March 6, 2008

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

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 160 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.

If you have any questions or comments concerning this matter, you may contact me at 301-415-2375 or ltp1@nrc.gov, or you may contact Eric Oesterle at 301-415-1365 or ero1@nrc.gov.

Sincerely,

/RA/

Leslie Perkins, Project Manager
ESBWR/ABWR Projects Branch 2
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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ESBWR/ABWR Projects Branch 2
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Request for Additional Information
cc: See next page
Distribution: See next page

ADAMS ACCESSION NO. ML080630254 NRO-002

OFFICE	PM:NGE2:NRO	PM:NGE1:NRO	BC:NGE1:NRO
NAME	LPerkins	EOesterle	MShuaibi
DATE	03/4/08	03/4/08	3/6/08

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Distribution:
PUBLIC
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NGE1/2 R/F
LPerkins, NRO
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E-Mail:
RidsNroDnrlNge1
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SMarshall, RES

Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD), Revision 4

RAI Number	Reviewer	Question Summary	Full Text
RAI 3.8-28 S03	Chakrabarti S	Revise DCD Tier 1, Rev. 4, Tables 2.15.1-1 and 2.15.2-2 to provide consistent information for all penetrations and to correct a typographical error.	In its response to RAI 3.8-28, Supplement 2, dated November 28, 2007, GEH stated that the mechanical and electrical penetrations are part of the containment boundary, for which design commitment is an ITAAC, as delineated in DCD Tier 1, Revision 4, Table 2.15.1-2, Item 2. Therefore, no COL action item is required. The staff reviewed DCD Tier 1, Revision 4, Table 2.15.1-2, Item 2, and the referenced Tier 1, Table 2.15.1-1, to determine if there is sufficient information to address the staff's concern. The staff concluded that with some additional clarification in Tier 1, Table 2.15.1-1 and correction of a typographical error in Tier 1, Table 2.15.1-2, Item 2, the information will be sufficient to address the staff's concern. The staff requests GEH to address the following in the next revision of DCD Tier 1: a) DCD Tier 1, Table 2.15.1-1 lists 11 pages of containment penetrations, including the mechanical and electrical penetrations for which only typical design details currently exist. This table is referenced by DCD Tier 1, Table 2.15.1-2, Item 2, apparently defining a commitment that all applicable provisions of ASME Code Section III will be met, and will be documented in the Code Stress Report. However, the information included in Tier 1, Table 2.15.1-1, related to ASME Code Section III, Seismic Category I, and Safety-Related classifications is not consistently identified for all rows of the table. Revise DCD Tier 1, Table 2.15.1-1 to specifically identify the ASME Code Section III, Seismic Category I, and Safety-Related classifications for each row of the table, and add a note that the evaluation of all penetrations designated ASME Code Section III will be documented in the Code Stress Report. b) Correct the typographical error in Tier 1, Table 2.15.1-2, Item 2. In the "Acceptance Criteria" column, "Table 2.1.51-1" should be "Table 2.1.15-1".

RAI Number	Reviewer	Question Summary	Full Text
RAI 3.8-41 S05	Chakrabarti S	The analysis and design must consider the entire range of concrete stiffnesses for the vent wall and diaphragm wall or clearly demonstrate that the member forces and response spectra are not affected.	GEH response dated December 12, 2007, provided information requested for four items related to the effects of the infill concrete within the vent wall and diaphragm floor structures located inside containment. The staff has two concerns as described below. (1) Based on the prior analytical results, consideration of 50% of the (unreinforced) infill concrete stiffness had a pronounced effect on the structural responses from seismic loadings and so GEH has indicated that it would envelop these results with those from the original seismic design case of 0% concrete stiffness. From the information provided in the current response it is still not evident that if 100% of the concrete stiffness was considered then the increase in member forces and response spectra would be negligible. The basis provided in the response for the small effect on frequency caused by increasing the concrete stiffness from 50% to 100% is still questionable, as well as the effect of this frequency shift on the member forces and response spectra. GEH needs to either consider the entire range of concrete stiffness in its analysis and design of the ESBWR or clearly demonstrate that the member forces and response spectra are not affected. Also, the current description in the DCD, including Sections 3A.8.4 and 3A.8.5 do not clearly state what percentage of concrete stiffness is considered for the vent wall and diaphragm floor, and it does not clearly state that member forces and response spectra from this set of analyses are enveloped with the results without the infill concrete in the vent wall and diaphragm floor. (2) This item covers the effect of the infill concrete stiffness for hydrodynamic loadings such as Annulus Pressurization, Safety Relief Valve Discharge, chugging, and condensation oscillation. Since the figures provided in this response show that the hydrodynamic spectra are greater in some locations, GEH needs to consider the entire range of concrete stiffness in its analysis and design of the ESBWR for hydrodynamic loads as well.

