Westinghouse

Westinghouse Electric Company
Nuclear Power Plants
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

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

Direct tel: 412-374-6206
Direct fax: 412-374-5005
e-mail: sisk1rb@westinghouse.com

Your ref: Docket No. 52-006
Our ref: DCP/NRC2280

October 17, 2008

Subject: AP1000 Response to Request for Additional Information (SRP3.10)

Westinghouse is submitting a revised response to the NRC request for additional information (RAI) on SRP Section 3.10. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in the response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

A response is provided for RAI-SRP3.10-EMB-10 as sent in an email from Mike Miernicki to Sam Adams dated August 28, 2008. This response completes all requests received to date for SRP Section 3.10. A revised response for RAI-SRP3.10-EMB--01,-03,-05,-08 and RAI-SRP3.10-EMB/EEB-04 was submitted under letter DCP/NRC2235 dated August 21, 2008. A response for RAI-SRP3.10-EMB-06 and -07 was submitted under letter DCP/NRC2152 dated June 6, 2008. A response for RAI-SRP3.10-EMB-01,-02,-03,-05,-08,-09 and RAI-SRP3.10-EMB/EEB-04 was submitted under Westinghouse letter DCP/NRC2144 dated May 28, 2008.

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,

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

/Enclosure

1. Response to Request for Additional Information on SRP Section 3.10

00519psa.doc

D063
NRO

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

ENCLOSURE 1

Response to Request for Additional Information on SRP Section 3.10

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.10-EMB-10
Revision: 0

Question:

In the revised response to NRC RAI-SRP 3.10-EMB-03 dated August 21, 2008, Westinghouse indicated that the five OBE (one-half SSE) and a minimum of one SSE AP1000 ISRS test runs preceding the HRHF screening test are performed in compliance with IEEE Std 344-1987. The staff understands that the same specimen is used for all these test runs. Westinghouse also indicated that all of the CSDRS test runs can be used to address seismic aging of the equipment in the high frequency exceedance region.

For AP1000 plants to be built on HRHF ground motion sites, Westinghouse is requested to provide justifications including the results from calculations that show seismic qualification of electrical/electronic equipment by tests for AP1000 CSDRS design spectra can be considered as equivalent to or more than 5 OBE peak stress cycles for HRHF spectra. This should be done using bounding AP1000 ISRS generated from CSDRS and bounding ISRS generated from HRHF Spectra and following the guidelines as delineated in Annex D of IEEE 344-1987.

Westinghouse Response:

The AP1000 safety-related equipment will be seismic qualified to the AP1000 Certified Seismic Design (CSD) In-Structure Response Spectra (ISRS) associated with the mounting location of the equipment as a minimum. Seismic qualification testing will consist of five AP1000 ISRS operating basis earthquakes (OBEs) followed by one Safe Shutdown Earthquake (SSE) as a minimum. The OBE level will be at least one-half the SSE level. The OBE testing is used to vibration age and address low-cycle fatigue of equipment prior to SSE testing. Cyclic fatiguing of equipment for Hard Rock High Frequency (HRHF) exceedance area is adequately addressed by performing five OBE (one-half the SSE) and a minimum of one SSE seismic test runs in compliance with IEEE Standard 344-1987 (Reference 1) prior to performing the supplemental HRHF screening test. Additional OBE testing in the high frequency exceedance range is not required since cyclic fatigue is not an issue with the very small displacements (mils) associated with the spectral accelerations in this region.

Westinghouse has performed an evaluation to demonstrate that OBE testing in the high frequency exceedance range is adequately addressed by AP1000 CSD ISRS seismic qualification testing (5 OBE and 1 SSE). The evaluation compared the peak stress cycles resulting from five one-half SSE events from AP1000 HRHF ISRS to the peak stress cycles resulting from five one-half SSE events and one full SSE event from AP1000 CSD ISRS using the guidelines defined in Annex D of IEEE Std 344-1987.

