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Subject: Response to Portion of NRC Request for Additional Information Letter No. 101 Related to ESBWR Design Certification Application, RAI Numbers 22.5-8 and 22.5-16.

The purpose of this letter is to submit the GE-Hitachi Nuclear Energy Americas LLC (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated June 21, 2007 (Reference 1). The GEH responses to RAI Numbers 22.5-8 and 22.5-16 are in Enclosure 1.

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

Sincerely,

Kathy Sedney for

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

Reference:

1. 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.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 101 Related to ESBWR Design Certification Application Regulatory Treatment of Non-Safety Systems (RTNSS) RAI Numbers 22.5-8 and 22.5-16

cc:	AE Cubbage	USNRC (with enclosure)	
	GB Stramback	GEH/San Jose (with enclosure)	
	RE Brown	GEH/Wilmington (with enclosure)	
	eDRFSection	0000-0075-4261	NRC RAI 22.5-8
		0000-0076-1916	NRC RAI 22.5-16

Enclosure 1
MFN 07-578

Response to Portion of NRC Request for Additional Information Letter No. 101 Related to ESBWR Design Certification Application Regulatory Treatment of Non-Safety Systems (RTNSS) RAI Numbers 22.5-8 and 22.5-16

NRC RAI 22.5-8

Section 19A.3.2 addresses seismic assessment and Section 19.2.3.2.4 refers to Section 15 of NEDO-33201 which implemented a seismic margin analysis to assess the seismic ruggedness of both safety-related and non-safety related plant systems. It is stated that no accident sequence has a High Confidence for Low Probability of Failure (HCLPF) value lower than 0.60 g. Please respond to the following:

A. Relative to adequate seismic ruggedness of the RTNSS systems to ensure maintenance of their SSC functions during the post 72-hour period, discuss the rationale for the assertion of no accident sequence having a HCLPF value lower than 0.60 g would suffice as demonstration of full compliance with the design requirements of the International Building Code (IBC) 2003.

B. Table 15-1, Seismic Capacity Summary, NEDO-33201, lists results of the ESBWR seismic margin analysis. Since for certain safety-related components such as pumps, valves, diesel generators, HVAC, and electrical equipment, generic seismic fragilities recommended in the EPRI ALWR Utility Requirements Document or other data sources are used, discuss the technical basis for applying these generic fragility and capacity data in judging the seismic ruggedness of the RTNSS systems.

C. Section 15.3, Seismic Fragilities, states, in part, that the seismic margin analysis approach identifies various conservatism and associated uncertainties introduced in the seismic design process and provides a probabilistic estimate of the earthquake level required to fail a structure or component in a postulated failure mode by linear extrapolation of the design information supplemented by judgment. Since the approach is basically based on qualitative judgment and assumptions including use of many judgmental parameters (e.g., design safety factors, standard deviation values and selection of probability density function), discuss available ESBWR specific component test-based or design experience based seismic capacity data that would further enhance the engineering validity of the seismic capacity, fragility and HCLPF values provided in Table 15-1, Seismic Capacity Summary.

GEH Response

A. The minimum HCLPF value has been revised to 0.84g in NEDO- 33201, Section 15.3 (ref. NEDO-33201 Revision 2, transmitted by MFN 07-237, Rev. 3) which is 1.67 times 0.5g peak ground acceleration of the SSE. The plant structures and components that are credited to achieve the minimum plant level HCLPF margin of 1.67 are summarized in DCD Tier 2, Revision 4, Table 19.2-4.

RTNSS B1 components shown on DCD Tier 2, Revision 4, Table 19A-2 are either included in Table 19.2-4 or designed to be Seismic Category II in accordance with DCD Tier 2 Revision 4 Section 19A.8.3. Since Seismic Category II components are designed to the same acceptance criteria as Seismic Category I components as stated in DCD Tier 2 Revision 4 Section 3.7, they are expected to be seismically rugged.

RTNSS B2 components are designed to IBC-2003 seismic requirements as delineated in DCD Tier 2 Revision 4 Section 19A.8.3. None of them are listed on DCD Tier 2 Revision 4 Table 19.2-4. RTNSS B2 components have a less direct effect on the success of key safety functions and are not credited in the seismic margin analysis.