RAI Number	Reviewer	Question Summary	Full Text
3.11-23	Lee J Pal A	Provide more details about the method used for establishing the radiation environmental conditions inside containment in Table 3H-11.	In Table 3H-11, "Radiation Environment Conditions Inside Containment Vessel for Accident Conditions," of DCD, Tier 2, Revision 4, GEH provided (1) operating dose rates using NUREG-1465, and (2) six month integrated doses, in upper and lower areas of drywell as well as wetwell and suppression pool gas space. Please provide the following information. 1. State fission product release phase(s) in NUREG-1465 used for developing the dose rates and integrated doses in the table. 2. State how GEH converted fission product release fractions in NUREG-1465 to calculate the dose rates and integrated doses in the table. 3. Provide a sample calculation GEH performed to calculate the dose rates and integrated doses in the table. 4. If GEH used a computer code(s), please state name(s) of the code and provide its input and output files.
3.11-24	Hinson C	Show how the operating dose rates in Table 3H-5 for areas in the drywell were derived and verify that these dose rates are bounding and conservative for these areas.	In DCD Tier 2, Revision 4, Table 3H-5 lists the operating dose rates for the various portions of the containment vessel. The listed operating dose rates for the upper drywell and upper area of the lower drywell are given as 26.1 R/hr and for the lower area of the lower drywell as 19.8 R/hr. On the basis of the different operating dose rates in different rooms in the containment vessel as shown in Figures 12.3, show how you arrived at the operating dose rate values for the drywell listed in Table 3H-5. Verify that the listed operating dose rates for the upper and lower drywell of 26.1 and 19.8 R/hr, respectively, in Table 3H-5 are conservative and bounding.
3.11-25	Hinson C Pal A	For Table 3H-6, explain how the integrated gamma doses were calculated and, for the areas where	The following apply to DCD Tier 2, Revision 4, Table 3H-6; a) using the average operating dose rates shown in Figures 12.3-1 through 12.3-8 for each of the areas listed in Table 3H-6, the 60-year integrated doses calculated by the staff appear to be well below the integrated doses listed in Table 3H-6 for most of these areas. Show how the integrated

RAI Number	Reviewer	Question Summary	Full Text
		these doses exceed the integrated dose that the equipment is qualified for, describe how the equipment will be protected from these high integrated doses during normal operating conditions.	gamma dose values listed in the second column of Table 3H-6 were calculated and, for one of the plant zones listed in Table 3H-6, provide a sample calculation showing how the zone area dose rate and integrated dose were calculated. b) explain why Table 3H-6 lists two different integrated doses for some areas and only a single integrated dose value for other areas, c) on the basis of the normal operation dose rates shown in Figures 12.3-1 through 12.3-8, the 60-year integrated doses for some of the areas listed in Table 3H-6 exceed the 10^4 rad qualification criteria for electronic equipment stated in the footnote for Table 3H-6. For each of these areas (those areas where the plant radiation zone designation is Zone D (25 mRem/hr) or greater), describe what plant design features (e.g. shielding, equipment location) will be used to ensure that the electronic equipment in these areas will not be exposed to integrated radiation doses that will exceed the equipment qualification for radiation, d) the integrated gamma dose listed in Table 3H-6 for the Main Steam Tunnel is listed as less than 10^7 rads. Since this value exceeds the equipment qualification values for both electronic equipment (10^4 rads) and other equipment (10^6 rads) as stated in the footnote for this table, describe the plant design features which will be used in the Main Steam Tunnel to ensure that the radiation qualification limits of the equipment in this area will not be exceeded.
3.11-21 S01	Pal A	Include digital and non-digital instrumentation and control in Section 3.11 or provide justification for not including them.	In response to RAI 3.11-21 dated February 22, 2008, GEH stated that the first paragraph in Section 3.11 will be revised in Revision 5 to state “EQ is based on limiting design conditions for electrical equipment (including digital instrumentation and control components) and safety-related mechanical equipment.” The staff does not understand why instrumentation (non-digital) is deleted from Section 3.11. Include both type of instrumentation and control in Section 3.11 or provide justification for not including them.