The Westinghouse evaluation of AP1000 CSD ISRS peak stress cycles to the AP1000 HRHF ISRS peak stress cycles is documented in Westinghouse Calculation CN-EQT-08-35 /

APP-GW-S2C-002 (Reference 2). The evaluation of AP1000 CSD ISRS peak stress cycles to the AP1000 HRHF ISRS peak stress cycles was performed for two AP1000 plant elevations; the AP1000 Nuclear Island Auxiliary and Shield Building (ASB) at or below 135 feet and the AP1000 Containment Internal Structure (CIS) at or below 134.25 feet.

Figure 1 shows the horizontal and vertical AP1000 CSD and HRHF SSE ISRS for the ASB at or below 135' at 5% critical damping. Figure 2 shows the horizontal and vertical AP1000 CSD and HRHF SSE ISRS for the CIS at or below 134.25' at 5% critical damping. These locations were chosen for the evaluation because most equipment is located at or below these plant elevations. Acceleration time histories were generated which produce response spectra at 5% critical damping that envelop each required AP1000 plant envelope response spectra with 0/+1% margin. The acceleration time histories associated with these required response spectra generated at 5% critical damping were used for evaluation of seismic adequacy of test cycles. Figures 3 through 6 provide examples of AP1000 CSD and HRHF SSE ISRS and their associated time history and power spectral density (PSD) plots. The tight tolerance between the enveloping response spectra to the required response spectra shown in Figures 3 and 5 was required to insure an accurate representation of the requirement. Since this tight tolerance is not likely to be maintained during an actual test program, the number of cycles counted in the evaluation is conservative. The PSD plots shown in Figures 4 and 6 demonstrate the energy content over the frequency range of interest.

The peak stress cycles in each direction were determined based on the zero period acceleration (ZPA) of the ½ SSE HRHF ISRS and the ½ SSE and SSE CSD ISRS acceleration time histories normalized to the same ZPA value to demonstrate equivalency of results. Results of the cycle counting in compliance with guidelines defined in Annex D of IEEE Std 344-1987 are summarized in Table 1.

Table 1: Summary of Peak Stress Cycle Counting

Location	Direction	Spectra	Event	Peak Stress Cycles
ASB at or below 135'	Horizontal	CSD	1 SSE + 5 (½ SSE)	431
		HRHF	5 (½ SSE)	195
	Vertical	CSD	1 SSE + 5 (½ SSE)	312
		HRHF	5 (½ SSE)	315
CIS at or below 134.25'	Horizontal	CSD	1 SSE + 5 (½ SSE)	356
		HRHF	5 (½ SSE)	240
	Vertical	CSD	1 SSE + 5 (½ SSE)	275
		HRHF	5 (½ SSE)	135

The completed evaluation has demonstrated that the peak stress cycles resulting from five one-half SSE events using the AP1000 HRHF ISRS are equivalent to or enveloped by the peak stress cycles resulting from five one-half SSE events and one full SSE event using the AP1000 CSD ISRS.

