August 31, 2007

Mr. Robert E. Brown
Senior Vice President, Regulatory Affairs
GE-Hitachi Nuclear Energy Americas LLC
3901 Castle Hayne Rd MC A-45
Wilmington NC 28401

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 107 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Brown:

By letter dated August 24, 2005, GE-Hitachi Nuclear Energy Americas, LLC (GEH) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter.

To support the review schedule, you are requested to provide the requested additional information within 45 days of the date of this letter.

If you have any questions or comments concerning this matter, you may contact me at 301-415-3863 or mmc1@nrc.gov or you may contact Amy Cubbage at 301-415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Manny Comar, Project Manager
ESBWR/ABWR Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket No. 52-010

Enclosure: Request for Additional Information

cc: See next page

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Distribution: See next page

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Letter to Robert E. Brown from Manny C. Comar dated August 31, 2007

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 107 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Distribution:
Docket No. 52-010
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RAI Number	**Reviewer**	**Question Summary**	**Full Text**
7.1-47, Supplement No. 1 (MFN 07-430 August 16, 2007)	Li H	Update the DCD Tier 1 Section 1.2.2.1 Item (3) to demonstrate that the ESBWR design has complied with RG 1. 209.	The Regulatory Guide (RG) 1.209, “Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants,” Position (4) states that for safety-related computer-based I&C systems intended for implementation in a mild environment, the NRC staff takes exception to Section 7.1 of IEEE Std. 323-2003. In Tier 1 Section 1.2.2.1 Item (3) stated that “Equipment located in a mild environment during of following a DBA need not be tested or analyzed” This statement should be deleted.
7.8-5, Supplement No. 1 (MFN 06-472, December 12, 2006)	Li H	Update the DCD Tier 1 Sections to address Chapter 15 events as listed in NEDO-33251 Appendix A Table-Summary of Events	In response to RAI 7.8-5, GEH stated that the confirmatory analyses to validate the assessment documented in NEDO-33251 will be included as an ITAAC in ESBWR DCD Tier 1, as part of the Revision 3 update. The staff has reviewed DCD Tier 1, Revision 3. There is no evidence that these confirmatory analyses were included in the Tier 1 documents as described above. Please markup the proposed Tier 1 documents to address these confirmatory analyses.

RAI Number	Reviewer	Question Summary	Full Text
9.1-28, Supplement No. 2 (MFN 07-354, June 28, 2007)	Diaz-Castillo, Y	Spent fuel pool (SFP) neutron absorbing panels monitoring program.	It is still not clear to the staff what type of neutron absorbing panels GEH will be using in the SFP. In the RAI response, GEH stated that the sample coupons are fabricated from the same borated stainless steel (BSS) material used in construction of the interlocking panels. 1. Identify the material specification for the BSS, e.g., ASTM Standard. Identify your plans to use composite materials such as Boral or Metamic. 2. Please provide the composition and physical properties of BSS and /or the composite materials, the manufacturing process, the results of long term stability and corrosion testing, the resistance to radiation damage, and minimum poison content. 3. For the material you plan to use as your neutron absorbing panel, please provide the following for your material testing program: a. the size and types of coupons to be used, b. the technique for measuring the initial elemental boron or boron carbide content of the coupons, c. the frequency of coupon sampling and its justification, d. the tests to be performed on coupons (e.g., weight measurement, measurement of dimensions (length, width and thickness), and poison content). These tests should also address, as a minimum, any bubbling, blistering, cracking, flaking, or areal density changes of the coupons, any dose changes to the coupons, and e. the effects of any fluid movement and temperature fluctuations of the pool water on long term stability

RAI Number	**Reviewer**	**Question Summary**	**Full Text**
9.3-38, Supplement No. 2 (MFN 07-398, July 23, 2007)	Diaz-Castillo, Y	Oxygen Injection System Compliance with EPRI Report NP-5283-SR-A	It is not clear to the staff whether the OIS would still need to meet the guidelines of EPRI Report NP-5283-SR-A if the Hydrogen Water Chemistry System is not implemented. If the OIS does not need to meet the guidelines of the above report, please clarify which document contains the requirements for design, operation, maintenance, surveillance, and testing of the oxygen storage facility and discuss how the ESBWR meets those requirements.

