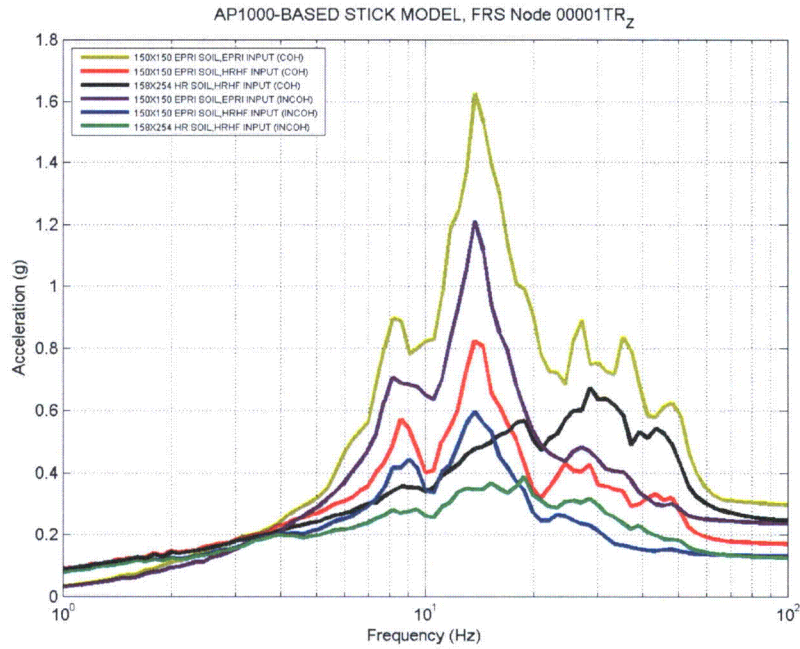


**RAI-SRP3.7.1-SEB1-10-23: Foundation of Auxiliary Shield Building – Elevation 60.5' Y-Direction**



# AP1000 TECHNICAL REPORT REVIEW

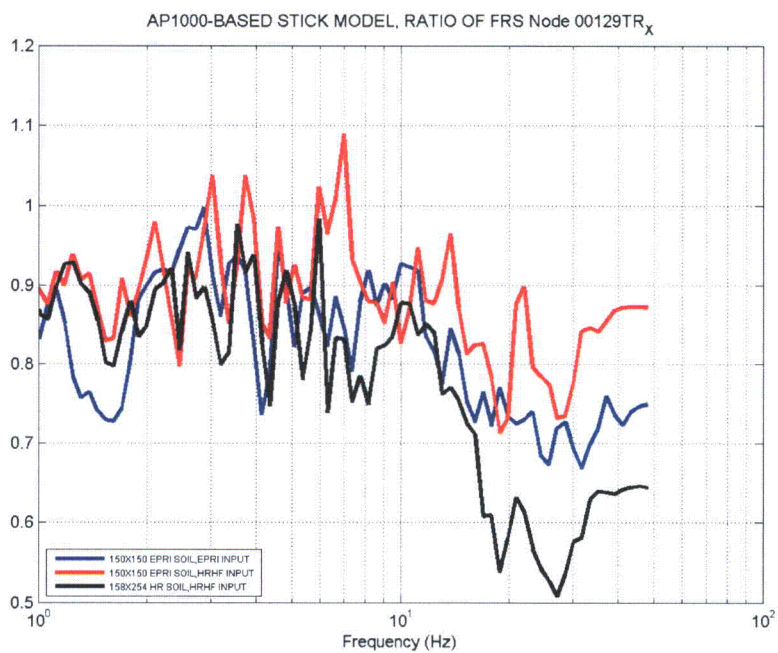
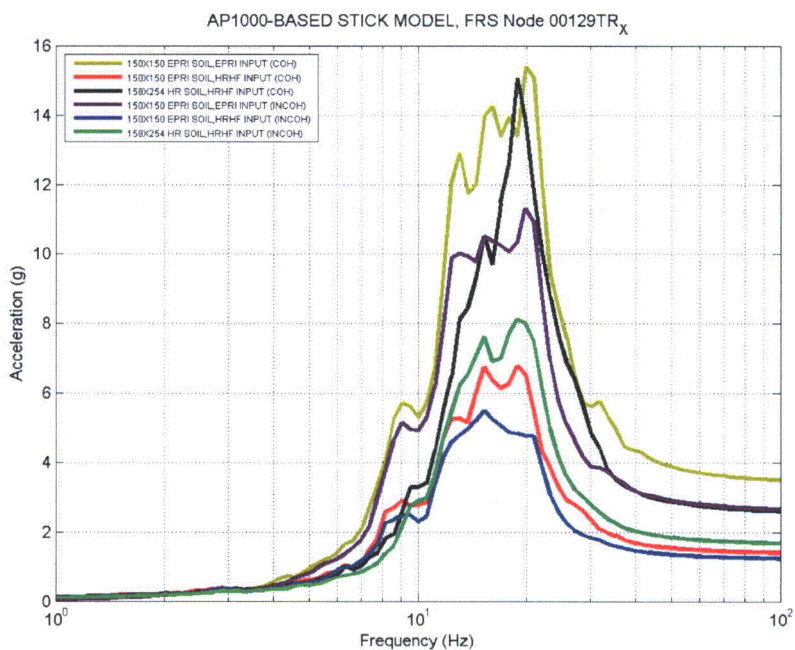
## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-24: Foundation of Auxiliary Shield Building – Elevation 60.5' Z-Direction**

