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MFN 08-336, Supplement 2

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 264 Related to ESBWR Design Certification Application ESBWR RAI Number 22.5-9 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) (Reference 1). The previous RAIs and response are in References 2 through 5. The GEH response to RAI Number 22.5-9 S02 is in Enclosure 1.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 08-810, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 264 Related To ESBWR Design Certification Application*, October 6, 2008.

2. MFN 08-477, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 194 Related To ESBWR Design Certification Application*, dated May 13, 2008.

3. MFN 08-336, S01, *Response to Portion of NRC Request for Additional Information Letter No. 194 Related to ESBWR Design Certification Application ESBWR RAI Numbers 22.5-5 S01, 22.5-9 S01, dated August 26, 2008.*

4. MFN 07-357, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 101 Related To ESBWR Design Certification Application*, June 21, 2007.

5. MFN 08-336, *Response to Portion of NRC Request for Additional Information Letter No. 101 Related to ESBWR Design Certification Application, RAI Numbers 22.5-5 & 22.5-9,* dated April 17, 2008.

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 264 Related to ESBWR Design Certification Application Regulatory Treatment of Non-Safety Systems (RTNSS) RAI Number 22.5-9 S02

2. Attachment 1, DCD Tier 2, Revision 6 Markups

cc:

AE Cubbage	USNRC (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
eDRF Section	0000-0095-7087 (RAI 22.5-9 S02)

Enclosure 1

MFN 08-336 , Supplement 2

Partial Response to NRC RAI Letter No. 264

Related to ESBWR Design Certification Application

Regulatory Treatment of Non-Safety Systems (RTNSS)

RAI Number 22.5-9 Supplement 2

[1] **Original Responses previously submitted under MFN 08-336 and MFN 08-336 S01 are included to provide historical continuity during review.**

NRC RAI 22.5-9

Section 19A.8.3, Augmented Design Standards, states that in addition to seismic standards, Criterion B systems must meet design standards to withstand winds and missiles generated from a category 5 hurricane. It further states that: "the plant design for protection of SSCs from the effects of flooding considers the relevant requirements of General Design Criterion 2, Design Bases for Protection Against Natural Phenomena, and 10 CFR Part 100, Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants, Section IV.C as related to protecting safety-related SSC from the effects of floods, tsunamis and seiches. The design meets the guidelines of Regulatory Guide 1.59 with regard to the methods utilized for establishing the probable maximum flood (PMF), probable maximum precipitation (PMP), seiche and other pertinent hydrologic considerations; and the guidelines of Regulatory Guide 1.102 regarding the means utilized for protection of safety-related SSC from the effects of the PMF and PMP. "
Please provide a discussion including key examples for demonstrating how the stated deterministic evaluation requirements were implemented for the RTNSS systems.

GEH Response

Please see response to RAI 22.5-5.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 22.5-9 Supplement 1

GEH's response to RAI 22.5-9 did not provide sufficient details about the design of RTNSS SSCs with respect to hurricanes. Additionally, the information provided in GEH's response to RAI 22.5-5 requires additional clarifications. The staff requests the following information to be provided in the DCD:

a - Identify the 3-second gust wind speed used in the design for the Category 5 hurricane.

b - Confirm that the procedures used for calculating and distributing the wind pressure and all the associated parameters that account for the physical and geometrical conditions of the structures are in accordance with the DCD Tier 2, Rev. 4, Section 3.3.1. Otherwise, fully describe the alternative procedure used.

c - Confirm that the hurricane missile spectrum is consistent with the tornado missile spectrum identified in DCD Tier 2, Rev. 4, Table 2.0-1. Otherwise, fully describe the alternative missile spectrum used.

d - Explain how the design of the Turbine Building for tornado winds without missiles will envelop the demands of a Category 5 hurricane wind with missiles. If hurricane missiles are assumed to penetrate the building, describe the protection provisions implemented to protect RTNSS systems from missile damage as stated in Table 19A-4.