RAI Number	Reviewer	Question Summary	Full Text
16.0-5 (Continued)	Harbuck, C.	Request for ITAAC to verify CRHA temperature variation during the 72-hour period post event initiation is within expected design limits. or Add electrical power capability to run AHUs for up to 72 hours post event. and Periodically verify CRHA temperature is below a maximum value during unit operation in Condition A, CRHA	The ESBWR CRHAVS does not rely on air conditioning units for temperature control following isolation of the control room as does the STS BWR/6 control room fresh air (CRFA) system. The STS requires an operable control room air conditioning system. The Bases for TS 3.7.2 states that following a DBA, the CRHAVS air handling units (AHUs) (the air conditioning units) are assumed to initially operate, with power from nonsafety-related uninterruptible AC sources, for up to 2 hours to remove heat from non-safety loads within the CRHA to maintain temperature ≤ 78°F; at time 2 hours, those non-safety loads are tripped and passive heat loss from the CRHA and the CRHAVS filtered air supply limit temperature increase to 15°F until ac power is restored no later than 72 hours after the event started. Assuming a CRHA temperature of 93°F is acceptable, the NRC staff requests the applicant to establish an ITAAC to demonstrate the claimed post-accident temperature behavior of the CRHA and passive heat sink. Alternatively, this issue over CRHA post accident cooling may be resolved by explicitly requiring the AHUs to be operable in LCO 3.7.2, and adding to the design electrical power support sufficient to run the AHUs for 72 hours without offsite or standby ac power. TS 3.7.2 Action A allows 72 hours to restore temperature in the CRHA to ≤ 78°F. Under normal unit power operating conditions, with CRHA air temperature and passive heat sink at 78°F, and assuming maximum expected ambient air temperature and no AHU cooling available, what temperature could the CRHA air reach in 72 hours? Consider adding a required action to verify CRHA air temperature and passive heat sink temperature at some maximum value, say on an hourly basis, as a condition for operating during the 72-hour window - to ensure the capacity of the heat sink remains available in case of a design basis event. 78°F .

RAI Number	Reviewer	Question Summary	Full Text
16.0-7 Supplement No.1 (MFN 06-431 November 13, 2006)	Harbuck, C.	Justification for use of modified end states (shutdown to Mode 3 instead of Mode 5 for loss of redundancy conditions) based on TSTF-423-A.	Identify where modified end states are applied to the ESBWR generic TS Actions. For each Action where a Mode 3 end state is proposed, provide justification, regardless of whether the modified end state was included in TSTF-423-A. See attached table. Revise Bases for TS 3.7.3 (Main Condenser Offgas) Action B to explain that entry into Mode 3 is acceptable from a risk perspective as stated in TSTF-423-A. Add a SR to TS 3.7.2 (CRHAVS) for the AHUs, analogous to STS SR 3.7.4.1, or explain in the TS 3.7.2 Bases and reference the DCD discussion of how CRHA temperature remains acceptable during loss of CRHAVS air conditioning for 72 hours after event initiation.
16.2-34 Supplement No.1 (MFN 06-431 November 13, 2006)	Harbuck, C. Beltz, T.	Justification for requiring only 2 SRVs with an operable safety mode, Non-ADS SRV testing, and Error correction in DCD Table 5.2-2.	The NRC staff requested the applicant to (1) justify the change from four to two SRVs with an operable safety mode required by LCO 3.4.1; (2) explain the methodology for periodic testing of the non-ADS SRVs, including a discussion of why the testing is not included in a TS SR; and (3) correct an apparent error in DCD Tier 2, Revision 3, Table 5.2-2, in which Note (1) indicates that "The SRVs also perform the automatic depressurization function." The non-ADS SRVs do not perform an automatic depressurization function. The superscript "(1)" should be deleted from the "Number of Valves" heading. This superscript should be relocated following "ADS SRV" and "DPV", since only the ADS SRVs and DPVs perform automatic depressurization function. The note should state "(1) The ADS SRVs and DPVs also perform the automatic depressurization function."