# AP1000 TECHNICAL REPORT REVIEW

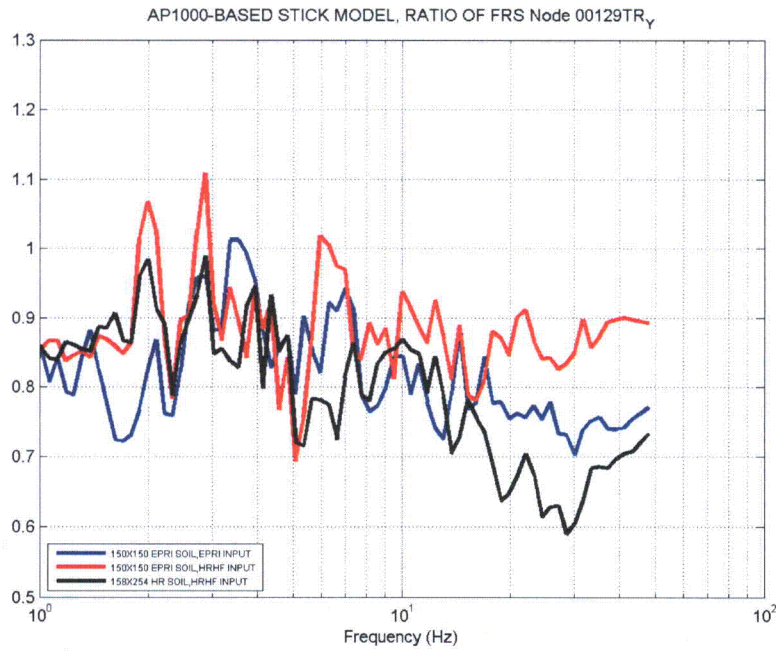
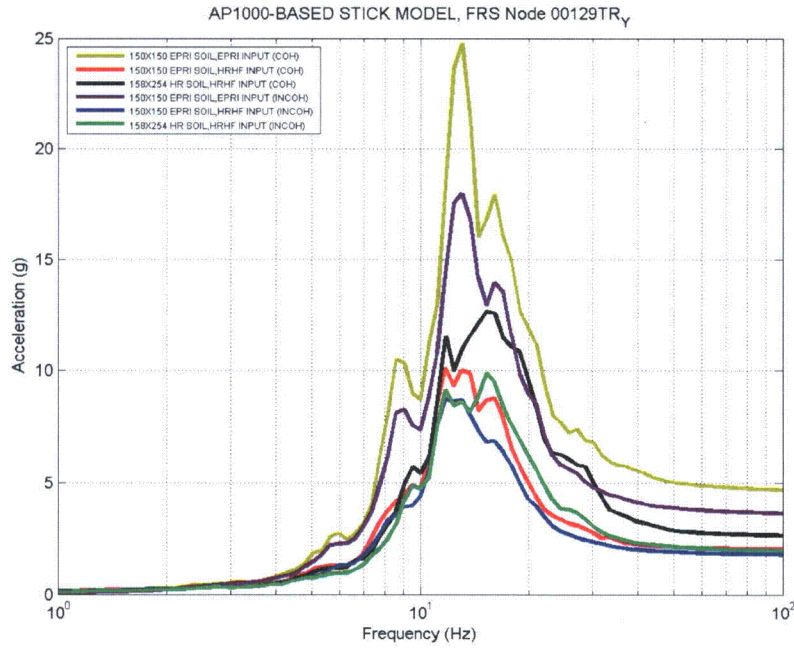
## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-25: Top of CIS Mass Center– Elevation 169' X-Direction**