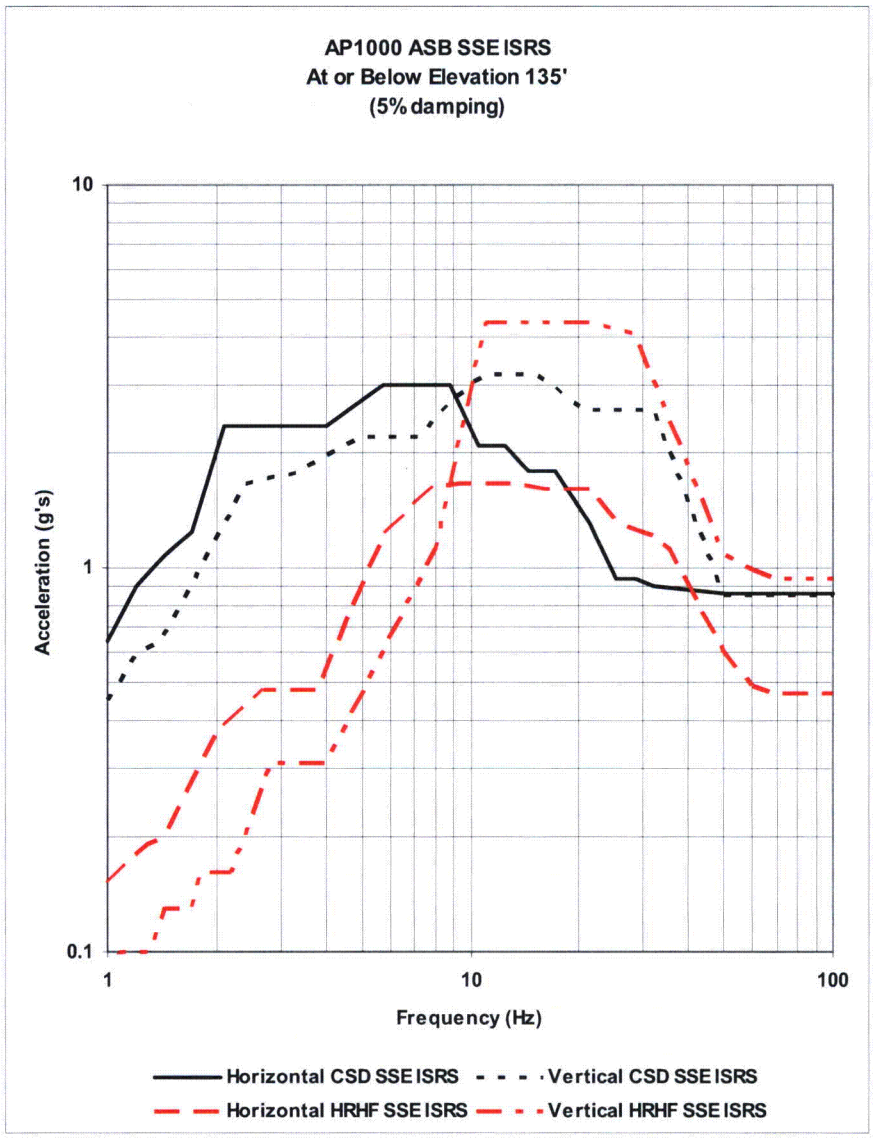

Figure 1: AP1000 ASB CSD and HRHF SSE ISRS At or Below Elevation 135'

