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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 156 – Related to ESBWR Design Certification Application – RAI Number 4.3-7 Supplement 1**

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 Number 4.3-7 Supplement 1 is addressed in Enclosures 1 and 2. A commitment is included in Enclosure 1 to provide DCD Tier 2 markups to reflect the response to RAI 4.3-7 S01 by May 22, 2008.

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

Sincerely,

James C. Kinsey

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Vice President, ESBWR Licensing

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NRO

Reference:

1. MFN 08-138, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 156 Related to the ESBWR Design Certification Application*, dated February 15, 2008

Enclosures:

1. MFN 08-226 – Response to Portion of NRC Request for Additional Information Letter No. 156 - Related to ESBWR Design Certification Application – RAI Number 4.3-7 S01
2. MFN 08-226 – Response to Portion of NRC Request for Additional Information Letter No. 156 - Related to ESBWR Design Certification Application – DCD Markups from the Response to RAI Number 4.3-7 S01

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Enclosure 1

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Response to Portion of NRC Request for

Additional Information Letter No. 156

Related to ESBWR Design Certification Application

RAI Number 4.3-7 S01

NRC RAI 4.3-7 S01

Generic Letter No. 86-02 and Standard Review Plan 15.9 require that a stability long term solution must be implemented in any BWR.

In GEH's response to RAI 4.3-7, GEH proposed to use DSS-CD as a solution. It is clear that the applicability range of DSS-CD (Table 6.1 of NEDC-33075PA) does not cover ESBWR or GE14E. The procedure for this methodology (Table 6.3 of NEDC-33075P-A) is geared for operating reactors by requiring a two-pump reactor pump trip, which is not possible for the ESBWR.

Provide in either the DCD or a supplement to NEDC-33075P an evaluation of the DSS-CD solution for use in ESBWR. Provide a table with the differences in recommended parameter settings (e.g. corner frequency, period tolerance...) that are fixed by NEDC-33075P-A.

GEH Response

The stability evaluation results as documented in DCD Chapter 4 (Reference 4.3-7-1) and Stability LTR (Reference 4.3-7-2) show that ESBWR is free of undamped oscillations and other thermal-hydraulic instabilities for all conditions of normal operation and for anticipated operational occurrences (AOOs). Therefore, a Detect and Suppress (D&S) solution is implemented to provide defense-in-depth protection from instabilities that are not anticipated. Based on the Defense in Depth algorithms of Detect and Suppress Solution – Confirmation Density (DSS-CD) (Reference 4.3-7-3), GEH develops the details of ESBWR D&S stability solution. In the next revision of DCD Appendix 4D, the detailed discussion and applicability evaluation will be included for the ESBWR DID stability solution where the major design features are summarized in the following Table 4.3-7-1.

References

4.3-7-1 ESBWR Design Control Document, Tier 2 Chapter 4, "Reactor", Revision 4, September 2007.

4.3-7-2 NEDE-33083P, Supplement 1, "TRACG Application for ESBWR Stability Analysis", December 2004.

4.3-7-3 NEDC-33075P-A, "General Electric Boiling Water Reactor Detect and Suppress Solution – Confirmation Density", Revision 6, Class III, January 2008.

DCD Impact

DCD Tier 2, Subsection 4.3.3.6.2 will be revised as noted in the attached markup.

DCD Tier 2 markups to incorporate the necessary information addressed in the above response will be submitted to the NRC by May 22, 2008. These DCD Tier 2 changes will include DCD Appendix 4D, Section 4D.3.

