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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 97 - Related to ESBWR Design Certification Application – RAI Numbers 4.3-8 and 4.3-9**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by the Reference 1 NRC letter. GEH response to RAI Numbers 4.3-8 and 4.3-9 is addressed in Enclosure 1.

If you have any questions or require additional information, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

Reference:

1. MFN 07-292, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 97 Related to the ESBWR Design Certification Application*, dated May 10, 2007.

Enclosure:

1. MFN 08-170 – Response to Portion of NRC Request for Additional Information Letter No. 97 - Related to ESBWR Design Certification Application – RAI Numbers 4.3-8 and 4.3-9

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	eDRF	0000-0078-2834 and 0000-0078-4815

Enclosure 1

MFN 08-170

Response to Portion of NRC Request for

Additional Information Letter No. 97

Related to ESBWR Design Certification Application

RAI Numbers 4.3-8 and 4.3-9

NRC RAI 4.3-8

Stability: armed region

All approved D&S solutions have an armed region. Typically, the solution is only armed for low-flow maneuvers, and this represents a small fraction of the cycle time. Since ESBWR operates at the equivalent of low-flow conditions at nominal conditions, one would expect that the D&S solution must remain armed for the complete cycle. Please provide a discussion of armed-region implications and the associated probability of false alarms.

GEH Response

The response is broken down into two items for clarity.

(1) Armed-Region

The implemented Detect and Suppress (D&S) solution is designed as Defense-in-Depth to reliably and readily detect and suppress unanticipated core wide and regional mode oscillations. For conventional BWR product line (e.g., BWR/3-6 product line), the ability to trip the reactor and generate system alarm is automatically enabled at power and flow conditions potentially susceptible to power oscillation. The trip-enabled region is termed the Armed Region. For ESBWR, however, there is no direct control over core flow. Therefore, the Armed Region Boundaries are specified on a Power – Feedwater Temperature operation map. Furthermore, the ESBWR is designed to have large margins to the instabilities. Such margin has been verified by using both numerical simulations (see the ESBWR Tier 2 DCD Appendix 4D discussion in Reference 4.3-8-1) and experimental investigations (Reference 4.3-8-1). Thus, the Armed Region Boundaries are established on a very conservative generic basis to envelop power and feedwater temperature conditions potentially susceptible to power oscillation.

GEH agrees that ESBWR operates at the most limiting condition in term of stability at rated conditions, condition of maximum power/flow ratio. Therefore, the D&S solution should remain armed for the rated conditions. The region on the Power – Feedwater Temperature map in which the D&S solution will be armed (i.e., operable) is specified in the "Core Operating Limits Report (COLR)" in accordance with Technical Specification 5.6.3 as referenced in Technical Specifications 3.3.1.4, "Neutron Monitoring System (NMS) Instrumentation" and 3.3.1.5, "Neutron Monitoring System (NMS) Automatic Actuation". The basis for determining the Armed Region boundaries is given in the report for the ESBWR D&S solution as discussed in the response to RAI 4.3-7 S01. The proposed Technical Specifications 3.3.1.4 and 3.3.1.5 related to the Armed Region are provided in the response to RAI 16.2-161.

(2) Probability of False Alarms

Arming the trip and alarm functions for ESBWR's normal operation condition throughout the complete cycle may increase the probability of unnecessary spurious scram because the probability is expected to be proportional to the time duration. However, the stability evaluation results as documented in ESBWR Tier 2 DCD Chapter 4 (Reference 4.3-8-1) and Stability Analysis Licensing Topical Report (Reference 4.3-8-2) show that ESBWR is free of undamped oscillations and other thermal-hydraulic instabilities for all conditions of normal operation.

Therefore, the D&S solution is implemented to provide Defense-In-Depth protection from instabilities that are not anticipated. Avoidance of spurious scram, therefore, is achieved by elevating the threshold setpoint of the oscillation detection algorithm of D&S well above the level of measured LPRM background noise. The detail of the detection algorithm is given in the report for the ESBWR D&S solution as discussed in the response to RAI 4.3-7 S01.

DCD Impact

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

References

4.3-8-1 26A6642AP, ESBWR Design Control Document, Chapter 4, "Reactor", Rev 4, September 2007.

4.3-8-2 TRACG Application for ESBWR Stability Analysis, NEDE-33083P, Supplement 1, December 2004.

NRC RAI 4.3-9

Stability: long term solution criteria

A future licensee may have the flexibility to deviate from the standard certification and choose a different L/T stability solution. Please specify criteria that must be met by ESBWR for L/T stability solutions.

GEH Response

ESBWR Tier 2 DCD Appendix 4D states that the ESBWR implements a Detect and Suppress solution as a defense-in-depth system. Further, GEH specifies the following criteria must be met by the selected L/T stability solution for ESBWR if a future licensee deviates from the standard certification and chooses a different L/T stability solution:

- The L/T stability solution should demonstrate by analysis that either (i) the probability of instabilities in the allowed operating region is sufficiently small or (ii) unstable power oscillations can be detected and suppressed readily without Specified Acceptable Fuel Design Limits (SAFDL) violations. The L/T stability solution may use a combination of both demonstrations for different instability modes.
- The implementation of L/T stability solution should be able to demonstrate the ability to avoid spurious reactor scrams.
- If the licensing basis option is declared inoperable, the L/T stability solution should provide a backup option that may implement manual or administrative actions only if operator actions required to prevent SAFDL violations can be reasonably prompt.
- The L/T stability solution option should include generic technical specifications that address: (i) The methodology for setpoint and region calculation and documentation of the setpoint on either cycle-specific basis (e.g., COLR) or generic basis; (ii) Operability and surveillance requirements for the licensing basis option; and (iii) A time limit (120 days maximum) for operation under the backup option. The ESBWR Tier 2 DCD Revision 4, Chapter 16 Specification 3.3.1.4, Neutron Monitoring System (NMS) Instrumentation, provides generic Technical Specifications and Bases consistent with these criteria for the standard L/T stability solution design.
- Establish a standard procedure for plant specific confirmations of reload designs and other design changes that may affect the generic licensing basis for the L/T stability solution

DCD Impact

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