June 3, 2008

Mr. Robert E. Brown
Senior Vice President, Regulatory Affairs
GE Hitachi Nuclear Energy
3901 Castle Hayne Road MC A-50
Wilmington, NC 28401

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 208 RELATED TO NEDE-33338P, "ESBWR FEEDWATER TEMPERATURE OPERATING DOMAIN FOR TRANSIENT AND ACCIDENT ANALYSIS"

Dear Mr. Brown:

By letter dated January 29, 2008, the U. S. Nuclear Regulatory Commission (NRC) staff informed you of the result of the acceptance review of NEDE-33338, "ESBWR Feedwater Temperature Operating Domain for Transient and Accident 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 Bruce.Bavol@nrc.gov or you may contact Amy Cubbage at 301-415-2875 or Amy.Cubbage@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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Requests for Additional Information (RAIs): ESBWR Design Control Document (DCD) Revision 4; NEDE-33338, "ESBWR Feedwater Temperature Operating Domain for Transient and Accident Analysis"

RAI Number	Reviewer	Question Summary	Full Text
4.3-16	Wang W	Explain how operating domain will be defined.	Explain how the power-temperature operating domain will be defined. Will the feedwater temperature values specified in NEDO-33338 be applied for every cycle, or will the operating domain points be defined on cycle-specific bases? How were and where are these values specified?
4.3-17	Wang W	Put lines for rod block, control system action, and protection system actuation in FWTOD map.	Provide in graphical form the power-temperature operating map showing the most relevant lines for alarms (e.g. rod block), control system action, and protection system actuation.
4.3-18	Wang W	Provide a summary of the core reload process as it relates to the power-temperature operating domain.	Provide a summary of the core reload process as it relates to the power-temperature operating domain. Specifically, define what transient calculations must be performed on a cycle specific basis at which operating point (i.e., SP0, SP1, or SP2) and at which exposure (i.e., beginning of cycle (BOC), middle of cycle (MOC), or end of cycle (EOC)). What is the final result of the analyses (e.g., what specific core operating limit reports (COLR) values are affected).

RAI Number	Reviewer	Question Summary	Full Text
4.3-19	Wang W	Provide additional data, such as flow distribution and core pressure drop.	For operating points SP1M and "SP1M following the loss of heating event," provide data similar to Figures 4A.1a through 4A.1e in the DCD Chapter 4, Appendix A. In addition, provide the 2-D channel flow distribution in the core and the core pressure drop. Please identify the location where the pressure drop is measured (e.g. lower to upper tie plate, channel inlet to outlet ...). Provide the above data for beginning of cycle (BOC), middle of cycle (MOC), and end of cycle (EOC) conditions.
4.3-20	Wang W	Define Middle of Cycle.	The calculations in NEDO-33338 and NEDO-33337 refer to the MOC exposure point. Please explain how the MOC exposure is defined.
4.3-21	Wang W	Justify TRACG model used for startup stability	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.
4.3-22	Wang W	Specify how TRACG uncertainties are applied in the stability results.	Section 2.2.1.4 of NEDO-33337 refers to the code scaling applicability and uncertainty (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 decay ratio (DR) results. Specify how the CSAU TRACG uncertainties are applied in relation to the DR acceptance and design criteria.

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4.3-23	Wang W	Provide the applicable rod motion limits.	In between control rod pattern changes, the excess reactivity can be controlled by either feedwater temperature changes or fine control rod motion. For the fuel temperature and conditions in a representative point in the cycle (e.g. middle of cycle (MOC)), provide the applicable rod motion limits (e.g. allowable withdrawal velocity). Using this data, explain why it is possible to move control rods at full power to maintain constant core reactivity after peak reactivity is achieved and rod withdrawal is required.
4.3-24	Wang W	Provide heat balance for SP1M and SP2 points.	For operating points SP1M and SP2, provide a heat balance sheet similar to the one in Figure 10.1-2 of DCD Chapter 10.
4.3-25	Wang W	Request information related to an end-of-cycle stretch.	Is it possible to use the region between SP0 and SP1M to provide an end-of-cycle stretch? Would technical specification changes be required similar to the end-of-cycle low feedwater temperature stretch in operating reactors? The end of cycle (EOC) conditions would be different at this point, which is typically called the end of rated life (EOR). If the stretch is allowed, justify why the EOC transient analysis are not also performed at SP1M with cross-section sets compatible with the cycle stretch time.
4.3-26	Wang W	Request information of operating point at SP2.	Is it possible to operate at point SP2 for extended periods of time to improve the end-of-cycle isotopics (e.g. increased Pu production to stretch the cycle time)? Would long term operation at SP2 require tech spec changes? Long term operation at SP2 would change the isotopics and safety-related parameters like the void reactivity coefficient, which would affect the results of limiting transient analyses at SP0. Evaluate the impact of possible long-term operation at SP2