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

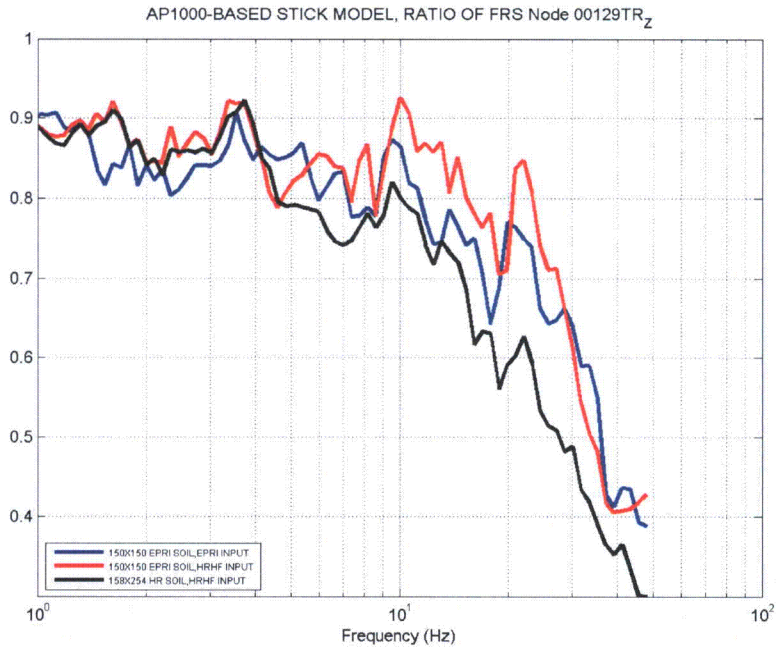
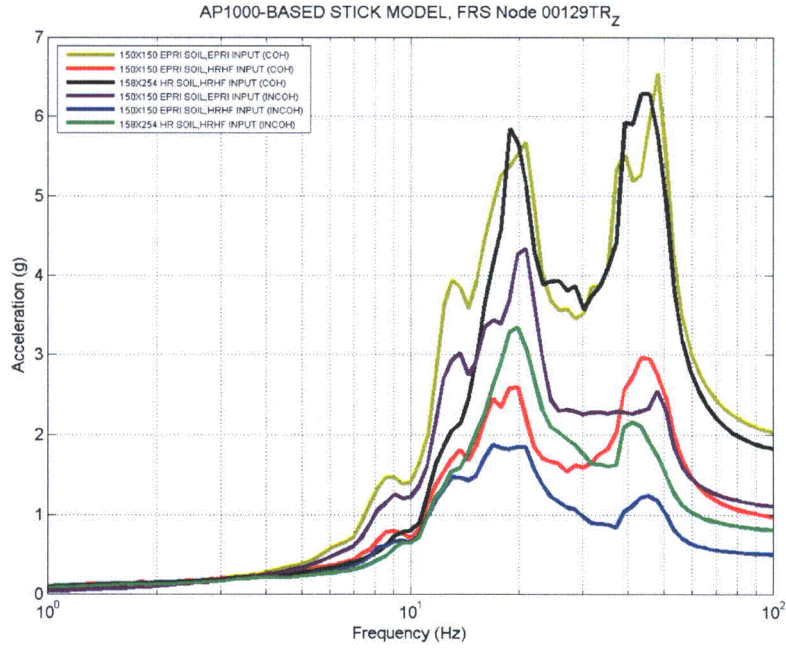


**RAI-SRP3.7.1-SEB1-10-26: Top of CIS Mass Center– Elevation 169' Y-Direction**



# AP1000 TECHNICAL REPORT REVIEW

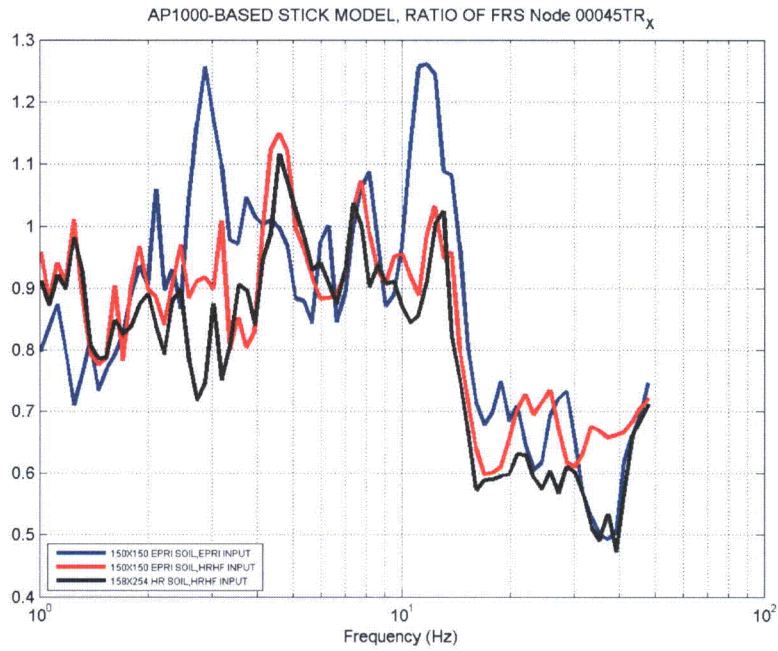
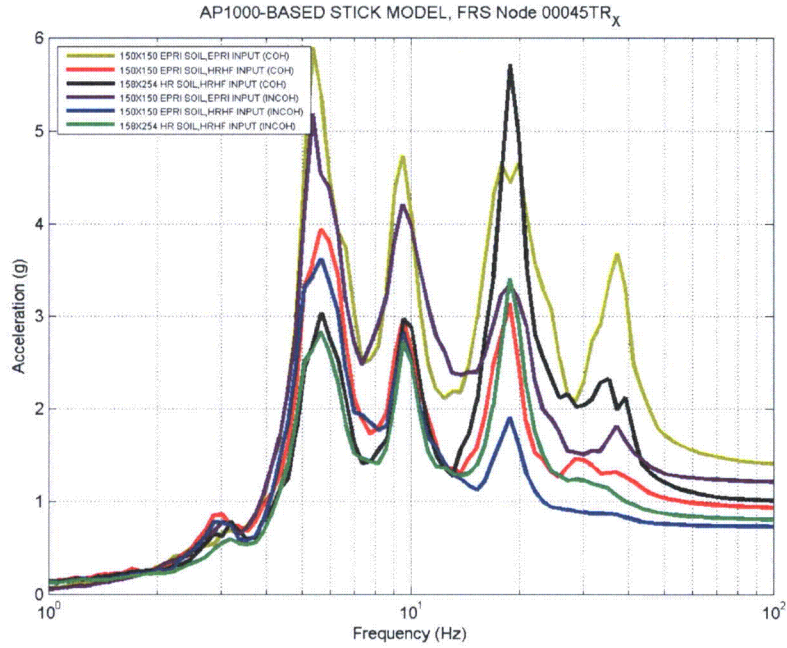
## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-27: Top of CIS Mass Center– Elevation 169' Z-Direction**

