March 13, 2008

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. 168 RELATED TO NEDO-33337, "ESBWR INITIAL CORE TRANSIENT ANALYSIS"

Dear Mr. Brown:

By letter dated January 8, 2008, Nuclear Regulatory Commission (NRC) staff informed you of the result of the acceptance review of NEDO-33337, "ESBWR Initial Core Transient Analysis." In that letter, the staff determined that the material presented in the topical report is sufficient to begin a detailed review as part of the ESBWR design certification review.

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 301-415-6715 or bmb2@nrc.gov or you may contact Amy Cubbage at 301-415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Bruce Bavol, 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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ADAMS ACCESSION NO. ML080700189

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DATED MARCH 13, 2008

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Requests for Additional Information (RAIs): ESBWR Design Control Document (DCD) Revision 4; NEDO-33337, "ESBWR Initial Core Transient Analysis"

RAI Number	Reviewer	Question Summary	Full Text
15.2-15	Gilmer J	Explain reasons why two TRACG04 code versions are utilized.	NEDO-33337, Table 1.2-1, "ESBWR Safety Analysis Codes" identifies the TRACG04 code version (Alpha VMS or Personal Computer) utilized for each transient. Please provide an explanation of the differences and reasons why two versions are necessary.
15.2-16	Strait K Thomas G Wang W	Applying equilibrium core Analyses	Throughout NEDO-33337, it is stated that the DCD analyses are "applicable" rather than "bounding." For example, in Section 1.2, for Analysis of Design Basis Accidents, it is stated that "----The analysis documented in the DCD is applicable to both equilibrium and initial core -----." Also in Sections 2.4.7 to 2.4.12, it is stated that "Analysis is in the DCD applies to the initial core." There are total of 4 sets of analyses from GEH: DCD equilibrium analyses on operation point SP0, initial core transient analyses on operation point SP0, and initial core transient analyses on operation points SP1 and SP2 (FW Temp Operating Domain Transient and Accident Analyses LTR). Identify the bounding analysis for each event identified in the DCD Chapter 15 from these 4 sets of analyses. Justify why transient analyses for all events on operation points SP1 and SP2 with equilibrium core are not needed to identify the most limiting transient.
15.2-17	Thomas G	RWE	NEDO-33337,Table 1.2.1-Add the new AOO, Control Rod Withdrawal Error During Power Operation, as shown in the DCD Table 15.0-2 mark up sent in letter dated December 12, 2007 (MFN-07-655). Incorporate this new AOO into the LTR.

15.2-18	Wang W	BOC, MOC, and EOC exposure points	For each exposure point analyzed (BOC, MOC, and EOC) in Section 2.2 “Stability Evaluation” of NEDO-33337, provide data similar to Figures 4A.1a through 4A.1e in the DCD Tier 2, Chapter 4, Appendix A. In addition, provide the 2-D channel flow distribution in the core and the core pressure drop.
15.2-19	Wang W	Core Flow Calculation Code	In the figures of DCD Tier 2, Chapter 4, Appendix A, the core flow appears to be a constant value of 78.508 Mlb/hr. In Table 2.2-1 of NEDO-33337, the core flow as function of exposure appears to be calculated based on power distributions, subcooling, and downcomer water level. What code was used to calculate the data in Table 2.2-1 of NEDO-33337? Are the conditions presented in the figures in the DCD Tier 2, Chapter 4, Appendix A representative of an ESBWR equilibrium core?
15.2-20	Wang W	Regional Mode Decay Ratio at EOC	Table 2.2-2 of NEDO-33337 does not show a calculated value for the regional mode decay ratio at EOC conditions, even though the regional mode appears to dominate the ESBWR response and it increases from BOC to MOC. Has GEH performed an EOC regional mode calculation at EOC for any core configuration? Provide a justification or additional data why the MOC exposure point results in the limiting stability condition for the cycle.

