GE Energy

James C. Kinsey
Project Manager, ESBWR Licensing

PO Box 780 M/C J-70
Wilmington, NC 28402-0780
USA

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

MFN 06-206
Supplement 1

Docket No. 52-010

May 8, 2007

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 37 Related to ESBWR Design Certification Application – Siting Issues – RAI Numbers 2.3-2 S01, 2.3-3 S01 and 2.3-4 S01**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via e-mail on April 2, 2007. GE's original response was provided in the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

D068

Reference:

1. MFN 06-206, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 37 Related to ESBWR Design Certification Application – Siting Issues, Hydrological Engineering – RAI Numbers 2.1-1, 2.2-1 through 2.2-3, 2.3-1 through 2.3-6, 14.3-22, 15.3-1, 15.3-3, and 2.4-32,* July 31, 2006

Enclosure:

1. MFN 06-206, Supplement 1 – Response to Portion of NRC Request for Additional Information Letter No. 37 Related to ESBWR Design Certification Application – Siting Issues – RAI Numbers 2.3-2 S01, 2.3-3 S01 and 2.3-4 S01

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GE (with enclosures)
	RE Brown	GE (w/o enclosures)
	eDRF	0000-0067-5213/1

Enclosure 1

MFN 06-206, Supplement 1

Response to Portion of NRC Request for

Additional Information

Related to ESBWR Design Certification Application

Siting Issues

RAI Numbers 2.3-2 S01, 2.3-3 S01 and 2.3-4 S01

Original Responses previously submitted under MFN 06-206 are included without DCD updates to provide historical continuity during review.

NRC RAI 2.3-2

In DCD Tier 2, Table 2.0-1, what is the basis for selection of the extreme winds used for design of safety-related structures? For example, are the speeds based upon historical fastest mile measurements or a percent exceedance over a certain period of time?

GE Response

The extreme wind speed of 62.6 m/s (140 mph) was selected to comply with expected requirements of southeastern coastal locations. This speed is approximately in the middle of wind speeds seen in a Category 4 hurricane. It exceeds the maximum wind speed value of 54.7 m/s based on a 100-year recurrence interval that was used for the design of safety-related structures in the ABWR design certification.

DCD Table 2.0-1 will be updated to clarify the basis for this value as shown in the attached markup.

NRC RAI 2.3-2 S01

Comments on response to RAI 2.3-2 (also related to RAI 14.3-22):

In reviewing the response to the RAI 2.3-2 dated July 31, 2006 contained in MFN 06-206 and the subsequent Revision 3 to the DCD, the staff notes the following regarding the basis for the selected extreme wind standard plant site design parameters:

The response to RAI 2.3-2 states that the DCD Revision 0 selected extreme wind speed value of 62.6 m/s (140 mph) is approximately in the middle of wind speeds seen in a Category 4 hurricane. Assuming the selected extreme wind speed value is a 3-second gust "basic wind speed value" as defined by SEI/ASCE 7-02, the selected extreme wind speed value represents a strong Category 2 hurricane rather than a moderate Category 4 hurricane. This is because the Saffir-Simpson Hurricane Scale is based on 1-minute average wind speeds whereas the value of the maximum 3-second gust in a hurricane environment is approximately 30 percent higher than the 1-minute average wind speed. Similarly, the higher DCD Revision 3 selected extreme wind speed value of 67.1 m/s (150 mph) represents a weak to moderate Category 3 hurricane.

- *Contrary to what is stated in the response to RAI 2.3-2, the updated DCD Revision 3 Tier 2 Table 2.0-1 did not describe the basis for the selected extreme wind standard plant site design parameters.*
- *It is unclear whether the 49.2 m/s (110 mph) extreme wind standard plant site design parameter for non-seismic structures is a 3-second gust wind speed.*

Consequently, please provide the following:

(a) Revise DCD Tier 1 Table 5.1-1 and Tier 2 Table 2.0-1 to provide the basis for the selection of the extreme wind standard plant site design parameters for seismic category I and II structures as well as non-seismic standard plant structures.

(b) Clarify whether the 49.2 m/s (110 mph) extreme wind standard plant site design parameter for non-seismic plant structures is a 3-second gust wind speed.

GE Response

(a) DCD Revision 3 is the result of multiplying the 62.6 m/s (140 mph) by the square root of the Importance Factor 1.15, which gives 67.1 m/s (150 mph) to account for the 100-year recurrence. It places it in the upper quartile of category 3 hurricanes in the Saffir-Simpson scale (Table 10.3 FEMA 361). Reference to the middle of category 4 in the previous response was a carry-over from the definition of the 1-minute average wind speed and is not correct. Note 13 will be added to DCD Tier 2 Table 2.0-1, to provide the basis for the selection of the extreme wind speed.