# AP1000 TECHNICAL REPORT REVIEW

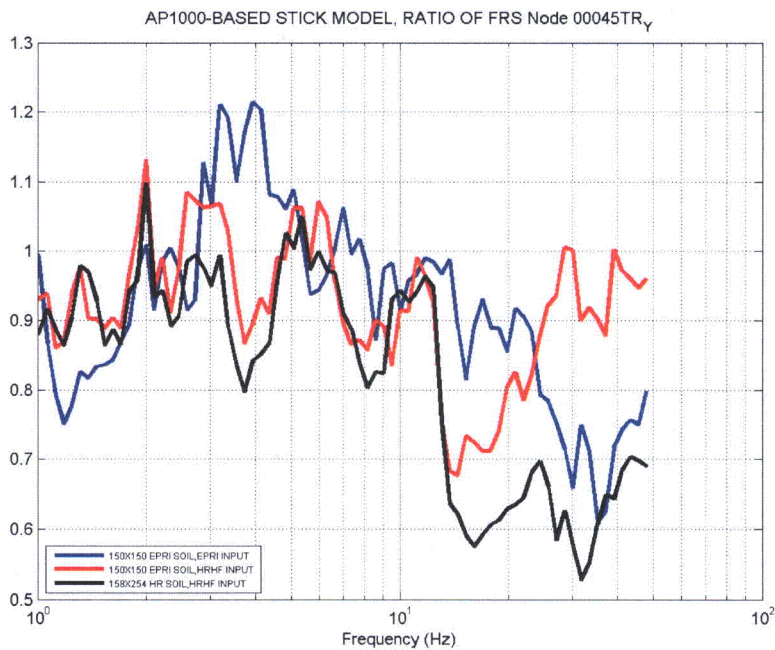
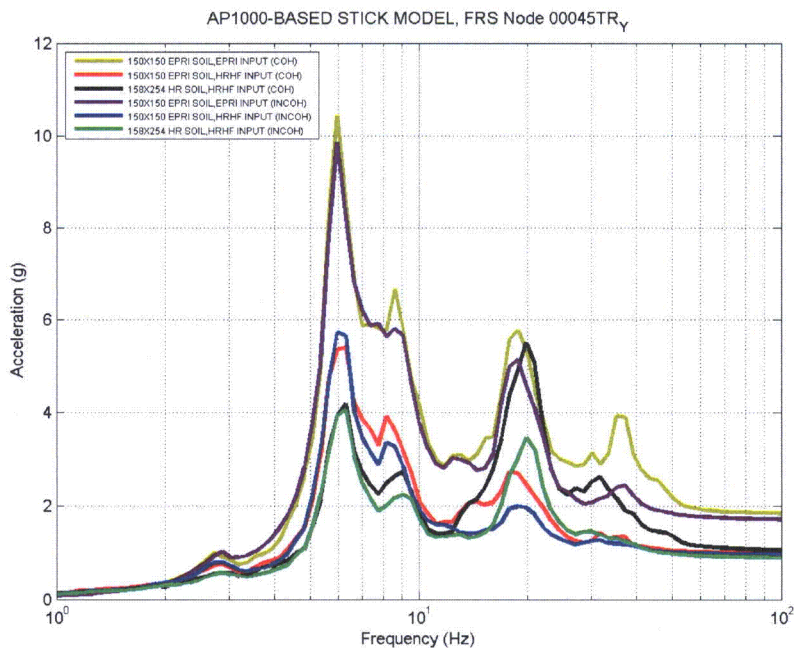
## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-28: Top of Steel Containment Vessel – Elevation 281.9' X-Direction**