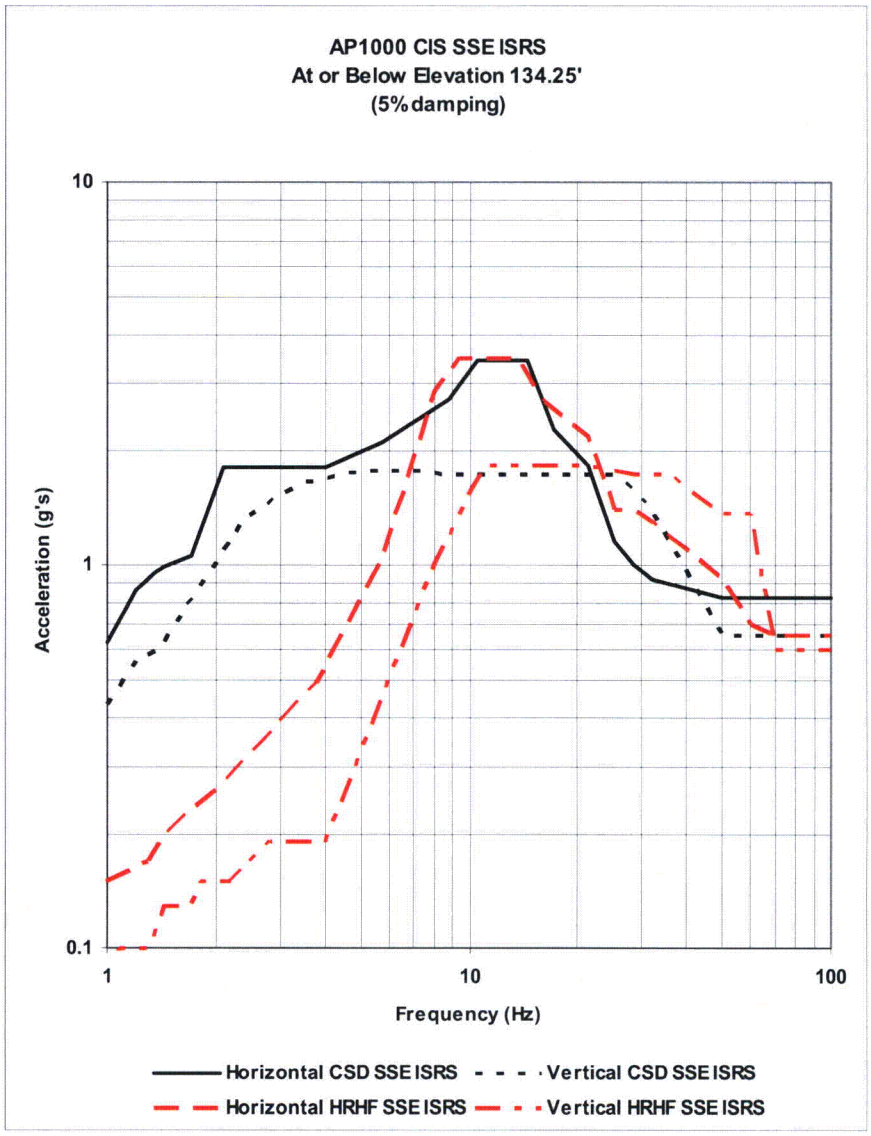

Figure 2: AP1000 CIS CSD and HRHF SSE ISRS At or Below Elevation 134.25'

