HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 166 Related to ESBWR Design Certification Application - Design of Structures, Components, Equipment, and Systems- RAI Number 3.3-3 S02**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC Letter 166 dated March 28, 2008, Reference 1. The GEH response to RAI Number 3.3-3 S02 is addressed in Enclosure 1. The GEH response to RAI 3.3-3 S01 was submitted via Reference 2 in response to Reference 3. The original response was submitted via Reference 4 in response to Reference 5.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.

Should you have any questions about the information provided here, please contact me.

Sincerely,

Lee F. Dougherty for

James C. Kinsey
Vice President, ESBWR Licensing

DC08
NRO

References:

1. MFN 08-316, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 166 Related to the ESBWR Design Certification Application,* dated March 28, 2008.

2. MFN 08-123, Response to NRC Request for Additional Information Letter No. 124 *Related to ESBWR Design Certification Application –Design of Structure, Components, Equipment, and Systems – RAI Numbers 3.3-3 S01 and 3.5-19* dated February 20, 2008.

3. MFN 08-029, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 124 Related to the ESBWR Design Certification Application,* dated January 14, 2008.

4. MFN 06-170, Response to NRC Request for Additional Information Letter No. 27 *Related to ESBWR Design Certification Application – Wind and Tornado Loadings – RAI Numbers 3.3-1 through 3.3-3 and 3.5-16* dated June 16, 2006.

5. MFN 06-143, Letter from U.S. Nuclear Regulatory Commission to David H. Hinds, *Request for Additional Information Letter No. 27 Related to the ESBWR Design Certification Application,* dated May 9, 2006.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 166 Related to ESBWR Design Certification Application - Design of Structures, Components, Equipment, and Systems - RAI Number 3.3-3 S02

cc:	AE Cubbage	USNRC (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	eDRF	0000-0083-5889

Enclosure 1

MFN 08-369

*Response to Portion of NRC Request for

Additional Information Letter No. 166

Related to ESBWR Design Certification Application

Design Of Structures, Components, Equipment, and Systems

RAI Number 3.3-3 S02

***Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.**

For historical purposes, the original text of RAI 3.3-3 and 3.3-3 S01 and the GE/GEH responses are included. The historical responses do not include any attachments or DCD mark-ups.

NRC RAI 3.3-3

DCD Tier 2, Section 3.3.3.2 states that the COL applicant shall ensure that the remainder of plant structures, systems, and components (SSCs) not designed for tornado loads are analyzed for the site-specific loadings to ensure that their modes of failure do not affect the ability of the Seismic Category I ESBWR Standard Plant SSCs to perform their intended functions. Since the site-specific loadings cited above exclude tornado loads, confirm that these SSCs were all assumed to fail under the tornado loadings, and appropriate tornado-related II/I interaction analyses were performed for the SSCs to ensure that their modes of failure do not affect the ability of the Seismic Category I ESBWR Standard Plant SSCs to perform their intended functions.

GE Response

The DCD will be revised to show that C-II structures are designed for tornado loads (wind force only and no missiles) to preclude adverse II/I interactions. Non-safety related, Non-seismic (NS) SSCs are postulated to fail under tornado loadings. The DCD will be clarified to require that these NS structures will be located at least one story height-above-grade from C-I or C-II structures.

DCD Sections 3.3 and 3.3.2.3 will be revised and DCD Section 3.3.3.2 will be deleted in the next update as noted in the attached markups.

NRC RAI 3.3-3 S01

In DCD Revision 3, Section 1.2.2.16.9, the applicant stated that the Radwaste Building is a non-seismic category structure and it is designed according to the safety classification defined in Regulatory Guide (RG) 1.143. Note 1 for Table 2.0-1 of the DCD indicates that the Radwaste Building is classified as Class RW IIa and is designed to the corresponding parameters in Table 2 of RG 1.143. This indicates that, for tornado hazard, the Radwaste Building is designed for three-fifths of the design basis tornado parameters used for seismic Category I structures. Given the exemption of the Radwaste Building from the location criteria and its reduced tornado design criteria, describe in details the approach and the technical bases for ensuring that the failure of the Radwaste Building under full tornado loadings either is precluded or will not adversely impact the safety-related functions of adjacent C-I and C-II SSCs.

GEH Response

The Radwaste Building is designed to provide a sufficient design margin such that it will not collapse under tornado winds specified in RG 1.76, Rev.1. DCD Tier 2 Subsection 3.3.2.3 will be revised to show this clarification. Therefore, there is no adverse impact on the safety-related functions of adjacent C-I buildings under tornado load winds specified in RG 1.76, Rev. 1. It should be noted that the design basis tornado parameters specified in Table 2.0-1 for Seismic Category I structures are much higher than RG 1.76, Rev. 1 values.

Revision 4 of DCD Tier 2 Subsection 3.3.2.3, removed the requirement to locate any NS structure a distance of its height from C-II structure since it was overly conservative. There are no safety-related functions associated with C-II structures.