GEH Response

a. The Category 5 Hurricane wind speed used in the design is 195 mph, 3-second gust.

b. The Seismic Category I and II structures that house Criterion B systems are designed in accordance with DCD Tier 2 Rev. 5 Section 3.3.1. For non-seismic (NS) structures that house Criterion C systems, the wind design procedure is in accordance with the IBC-2003.

c. The standard missile used to determine impact resistance is a 6.8 kg (15 lbs) 2x4 (nominal) wood stud in accordance with FEMA 361. The missile impact velocity is equal to the hurricane wind speed of 195 mph, 3-second gust, times the shape factor. The shape factor is 0.4 for horizontal travel and 0.27 for vertical travel. Missile angle of impact is 90 degrees to the surface.

d. The Turbine Building (TB) is designed for Tornado winds, hurricane Category 5 winds and missiles generated by hurricane. The TB enclosure or barrier design against hurricane-generated missiles meets the requirements of FEMA 361, Section 6. These requirements are incorporated in the Design Specifications and implemented in the detailed design.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 22.5-9 Supplement 2

GEH's response to Supplement 1 to RAI 22.5-9 did not include the information provided in the DCD as requested. This information represents design criteria and must be included in the DCD. Additionally, the missile spectrum proposed by GEH is not adequately justified. The staff requests the following:

1. Include the 195 mph, 3-second gust as the design wind speed associated with Category 5 hurricanes in the DCD.

2. Justify the use of the FEMA 361 2x4 wood stud as an appropriate missile for the design of a nuclear facility. This justification must address the following:

a. FEMA 361 adopted the 2x4 wood stud missile based on field observations of residential communities after severe wind phenomena. Justify how the 2x4 wood stud would represent common objects that could be found in the vicinity of nuclear power plants and could become a missile in the path of a wind storm.

b. FEMA 361 does not contain mathematical formulas to calculate an equivalent force to represent the effect of missile impact on objects. Provide the models which will be used to quantify that effect and justify the adequacy of the models for use with the 2x4 missile considering missile's mechanical properties.

c. FEMA 361 does not contain load combinations to combine the effect of the missile impact with other loads present on the impacted object at the time of impact. Provide load combinations to assess the effects of this loading condition and justify their use.

d. FEMA 361's conclusions are based on experiments conducted for wall panel compositions and configurations representative of residential construction. Justify the applicability of these conclusions to the construction materials, wall compositions, and structural arrangements used in ESBWR design.

Otherwise, assume that the hurricane missile spectrum is consistent with the tornado missile spectrum indentified in DCD Tier 2, Rev. 5, Table 2.0-1, which is also consistent with the staff's implementation of SECY-96-128 delineated in the staff's memorandum to the Commission dated June 23, 1997 and titled "Implementation of Staff Position in SECY-96-128, Policy and Key Technical Issues Pertaining to the Westinghouse AP600 Standard Pressurized Reactor
Design", Related to post-72 Hour Actions."

3. Provide the design criteria associated with hurricane missiles in the DCD.

GEH Response

1. DCD Tier 2 Subsection 19A.8.3 and Table 19A-4 will be revised to include Hurricane Category 5 equivalent to 195 mph, 3-sec gust.

2. The hurricane missile spectrum will be changed to be consistent with the tornado missile spectrum identified in DCD Tier 2 Rev. 5 Table 2.0-1 in compliance with SECY-96-128 as the NRC requested. DCD Tier 2 Subsection 19A.8.3 and Table 19A-4 will be revised to include the hurricane missile spectrum description.

3. The design criteria associated with hurricane missiles follows DCD Tier 2 Rev. 5 Section 3.5 for missiles generated by natural phenomenon. The tornado wind speed is substituted with hurricane wind speed to design the concrete or steel barriers against missile impact. DCD Tier 2 Subsection 19A.8.3 and Table 19A-4 will be revised to include the design criteria associated with hurricane missiles.

Table 19A-4, column D will be revised to state that the Ancillary Diesel Building and the Turbine Building design includes Category 5 hurricane wind loads.

DCD Impact

DCD Tier 2 Subsection 19A.8.3 and Table 19A-4 will be revised in DCD Revision 6 as noted in the attached markups.

Attachment 1

DCD Tier 2, Revision 6 Markups

Section 19A.8.3 Augmented Design Standards

Table 19A-4 Capability of RTNSS Related Structures

LRO - If a RTNSS system is not significant, as described above, then the proposed level of regulatory oversight is Low Regulatory Oversight (LRO), which is addressed in regulatory availability specifications, which are described in the Availability Controls Manual.