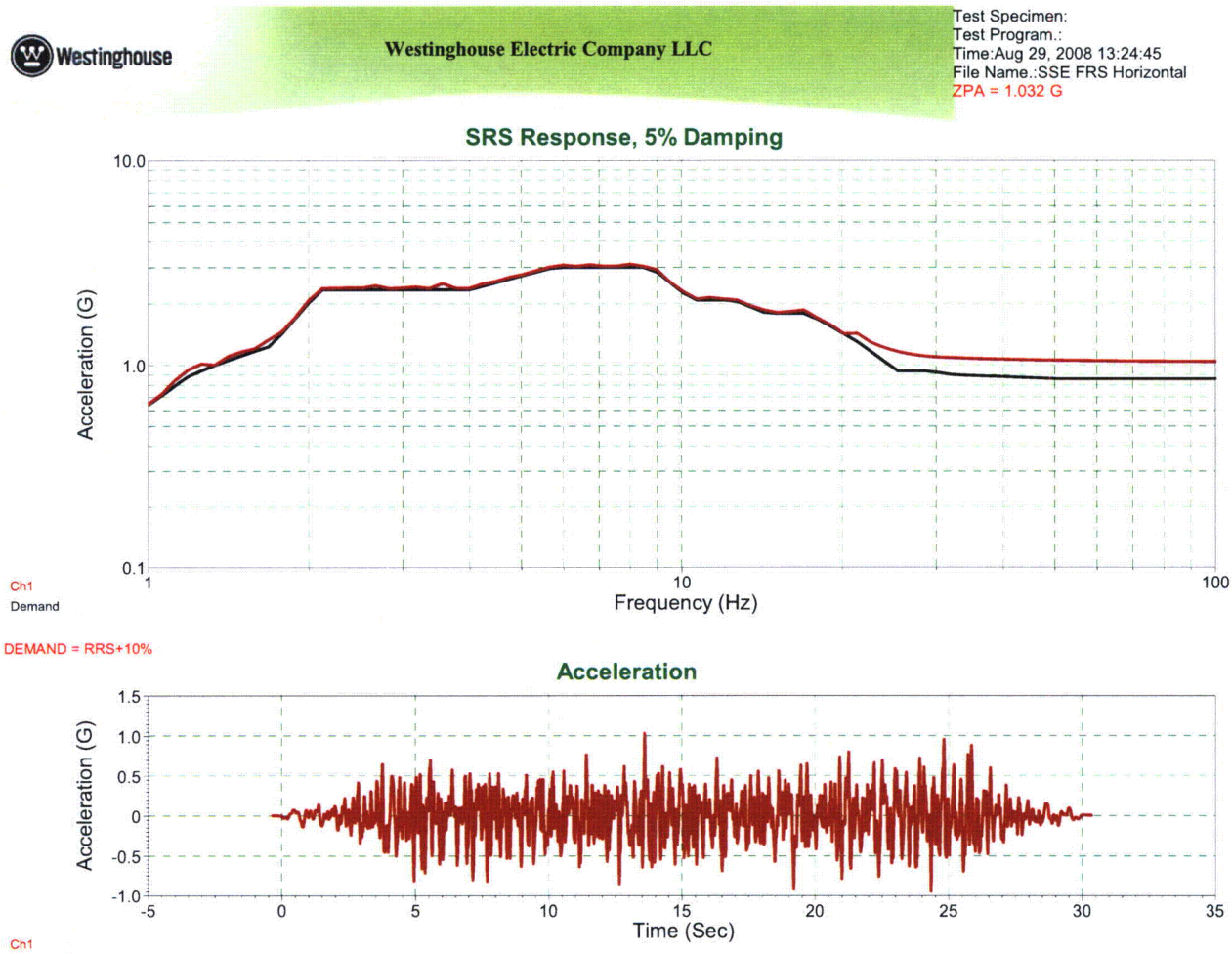

Figure 3: Auxiliary and Shield Building At or Below 135' Horizontal CSD ISRS SSE at 5% Damping

