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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 97 – Related to ESBWR Design Certification Application – RAI Number 4.3-7**

Enclosure 1 contains GEH's response to the subject NRC RAIs transmitted via the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

DO68

NRO

Reference:

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

Enclosures:

1. MFN 07-529 – Response to Portion of NRC Request for Additional Information Letter No. 97 – Related to ESBWR Design Certification Application – RAI Number 4.3-7

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH Wilmington (with enclosures)
	RE Brown	GEH Wilmington (with enclosures)
	eDRF	72-2471

Enclosure 1

MFN 07-529

Response to Portion of NRC Request for

Additional Information Letter No. 97

Related to ESBWR Design Certification Application

Reactor Thermal Hydraulic Stability

RAI Number 4.3-7

NRC RAI 4.3-7

All operating BWRs are required to implement an approved long term (L/T) stability solution. Section 4.3.3.6.2 "Thermal Hydraulic Stability" of the ESBWR DCD Rev. 3 indicates that a Detect and Suppress (D&S) solution is the preferred option for ESBWR. Please provide a detailed description of the stability solution chosen for ESBWR. Include in your description the following items:

(a) Which solution was chosen?

(b) Will the solution need to be reviewed by the staff, or is it a standard solution?

(c) Proposed technical specifications associated with the solution

(d) How will the setpoint calculation (if any) be reflected in technical specifications?

GEH Response

(A) For initial design evaluations, a standard solution is being utilized. GEH's currently chosen long term (L/T) stability solution for ESBWR is DSS-CD (NEDC-33075P, General Electric Boiling Water Reactor Detect and Suppress Solution – Confirmation Density, Revision 5, Class III, November 2005), which can reliably detect and suppress anticipated stability related power oscillations by using Confirmation Density Algorithm (CDA). The DSS-CD solution also includes additional detection algorithms to provide defense-in-depth protection. As refinement of the ESBWR DSS-CD progresses, an alternate solution may be developed for final usage in the standard ESBWR plant. If an alternate solution is developed it will be submitted for NRC review.

(B) Standard stability solution DSS-CD is currently anticipated for use in the ESBWR and the solution methodology was documented in the NRC approved GE proprietary report NEDC-33075P, General Electric Boiling Water Reactor Detect and Suppress Solution – Confirmation Density, Revision 5, Class III (GE Proprietary Information), dated November 2005. DSS-CD specific setpoints for ESBWR based on the corresponding limiting stability events, will be provided in the individual plant Core Operating Limits Report (COLR) as required by DCD Tier 2 Chapter 16 "Technical Specifications" section 5.6.3." Core Operating Limits Report (COLR)" section 5.6.3.c.

(C) DCD Tier 2 Chapter 16 "Technical Specifications" section 3.3.1.4, Table 3.3.1.4-1 function #3, and associated Basis 3.3.1.4 address the requirements associated with the Detect and Suppress solution system. Applicable mark-ups of the technical specification and basis are attached.

(D) The cycle specific setpoints for the DSS-CD system is provided in the individual plant Core Operating Limits Report (COLR) as required by DCD Tier 2 Chapter 16 "Technical Specifications" Subsection 5.6.3 "Core Operating Limits Report (COLR)" section 5.6.3.c. The NRC approved Topical Report for the DSS-CD application has been referenced in DCD Tier 2 Revision 4 Chapter 16 Subsection 5.6.3.b.

DCD Impact

DCD Tier 2, Subsection 4.3.3.6.2 was revised in DCD Revision 4 as noted in the attached markup.

DCD Tier 2, Chapter 16 "Technical Specifications" Subsection 3.3.1.4, Table 3.3.1.4-1 function #3, and associated Basis 3.3.1.4, Subsection 3.3.1.5, Table 3.3.1.5-1 and associated Basis 3.3.1.5, Subsection 5.6 were revised in DCD Revision 4 as noted in the attached markup.

DCD Chapter 4, Section 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.

~~In addition, the ESBWR will implement a Detect and Suppress solution as a defense-in-depth system.~~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. 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.

DCD Chapter 16, 3.3.1.4 Neutron Monitoring System (NMS) Instrumentation

Table 3.3.1.4-1 (page 2 of 2)
Neutron Monitoring System (NMS) Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	CONDITIONS REFERENCED FROM REQUIRED ACTION E.1	SURVEILLANCE REQUIREMENTS	SETTING BASIS
2. Average Power Range Monitors				
a. Fixed Neutron Flux - High, Setdown	2	E	SR 3.3.1.4.1 SR 3.3.1.4.3 SR 3.3.1.4.4 SR 3.3.1.4.5 SR 3.3.1.4.7	≤ 15% RTP
b. APRM Simulated Thermal Power - High	1	D	SR 3.3.1.4.1 SR 3.3.1.4.2 SR 3.3.1.4.3 SR 3.3.1.4.4 SR 3.3.1.4.5 SR 3.3.1.4.6 SR 3.3.1.4.7	≤ 115% RTP
c. Fixed Neutron Flux - High	1	D	SR 3.3.1.4.1 SR 3.3.1.4.2 SR 3.3.1.4.3 SR 3.3.1.4.4 SR 3.3.1.4.5 SR 3.3.1.4.7	≤ 125% RTP
d. Inop	1,2	E	SR 3.3.1.4.3	N/A
3. Oscillation Power Range Monitor - Upscale	1,2	E	SR 3.3.1.4.3 SR 3.3.1.4.5 SR 3.3.1.4.7	As specified in the COLR