15.2-21	Wang W	Axial Power Shape Trends	Figure 2.2-3 of NEDO-33337 and Figure 4D-3 of DCD Tier 2, Rev 4 appear to show conflicting trends of axial power shape with respect to exposure. In the DCD figure, the MOC condition has higher power on the top of the core and lower power in the bottom of the core than the BOC condition. In the NEDO-33337 figure, the shifts in power appear to be reversed (lower power at the core top in MOC than in BOC). In addition, the axial peaking factors appear to have changed significantly (~1.7 in node 4 for NEDO-33337, and ~1.4 in node 3 for DCD). Please explain the differences.
15.2-22	Wang W	Startup Stability Calculations	Was the TRACG fine nodalization model used for the startup stability calculations in Section 2.2.2.2.3 of NEDO-33337? Justify the model used.
15.2-23	Wang W	Stability Uncertainties	Section 2.2.1.4 of NEDO-33337 refers to the CSAU statistical analysis performed for the TRACG qualification report (NEDE-33083P). Section 2.2.1.4.4 states that “The Monte Carlo decay ratio adders determined and documented in Reference 2.2-1 are applied to the initial core decay ratio results.” However, Table 2.2-2 of NEDO-33337 shows decay ratio values of ~0.0, which clearly do not include the CSAU uncertainties. Please, specify how the CSAU TRACG uncertainties are applied to the DR results. Specify how the CSAU TRACG uncertainties are applied in relation to the DR acceptance and design criteria.

15.2-24	Streit K Gilmer J	TRACG Variables	NEDO-33337, Table 2.3-1 is incomplete. Provide the following variables used or calculated in TRACG for AOO and Infrequent event analyses: • Core Flow • Steam Flow • Feedwater Flow Rate Analysis Value • Vessel Core Pressure • Core Leakage Flow % • Safety Relief Valve Capacity • Safety Function Delay • Safety Function Opening Time NEDO-33337, Section 2.3.2.1.2, Closure of One Turbine Control Valve, states that Table 2.3-2 will provide the Closure time assumed in the slow closure analysis. But the closure time is not provided in the Table 2.3-1. Include the slow closure time in the table. Add the unit "seconds" in the parameter column of the Table.
15.2-25	Streit K Thomas G	Loss of Feedwater Heating	NEDO-33337, Section 2.3.1.1.1 states: "Under circumstances in which no SCRRI/SRI pattern is defined, the power would rise to the simulated thermal power trip scram setpoint." This implies that there is no credit taken for SCRRI for the initial core analysis. What is the difference between this event and Loss of Feedwater Heating without SCRRI?
15.2-26	Streit K Gilmer J	Loss of Feedwater Heating Temperature Change	NEDO-33337, Section 2.3.1.1.1 states that no single operator error or equipment failure shall cause a loss of more than 55.6 °C (100 °F) FW heating. However, Table 2.3-5 shows the analysis assumes a change of 39 °C (70 °F). Why is 70 °F assumed instead of 100 °F?

15.2-27	Streit K Gilmer J	Typical SCRRI/SRI rod pattern	Sections 2.3.2.2.1 and 2.3.2.4.1 of NEDO-33337 state “A typical rod pattern is analyzed in this event” for both turbine trip with turbine bypass and generator load rejection with turbine bypass analyses. How is a typical rod pattern defined? Demonstrate that this is the most conservative rod pattern for both events. If it is not the most conservative, demonstrate how the ESBWR avoids violating local thermal limits with the most conservative pattern.
15.2-28	Streit K Gilmer J	SCRRI/SRI power increase	Section 2.3.2.4.3 of NEDO-33337 states SCRRI/SRI will activate to reduce the power to 60% in the Turbine Trip with Turbine Bypass analysis. In Figure 15.2-6a of DCD Tier 2, SCRRI/SRI does reduce power to 60%, where power then appears to stabilize. In Figure 2.3-6a of NEDO-33337, power is shown to reduce to 60% but then increase to approximately 75%. This is additionally shown in the results of the Generator Load Rejection with Turbine Bypass analysis in Figure 2.3-4a, where power approaches 80%. Explain this power increase and describe if it continues to rise after the 400 seconds.

