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Your ref: Docket No. 52-006
Our ref: DCP/NRC2384

February 19, 2009

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

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:

RAI-SRP3.7.1-SEB1-02 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,

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

/Enclosure

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

DO63
NRO

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	R. Kitchen	-	Progress Energy	1E
	A. Monroe	-	SCANA	1E
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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 3

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP3.7.1-SEB1-02
Revision: 2

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.

On August 21, 2008 the NRC has requested the following additional information be provided.

The staff requested Westinghouse to revise the TR-115 introduction and conclusion, to more accurately describe the scope of applicability of the TR-115 results. In its response, Westinghouse proposed revised wording that is generally acceptable to the staff. However, the staff noted that Westinghouse has not defined the site parameter requirements (i.e., minimum shear wave velocity of underlying medium) that must be satisfied in order to reference the results in TR-115. The staff notes that the definition of a hard rock site in the DCD is a minimum shear wave velocity equal to 8000 fps.

Therefore, the staff requests that Westinghouse specifically identify in TR-115 the site parameter requirements (i.e., minimum shear wave velocity of underlying medium) that must be satisfied in order to reference the results in TR-115, and provide the technical basis for this determination. The staff also requests Westinghouse to identify the 3 COL applicants that are currently covered by TR-115, and the minimum shear wave velocity of the underlying medium at each site.

Additional Request (Revision 2):

The staff determined that Westinghouse's response to RAI-SRP3.7.1-SEB1-02 (Revision 1) did not sufficiently address the staff's questions. Therefore, the staff is repeating its request in a more specific manner:

(a) Describe in detail the modeling of underlying media and any side media in the special SASSI analyses of the HRHF GMRS. How many cases were analyzed? Describe each case and the purpose for each case.

(b) What is the shear wave velocity associated with each of the media included in the SASSI analyses?

(c) How was the seismic motion at the surface developed, for input to the SASSI analyses? Was the HRHF GMRS applied directly as surface motion, or was the surface motion developed from the HRHF GMRS applied at the NI foundation level? If the latter, describe in detail the method used to calculate the surface motion.

(d) Define numerically, the range of shear wave velocity of the underlying media for which the special SASSI analyses are valid. Provide a detailed technical basis for this determination (e.g., results from parametric studies, previous documented studies, documented test results, "expert" judgment, etc.)

(e) For all COL applications that reference DCD Appendix 3I and/or TR 115, are the site characteristics enveloped by the range of shear wave velocities defined in (d) above?

Westinghouse Response (Revision 0 & 1):

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.

The only requirement that the COL applicants must demonstrate so that they are currently covered by TR-115 is to demonstrate that their site ground motion response spectra is enveloped by the HRHF spectra as defined in TR-144, and provided below under Technical Report (TR) Revisions. Sites with high shear wave velocities have higher loads due to high frequency than those with lower shear wave velocity. Sites that are enveloped by the HRHF input spectra, but have lower shear wave velocities, will have lower HRHF seismic loads than those used in the evaluation reported in TR-115 and are acceptable for AP1000.

It is not appropriate for Westinghouse to identify the COL applicants that are currently covered by TR-115 along with the minimum shear wave velocity of the underlying medium at each site. This is considered to be part of the COL application.

Westinghouse Response (Revision 2):

a) One Hard Rock Soil Profile was analyzed with ACS SASSI incoherent SSI analysis. Table RAI-SRP3.7.1-SEB1-02-1 shows the hard rock underlying media. There is no side media considered in the analysis. Only one case was considered since it is sufficient to demonstrate that the high frequency seismic input is non-damaging to equipment and structures qualified by analysis for the AP1000 Certified Seismic Design Response Spectra (CSDRS).

b) HRHF shear wave velocity profile is shown in Table RAI-SRP3.7.1-SEB1-02-1.

c) Two horizontal and one vertical synthesized time history was generated which enveloped the HRHF GMRS shown below in Figure 1.0-1 and Figure 1.0-2 under the section titled "Technical Report (TR) Revision." The HRHF GMRS time histories are applied at NI foundation level of 60.5 ft. HRHF GMRS and FIRS are identical for the HRHF sites.