RAI Number	Reviewer	Question Summary	Full Text
16.2-45 Supplement No.2 (MFN 07-022, July 19, 2007)	Harbuck, C.	Operability and surveillance requirements for the automatic isolation valves for the RWCU/SDC system.	Explain how the TS address operability and surveillance requirements for the automatic isolation valves for the RWCU/SDC system, associated with the following proposed isolation instrumentation functions 3.3.6.3.1, "Reactor Vessel Water Level – Low, Level 2," 3.3.6.3.2, "Reactor Vessel Water Level – Low, Level 1," and 3.3.6.3.9, "{RWCU/SDC System Differential Flow – High (Per RWCU/SDC subsystem)},", and isolation actuation function 3.3.6.4.2, "RWCU/SDC System Lines."
16.2-55 Supplement No.1 (MFN 06-431, November 13, 2006)	Rhow, S.	Float current as an indication of battery state of charge for VRLA batteries.	The NRC staff will need confirmation from the valve regulated lead acid (VRLA) battery manufacturer that float current monitoring provides an accurate indication of the battery state of charge (SOC) during steady-state and discharge conditions. If float current monitoring does not indicate 100% SOC, the COL applicant must commit to additional design margins in the battery sizing calculations to compensate for measurement uncertainty and that these design margins would be stated in the TS Bases.

RAI Number	Reviewer	Question Summary	Full Text
16.2-57 Supplement No.1 (MFN 06-431, November 13, 2006)	Rhow, S.	Minimum acceptable pilot cell temperature and pilot cell temperature surveillance for a VRLA battery.	In RAI 16.2-57 and RAI 16.2-87, the staff requested the applicant to include a value for the minimum acceptable pilot cell temperature. The revised DCD did not justify using battery room temperature and did not state whether continuous monitoring of the battery room temperature with high and low level alarms in the main control room is included in the design. Since battery cell temperature could change for reasons other than ambient conditions (e.g., power flow, resistivity issues or internal shorts, etc.), new SRs should be specified for the battery pilot cells and connected cells. The surveillance Frequency should specify taking temperature measurements at the negative post of battery pilot cells every 31 days and at the negative post of connected cells every 92 days. RAI 16.2-87 is closed because this issue will be tracked under RAI16.2-57. (Also see RAI 16.2-122.)
16.2-62 Supplement No.1 (MFN 06-431, Supplement 2 May 14, 2007)	Clark, R.	Availability Controls (ACs) for ac power sources and distribution	Justify not including TS requirements (LCO, Applicability, Actions, and Surveillance) for ac circuits in the Regulatory Treatment of Non-Safety Systems (RTNSS) program

RAI Number	Reviewer	Question Summary	Full Text
16.2-89 Supplement No.1 (MFN 07-172, March 27, 2007)	Rhow, S.	Content of TS 5.5.10.	Provide justification for referencing IEEE 450-1995, and considering the battery maintenance program in proposed TS 5.5.10 to be comprehensive. In a follow-up question, the staff stated that it had not yet endorsed IEEE Standard 1188-2005, and requested the applicant to revise the program to state the following: "This Program provides for battery restoration and maintenance which includes the following: a. Actions to restore battery cells with float voltage < 2.18 VDC, b. Actions to determine the cause and correct when cell temperatures deviate more than 3°C (5°F) from each other. c. Actions to verify that remaining cells are ≥ 2.14 VDC when a cell or cells have been found to be < 2.18 VDC."
16.2-110 Supplement No.1 (MFN 07-025, June 29, 2007)	Goel, R.	Request TS limitation on containment oxygen concentration.	The regulatory limit proposed by the applicant, based on the future design certification rulemaking for ESBWR, will be too far removed from the day-to-day operation of a plant to provide sufficient control of and attention to the containment oxygen concentration limit. It adds little to the requirements already present in 10 CFR 50.44. Further, using the applicant's suggested Availability Control also lacks sufficient regulatory force. The staff's position is that a TS limiting condition for operation must be established for an inerted containment to meet 10 CFR 50.36(c)(2)(ii)(D). The structure is the inerted containment. The NRC has determined that combustible gases produced by beyond design-basis accidents involving both fuel-cladding oxidation and core-concrete interaction would be risk-significant for plants with inerted containments, if not for the inerted containment atmosphere. It is essential to have a regulatory limit on containment oxygen concentration in each ESBWR plant license, meaning a TS LCO. Provide a TS of this type in DCD Tier 2, Chapter 16.