RAI Number	Reviewer	Question Summary	Full Text
3.11-17 S01	Pal A	Modify Table 3.11-1 to indicate all electrical penetrations rather than multiple electrical penetrations as proposed or provide justification for not doing so.	In response to RAI 3.11-17 dated February 22, 2008, GEH stated that Table 3.11-1 will be revised in Revision 5 to include electrical penetrations. The proposed modification indicates multiple electrical penetrations in Table 3.11-1. ESBWR design identified all electrical penetrations as safety-related. There are no non-safety-related electrical penetrations. Modify Table 3.11-1 to indicate **all** electrical penetrations rather than **multiple** electrical penetrations as proposed or provide justification for not doing so.
3.2-34 S03	R. McNally	The response to RAI 3.2-34 S02 includes proposed criteria for application of ASME Section XI that is inconsistent with the applicant's position stated in the response to RAI 3.2-1.	The response to RAI 3.2-34 S02 includes criteria to be included in DCD Tier 2 Subsection 3.2.3.4 that is inconsistent with the applicant's response on RAI 3.2-1 S02 in regard to a commitment to ASME Section XI inspections for the Quality Group (QG) B Turbine main Steam (TMSS) piping (N11, Item 1). Seismic Category II QG B piping that is upgraded to ASME Section III should be subject to ASME Section XI inspections, unless adequate technical justification is provided. The applicant is requested to modify the criteria relative to ASME Section XI inspections for the N11 TMSS Item 1 and B21 Item 13 main steam drains to be consistent with the response to RAI 3.2-1 S02.
5.2-66 S01	Thomas G Wang W	Justify safety relief valve (SRV) Flow Capacity Assumed in TRACG.	In response to RAI 5.2-66 dated February 26, 2008, GEH provided a revised Table 6.3-1 which showed that the Total Mini. Automatic Depressurization System (ADS) Flow Capacity at Vessel Pressure (1250psig) is in a range between 1380 to 1440 kg/s. DCD Revision 4, Chapter 5, Table 5.2.2 provided a value of 138 kg/s for each Mini. ADS Flow capacity at Vessel Pressure. Explain and justify the discrepancy for the values provided in DCD Revision 4 and RAI 5.2-66 response. Provide limiting TRACG ECCS-LOCA analysis using ADS flow capacity values at 1380 and 1440 kg/s.