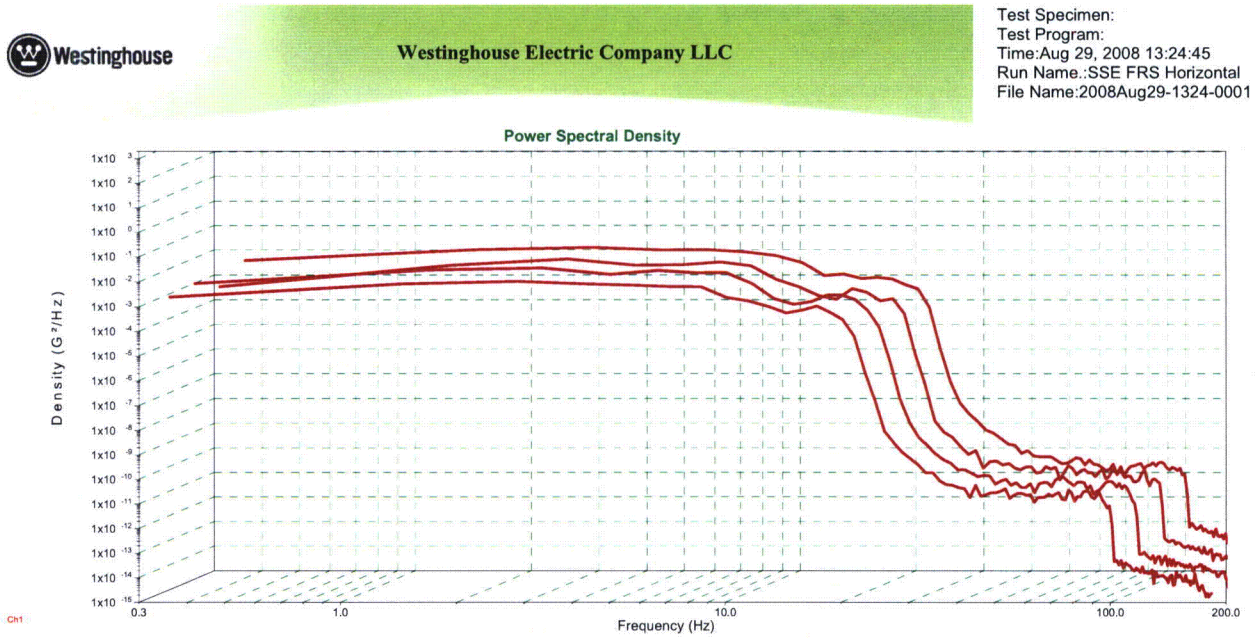

Figure 4: Auxiliary and Shield Building At or Below 135' Horizontal CSD ISRS SSE PSD