15.2-29	Thomas G	Generator Load Rejection with Turbine Bypass	NEDO-33337, Section 2.3.2.2.1 states that: "No SCRRI rods are assigned." Confirm whether SRI rods are assigned. In the same paragraph it is stated: "—The SCRRI/SRI function reduces the core power and limits the change in MCPR after a generator load rejection with turbine bypass." If no SCRRI rods are selected, but SRI rods are only selected explain how the SRI function alone reduces the core power and limits the change in the MCPR. For the analyses shown in the DCD, credit is taken for SCRRI and SRI. Why is deviation taken for the initial core analyses compared with the DCD analysis?
15.2-30	Thomas G	Turbine Trip With Turbine Bypass	NEDO-33337, Section 2.3.4.1. Confirm whether SRI rods are assigned. In the same paragraph it is stated: "—The SCRRI/SRI function reduces the core power and limits the change in MCPR after a generator load rejection with turbine bypass." If no SCRRI rods are selected, but SRI rods are only selected explain how the SRI function reduces the core power and limits the change in the MCPR. For the analyses shown in the DCD, credit is taken for SCRRI and SRI. Why deviation is taken for the initial core analyses compared with the DCD analysis?
15.2-31	Thomas G	Turbine Trip With Turbine Bypass	NEDO-33337, Section 2.3.2.4.2, Systems Operation - In the DCD Section 15.2.2.4.2, credit is taken for RPS. Why is credit <u>not</u> taken for RPS in the initial core transient analyses?
15.2-32	Streit K Gilmer J	Limiting AOOs	NEDO-33337, Section 2.3.6 states, "The Potentially limiting events that establish the CPR operating limit are identified below." However, there are no events listed. What are the potentially limiting events used to establish the CPR operating limit for the initial core?

15.2-33	Thomas G	TCV closing sequence	NEDO-33337, Table 2.3-20 Sequence of Events for Opening of one TCV - In the analysis shown in the DCD, Turbine Control Valve (TCV) opens at 0.1 second, but in the initial core analysis, TCV opens only at 3 to 7 seconds. Explain the difference in the sequence between the DCD analysis and the initial core analysis.
15.2-34	Thomas G	Nodes	NEDO-33337, Figure 2.3-1g-Nodes 2404 to 2430 are identified in the figure. Submit a diagram to show the relative positions of the nodes in the core model.
15.2-35	Thomas G	IC flow	NEDO-33337, Figure 2.3-9b, Confirm whether the IC flow shown is only for one IC or the total IC flow.
15.2-36	Thomas G	MCPR	NEDO-33337, Figure 2.3-16g includes MCPR for nodes 0110, 0140, 0210, and 0240. Confirm whether the single line shown is applicable for all nodes?
15.2-37	Thomas G	Pressure Regulator Failure-Closing of all TCV and Bypass valves	NEDO-33337, Section 2.4.4.5 states: “Because the delta CPR/ICPR for this event is bounded by the limiting AOO value, no fuel failures are expected; therefore, no radiological analysis is required.” Why is the AOO value applied for an Infrequent Event? DCD Tier 2, Section 15.3.4.5 states: “A radiological analysis was performed for an event where 1000 fuel rods fail as a result of entering boiling transition.” Why are the results different? Please clarify.
15.2-38	Thomas G	Inadvertent Opening of a SRV Stuck Open SRV	NEDO-33337, Sections 2.4.13.3 and 2.4.15.2 state that open SRV capacity is assumed to be 1.1 times the capacity of the SV in DCD Tier 2, Table 5.2.2, and that this increased capacity, 154.2 Kg/s, is assumed to observe bounding depressurization results. What is the basis for assuming 154.2 kg/s, when the design capacity of the SRV is 138 Kg/s?

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