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

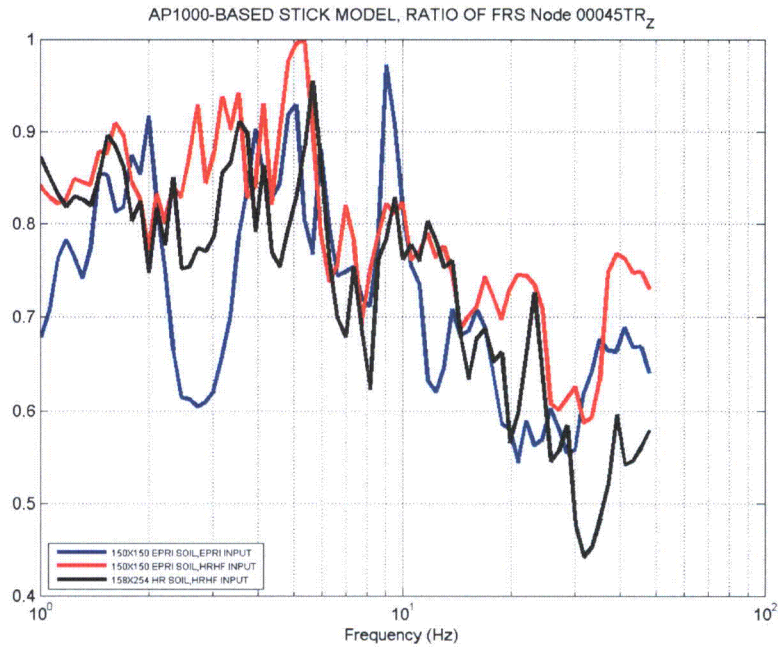
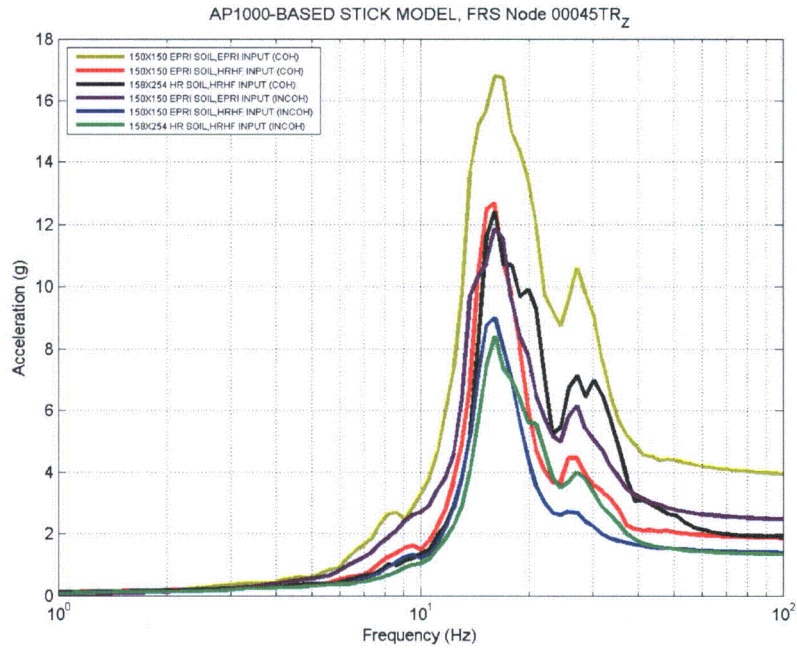


**RAI-SRP3.7.1-SEB1-10-29: Top of Steel Containment Vessel – Elevation 281.9' Y-Direction**



# AP1000 TECHNICAL REPORT REVIEW

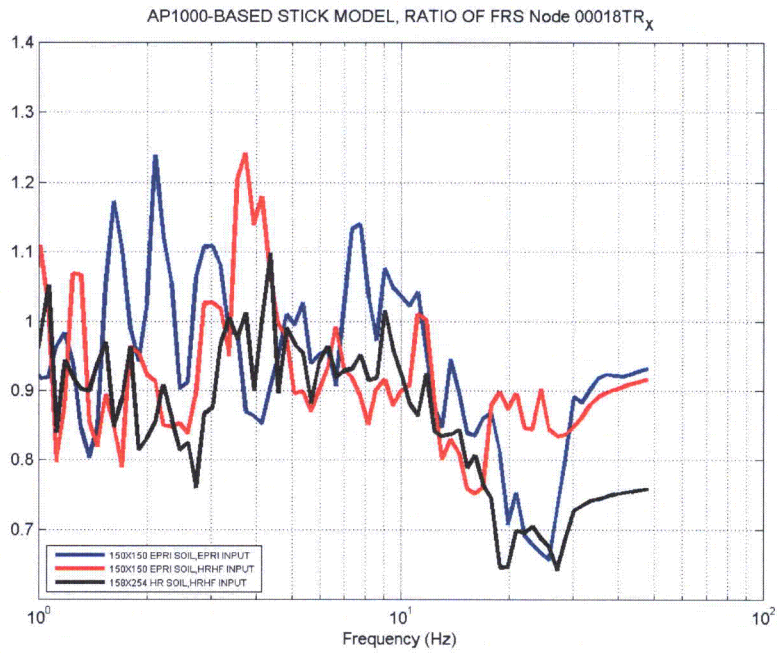
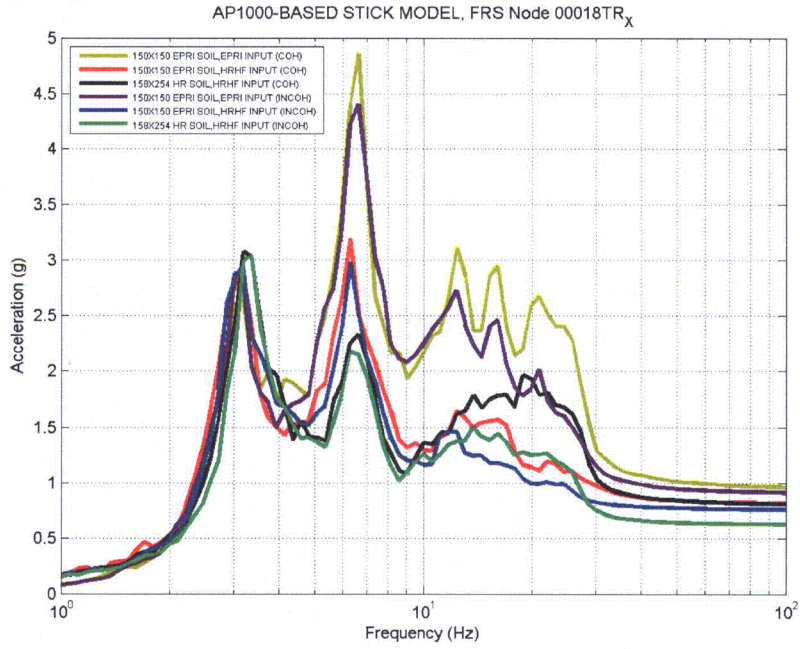
## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-30: Top of Steel Containment Vessel – Elevation 281.9' Z-Direction**