Support – These systems are LRO and they provide support (generally component and room cooling) for RTNSS systems that provide active mitigation functions. Treatment of support systems relative to the systems they support is described in the Availability Controls Manual.

19A.8.2 Reliability Assurance

All RTNSS systems shall be in the scope of the Design Reliability Assurance Program, as directed by DCD Tier 2, Chapter 17, which will be incorporated into the Maintenance Rule program.

Quality assurance controls for RTNSS SSCs are addressed in DCD Tier 2, Subsection 17.1.22, which states that nonsafety-related structures, systems and components (SSCs) that perform safety significant functions have quality assurance requirements applied commensurate with the importance of the items function. The identification of nonsafety-related structures, systems and components and their quality classification is shown in DCD Tier 2, Table 3.2-1.

19A.8.3 Augmented Design Standards

Systems that meet RTNSS Criterion B (that is, for actions required beyond 72 hours and seismic events) require augmented design standards to assure reliable performance in the event of hazards, such as seismic events, high winds, flooding, and environmental conditions experienced during an accident.

RTNSS B components are required to function following a seismic event and they are designed to Seismic Category II, at a minimum. (Some structures are Seismic Category I due to safety-related equipment within). Because these systems are designated to perform their function post 72 hours, the equipment does not need to be able to perform their functions during the seismic event, but must be available following the event. The structures housing RTNSS B components are identified in Table 19A-3. In addition, any non-RTNSS system that can adversely interact with RTNSS B systems are designed to the same seismic requirements as the affected RTNSS system.

RTNSS Criterion B equipment are qualified to IEEE-344-1987 to demonstrate seismic performance and structural integrity.

In addition to seismic standards, Criterion B systems must meet design standards to withstand winds and missiles generated from Category 5 hurricanes at 195 mph, 3-sec gust. As with seismic, the systems do not need to perform their functions during the high wind event, but must be available following the event. Table 19A-4 discusses the capability of structures housing RTNSS B components with respect to flooding, winds and wind-generated missiles.

The plant design for protection of SSCs from the effects of flooding considers the relevant requirements of General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," and 10 CFR Part 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," Section IV.C as related to protecting safety-related SSC from the effects of floods, tsunamis and seiches. The design meets the guidelines of Regulatory Guide 1.59 with regard to the methods utilized for establishing the probable maximum flood (PMF), probable

maximum precipitation (PMP), seiche and other pertinent hydrologic considerations; and the guidelines of Regulatory Guide 1.102 regarding the means utilized for protection of safety-related SSC from the effects of the PMF and PMP. To ensure that RTNSS systems are protected from flood-related effects associated with fluid piping and component failures, they are located above the maximum internal flooding level analyzed by DCD Tier 2, Section 3.4

To provide assurance that RTNSS components are capable of performing in any anticipated environmental conditions, they are designed with the following requirements:

(1) RTNSS components inside containment are designed, procured, and maintained in accordance with the environmental requirements of the equipment qualification (EQ) program, as described in DCD Tier 2, Sections 3.9, 3.10, and 3.11.

(2) RTNSS components outside the containment are required to be designed and procured with the requirement that they remain functional in any anticipated environmental conditions.

Systems that meet RTNSS Criteria A, C, D, or E do not require augmented design standards described above, but must incorporate the defense-in-depth principles of redundancy and physical separation to ensure adequate reliability and availability.

RTNSS C systems do not require augmented seismic design criteria. However, some RTNSS C systems are housed in Seismic Category I or II structures, and some are housed in non-seismic (NS) structures that are designed using the IBC-2003 to maintain structural integrity ~~with a margin of safety that is equivalent to a Seismic Category I structure~~ under SSE conditions. ~~These structures are the Electrical, Turbine, and Service Water Buildings, and they~~NS structures that house RTNSS Criterion C systems are seismically designed using dynamic analysis method with the SSE ground input motion equal to two-thirds of the Certified Seismic Design Spectra taken from Figures 2.0-1 and 2.0-2 adjusted as required to their bases. An Occupancy Importance Factor of 1.5, Response Modification Factor of 2 and Seismic Design Category D/Seismic Use Group III apply to these structures. RTNSS C systems and components are designed to the seismic requirements of IBC-2003 consistent with the above SSE ground motion.