RAI Number	Reviewer	Question Summary	Full Text
RAI 19.1.0-1, Supplement No. 1, (MFN 07-324, 6/14/07)	Caruso, M Klein, V	Additional information is needed to justify the PRA Thermal Hydraulic success criteria	The staff performed a review of the response to NRC RAI 19.1.0-1 provided by the applicant with their letter dated June 14, 2007 (MFN 07-324). The information provided is not sufficient to address the issues raised in the RAI. Additional information, as described below, is needed. A. The applicant used the MAAP 4 code to evaluate thermal-hydraulic success criteria. The staff is aware of thermal-hydraulic modeling issues with the code that could compromise its ability to confirm the validity of the PRA success criteria involving minimal sets of mitigating equipment. The applicant justified the use of the MAAP code by comparing simulations of loss of coolant accidents performed with MAAP and the TRACG code. However, these benchmark calculations may not reflect thermal-hydraulic conditions in the reactor vessel during such accidents because the design basis accident analysis assumptions (i.e., the single failure criterion) regarding availability of passive mitigating systems were applied rather than the assumptions made for the PRA which are substantially more limiting. Please address this concern by analyzing the limiting accident scenarios assuming PRA success criteria with a code such as TRACG that is clearly capable of treating the thermal-hydraulic phenomena expected to occur. Such calculations would also provide a means for adequately benchmarking the MAAP code for use in analyzing additional PRA accident sequences that may be affected by thermal-hydraulic uncertainties associated with passive systems. B. The applicant's response to the RAI does not include enough information for the staff to understand the basis for selecting the limiting accident scenarios used to determine minimum success criteria. Please provide the rationale for accident scenarios selected. Please include any criteria that were applied in making the selections and/or the results of any parametric studies that may have been used to identify limiting scenarios.

RAI Number	Reviewer	Question Summary	Full Text
			C. In order to understand the uncertainty in the determination of minimal success criteria, the staff needs to know how key thermal-hydraulic parameters that could affect the results are selected. For example: Are nominal values or bounding values being used? Such parameters may include: decay heat rate, containment pressure, flow resistance in piping, heat transfer area and heat transfer coefficient in the IC and PCCS, and flow area through the break, SRVs, DPVs and check valves in the GDCS. Please list the key parameters and describe how each was treated in the analysis. If nominal parameter values are used in the analyses, please discuss the impact on the results of the analyses when bounding parameter values are used.
RAI 19.1.0-1, Supplement No. 1, (MFN 07-324, 6/14/07)			D. In the analyses, the applicant applied a limit of 2200 deg F for peak cladding temperature as the acceptance criterion for avoidance of core damage. Such a criterion is acceptable for the evaluation of PRA success criteria. However, the staff has not reviewed and approved the heat transfer, transition and film boiling models in TRACG needed for calculating peak cladding temperature in evaluations of emergency core cooling system performance. Please discuss the adequacy of TRACG for modeling clad heat up and approach to thermal limits in studies of PRA success criteria. Please discuss any comparisons of the code predictions with tests that may apply. The staff acknowledges that justification of TRACG in this application would be less comprehensive than that required for approval of an ECCS evaluation model. E. The staff agrees that setting the PRA success criterion for the IC as three of four condensers (i.e., same as design basis single failure criterion) is a bounding assumption in the analyses. However, it has been observed in the design basis accident analysis that there are pipe break scenarios involving isolation condenser piping which leave only two IC available for mitigation. Please explain whether the safety function provided by the IC will always fail in these scenarios or there are circumstances in which two of four IC can provide minimal success.