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

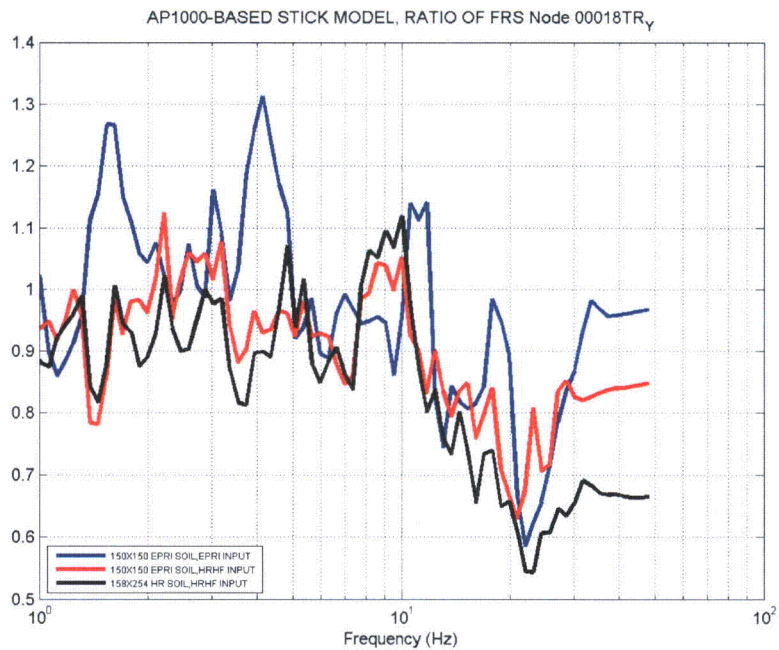
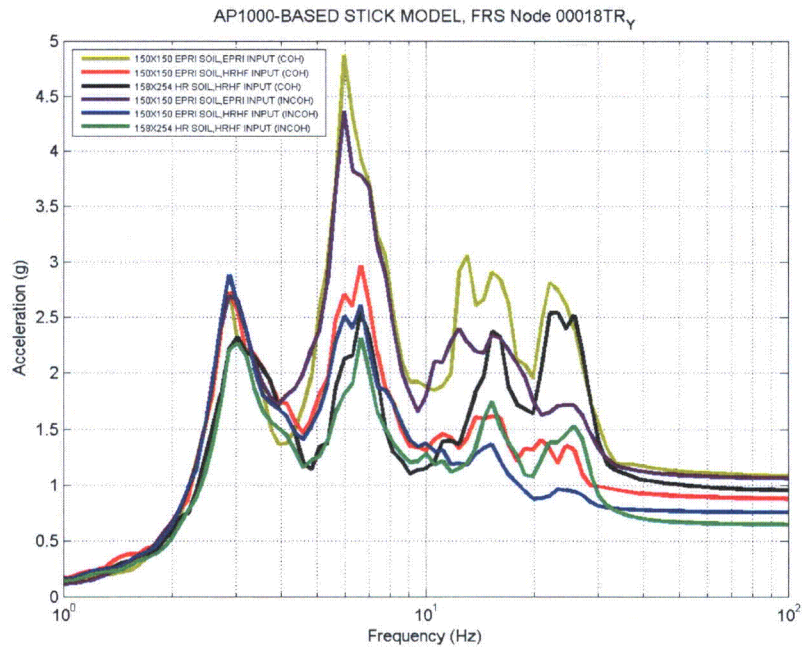