Chapter 16, 3.3.1.5 Neutron Monitoring System (NMS) Automatic Actuation

Table 3.3.1.5 -1 (page 1 of 1)
Neutron Monitoring System (NMS) Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	CONDITIONS REFERENCED FROM REQUIRED ACTION C.1
1. Startup Range Neutron Monitors (SRNM)	2	D
	6[(a)]	E
2. Average Power Range Monitors	1,2	D
3. Oscillation Power Range Monitors	1,2	D

(a) With any control rod withdrawn from a core cell containing one or more fuel assemblies.

DCD Chapter 16, 5.6 Reporting Requirements

5.6.3 CORE OPERATING LIMITS REPORT (COLR)

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:

1. Specification 3.2.1, "Linear Heat Generation Rate (LHGR)"

2. Specification 3.2.2, "Minimum Critical Power Ratio (MCPR)"

3. Specification 3.3.1.4, "Neutron Monitoring System (NMS) Instrumentation," Function 3

[34. Specification 3.7.4, "Main Turbine Bypass System"]

[45. Specification 3.7.6, "Selected Control Rod Run-In (SCRRI) Function"]

[Any additional individual specifications that address core operating limits must be referenced here.]

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

[Identify the Topical Report(s) by number and title or identify the staff Safety Evaluation Report for a plant specific methodology by NRC letter and date. The COLR will contain the complete identification for each of the Technical

DCD Chapter 16B, 3.3.1.4 Neutron Monitoring System (NMS) Instrumentation

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

3. Oscillation Power Range Monitor ~~{Period-Based Trip}~~ Upscale

The Oscillation Power Range Monitor (OPRM) consists of four channels. The OPRM channel utilizes the same set of LPRM signals used by the associated APRM channel in which this OPRM channel resides and forms many OPRM cells to monitor the neutron flux behavior of all regions of the core. The LPRM signals assigned to each cell are summed and averaged to provide an OPRM signal for this cell. The OPRM trip protection algorithm detects thermal hydraulic instability (flux oscillation with unacceptable amplitude and frequency) and provides trip output to the RPS if the trip setpoint is exceeded.

Three channels of OPRM are required to be OPERABLE to ensure no single failure will preclude a scram from this Function on a valid signal. In addition, to provide adequate coverage of the entire core, at least {40} LPRM inputs are required to be OPERABLE.

The Analytical / Design Limit specified in the COLR is based on preventing safety thermal limit violation and fuel damage in response to core neutron flux oscillation conditions and thermal-hydraulic instability.

The OPRM Function is required to be OPERABLE in MODES 1 and 2 to respond to core neutron flux oscillation conditions and thermal-hydraulic instability in time to prevent safety thermal limit violation and fuel damage. ~~In MODE 2, core neutron flux oscillation conditions and thermal-hydraulic instability is prevented by following startup procedures.~~ In MODES 3, 4, 5, and 6, core neutron flux oscillation conditions and thermal-hydraulic instability is not postulated to occur and therefore the monitors are not required to be OPERABLE.

DCD Chapter 16B, 3.3.1.5 Neutron Monitoring Instrument (NMS) Automatic Actuation

APPLICABILITY

Three SRNM automatic actuation channels are required to be OPERABLE in MODE 2 and in MODE 6 with any control rod withdrawn from a core cell containing one or more fuel assemblies. In these conditions, the control rods are assumed to function during a DBA or transient and therefore the four SRNM automatic actuation channels are required to be OPERABLE. In MODES 3, 4, and 5, control rods are not able to be withdrawn since the reactor mode switch is in shutdown and a control rod block is applied. Therefore, SRNM automatic actuation is not required to be OPERABLE in these MODES.

Three APRM automatic actuation channels are required to be OPERABLE in MODES 1 and 2. In these conditions, the control rods are assumed to function during a DBA or transient and therefore the APRM automatic actuation channels are required to be OPERABLE. In MODES 3, 4, and 5, control rods are not able to be withdrawn since the reactor mode switch is in shutdown and a control rod block is applied. Therefore, the APRM automatic actuation channels are not required to be OPERABLE in these MODES. In MODE 6 with any control rod withdrawn from a core cell containing one or more fuel assemblies, the APRM to be OPERABLE in these MODES.

Three OPRM automatic actuation channels are required to be OPERABLE in MODES 1 and 2. In this condition the power and flow relationships that contribute to power oscillations could be present. In MODES 3, 4, and 5, power oscillations are unlikely. Therefore, the OPRM automatic actuation channels are not required to be OPERABLE in these MODES. In MODE 6 with any control rod withdrawn from a core cell containing one or more fuel assemblies, the OPRM automatic actuation channels are not required to support the OPRM instrumentation in LCO 3.3.1.4, therefore OPRM automatic actuation channels are not required to be OPERABLE in these MODES.