4.3-7-1, Design Features of ESBWR Defense-In-Depth D&S Stability Solution

	ESBWR DID DSS
Solution Overview	A Detect and Suppress Solution (DSS) will be implemented on ESBWR to provide adequate Defense-in-Depth (DID) protection against unlikely instability event. The DSS so developed is based on existing DSS-CD Solutions with modifications considering ESBWR stability characteristics and applicability.
Hardware	• Principal inputs to the DSS are the signals from a large number of LPRM detectors via the OPRM cell grouping. • ESBWR plant-specific OPRM cell assignment has been established in DCD (Figure 7.2-10). • A part of safety-related NUMAC PRNM equipment.
Licensing Basis Detection Algorithm	A high degree of confidence has been established that the safe limit will not be challenged due to the stability related power oscillations during normal operation and AOO. Therefore, there is no licensing basis detection algorithm. However, protection against unanticipated oscillations is provided through a set of defense-in-depth detection algorithms.
Defense-In-Depth Algorithms	• Not required to provide licensing basis protection for the safety limit. • The oscillation detection algorithms are designed to capture the three dominant characteristics of instability in the OPRM signal: Period, Growth Rate and Magnitude. The design of the ESBWR DID algorithms will utilize Period Based Detection Algorithm (PBDA), Amplitude Based Algorithm (ABA) and Growth Rate Algorithm (GRA) to offer protection for unanticipated instability events. • Utilize Period Based Detection Algorithm (PBDA) to recognize periodic oscillatory behavior and also employ an amplitude setpoint well above noise level to prevent spurious reactor scrams (e.g., ~25 counts and ≥1.1 amplitude). • Note that the initial startup testing will evaluate OPRM noise and uncertainty and can accommodate establishing background noise for acceptable trip avoidance. The setpoint confirmation will include use of appropriate simulated & measured LPRM to establish trip avoidance.

Armed-Region	• ESBWR operates at the most limiting condition in term of stability at rated condition due to the highest power/flow ratio, and therefore, the D&S solution should remain armed for the rated condition. • The Armed-Region for ESBWR is defined conservatively when the power level is above the MCPR monitoring threshold power level (25%).
SLMCPR Protection Confirmation	A high degree of confidence has been established that the safety limit will not be challenged due to the stability related power oscillations during normal operation and AOO, and protection against unanticipated oscillations is provided through a set of defense-in-depth detection algorithms. Therefore, SLMCPR protection confirmation is not required.
Backup Stability Protection (BSP)	• When the OPRM system is inoperable, a BSP option is developed to provide adequate protection for continued operation in the unlikely event where the DID algorithm cannot provide its intended protection. • A Manual BSP that comprises plant and cycle specific regions in the power-FW temp operating domain and specified manual operator actions will be developed. • The manual BSP region boundary is established by applying the stability criterion (e.g. DR $\geq$ 0.6) on the power-FW temp operation map.

Enclosure 2

MFN 08-226

Response to Portion of NRC Request for

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DCD Markups from the Response to RAI Number 4.3-7 S01

DCD Chapter 4, Subsection 4.3.3.6.2, Thermal Hydraulic Stability

The most limiting stability condition in the ESBWR normal operating region is at the rated power/flow condition. Therefore, the ESBWR is designed so that the core remains stable throughout the whole operating region, including plant startup. In order to establish a high degree of confidence that oscillations will not occur, conservative design criteria were imposed on the channel, core wide and regional decay ratios under all conditions of normal operation and anticipated transients. The ESBWR licensing basis for stability is satisfied by determining a stability criteria map of core decay ratio vs. channel decay ratio to establish margins to stability.

Because oscillations in power and flow are precluded by design, the requirements of GDC 10 are met through the analysis for AOOs, and are automatically satisfied with respect to stability.

~~For ESBWR stability, the NRC approved DSS-CD solution, employing Confirmation Density Algorithm (CDA), is utilized to reliably detect and suppress anticipated stability related power oscillations.~~ In addition, a Detect and Suppress (D&S) solution is implemented to provide defense-in-depth protection from instabilities that are not anticipated. This solution is developed based on the existing NRC approved DSS-CD solution with modifications on detection algorithms and licensing basis for ESBWR application. The cycle dependent Oscillation Power Range Monitor (OPRM) setpoints, used to implement this solution, are documented in the Core Operating Limits Report (COLR). The thermal hydraulic stability is discussed in detail in Appendix 4D.