RAI Number	Reviewer	Question Summary	Full Text
14.3-176 (Revised)	Hoffman K	Turbine Missile Probability and Turbine material, design, inspection and test verification Turbine material, design, inspection and test verification.	a. In Revision 3 of the DCD Tier 1, Section 2.11.4 discussed external turbine missile probability and required it to be less than $1x10^{-4}$ per turbine year. Revision 3 also included an ITAAC #5 in Table 2.11.4-1 that confirmed the probability was less than $1x10^{-4}$ per turbine year and verified the calculation existed. Revision 4 deleted the Tier 1 missile probability discussion and the ITAAC. In order for the staff to conclude that GDC 4 is satisfied, the staff requests that the applicant revise Revision 4 of DCD Tier 1 to add a description of the "P_1 probability", i.e. $P_1 < 10^{-4}$ for turbine failure resulting in the ejection of turbine rotor fragments in terms of the criteria shown in Table 3.5.1.3-1 of SRP Section 3.5.1.3. b. In Revision 3 of the DCD Tier 1, Section 2.11.4 discussed Turbine Disk Integrity being provided through the combined use of selected materials with suitable toughness, analyses, testing, inspections, and operating procedures. Tier 1 of the DCD also discussed how turbine components and valves would be in-service tested and inspected in accordance with industry practice or as required to meet the Original Equipment Manufacturer's (OEM) turbine missile generation probability requirements. Revision 3 also included an ITAAC #4 in Table 2.11.4-1 which provided a means to verify the materials, analyses, testing, inspections, and operating procedures to ensure turbine disk integrity. Revision 4 deleted these turbine disk integrity related discussions and the ITAAC. In order for the staff to conclude that GDC 4 is satisfied, the staff requests that the applicant revise Revision 4 of DCD Tier 1 to add an ITAAC to verify that the as-built turbine material properties, the turbine rotor and blade designs and pre-service and inservice inspection and testing requirements meet the requirements of the turbine missile generation probability calculation.

RAI Number	Reviewer	Question Summary	Full Text
			This RAI supercedes the previously issued RAI 14.3-176 (RAI Letter No. 126, Adams Accession No. ML073532238)
10.2-26 (Revised)	Hoffman K	Turbine Missile Probability calculation and maintenance program	In Revision 4 to the ESBWR DCD, the ITAAC requiring the COL applicant to provide an analysis of the probability of missile generation was deleted. The probability of external turbine missile generation is dependent also upon effective implementation of the turbine system vendors' maintenance program. In order for the staff to conclude that GDC 4 is satisfied, the staff requests that the applicant revise the Tier 2 information in Revision 4 of the DCD to include the following actions for the COL Applicant: (1) The COL Applicant shall submit for NRC review and approval, a turbine missile generation probability calculation based on the NRC approved methodologies including proposed material properties (using bounding values if actual values are unknown), rotor and blade design analyses as well as maintenance and inspection activities. (2) The COL Applicant shall fully describe the plant specific turbine maintenance and inspection program required to satisfy the Original Equipment Manufacturer's turbine missile generation probability calculation including each of the criteria identified in Section II of SRP Section 3.5.1.3. This RAI supercedes the previously issued RAI 10.2-26 (RAI Letter No. 122, Adams Accession No. ML073381170)

cc:

Ms. Michele Boyd
Legislative Director
Energy Program
Public Citizens Critical Mass Energy
and Environmental Program
215 Pennsylvania Avenue, SE
Washington, DC 20003

W. Craig Conklin, Director
Chemical and Nuclear Preparedness &
Protection Division (CNPPD)
Office of Infrastructure Protection
Department of Homeland Security
Washington, DC 20528

Mr. Marvin Fertel
Senior Vice President
and Chief Nuclear Officer
Nuclear Energy Institute
1776 I Street, NW
Suite 400
Washington, DC 20006-3708

Mr. Ray Ganthner
Senior Vice President
AREVA, NP, Inc. 3315
Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

Vanessa E. Quinn, Acting Director
Technological Hazards Division
National Preparedness Directorate
Federal Emergency Management Agency
500 C Street, NW
Washington, DC 20472