d) There is no specific range of shear wave velocity of the underlying media for which the special SASSI analyses are valid. The only requirement is stated in Westinghouse Response (Revision 0 & 1): "The site ground motion response spectra is enveloped by the HRHF spectra as defined in TR-144." Further it is stated in DCD Revision 17, Tier 1.0, Section 5.0:

> "Structures, systems, and components for the AP1000 are evaluated for generic ground motion response spectra (GMRS) with high frequency seismic input. The spectra shown in Figure 5.0-3 and Figure 5.0-4 provide hard rock high frequency (HRHF) GMRS at the foundation level for both the horizontal and vertical directions for 5% damping. An actual

site is acceptable if its site-specific GMRS falls within the AP1000 HRHF parameters in Figures 5.0-3 and 5.0-4. No additional design or analyses are required for the structures, systems, and components for sites that fall within the AP1000 HRHF parameters."

e) The COL applicants that reference DCD Appendix 3I and/or TR115 need only consider that their site specific GMRS is enveloped by the HRHF GMRS (see item d response).

There are no shear wave requirements or limits given in the Interim Staff Guidance (ISG). The only place that mentions the shear wave velocity is in ISG Section 5, "The staff also expects COL applicants to address quantitatively in terms of soil dynamic properties (e.g., shear wave velocity and/or shear wave velocity gradient) to make it clear what kind of soil/rock needs to have RC/TS testing."

According to the ISG, the shear wave velocity is not a requirement for the high frequency SSC evaluation.

Table RAI-SRP3.7.1-SEB1-02-1 - HRHF Soil Properties

Layer width (ft)	Soil Wt (kcf)	Vs (ft/s)	Vp (ft/s)	Dampin g
5.5	0.16	7847	13591	0.005
5	0.16	9777	16934	0.005
10	0.16	9777	16934	0.005
20	0.16	9777	16934	0.006
20	0.16	9769	16920	0.006
20	0.16	9759	16904	0.007
20	0.16	9754	16895	0.007
20	0.16	9751	16889	0.007
10	0.16	9194	15924	0.007
15	0.16	9191	15920	0.007
Half Space	0.16	9625	16671	0.01

Reference(s): None

Design Control Document (DCD) Revision: (These Changes are in Revision 17)

~~None~~Since it is not necessary to specifically state that a site must be founded on hard rock to be covered by TR-115, the following change is made to Tier 1, DCD Section 5.0, and second paragraph:

> Structures, systems, and components for the AP1000 are evaluated for generic ground motion response spectra (GMRS) with high frequency seismic input. ~~at a site where the nuclear island is founded on hard rock.~~

The second paragraph of Tier 2, Subsection 2.5.2, and second paragraph should be changed to the following:

> The AP1000 is ~~also~~ evaluated ~~at a hard rock site~~ for high frequency input using ~~a safe shutdown earthquake (SSE) defined by a peak ground acceleration (PGA) of 0.30g and~~ the ~~design~~ response spectra specified in Appendix 3I, ~~and~~ Figures 3I.1-1 and 3I.1-2. ~~These design response spectra are applicable to certain east coast rock sites.~~ The seismic response spectra given in Figures 3I.1-1 and 3I.1-2 are bounding (GMRS) with high frequency content.

Modify the first paragraph in Appendix 3I, Subsection 3.I.1, Introduction, to the following:

> The seismic analysis and design of the AP1000 plant is based on the Certified Seismic Design Response Spectra (CSDRS) shown in subsection 3.7.1.1. These spectra are based on Regulatory Guide 1.60 with an increase in the 25 hertz region. Ground Motion Response Spectra (GMRS) for some Central and Eastern United States rock sites show higher amplitude at high frequency than the CSDRS. Evaluations are described in this appendix for a GMRS with high frequency for the seismic input ~~at a site where the nuclear island is founded on hard rock~~. The resulting spectra of this site is shown in Figure 3I.1-1 and Figure 3I.1-2 and compares this hard rock high frequency (HRHF) GMRS at the foundation level against the AP1000 CSDRS for both the horizontal and vertical directions for 5% damping. The HRHF GMRS exceed the CSDRS for frequencies above about 15 Hz.