(b) The 49.2 m/s (110 mph) extreme wind standard plant site design parameter for non-seismic plant structures is for 50-year occurrence and represents the fastest mile wind. This was selected based on Table 1.2-6, Volume III of the Utility Requirements Document (URD).

DCD Impact

DCD Tier 2, Table 2.0-1 will be revised as noted in the attached markup. The same change will be made to DCD Tier 1, Table 5.1-1.

NRC RAI 2.3-3

With respect to design temperatures given in DCD Tier 2, Table 2.0-1, what is the definition of the zero and one percent design temperature exceedances? For example, is the zero percent exceedance the historical high or low value as stated in Tier I Table 5.1-1? Is the one percent exceedance an annual exceedance or is it a 100 year return value? Please revise tables and text to provide this level of detail at all places where values are given.

GE Response

The zero percent exceedance values for design temperatures given in DCD Tier 2, Table 2.0-1 are the historical high or low values as stated in Tier 1, Table 5.1-1.

The one percent exceedance values are also historical values based on a review of the data available in the ESP applications submitted by Dominion, Entergy and Exelon for the North Anna, Grand Gulf and Clinton sites, respectively. Table 1.2-6 in Volume III of the Utility Requirements Document (URD) was also reviewed. A set of parameters that bounds all three sites and the URD were selected for use in the ESBWR DCD.

The attached markup shows how the DCD tables and text will be updated to reflect this clarification.

DCD Impact

Markups of the DCD were provided in MFN 06-206.

NRC RAI 2.3-3 S01

Comments on response to RAI 2.3-3:

This RAI addresses a concern that the ESBWR zero percent exceedance (historic limit) maximum dry bulb temperature and maximum non-coincident wet bulb temperature standard plant site design parameters may not bound a reasonable number of sites.

In order to determine whether the ambient design temperature standard plant site design parameters bound a reasonable number of sites that may be considered within a COL application, the staff compared the ESBWR ambient design temperature standard plant site design parameters to the ambient air temperature and humidity site characteristics identified in the Safety Evaluations for the first three docketed Early Site Permit Applications. In performing this comparison, the staff considers the zero percent exceedance or historic limit ambient design temperature standard plant site design parameters presented in the ESBWR DCD to be equivalent to 100-year return period ambient air temperature and humidity site characteristic values presented in the first three docketed ESP Safety Evaluations.

The staff found that the ESP 100-year return period maximum dry bulb temperature site characteristic for Clinton, 117°F, was higher than the ESBWR zero percent exceedance (historic limit) standard plant site design parameter of 115°F. Likewise, the staff found that the ESP 100-year return period maximum non-coincident wet bulb temperature site characteristics for North Anna and Clinton, 88°F and 86°F, respectively, were higher than the ESBWR zero percent exceedance (historic limit) standard plant site design parameter of 85°F. Consequently, the ESBWR zero percent exceedance (historic limit) maximum dry bulb temperature and maximum non-coincident wet bulb temperature standard plant site design parameters may not bound a reasonable number of sites that may be considered within a COL application.

Consequently, please revise the ESBWR zero percent exceedance (historic limit) maximum dry bulb temperature and maximum non-coincident wet bulb temperature standard plant site design parameters to be more inclusive of a number of sites that may be considered within a COL application.

GE Response

GE has reviewed the staff's Safety Evaluation Reports for North Anna (NUREG-1835, Table 2.3.1-1) and Clinton (NUREG-1844, Table 2.3.1-5), and agrees with the requested change in 0% exceedance values.

DCD Impact

DCD Tier 2, Table 2.0-1, will be revised as noted in the attached markup. The same change will be made to DCD Tier 1, Table 5.1-1.

NRC RAI 2.3-4

What is the basis for the maximum rainfall rate and maximum snow load for the roof design given in DCD tier 2, Tale 2.0-1? Is the maximum rainfall rate assumed to be over a period of five minutes?

GE Response

The maximum rainfall rate and maximum snow loads were taken from the Advanced Light Water Reactor Utility Requirements Document (URD), Volume III, Table 1.2-6. These values are also the same as those that were applied during design certification of the Advanced Boiling Water Reactor (ABWR).
As Indicated in the text of Table 2.0-1 for Subsection 2.3.1, the maximum rainfall rate in the URD was obtained from National Weather Service Publication HMR No. 52 using the probable maximum precipitation (PMP) for 1 hour over a 2.6×10^6 m^2 (1 sq. mile) area with a PMP ratio of 5 minutes to 1 hour of 0.32.
DCD Table 2.0-1 will be updated to clarify that the URD is the source of these values as shown in the attached markup.