RAI Number	Reviewer	Question Summary	Full Text
			during the cycle on the transient ΔCPR for the limiting end of cycle (EOC) transients.
4.3-27	Wang W	Evaluation of stability between points SP1M and SP5.	Provide an evaluation of stability between SP1M and SP5 to demonstrate that the stability exclusion region (decay ratio>0.8) does not intersect the power-temperature operating domain.
4.3-28	Wang W	Are there any safety limits in ESBWR that will be function of power or feedwater temperature?	Operating reactors have limits (e.g., minimum critical power ration (MCPR) and linear heat generation rate (LHGR) limits) that are function of flow and other parameters. Are there any safety limits in ESBWR that will be a function of power or feedwater temperature? Please describe how limit setdowns are determined. Consider the following limits: the MCPR limit, the LHGR limit, simulated thermal power trip setpoint, multi-channel rod block monitor (MRBM) setpoints, and other similar limits.
4.3-29	Wang W	Justify which AOO event is bounding for the instability analysis.	In response to RAI 4.4-57 the regional decay ratio was calculated for a loss of feedwater heating (LOFWH) with selected control rod run-in/select rod insert (SCRRI/SRI) anticipated operational occurrences (AOO) and loss of feedwater (LOFW) AOO for the equilibrium core at the peak hot excess (PHE) exposure point. The results indicate that the LOFWH regional mode decay ratio is 0.66 while the LOFW regional mode decay ratio is 0.58. The staff notes that these values are somewhat similar (within one standard deviation). Considering variation in nuclear parameters from cycle to cycle and variation in core neutronic and stability characteristics with variation in inlet subcooling, please describe what analyses are performed on a cycle specific basis to determine the limiting AOO from a stability standpoint to determine the location of the

RAI Number	Reviewer	Question Summary	Full Text
			SP1M point on the power/temperature operating map. If LOFWH with SCRRI/SRI is considered generically bounding, please provide additional quantitative and qualitative justification.
4.3-30	Wang W	Demonstrate transient thermal mechanical fuel performance is acceptable.	Please describe how acceptable transient thermal mechanical fuel performance is demonstrated in the expanded operating domain.
4.3-31	Wang W	Describe plant response to a steam line break near 7th FWH.	Please qualitatively describe the response of the plant to a break in the line from the mainsteam line to the 7th FWH. In particular, how is a break in this line detected and what signal will actuate ESF?
4.3-32	Wang W	Describe the algorithm for SCRRI/SRI actuation when the feedwater temperature changes by more than 30F	Describe the algorithm for selected control rod run-in/select rod insert (SCRRI/SRI) actuation when the feedwater temperature changes by more than 30F. Can the algorithm reset itself and fail to operate if the feedwater temperature transient is very slow?
15.2-39	Wang W	Evaluate other events missing in NEDO-33338 and update Table 1.2.	Section 1.2 of NEDO-33338 provides the justification of which are the limiting events when FW temperature is allowed to vary, and which events are bounded by the DCD analyses. A review of this section indicates that a number of events that were analyzed in the DCD were not covered in Section 1.2 of

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			NEDO-33338. Examples of events analyzed in the DCD that appear to be missing in the NEDO-33338 evaluation are: Section 15.2.2.9 “Loss of Shutdown Cooling Function of RWCU/SDC”, Section 15.3.10 “Fuel Assembly Loading Error, Mislocated Bundle”, Section 15.3.11 “Fuel Assembly Loading Error, Misoriented Bundle”, Section 15.3.12 “Inadvertent SDC Function Operation”, Section 15.3.14 “Inadvertent Opening of a Depressurization Valve”, Section 15.5.2 “Shutdown Without Control Rods (Standby Liquid Control System Capability)”, Section 15.5.3 “Shutdown from Outside Main Control Room”, and Section 15.5.6 “Safe Shutdown Fire”. For completeness, evaluate these and any other events missing in NEDO-33338 and update Table 1.2 accordingly. If any of these events are not bounded by the SP0 DCD analysis, the event will require analysis at SP1 or SP2.
15.2-40	Wang W	Describe how limiting power shapes and rod patterns are determined for the ESBWR at any allowed operating point to ensure that the OLMCPR includes adequate margin to account for operational flexibility.	In defining cycle specific operating limit minimum critical power ratios (OLMCPRs), limiting transient ΔCPRs are calculated using TRACG. For operating reactors, initial conditions are set to limiting control rod patterns to develop enveloping power shapes for the evaluations (i.e. MOC to EOC HBB or black and white rod patterns). Please describe how limiting power shapes and rod patterns are determined for the ESBWR at any allowed operating point to ensure that the OLMCPR includes adequate margin to account for operational flexibility. Please evaluate analysis assumptions for conservatism considering effects such as SCRAM worth and transient varying axial power shape to justify that the cycle analyses are adequately conservative to bound potential operating conditions.

cc:

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