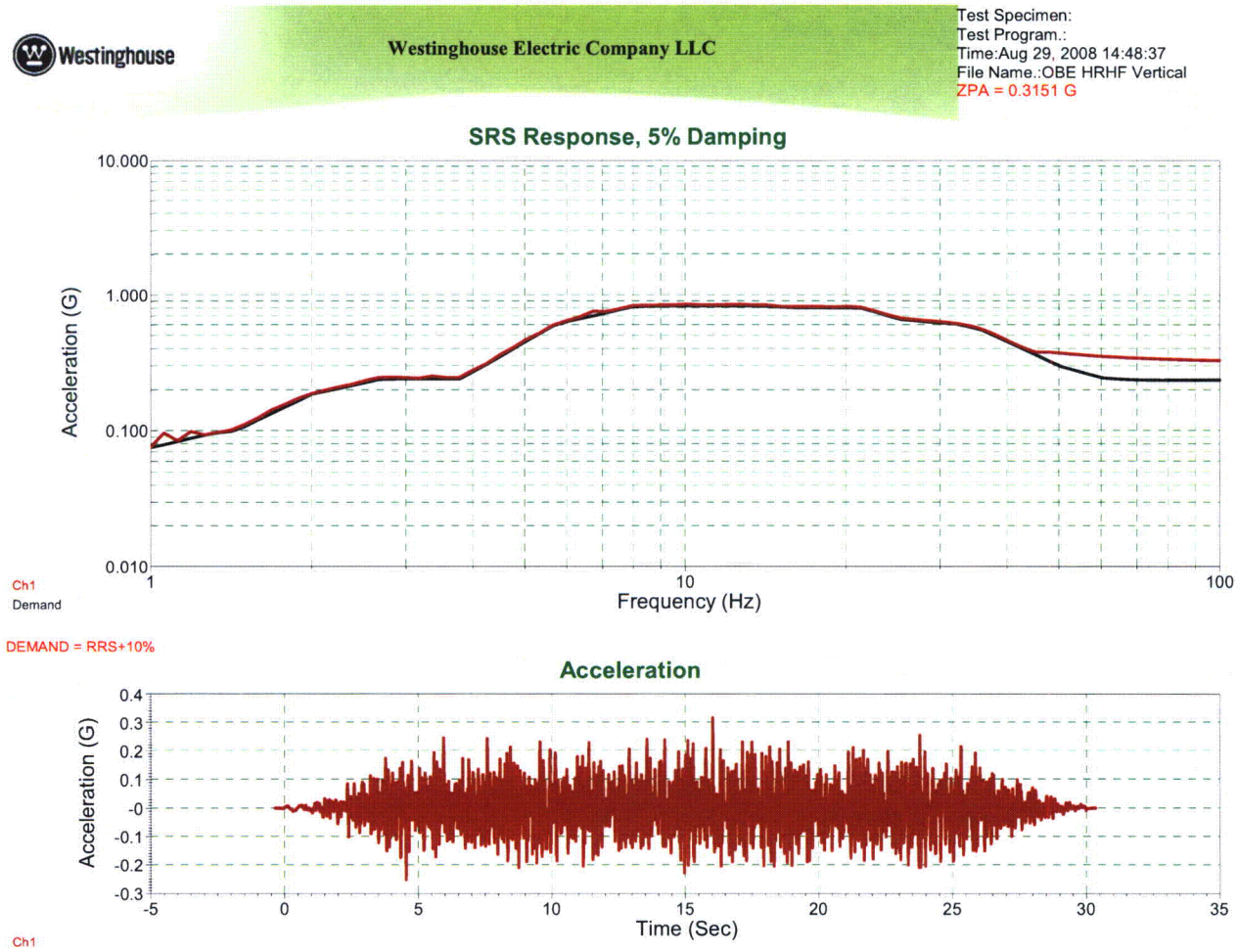

Figure 5: Auxiliary and Shield Building At or Below 135' Horizontal HRHF ISRS OBE at 5% Damping

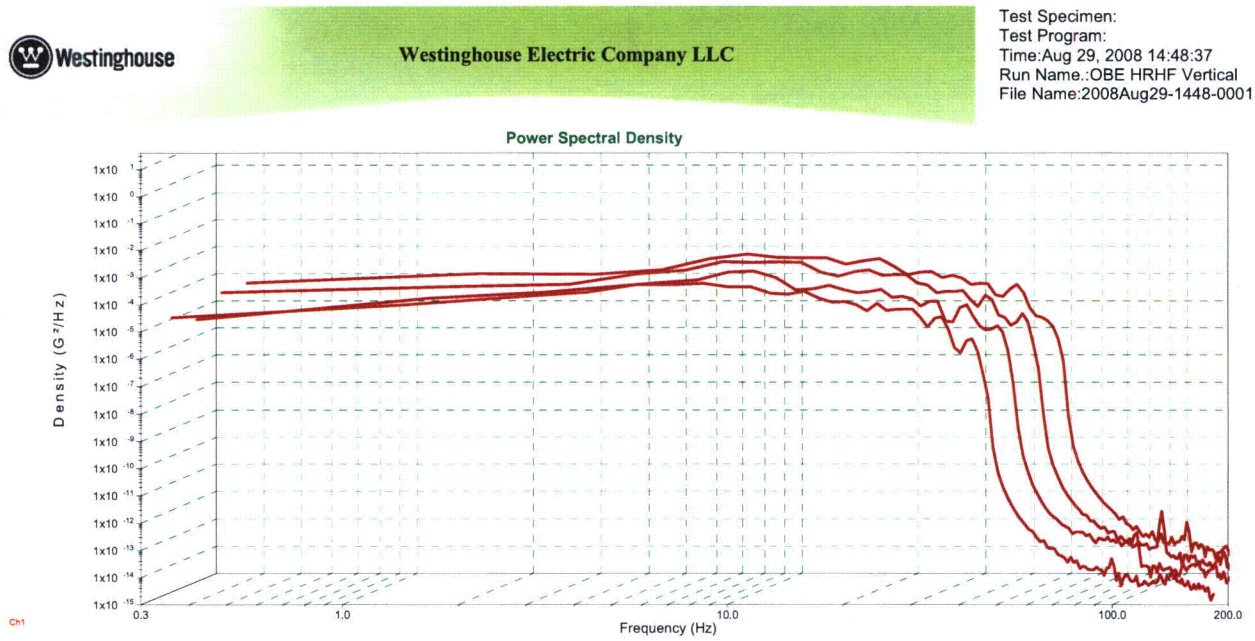

Figure 6: Auxiliary and Shield Building At or Below 135' Horizontal HRHF ISRS SSE PSD

References:

1. Westinghouse Calculation CN-EQT-08-35/APP-GW-S2C-002 (Westinghouse Proprietary), "Documentation of Comparison of Peak Stress Cycles Resulting from AP1000 CSD Spectra to Peak Stress Cycles Resulting from AP1000 HRHF Spectra," Revision 0, October 2008.

2. IEEE Standard 344-1987, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc.

Design Control Document (DCD) Revision: None

PRA Revision: None

Technical Report (TR) Revision: None