B. Component fragilities listed in Table 15-1 of NEDO-33201 Revision 1 have been revised and moved to Table 15-7 (ref. NEDO-33201 Revision 2, transmitted by MFN 07-237, Rev. 3). None of the components in this table belong to RTNSS systems, except for the diesel-driven pump of the fire protection system. The RTNSS diesel-driven pump is, however, designed to Seismic Category I requirements in accordance with Section 19A.4.2.4 of DCD Tier 2, Revision 4, and its generic fragility is therefore achievable.

C. The seismic margin analysis approach is a qualitative process. However, safety-related equipment is also seismically qualified in a process that is test based following IEEE Standard 323 and IEEE Standard 344.

The seismic qualification process not only demonstrates seismic performance, it adds conservatism, and high confidence is afforded the seismically qualified equipment. The process of qualification looks at all of the applications of safety-related equipment and identifies the worst-case environments. The same or similar safety-related equipment from the same manufacturer is utilized at multiple units and multiple sites. Conservatism is added to the seismic qualification process by creating an enveloping Required Response Spectra (RRS), which represents the worst-case seismic environments for all applications. The RRS for testing includes the highest acceleration and frequency content for each frequency. The actual test RRS, therefore, adds a conservatism by this enveloping method. The test RRS represents the extreme content of each application and a planned over-test per application at the frequencies that are not dominant.

When testing is performed the actual resulting table motion is measured for the equipment being qualified and is designated as the Test Response Spectra (TRS). In order to be seismically qualified per IEEE Standard 344, the TRS must envelope the RRS.

The result is that the TRS envelopes the RRS within seismic machine limitations, and comparison of seismic margin is achieved in this testing. When the TRS is compared to the actual plant RRS, for each location a Maximum Tested Equipment Seismic Margin (MTESM) can be determined by comparing the acceleration at frequency of the requirement to the acceleration at frequency of the test. Large MTESM have been experienced generally in safety-related equipment.

The qualification process in IEEE Standard 323 and IEEE Standard 344 is a stable process for which high confidence is afforded the qualified equipment and the ability to meet seismic margin. Therefore, the commitment to meet those minimum HCLPF values is achievable in practice.

DCD/NEDO-33201 Impact

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

NEDO-33201 Revision 2, Section 15.3 was revised in response to this RAI.

NRC RAI 22.5-16

Section 19A.8.4 refers to NEDO-33331, "ESBWR Availability Controls Manual," for regulatory oversight of structures, systems, and components (SSCs) and Table 19A-2 identifies RTNSS systems with the levels of regulatory treatment indicated as High Regulatory Oversight (HRO), Low Regulatory Oversight (LRO), or Support. Please provide additional information regarding categorization and treatment as follows:

A. *Section 19A.2.1 states that the ATWS actuation logic includes isolation of the Reactor Water Cleanup and Shutdown Cooling (RWCU/SDC) system. Discuss the valves that are isolated by this actuation logic, and their categorization and treatment.*

B. *Section 19A.3.1.2, Decay Heat Removal, states that the Fire Protection System (FPS) provides on-site makeup water to extend the decay heat cooling period from 72 hours to 7 days. Discuss the categorization of the FPS components and their treatment.*

C. *Section 19A.3.1.4, Post-Accident Monitoring, 5 states that portions of the Heating, Ventilation, and Air Conditioning (HVAC) systems in the Reactor Building, Electrical Building, Fuel Building, Control Building, and some areas of the Turbine Building perform component and area cooling functions. The section also states that support for these nonsafety-related functions is required from Reactor Component Cooling Water (RCCW), Plant Service Water (PSW), and the Chilled Water System. Discuss the categorization of these components and functions, and their treatment.*

D. *Section 19A.4.3, Assessment of Uncertainties, states that the support systems needed to use the Fuel and Auxiliary Pools Cooling System (FAPCS) are the RCCWS, diesel generators, Fuel Building HVAC, and PSWS, that are covered by RTNSS. Discuss the treatment for the components in these systems under the RTNSS process.*

