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MFN 08-199, Supplement 1

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U.S. Nuclear Regulatory Commission
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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 214 Related to ESBWR Design Certification Application ESBWR RAI Number 19.1-169, Supplement 1**

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) dated April 23, 2008 (Reference 1). The previous RAI and responses to RAI 19.1-169 were transmitted in References 2 and 3.

The GEH response to RAI Number 19.1-169 S01 is in Enclosure 1.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

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Vice President, ESBWR Licensing

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NRO

References:

1. MFN 08-552, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 214 Related To ESBWR Design Certification Application*, dated June 25, 2008.

2. MFN 08-199, *Response to Portion of NRC Request for Additional Information Letter No. 132 Related to E5BWR Design Certification Application, RAI Numbers 19.1-156 through 19.1-159,19.1-165 Through 19.1-170 and 22.5-20*, Dated March 8, 2008.

3. MFN 08-040. Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown," *Request For Additional Information Letter No. 132 Related To ESBWR Design Certification Application.* January 15, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 214 Related to ESBWR Design Certification Application DCD Tier 1 RAI Number 19.1-169 S01

cc:

AE Cubbage	USNRC (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
eDRF	0000-0087-7615

Enclosure 1

MFN 08-199, Supplement 1

Response to Portion of NRC Request for

Additional Information Letter No. 214

Related to ESBWR Design Certification Application

Probabilistic Risk Assessment

RAI Number 19.1-169 S01

Note: The original text of the RAI is provided for ease of reference.

RAI Response 19.1-169 (original)

Please explain the basis for assuming in the high winds risk assessment that no hurricane or tornado will significantly damage any ESBWR Seismic Category 1 and 2 structure.

GEH Response (original response)

Please refer to GEH response to RAI 19.1-167 for a discussion and table providing information on wind speeds and impact to ESBWR structures.

DCD/NEDO-33201 Impact (original)

No DCD change will be made in response to this RAI.
No change to the NEDO-33201, Rev. 3 will be made in response to this RAI.

RAI Response 19.1-169 S01 *Revised*
(Note: This RAI supercedes RAI 19.1-169 S01 issued in RAI Letter 186)

GEH's response to RAI 19.1-169 indicated that the buildings were built to withstand seismic criteria and are assumed to be able to withstand high winds. It did not provide a technical basis for why hurricane or tornados cannot at any probability damage seismic Category I or II structures. Their argument is a deterministic, not a probabilistic one.

Explain the basis for assuming in the high winds risk assessment that no hurricane or tornado will significantly damage any ESBWR Seismic Category 1 and 2 structure.

[In addition, please provide the engineering basis for the estimated probability of failure of a Seismic Category I structures when subjected to a Category 4 or 5 hurricane.

In general, please justify why the conditional probability of a Seismic Category I structure suffering significant damage from a Category 4 or 5 hurricane (considering that Category 5 winds may exceed those assumed in the ESBWR FSAR) is smaller that 10^{-7}.

One acceptable approach is to compare the design loads generated by a hurricane load combination to the actual controlling design or failure loads of the structure. Based on the controlling design load or the actual estimated failure load of the structure, estimate an equivalent failure hurricane wind speed and its associated annual exceedance probability. Calculate the structural failure probability associated with the equivalent failure hurricane wind. Discuss the calculations and major assumptions made.]

GEH Response

The information used in the PRA high winds risk analysis is based on the ESBWR bounding site characteristics for extreme wind and tornados. The site characteristics defining wind events are specified based on the seismic classification of ESBWR structures and are used to determine wind loadings for hurricanes and tornados. A summary of this information is provided in the DCD, Rev. 5, Table 2.0-1. By applying the wind loadings associated with each of the wind events, an assessment of potential damage is predicted for site structures based on the seismic classification of the structures. A summary of the potential site damage for specific wind events is contained in NEDO-33201, Rev. 3 Table 14.3-1 for hurricane winds and Table 14.3-2 for tornado winds.