DCD Impact

DCD Tier 2 Subsection 3.3.2.3 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.3-3 S02

The staff considers GEH's response to supplemental RAI 3.3-3 S01 in Letter No. MFN 08-123 inadequate. GEH did not provide the requested information. The information requested by the staff is for GEH to demonstrate that a potential failure of the Radwaste Building (RWB) under the ESBWR tornado loads is either precluded or will not affect the ability of seismic Category I (C-I) structures, systems, and components (SSCs) to perform their safety functions. The staff continues to ask GEH to provide the requested information.

This information is requested because DCD Section 3.3.2.3 indicates that the RWB is not located a sufficient distance away from C-I SSCs to preclude adverse interaction. Further, according to Note 1 to DCD Table 2.0-1, the RWB is designed to a lower tornado wind speed than that for C-I SSC. These two conditions do not provide a reasonable assurance that, under tornado loading, adverse interaction between the RWB and the adjacent C-I SSCs is avoided.

RG 1.76, Rev. 1 is not referenced by GEH as applicable to the ESBWR design. RG 1.76 Rev. 1 specifies tornado loads that are much lower than those for which GEH is seeking certification for ESBWR. The fact that the RWB is designed to have a sufficient margin not to collapse under the tornado loads specified in RG 1.76, Rev. 1 is not relevant and does not address the potential adverse interaction issue with adjacent C-I SSCs under the ESBWR tornado design criteria.

GEH Response

The Radwaste Building is designed for the tornado wind loads described in DCD Tier 2 Rev. 4 Table 2.0-1. Therefore, any adverse interaction with adjacent C-I structures due to tornado loads is precluded. This response supersedes the response to RAI 3.3-3S01 regarding the design of the Radwaste Building against tornado loads.

In addition, the Radwaste Building will be designed to full SSE instead of ½ SSE as required by RG 1.143; this will preclude any adverse interaction with adjacent C-I structures due to seismic loading.

DCD Tier 2 Subsection 3.3.2.3 and footnote no. 1 of Table 2.0-1 and DCD Tier 1 footnote no. 1 of Table 5.1-1 will be clarified to reflect the above response.

DCD Impact

DCD Tier 2 Subsection 3.3.2.3 and Table 2.0-1 and DCD Tier 1 Table 5.1-1 will be revised in DCD Revision 5 as noted in the attached markup pages.

Notes for Table 2.0-1:

(1) The design of the Radwaste Building uses a set of design parameters that are specified in Regulatory Guide 1.143, Table 2, Class RW-IIa instead of the corresponding values given in this table for all parameters except as follows: (1) Tornado: Winds Speeds, Radius, Pressure Drop, and Rate of Pressure Drop; (2) Seismology: Horizontal and Vertical Ground Spectra: See Figures 2.0-1 and 2.0-2.

(2) Probable maximum flood level (PMF), as defined in Table 1.2-6 of Volume III of Reference 2.0-4.

(3) Maximum speed selected is based on Attachment 1 of Reference 2.0-5, which summarizes the NRC Interim Position on Regulatory Guide 1.76. Concrete structures designed to resist Spectrum I missiles of SRP 3.5.1.4, Rev. 2, also resist missiles postulated in Regulatory Guide 1.76, Revision 1.

(4) Based on probable maximum precipitation (PMP) for one hour over 2.6 km^2 (one square mile) with a ratio of 5 minutes to one hour PMP of 0.32 as found in Reference 2.0-3. Roof scuppers and drains are designed independently to limit water accumulation on the roof to no more than 100 mm (4 in) during PMP conditions. See also Table 3G.1-2.

(5) Maximum design roof load accommodates snow load and 48-hour probable maximum winter precipitation (PMWP) in References 2.0-2 and 2.0-6. Roof scuppers and drains are designed independently to limit water accumulation on the roof to no more than an average depth of 100 mm (4 in) during PMWP conditions. See also Table 3G.1-2.

(6) Zero percent exceedance values are based on conservative estimates of historical high and low values for potential sites. One and two percent annual exceedance values were selected in order to bound the values presented in Reference 2.0-4 and available Early Site Permit applications.

(7) At foundation level of Seismic Category I structures. For minimum dynamic bearing capacity site-specific application, use the larger value or a linearly interpolated value of the applicable range of shear wave velocities at the foundation level. The shear wave velocities of soft, medium and hard soils are 300 m/sec (1000 ft/sec), 800 m/sec (2600 ft/sec) and greater than or equal to 1700 m/sec (5600 ft/sec), respectively.

(8) This is the equivalent uniform shear wave velocity (V_{eq}) over the entire soil column at seismic strain, which is a lower bound value after taking into account uncertainties. V_{eq} is calculated to achieve the same wave traveling time over the depth equal to the embedment depth plus 2 times the largest foundation plan dimension below the foundation as follows:

$$V_{eq} = \frac{\sum d_i}{\sum \frac{d_i}{V_i}}$$

where d_i and V_i are the depth and shear wave velocity, respectively, of the ith layer. The ratio of the largest to the smallest shear wave velocity over the mat foundation width at the foundation level does not exceed 1.7.