ESBWR Generic TS (# Mode 3 end state not adopted)			Equivalent STS (*Not revised by TSTF-423)		
Action	Title	End State	Action	Title	End State
NA	NA	NA	3.3.8.2.C.1	Reactor Protection System Electric Power Monitoring	Mode 3
3.3.4.1.E.1	Reactor Coolant System (RCS) Leakage Detection Instrumentation	Mode 3	3.4.7.E.1 3.4.7.E.2 3.4.7.F.1	* RCS Leakage Detection Instrumentation	Mode 4
3.4.1.B.1	Safety Relief Valves (SRVs)	Mode 3	3.4.4.B.1	Safety/Relief Valves (S/RVs)	Mode 3
3.5.1.E.1	# Automatic Depressurization System (ADS) — Operating	Mode 5	3.5.1.G.1	Emergency Core Cooling System — Operating	Mode 3
3.5.2.E.1	# Gravity-Driven Cooling System (GDCS) — Operating	Mode 5	3.5.1.D.1	Emergency Core Cooling System — Operating	Mode 3
3.6.1.1.B.1	Containment	Mode 3	3.6.1.1.B	Primary Containment	Mode 3
3.6.1.2.D.1	Containment Air Lock	Mode 3	3.6.1.2.D.1 3.6.1.2.D.2	* Containment Air Lock	Mode 4
3.6.1.3.E.1	Containment Isolation Valves (CIVs)	Mode 3	3.6.1.3.F.1 3.6.1.3.F.2	* Primary Containment Isolation Valves (PCIVs)	Mode 4
NA	NA	NA	3.6.1.6.B.1	LLS Valves	Mode 3
NA	NA	NA	3.6.1.7.C.1	RHR Containment Spray System	Mode 3
NA	NA	NA	3.6.1.8.C.1	PVLCS	Mode 3
NA	NA	NA	3.6.1.9.C.1	MSIV LCS	Mode 3
NA	NA	NA	3.6.2.3.B.1	RHR Suppression Pool Cooling	Mode 3
3.6.1.4.B.1	Drywell Pressure	Mode 3	3.6.1.4.B.1 3.6.1.4.B.2	* Primary Containment Pressure	Mode 4

ESBWR Generic TS (# Mode 3 end state not adopted)			Equivalent STS (*Not revised by TSTF-423)		
Action	Title	End State	Action	Title	End State
3.6.1.5.B.1	Drywell Air Temperature	Mode 3	3.6.1.5.B.1 3.6.1.5.B.2	* Primary Containment Air Temperature	Mode 4
3.6.1.6.C.1	Wetwell-to-Drywell Vacuum Breakers	Mode 3	3.6.5.6.D.1	Drywell Vacuum Relief System	Mode 3
3.6.3.1.D.1	Reactor Building	Mode 3	3.6.4.1.B.1	Secondary Containment	Mode 3
NA	NA	NA	3.6.4.3.B.1 3.6.4.3.D.1	Standby Gas Treatment System	Mode 3
NA	NA	NA	3.7.1.C.1	Standby Service Water System and Ultimate Heat Sink	Mode 3
3.7.2.D.1	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning Subsystem (CRHAVS)	Mode 3	3.7.3.C.1	Control Room Fresh Air System	Mode 3
3.7.2.D.1	CRHAVS	Mode 3	3.7.4.B.1 3.7.4.D.1	Control Room Air Conditioning System	Mode 3
3.7.3.B.1 3.7.3.B.2	Main Condenser Offgas	Mode 3	3.7.5.B.3	Main Condenser Offgas	Mode 3
NA	NA	NA	3.8.1.G.1	AC Sources — Operating	Mode 3
NA	NA	NA	3.8.4.D.1	DC Sources — Operating	Mode 3
NA	NA	NA	3.8.7.B.1	Inverters — Operating	Mode 3
NA	NA	NA	3.8.9.D.1	Distribution Systems — Operating	Mode 3

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