For hurricane wind loads, the loading is based on the basic wind speed and is applied to the roof slabs and external, above grade walls of the structures. Similarly, the tornado wind loading is based on the maximum tornado wind speed and is applied to the roof slabs and external, above grade walls of the structures. In addition to the wind velocity component of the tornado wind load, differential pressure loads and missile loads are included in the overall tornado wind load and applied to the structures (see example below). For the site characteristics and design basis data shown in the table below, wind load values for seismic category I structures ranged from 7 to 9 kN/m^2 for hurricane events and from 9 to 13 kN/m^2 for tornados (equal to maximum force of about 22 MN). This comparison of the hurricane and tornado wind loads shows the tornado wind

loadings to be equivalent to or greater than the hurricane wind loads. For the ESBWR, tornados represent the dominant force in generating potential high wind damage to site structures.

Wind Loads for Tornado, W_t

$$W_t = W_w + 0.5\ W_p + W_m$$

where

W_w = total wind load

W_p = total differential pressure load

W_m = total missile load

In order to assess potential damage to ESBWR structures predicted from wind events, the seismic classification of the structures was used. Design basis seismic forces applied to the ESBWR seismic category I structures ranged from about 45 to 840 MN. The forces associated with the design basis seismic events represent forces that are two to almost 40 times greater than the forces associated with the high wind events. Thus, the high wind forces are bounded by the seismic forces with considerable margin. Because the ESBWR seismic category I structures are designed to withstand these seismic forces, it is reasonable to assume that high wind events do not result in forces that would adversely impact the seismic fragility of the ESBWR structures. The margin established by the seismic design basis of the ESBWR supports the structural damage predictions used in the PRA high wind analysis.

ESBWR Buildings		ESBWR Design Basis		
Name	ID	Seismic Category[1]	Hurricane Basic Wind Speed (mph)	Tornado[2] Maximum Tornado Wind Speed (mph)
Reactor Building	RB	I	150[3]	330
Control Building	CB	I	150[3]	330
Fuel Building	FB	I	150[3]	330
Fire Water Service Building	FWSB	I	150[3]	330
Turbine Building	TB	NS[6]	195[7]	330
Service Building	SB	II	150[3]	330
Radwaste Building	RW	NS[4]	130[5]	330
Circulating Water Pump House	CP	NS	130[5]	---
Service Water Building	SF	NS[6]	195[7]	---
Electrical Building	EB	NS[6]	195[7]	---

Notes: [1] Building classification based on Table 3.2-1, Rev. 5 of DCD
[2] Wind event speeds based on Table 2.0-1, Rev. 5 of DCD
[3] 100-year wind speed based on 3-sec gust
[4] Requirements based on RG 1.143 for Safety Class RW-IIa, some exceptions – see Note 1: Table 2.0-1
[5] 50-year wind speed based on 3-sec gust

[6] Building classification based on Section 3.2-1, Rev. 5 of DCD (last paragraph)
[7] Category 5 Hurricane, 3-sec gust wind speed over water

The bounding site characteristics and design basis data form the basis for the PRA high wind risk analysis. In conducting the high wind risk analysis, some wind events have the potential to exceed bounding site characteristics for high wind events. For example, hurricane wind speeds associated with a Category 5 wind event may exceed the ESBWR site characteristics. However, as demonstrated by the analysis of wind loads to seismic category I structures, these wind events are bounded by the site characteristic tornado winds, and for PRA purposes, no damage is assumed. In conjunction with the design basis for site structures, all ESBWR structures are assumed to be constructed and maintained to survive the design basis wind events.

Recognizing that some damage to these structures may occur at some point during certain high wind events, a sensitivity was conducted to evaluated the impact to CDF for a postulated wind damage scenario beyond site characteristics and design basis. Wind damage to seismic category I and II structures would be localized and not considered significant. A sensitivity was performed on select components of the seismic category II portion of the fire protection system (FPS). Insights on possible localized damage scenarios and the results are included in NEDO-33201, Rev. 3 Section 22.14.4.

DCD/NEDO-33201 Impact

No DCD change was required in response to this RAI.

NEDO-33201, Rev. 3 was updated to provide the additional predicted wind damage tables and the high wind sensitivities as clarification in support of this RAI.