E. *Section 19A.4.4.8, Shutdown LOCA, states that breaks outside containment can be originated only in the Isolation Condenser System (ICS), RWCU/SDC or FAPCS piping, or instrument lines. The section does not appear to discuss the isolation of instrument lines. Discuss the categorization of the instrument lines and their isolation valves, and their treatment.*

F. *Section 19A.5, Criterion D: Containment Performance Assessment, states that Criterion D safety concerns are addressed in the ESBWR design, and no RTNSS candidates were identified. Discuss the categorization and treatment of those containment isolation valves, if any, which are not safety-related valves.*

G. *Section 19A.6 does not discuss potential adverse impacts from the failure of reactor pressure internals (e.g., steam dryer) on safety-related or RTNSS SSCs. Discuss the categorization and treatment of reactor pressure vessel internals (including the steam dryer).*

H. *Section 19A.6.1.1.3, Analysis of Potential Adverse System Interactions, refers to four motor-operated valves attached to the FAPCS Cooling and Cleanup trains when describing the*

Gravity Driven Cooling System (GDCS). Discuss the categorization and treatment of these valves.

I. Section 19A.6.1.2.1, Design Features, for the Automatic Depressurization System (ADS) refers to the use of safety/relief valves (SRVs) and depressurization valves (DPVs). The section also refers to the nonsafety-related High Pressure Nitrogen Supply System. Discuss the categorization and treatment of SRVs, DPVs, and components in the High Pressure Nitrogen Supply System.

J. Section 19A.6.1.2.3, Analysis of Potential Adverse System Interactions, refers to the SRV solenoids and DPV squibs in the ADS. Discuss thecategorization and treatment of these components.

K. Section 19A.6.1.3.1, Design Features, of the ICS refers to a valve in the bottom of each IC/Passive Containment Cooling (PCC) pool subcompartment, and two valves in the condensate return piping. Discuss the categorization and treatment of these valves.

L. Section 19A.6.1.3.3, Analysis of Potential Adverse System Interactions for the ICS refers to the makeup water supply isolation valve, and the steam supply and condensate return line isolation valves. Discuss the categorization and treatment of these valves.

M. Section 19A.6.1.5.3, Analysis of Potential System Interactions, for the PCCS states that the PCCS and ICS have similar considerations for potential system interactions. Discuss the system interaction considerations and the treatment for components in the PCCS.

N. Section 19A.8.4.5, Diverse Protection System, states that the proposed level of regulatory oversight for the Diverse Protection System (DPS) is contained in Technical Specifications. Discuss the categorization and treatment of components in the DPS.

<u>GEH Response</u>

A. The Reactor Water Cleanup and Shutdown Cooling (RWCU/SDC) valves that are isolated by SLCS actuation logic are the upper suction line isolation valves (G31-F002A,B and F003A,B) and the lower suction line isolation valves (G31-F007A,B and F008A,B). These valves are containment isolation valves and they are safety-related. Therefore, no additional regulatory treatment is required.

B. The FPS pump and the FPS piping and valves are classified as nonsafety-related. The components for connection of FPS makeup include the Fire Pump Enclosure (FPE), the water supply, the suction pipe from the water supply to the pump, and one of the supply pipes from the FPE to the Reactor Building. This function and the components are classified as RTNSS category B1 (actions required beyond 72 hours to ensure safe shutdown conditions.) Their regulatory treatment is defined in DCD Tier 2 Section 19A.8.3. The availability requirements placed on the system are specified in the Availability Controls Manual (DCD Chapter 19, Appendix 19A) in ACM 3.7.1.

C. Portions of the Heating, Ventilation, and Air Conditioning (HVAC) systems in the Reactor Building, Electrical Building, Fuel Building, Control Building, and some areas of the Turbine Building perform component and area cooling. These systems provide cooling for RTNSS systems that provide active mitigation functions. Support for these HVAC functions is required from Reactor Component Cooling Water (RCCW), Plant Service Water (PSW), and the Chilled Water System. The applicable portions of these systems are classified as RTNSS. Their regulatory treatment is categorized as Support, as described in Section 19A.8.1 of DCD Chapter 19.