RTNSS C systems and structures must meet design standards to withstand wind and missiles generated from Category 5 hurricanes at 195 mph, 3-sec gust. Table 19A-4 discusses the capability of structures housing RTNSS C components with respect to flooding, winds and wind-generated missiles. RTNSS Criterion C equipment are qualified to IEEE-344-1987 to only demonstrate structural integrity. RTNSS C components are not required to remain functional following a seismic event. The seismic margins analysis results indicate that RTNSS C components are not required to function in order to avoid core damage following a seismic event. In addition, any non-RTNSS system that can adversely interact with RTNSS C systems are designed to the same seismic requirements as the affected RTNSS system.

The hurricane missile spectrum is consistent with the tornado missile spectrum identified in Table 2.0-1. The design criteria associated with hurricane missile protection follows Section 3.5 for missiles generated by natural phenomenon. The tornado wind speed is substituted with hurricane wind speed to design the concrete or steel barriers for missile impact.

19A.8.4 Regulatory Treatment

The proposed regulatory treatment of RTNSS systems is presented below, and is summarized in Tables 19A-2, 19A-3 and 19A-4.

Table 19A-4
Capability of RTNSS Related Structures[(1)(2)]

System Location	A. (Internal Flooding)	B. (External Flooding)	C. (Internal Missiles)	D. (Extreme Wind and Missiles)
Reactor Bldg. (RB) Control Bldg. (CB) Fuel Bldg. (FB) Fire Pump Enclosure Bldg. (FPE)	The design/installation of RTNSS B equipment includes protection from the effects of internal flooding.	Seismic Category I structures are designed to withstand the flood level and groundwater level specified in Table 2.0-1 and described in Subsection 3.4.1.2. All exterior access openings are above flood level and exterior penetrations below design flood and groundwater levels are appropriately sealed as described in Subsection 3.4.1.1. On-site storage tanks are designed and constructed to minimize the risk of catastrophic failure and are located to allow drainage without damage to site facilities in the event of a tank rupture per Subsection 3.4.1.2.	There are no credible sources of internal missiles per Section 3.5.	Seismic Category I structures designed for tornado and extreme wind phenomena are described inSection 3.3 and Subsection 3.5.1.4.
Ancillary DG Building		The Ancillary DG Building. Is designed to withstand external flooding with the same acceptance criteria as a Seismic Category I Structure.		The Ancillary DG Building is designed for tornado and ~~extreme wind phenomena per Section 3.3~~ Category 5 hurricane wind loads. It is ~~designed to withstand missiles~~ generated from Category 5 hurricanes.

Table 19A-4
Capability of RTNSS Related Structures[1][2]

System Location	A. (Internal Flooding)	B. (External Flooding)	C. (Internal Missiles)	D. (Extreme Wind and Missiles)
Electrical Bldg. (EB) Service Water Bldg. (SF) Turbine Bldg. (TB)	The design/installation of RTNSS C equipment includes protection from the effects of internal flooding.	All exterior access openings are above flood level and exterior penetrations below design flood and groundwater levels are appropriately sealed; basemat and walls are designed for hydrostatic loading, therefore protected from external flooding.	N/A	The EB and SF are RTNSS Structures designed for Category 5 hurricane winds and missiles that meet the requirement of Subsection 19A.8.3. The TB structure is designed for tornado ~~wind speed which envelops~~ and Category 5 hurricane ~~speed~~wind loads. The design/installation of the RTNSS C systems in the TB includes protection to comply with the requirement of Subsection 19A.8.3 to withstand winds and missiles generated from Category 5 hurricanes.
PSW System located Outdoors Onsite (OO)	N/A	The design/installation of the RTNSS C system includes protection from the effects of flooding.	N/A	The design/installation of the RTNSS C system complies with the requirement of Subsection 19A.8.3 to withstand winds and missiles generated from Category 5 hurricanes.

(1) Category 5 hurricane wind speed is 195 mph, 3-sec. gust.

(2) The hurricane missile spectrum is consistent with the tornado missile spectrum identified in Table 2.0-1. The design criteria associated with hurricane missile protection follows Section 3.5 for missiles generated by natural phenomenon. The tornado wind speed is substituted with hurricane wind speed to design the concrete or steel barriers for missile impact.