Email

aec@nrc.gov (Amy Cubbage)
APH@NEI.org (Adrian Heymer)
art.alford@ge.com (Art Alford)
awc@nei.org (Anne W. Cottingham)
bennettS2@bv.com (Steve A. Bennett)
bevans@enercon.com (Bob Evans)
bob.brown@ge.com (Robert E. Brown)
BrinkmCB@westinghouse.com (Charles Brinkman)
chris.maslak@ge.com (Chris Maslak)
CumminWE@Westinghouse.com (Edward W. Cummins)
cwaltman@roe.com (C. Waltman)
dan1.williamson@ge.com (Dan Williamson)
david.hinds@ge.com (David Hinds)
david.lewis@pillsburylaw.com (David Lewis)
David.piepmeyer@ge.com (David Piepmeyer)
dennis.chin@ge.com (Dennis Chin)
dlochbaum@UCSUSA.org (David Lochbaum)
don.lewis@ge.com (Don Lewis)
erg-xl@cox.net (Eddie R. Grant)
Eugene_Grecheck@dom.com (Eugene S. Grecheck)
frankq@hursttech.com (Frank Quinn)
Frostie.white@ge.com (Frostie White)
gcesare@enercon.com (Guy Cesare)
george.honma@ge.com (George Honma)
george.stramback@gene.ge.com (George Stramback)
george.wadkins@ge.com (George Wadkins)
GovePA@BV.com (Patrick Gove)
greshaja@westinghouse.com (James Gresham)
gzinke@entergy.com (George Alan Zinke)
hickste@earthlink.net (Thomas Hicks)
james.beard@gene.ge.com (James Beard)
jcurtiss@winston.com (Jim Curtiss)
jeff.waal@ge.com (Jeff Waal)
jgutierrez@morganlewis.com (Jay M. Gutierrez)
jim.kinsey@ge.com (James Kinsey)
jim.riccio@wdc.greenpeace.org (James Riccio)
jim.rogers@ge.com (Jim Rogers)
JJNesrsta@cpsenergy.com (James J. Nesrsta)
joel.Friday@ge.com (Joel Friday)
John.O'Neill@pillsburylaw.com (John O'Neill)
john.sorensen@ge.com (John Sorensen)
Joseph_Hegner@dom.com (Joseph Hegner)
junichi_uchiyama@mnes-us.com (Junichi Uchiyama)
kathy.sedney@ge.com (Kathy Sedney)
kathy.warnock@ge.com (Kathy Warnock)
kenneth.ainger@exeloncorp.com (Kenneth Ainger)
kimberly.milchuck@ge.com (Kimberly Milchuck)

KSutton@morganlewis.com (Kathryn M. Sutton)
kurt.schaefer@ge.com (Kurt Schaefer)
kwaugh@impact-net.org (Kenneth O. Waugh)
laura.bello@ge.com (Laura Bello)
lou.lanese@ge.com (Lou Lanese)
maria.webb@pillsburylaw.com (Maria Webb)
mark.beaumont@wsms.com (Mark Beaumont)
Marvin.Smith@dom.com (Marvin L. Smith)
matias.travieso-diaz@pillsburylaw.com (Matias Travieso-Diaz)
media@nei.org (Scott Peterson)
mgiles@entergy.com (M. Giles)
mike_moran@fpl.com (Mike Moran)
mwetterhahn@winston.com (M. Wetterhahn)
nirsnet@nirs.org (Michael Mariotte)
PAC2@nrc.gov (Peter Cochran)
pareez.golub@ge.com (Pareez Golub)
Pat.Woodfin@ge.com (Pat Woodfin)
patriciaL.campbell@ge.com (Patricia L. Campbell)
paul.gaukler@pillsburylaw.com (Paul Gaukler)
Paul@beyondnuclear.org (Paul Gunter)
peter.jordan@ge.com (Peter Jordan)
phinnen@entergy.com (Paul Hinnenkamp)
pshastings@duke-energy.com (Peter Hastings)
randy.newton@ge.com (Randy Newton)
RJB@NEI.org (Russell Bell)
RKTemple@cpsenergy.com (R.K. Temple)
roberta.swain@ge.com (Roberta Swain)
sandra.sloan@areva.com (Sandra Sloan)
SauerB@BV.com (Robert C. Sauer)
sfrantz@morganlewis.com (Stephen P. Frantz)
sharon.lyons@ge.com (Sharon Lyons)
steven.hucik@ge.com (Steven Hucik)
steven.stark@ge.com (Steven Stark)
tjh2@nrc.gov (Thomas Herrity)
tom.miller@hq.doe.gov (Tom Miller)
trsmith@winston.com (Tyson Smith)
VictorB@bv.com (Bill Victor)
Wanda.K.Marshall@dom.com (Wanda K. Marshall)
waraksre@westinghouse.com (Rosemarie E. Waraks)
wayne.marquino@ge.com (Wayne Marquino)
whorin@winston.com (W. Horin)