NRC RAI 2.3-4 S01

Comments on response to RAI 2.3-4:

This RAI addresses the design values and bases for winter precipitation loads to be included in the combination of (1) normal live loads and (2) extreme live loads.

Tier 1 Table 5.1-1 and Tier 2 Table 2.0-1 of DCD Revision 3 state that the maximum design roof load of 2873 Pa (60 lbf/ft2) accommodates snow load and probable maximum winter precipitation as specified in ASCE 7-02 and HMR-52. The March 24, 1975 Site Analysis Branch Position on Winter Precipitation Loads (ML050470024) states that (1) winter precipitation loads to be included in the combination of normal live loads should be based on the weight of the 100-year snowpack or snowfall, whichever is greater, recorded at ground level, and (2) winter precipitation loads to be included in the combination of extreme live loads should be based on the addition of the weight of the 100-year snowpack at ground level plus the weight of the 48-hour Probable Maximum Winter Precipitation (PMWP) at ground level for the month corresponding to the selected snowpack. Modifications to this procedure are allowed for certain areas where it can be satisfactorily demonstrated that the PMWP could neither fall nor remain entirely on top of the antecedent snowpack and/or roofs.

Consequently, please update the DCD to provide the design values and bases for winter precipitation loads to be included in the combination of (1) normal live loads and (2) extreme live loads. Note that the 48-hour PMWP should be based on data presented in HMR-53.

GE Response

The roof load design bases for concrete structures is 2873 Pa (60 psf) which is multiplied by the Load Factors indicated depending on the particular combination and is combined with other loads as shown on DCD Table 3.8-15.
The rain and snow loads are described in Section 3G.1.5.2.1.2.
The live load represents a 100-year return ground snow load of 2394 Pa (50 psf) that on the roof is 60% of that based on exposure and thermal conditions (ASCE 7 Commentary). Therefore, the basic roof snow load is 1436 Pa (30 psf). The lower lip of roof scuppers is 100 mm (4 in) above the roof and assuming all primary roof drains are clogged, this added load is 996 Pa (21 psf).
The PMWP is based on the 48-hour PMWP in HMR 53 Section 6 example calculation for December, January, February and the drainage system (roof drains and scuppers independently) will be sized accordingly. Therefore, the total maximum conservative loading (rain + snowpack) would be 2442 Pa (51 psf), which is less than the design live load of 2873 Pa (60 psf).

DCD Impact

DCD Tier 2 Table 3G.1-2 will be revised as noted in the attached markup to clarify that the ground snow load represents a 100-year recurrence interval.

2.0-5 U. S. Nuclear Regulatory Commission, "A Risk-Informed Approach to Defining the Design Basis Tornado for New Reactor Licensing," SECY 04-0200, October 26, 2004.

Table 2.0-1

Envelope of ESBWR Standard Plant Site Design Parameters [1]

Maximum Ground Water Level:	0.61 m (2 ft) below plant grade	
Extreme Wind:	**Seismic Category I and II Structures** - 100-year Wind Speed (3-sec gust): [13] - Exposure Category: **Non-Seismic Standard Plant Structures** - 50-year Wind Speed (fastest mile wind):	 67.1 m/s (150 mph) D 49.2 m/s (110 mph)
Maximum Flood (or Tsunami) Level: [2]	0.3 m (1 ft) below plant grade	
Tornado:	- Maximum Tornado Wind Speed: [3] - Maximum Rotational Speed: - Translational Velocity: - Radius: - Maximum Pressure Differential: - Rate of Pressure Change: - Missile Spectra: [3]	147.5 m/s (330 mph) 116.2 m/s (260 mph) 31.3 m/s (70 mph) 45.7 m (150 ft) 16.6 kPa (2.4 psi) 11.7 kPa/s (1.7 psi/s) Spectra I of SRP 3.5.1.4, Rev 2 applied to full building height.
Precipitation (for Roof Design):	- Maximum Rainfall Rate: [4] - Maximum Short Term Rate: - Maximum Roof Load: [5]	49.3 cm/hr (19.4 in/hr) 15.7 cm (6.2 in) in 5 minutes 2873 Pa (60 lbf/ft^2)
Ambient Design Temperature: [6]	**2% Exceedance Values** - Maximum: 35.6°C (96°F) dry bulb 26.1°C (79°F) wet bulb (coincident) 27.2°C (81°F) wet bulb (non-coincident) - Minimum: -23.3°C (-10°F) **1% Exceedance Values** - Maximum: 37.8°C (100°F) dry bulb 26.1°C (79°F) wet bulb (coincident) 27.8°C (82°F) wet bulb (non-coincident) - Minimum: -23.3°C (-10°F) **0% Exceedance Values** - Maximum: 47.2°C (117°F) dry bulb 26.7°C (80°F) wet bulb (coincident) 31.1°C (88°F) wet bulb (non-coincident) - Minimum: -40°C (-40°F)	
Soil Properties:	- Minimum Static Bearing Capacity: [7] - Minimum Shear Wave Velocity: [8] - Liquefaction Potential:	≥ 718 kPa (15000 lbf/ft^2) 300 m/s (1000 ft/s) None under footprint of Seismic Category I or II structures.