D. The systems that support the RTNSS functions of the Fuel and Auxiliary Pools Cooling System (FAPCS) are RCCWS, Diesel Generators, Fuel Building HVAC, and Plant Service Water. These systems are classified as RTNSS. Their regulatory treatment is categorized as Support, as described in Section 19A.8.1 of DCD Chapter 19.

E. Level and pressure sensing lines, up to the outboard excess flow check valve, are connected to the Reactor Coolant Pressure Boundary (RCPB) and are classified as Quality Group A, ASME Section III, safety-related, and Seismic Category 1. The typical arrangement for these sensing lines is a restricting orifice located inside the containment and a manual isolation valve located outside the containment which is followed by an excess flow check valve. If a line break occurs in a nonsafety-related portion of a sensing line, the excess flow check valve closes to stop the flow of reactor coolant. If there is a single failure of the excess flow check valve, a restriction orifice limits the flow of coolant to within acceptable bounds. Therefore, no additional regulatory treatment is required.

F. As described in DCD Section 3.2.3, the pressure-retaining portions, and their supports, of the primary containment that provide primary containment isolation are safety-related. Therefore, the containment isolation valves are safety-related.

G. Safety-related reactor pressure vessel internal structures are: the SLC header and spargers and piping, in-core guide tubes and stabilizers, and non-pressure boundary portion of in-core housings. Nonsafety-related reactor pressure vessel internals are: the chimney and partitions, chimney head and steam separator assembly, steam dryer assembly, feedwater spargers, surveillance sample holders, and RPV vent assembly. The plant meets the requirements of GDC 4, which requires that reactor internals are designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operations, maintenance, testing, and postulated LOCA. Furthermore, the main steam flow exits the reactor pressure vessel, past redundant isolation valves, and goes to balance of plant equipment. Therefore, reactor pressure vessel internals have no adverse impact on safety-related or RTNSS functions. DCD Section 3.9.5 provides details on the classification of safety-related and nonsafety-related reactor internals.

H. The significance of the four motor-operated valves in the FAPCS Cooling and Cleanup trains is whether they have the potential to adversely impact the Gravity Driven Cooling System

(GDCS) pools. These valves are not required to operate during accident conditions to support GDCS. Since neither failure to operate, nor inadvertent operation of these valves has an adverse impact on the pools, they are not candidates for RTNSS.

I. The SRVs and DPVs are safety-related. The High Pressure Nitrogen Supply System (HPNSS) does not have an active function with respect to RTNSS. HPNSS provides pressurized nitrogen to charge the safety-related SRV accumulators during normal plant operations. HPNSS is not needed to support SRV actuation during an ADS demand. Therefore, no additional regulatory treatment is required.

J. The SRV solenoids and DPV squibs are safety-related. Therefore, no additional regulatory treatment is required.

K. The locked-open manual valve in the bottom of each IC/Passive Containment Cooling (PCC) pool subcompartment and the two valves in the ICS condensate return piping are verified to be in their correct position by Technical Specification Surveillance Requirements 3.5.4.1 and 3.5.4.3. Therefore the valves are not categorized as RTNSS.

L. Pool inventory makeup during normal operations is controlled by the makeup water supply isolation valve, which is part of the FAPCS pool cooling and cleanup mode. This is not a RTNSS function because this FAPCS mode does not provide pool inventory makeup during an accident. The ICS steam supply and condensate return line isolation valves are safety-related. Therefore, no additional regulatory treatment is required.

M. Due to similar passive designs and physical arrangements, PCCS and ICS have similar considerations for potential system interactions. For example, the IC/PCC pools are similar in design and function. As described in Section 19A.6.1.3.3, the potential for adverse system interactions in ICS is not significant. In fact, PCCS is less susceptible than ICS to adverse interactions because it requires no active components for operation.

N. In accordance with DCD Section 16.0, the RTNSS functions of the Diverse Protection System (DPS) will be reflected in the Technical Specifications. DCD Section 19A.8.1 describes the RTNSS classification of the DPS.

DCD/NEDO-33201 Impact

DCD Revision 4, Section 19A ACM 3.7.1 has been revised in response to item B of this RAI.

No impact to NEDO 33201 Revision 2.