**RAI-SRP3.7.1-SEB1-10-31: Top of Shield Building – Elevation 333.3' X-Direction**



# AP1000 TECHNICAL REPORT REVIEW

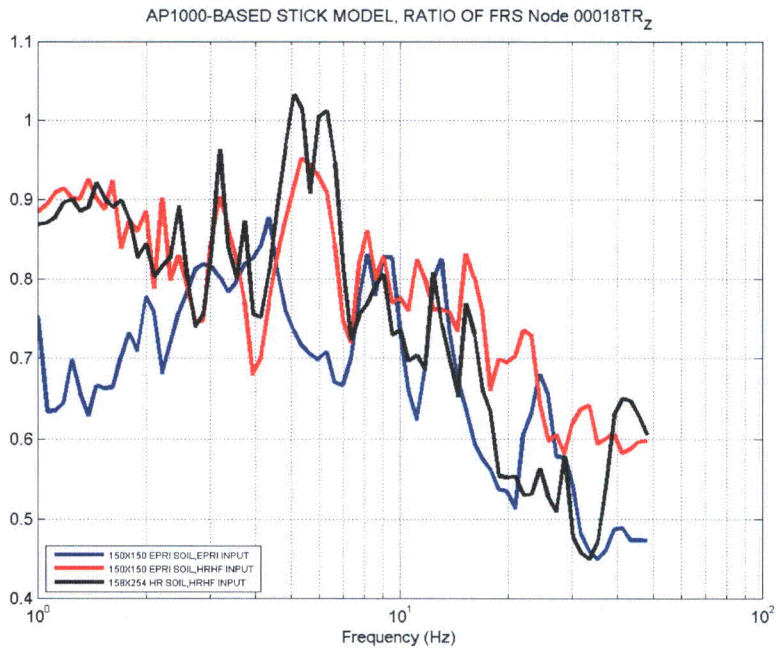
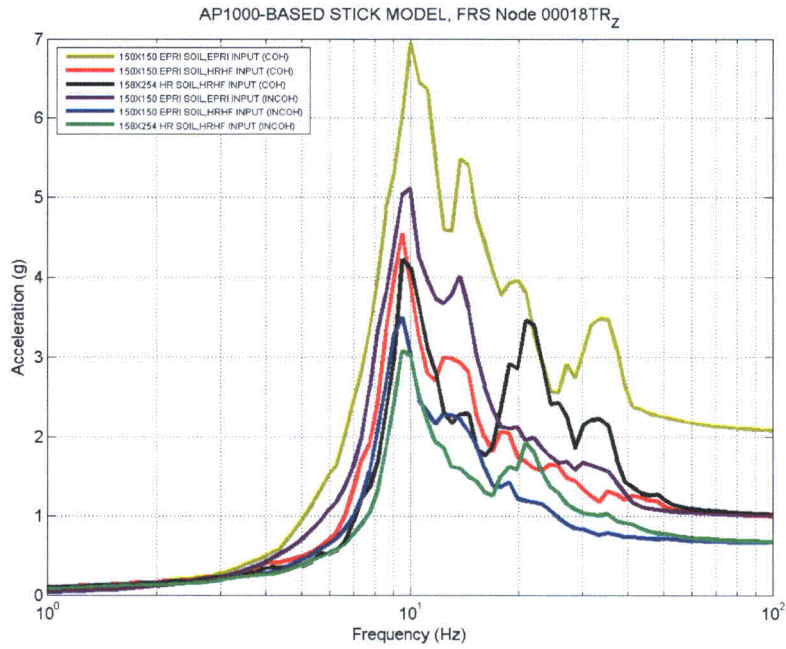
## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-32: Top of Shield Building – Elevation 333.3' Y-Direction**

# AP1000 TECHNICAL REPORT REVIEW

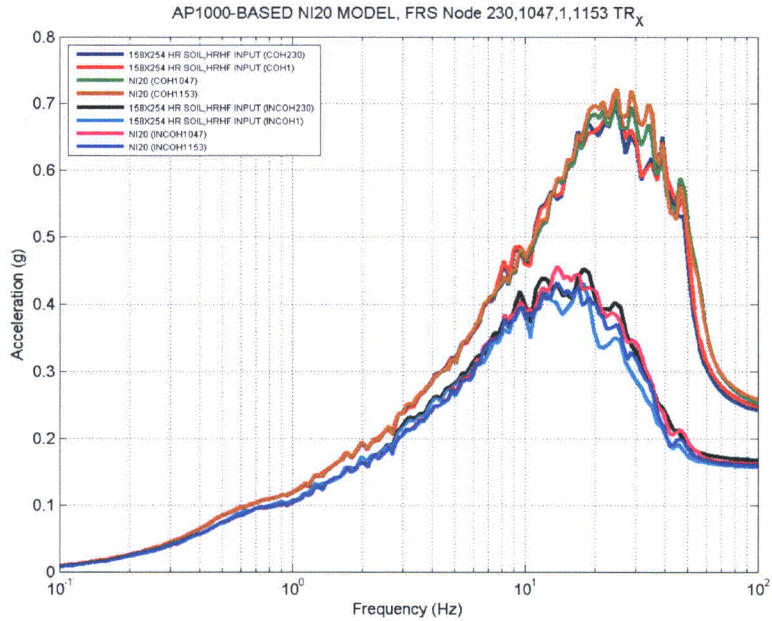
## Response to Request For Additional Information (RAI)