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.

(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, will 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 are designed to handle the PMP. When used in combination with snow pack, the roof and drainage design is for 2873 Pa (60 lbf/ft^2) extreme load. See also Table 3G.1-2.

(5) Maximum design roof load accommodates snow load and probable maximum winter precipitation in References 2.0-2 and 2.0-3. 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 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. See Subsections 3G.1.5.5, 3G.2.5.5 and 3G.3.5.5 for minimum dynamic bearing capacity for the Reactor, Control and Fuel Buildings, respectively.

(8) This is the equivalent uniform shear wave velocity (V_{eq}) at seismic strains after the soil property uncertainties have been applied. 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.

(9) Safe Shutdown Earthquake (SSE) design ground response spectra are defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of Seismic Category I structures.

(10) Values reported here are actually design criteria rather than site design parameters. They are included here because they do not appear elsewhere in the DCD.

(11) If a selected site has a X/Q value that exceeds the ESBWR reference site value, the COL applicant will address how the radiological consequences associated with the controlling design basis accident continue to meet the dose reference values provided in 10 CFR 50.34(a) and control room operator dose limits provided in General Design Criterion 19 using site-specific X/Q values.

(12) If a selected site has a X/Q value that exceeds the ESBWR reference site value, the release concentrations in Table 12.2-17 would be adjusted proportionate to the change in X/Q. In addition, for a site selected that exceeds the bounding X/Q or D/Q values, the COL applicant will address how the resulting annual average doses (Table 12.2-18b) continue to meet the dose reference values provided in 10 CFR 50 Appendix I using site-specific X/Q and D/Q values.

(13) Value was selected to comply with expected requirements of southeastern coastal locations.

Table 3G.1-2

Site Design Parameters

Parameter	Value(s)
Soil:	
Minimum shear wave velocity, m/s (ft/s)	300 (1000)
Maximum Ground Water Level, m (ft)	0.61 (2.0) below grade
Maximum Flood Level, m (ft)	0.30 (1.0) below grade
Maximum Ground Snow Load (100 years recurrence interval), kPa (lbf/ft^2)**	2.394 (50)
Design Temperatures (0% exceedance values)	
Summer, °C (°F)	46.1 (115)
Winter, °C (°F)	-40.0 (-40)
Seismology: For seismic design parameters, refer to Subsection 3.7.1.	
Extreme Wind	
Basic wind speed (100 year recurrence interval), m/s (mi/hr)*	67.1 (150)
Exposure Category	Exposure D
Tornado	
Maximum Tornado wind speed, m/s (mi/hr)	147.5 (330)
Maximum Rotational Speed, m/s (mi/hr)	116.2 (260)
Maximum Translational Speed, m/s (mi/hr)	31.3 (70)
Radius, m (ft)	45.7 (150)
Maximum Pressure Drop, kPa (psi)	16.6 (2.4)
Maximum Rate of Pressure Drop, kPa/s (psi/s)	11.7 (1.7)
Missile Spectrum	Spectra I of SRP 3.5.1.4, rev. 2 applied to full building.
Maximum Rainfall**	
Design rainfall, cm/hr (in/hr)	49.3 (19.4)

Note * Equivalent to 62.6 m/s (140 mi/hr) 50-year recurrence interval speed with importance factor of 1.15 per ASCE 7-02.

** 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 National Weather Source Publication Hydrometeorology Report No. 52 (HMR-52). 49.3 cm/hr (19.4 in/hr) for maximum rainfall rate is selected for design. The maximum short term rate selected is 15.7 cm (6.2 in) in 5 minutes. The roof scuppers are designed to handle the PMP. When used in combination with the snow pack on the ground, the roof is designed for 2873 Pa (60 psf) as live load category on all Seismic Category I structures. ASCE 7-02 requirements for snow are used to analyze the various roof geometries and heights.