PRA Revision:

None

Technical Report (TR) Revision (These changes were made to Revision 1):

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 5th paragraph of the introduction to:

A Hard Rock High Frequency (HRHF) spectrum has been developed that envelopes three hard rock sites for which Combined License applications using the AP1000 as the vendor design are being prepared. Figures 1.0-1 and 1.0-2 compare the HRHF at foundation level against the AP1000 CSDRS for both the horizontal and vertical directions for 5% damping. The HRHF exceeds the CSDRS for frequencies above about 15 Hz. Evaluations in this report ~~describe the seismic input at a hard rock site where the nuclear island is founded on hard rock.~~are for Ground Motion Response Spectra (GMRS) with high frequency input.

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.

Replace Appendix 3I, Evaluation for High Frequency Seismic Input, with the version that appears in DCD Revision 17.

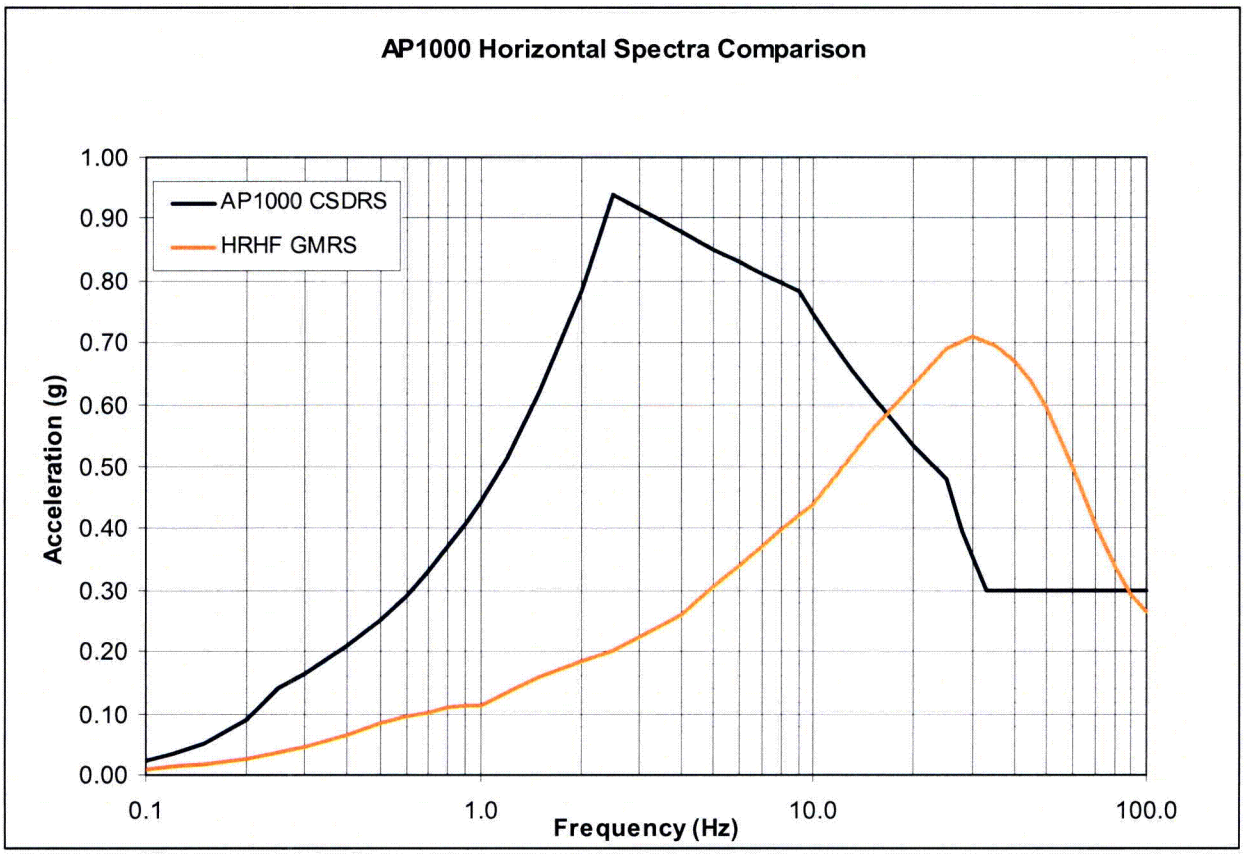

Figure 1.0-1: Comparison of the HRHF horizontal input spectra to the CSDRS

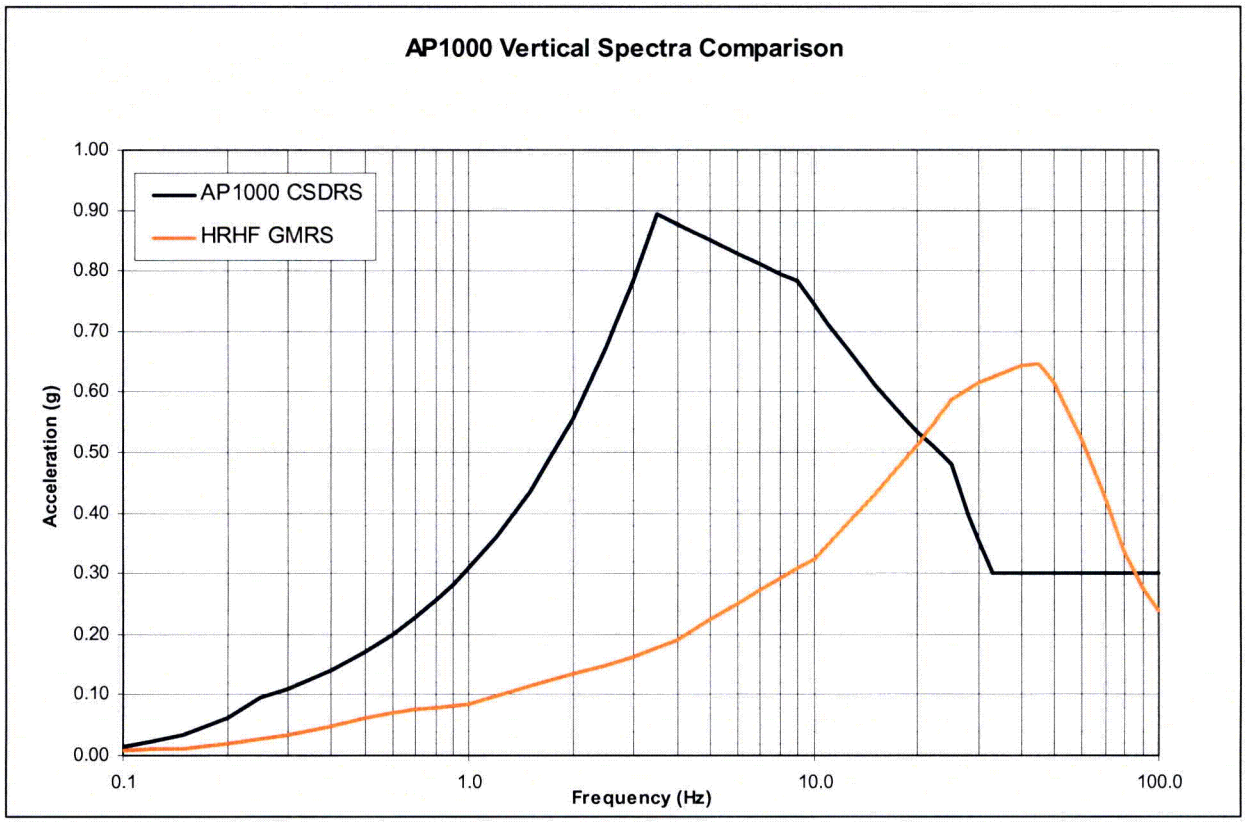

Figure 1.0-2: Comparison of the HRHF vertical input spectra to the CSDRS