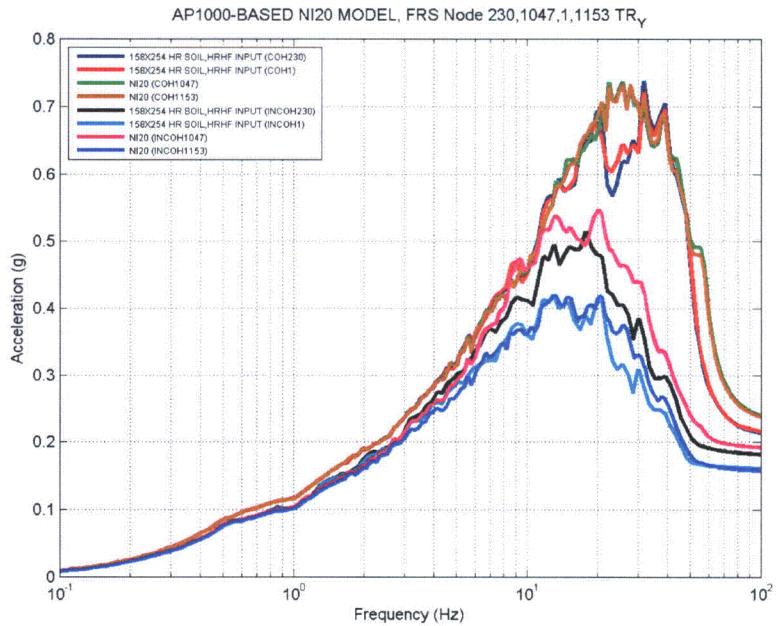
**RAI-SRP3.7.1-SEB1-10-33: Top of Shield Building – Elevation 333.3' Z-Direction**

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)



### RAI-SRP3.7.1-SEB1-10-34: NI20 Basemat – Elevation 60.5' X-Direction

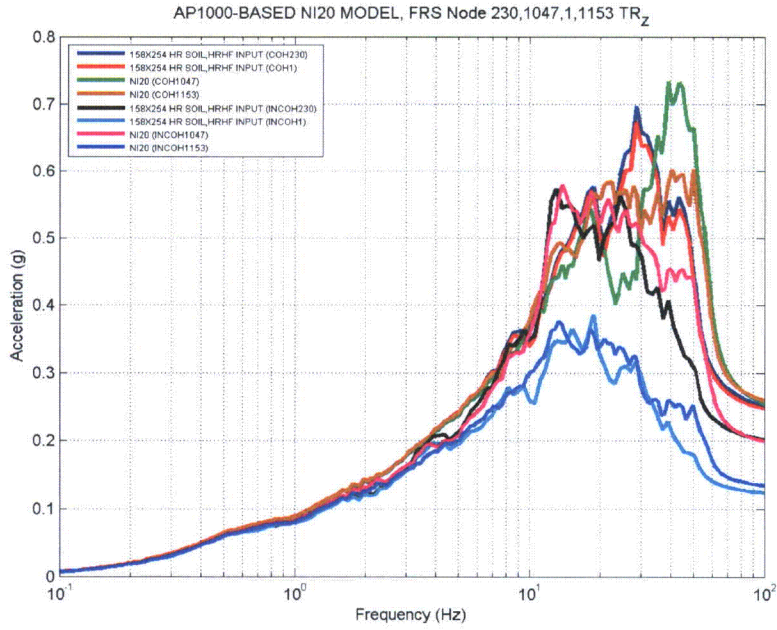


### RAI-SRP3.7.1-SEB1-10-35: NI20 Basemat – Elevation 60.5' Y-Direction



# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)



**RAI-SRP3.7.1-SEB1-10-36: NI20 Basemat – Elevation 60.5' Z-Direction**

# AP1000 TECHNICAL REPORT REVIEW

## Response to Request For Additional Information (RAI)

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### Reference:

1. Draft EPRI Report, "Hard-Rock Coherency Functions Based on the Pinyon Flat Array Data," July 5, 2007, (ADAMS Accession NO. ML071980104).

**Design Control Document (DCD) Revision:** None

**PRA Revision:** None

**Technical Report (TR) Revision:** The Figure RAI-SRP3.7.1-SEB1-10-1 to RAI-SRP3.7.1-SEB1-10-21 will replace Figure 5.2-1 through 5.2-6 in TR-115. See also RAI-SRP3.7.1-SEB1-11 for changes to Section 5.2.

### 5.2 Comparison of CSDRS and HRHF Response Spectra

To show the significance of the HRHF response spectra, the CSDRS and HRHF seismic responses are compared. Figures 5.2-1 through 5.2-6 (5% damping) compare the response spectra with coherent and incoherent considerations at a number of locations in the nuclear island. There are some exceedances, mostly above the 15 Hz region. These curves are typical of the plant comparative responses found throughout the plant.