3.3.2.1 Applicable Design Parameters

The design basis tornado and applicable missiles are described in Table 2.0-1.

3.3.2.2 Determination of Forces on Structures

The procedures of transforming the tornado loading into effective loads and the distribution across the structures are in accordance with Reference 3.3-3. The velocity pressure used meets the SRP 3.3.2 discussion. The procedure for transforming the tornado-generated missile impact into an effective or equivalent static load on structures is given in Subsection 3.5.3. The loading combinations of the individual tornado loading components and the load factors are in accordance with SRP 3.3.2.

Loading combinations and load factors used are as follows:

$W_t = W_w$

$W_t = W_p$

$W_t = W_m$

$W_t = W_w + 0.5\ W_p$

$W_t = W_w + W_m$

$W_t = W_w + 0.5\ W_p + W_m$

Where:

W_t = total tornado load

W_w = total wind load

W_p = total differential pressure load

W_m = total missile load

The reactor building, fuel building, and control building are not vented (enclosed) structures. The exposed exterior roofs and walls of these structures are designed for the full pressure drop. Tornado dampers are provided on Control Building EFU air intake openings. These dampers are designed to withstand the full negative pressure drop.

All Control Room Habitability Area (CRHA) ventilation penetrations for outside air intake and exhaust openings are provided with tornado protection. In addition, the Control Building HVAC System outside air intake and return/exhaust openings are provided with tornado protection.

3.3.2.3 Effect of Failures of Structures or Components Not Designed for Tornado Loads

Safety-related systems and components are protected within tornado-resistant structures. The remainder of plant structures and components not designed for tornado loads are arranged or designed such that their failures do not adversely affect the ability of any Seismic Category I structures, systems and components to perform their safety-related function(s). Any nonsafety-related, non-seismic (NS) structure ~~(except the Radwaste Building)~~ postulated to fail under tornado loading is located at least a distance of its height above grade from Seismic Category I structures. The Radwaste Building is designed for extreme and tornado wind loads. The Turbine Building is designed for extreme and tornado wind loads (excluding missiles).

Table 5.1-1
Envelope of ESBWR Standard Plant Site ~~Design~~ Parameters (continued)

Meteorological Dispersion (X/Q): (continued)	Fuel Building Cask Doors		
	0-2 hours:	NA	1.50E-03 s/m3
	2-8 hours:	NA	1.30E-03 s/m3
	8-24 hours:	NA	6.80E-04 s/m3
	1-4 days:	NA	5.60E-04 s/m3
	4-30 days:	NA	4.30E-04 s/m3
	Radwaste Building		
	0-2 hours:	NA	1.50E-03 s/m^3
	2-8 hours:	NA	1.30E-03 s/m^3
	8-24 hours:	NA	6.80E-04 s/m^3
	1-4 days:	NA	5.60E-04 s/m^3
	4-30 days:	NA	4.30E-04 s/m^3

Notes:

(1) The design of the Radwaste Building uses a set of design parameters that are specified in Regulatory Guide 1.143, Table 2, Class RW-IIa instead of the corresponding values given in this table for all parameters except as follows: (1) Tornado: Wind Speeds, Radius, Pressure Drop, and Rate of Pressure Drop; (2) Seismology: Horizontal and Vertical Group Spectra: See Tier 2 Figures 2.0-1 and 2.0-2.

(2) At foundation level of Seismic Category I structures. For minimum dynamic bearing capacity site-specific application, use the larger value or a linearly interpolated value of the applicable range of shear wave velocities at the foundation level. The shear wave velocities of soft, medium and hard soils are 300 m/sec (1000 ft/sec), 800 m/sec (2600 ft/sec) and greater than or equal to 1700 m/sec (5600 ft/sec), respectively.

(3) This is the equivalent uniform shear wave velocity (Veq) over the entire soil column at seismic strain, which is a lower bound value after taking into account uncertainties. Veq is calculated to achieve the same wave traveling time over the depth equal to the embedment depth plus 2 times the largest foundation plan dimension below the foundation as follows:

$$V_{eq} = \frac{\sum d_i}{\sum \frac{d_i}{V_i}}$$

where d_i and V_i are the depth and shear wave velocity, respectively, of the ith layer. The ratio of the largest to the smallest shear wave velocity over the mat foundation width at the foundation level does not exceed 1.7.

(4) Safe Shutdown Earthquake (SSE) design ground response spectra of 5% damping, also termed Certified Seismic Design Response Spectra (CSDRS), are defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor/Fuel and Control Building structures. For ground surface founded Fire Water Service Complex structures, the CSDRS is 1.35 times the values shown in Figures 5.1-1 and 5.1-2.