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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 369 Related to ESBWR Design Certification Application RAI Number 3.6-11 S03**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to a portion of the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) letter number 369 sent by NRC letter dated September 9, 2009 (Reference 1). RAI Number 3.6-11 S03 is addressed in Enclosure 1.

Enclosure 2 contains the changes to DCD Tier 2 and LTR NEDE-33440P as a result of GEH's response to this RAI. Verified DCD and LTR changes associated with this RAI response are identified in the enclosed markups. For convenience the proprietary LTR marking has been removed from the revised page since the revised RAI response itself is non-proprietary. Portions of LTR NEDE-33440P remain proprietary and are so marked.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

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NRO

Reference:

1. MFN 09-369 Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, GEH, *Request For Additional Information Letter No. 369 Related to ESBWR Design Certification* dated September 16, 2009

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 369 Related to ESBWR Design Certification Application RAI Number 3.6-11 S03

2. Response to Portion of NRC Request for Additional Information Letter No. 369 Related to ESBWR Design Certification Application - DCD and LTR Markups for RAI 3.6-11 S03

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	Peter Yandow	GEH/Wilmington (with enclosures)
	EDRF Section	0000-0107-6265 (RAI 3.6-11 S03)

Enclosure 1

MFN 09-635

Response to Portion of NRC Request for

Additional Information Letter No. 369

Related to ESBWR Design Certification Application

RAI 3.6-11 S03

NRC RAI 3.6-11 S03

In its RAI response, GEH provided a Technical Report 0000-0102-6265-R0, which describes in detail the modeling procedure they plan to apply to ESBWR blast wave calculations. GEH demonstrates a calculation of a blast wave induced by a high energy line break inside containment of ESBWR feedwater piping. The blast wave propagates into the annular region between the Reactor Pressure Vessel (RPV) and the shield wall, and reflects between the boundaries of the annulus. GEH established that a two-dimensional (2D) approximation of the annulus is conservative by comparing 2D pressure amplitudes with those computed using a 3D model. GEH will use 2D models where applicable in ESBWR calculations. GEH also established that the mesh discretization used in their example is conservative by comparing pressures and velocities to those from a model generated with a coarser mesh. While the staff accepts the technical approach described in the report, GEH has not referenced the report in a revised version of the DCD. GEH is therefore, requested to reference GEH Technical Report 0000-0102-6265-R0 and briefly describe the modeling procedure discussed in the report in a revised version of Section 3.6.2.6 of the DCD.

GEH Response

GEH Technical Report 0000-0102-6265-R0 will be included as Appendix A in a revision to NEDE-33440P. DCD Tier 2, Section 3.6.2.6 will be revised to briefly discuss the blast wave modeling procedure documented in Technical Report 0000-0102-6265-R0 and to reference Appendix A of NEDE-33440P.

DCD Impact

DCD Tier 2, Sections 3.6.2.6 and 3.6.6 will be revised as noted in the attached markup. LTR NEDE-33440P, Revision 1, will be revised as noted in the attached markup.

Enclosure 2

MFN 09-635

Response to Portion of NRC Request for

Additional Information Letter No. 369

Related to ESBWR Design Certification Application

DCD and LTR Markups for RAI Number 3.6-11 S03

16.0 NRC RAI 3.6-11 S03

In its RAI response, GEH provided a Technical Report 0000-0102-6265-R0, which describes in detail the modeling procedure they plan to apply to ESBWR blast wave calculations. GEH demonstrates a calculation of a blast wave induced by a high energy line break inside containment of ESBWR feedwater piping. The blast wave propagates into the annular region between the Reactor Pressure Vessel (RPV) and the shield wall, and reflects between the boundaries of the annulus. GEH established that a two-dimensional (2D) approximation of the annulus is conservative by comparing 2D pressure amplitudes with those computed using a 3D model. GEH will use 2D models where applicable in ESBWR calculations. GEH also established that the mesh discretization used in their example is conservative by comparing pressures and velocities to those from a model generated with a coarser mesh. While the staff accepts the technical approach described in the report, GEH has not referenced the report in a revised version of the DCD. GEH is therefore, requested to reference GEH Technical Report 0000-0102-6265-R0 and briefly describe the modeling procedure discussed in the report in a revised version of Section 3.6.2.6 of the DCD.

16.1 GEH RESPONSE

GEH Technical Report 0000-0102-6265-R0 is included as Appendix A of this report. DCD Tier 2, Section 3.6.2.6 will be revised to briefly discuss the blast wave modeling procedure documented in Technical Report 0000-0102-6265-R0 and to reference Appendix A of this report.

APPENDIX A: TECHNICAL REPORT 0000-0102-6265-R0: CFD MODELING OF BLAST WAVE PROPAGATION DURING AN ESBWR FEEDWATER LINE BREAK

[A copy of Technical Report 0000-0102-6265-R0 was provided in the response to RAI 3.6-11 S02 and is therefore not included in this RAI response but will be included in Revision 2 of NEDE-33440P.]

3.6.5 COL Information

3.6.5-1-A (Deleted)

3.6.6 References

3.6-1 USNRC, "Modification of General Design Criterion 4, Requirements for Protection Against Dynamic Effects of Postulated Pipe Rupture," Federal Register, Volume 52, No. 207, Rules and Regulations, Pages 41288 through 41295, October 27, 1987.

3.6-2 (Deleted)

3.6-3 (Deleted)

3.6-4 ANSI/ANS-58.2-1988 "Design Basis for Protection of Light Water Nuclear Power Plants Against the Effects of Postulated Pipe Rupture."

3.6-5 (Deleted)

3.6-6 (Deleted)

3.6-7 (Deleted)

3.6-8 10 CFR 50 "Domestic licensing of production and utilization facilities."

3.6-9 (Deleted)

3.6-10 NEDE-33440P, "Licensing Topical Report ESBWR Safety Analysis – Additional Information," Revision 2.

structures or compartments (including any additional drainage system or equipment environmental qualification needs).

- *The details of how the feedwater line check and feedwater isolation valves functional capabilities are protected against the effects of postulated pipe failures.*]*

* Text sections that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

3.6.2.6 Analytic Methods to Define Blastwave Interaction to SSCs

SSCs are evaluated for the blast wave effects. The blast wave occurs as a result of a pipe rupture that creates a rapid wave propagation of air surrounding the break due to the differential pressure between the rupture of a pressurized fluid in pipe and the ambient air. The blast effects are evaluated from all break types such as for the circumferential and longitudinal breaks for high and moderate energy piping systems. The wave propagation of the blast wave is dependent on the following conditions:

Blast Wave Due to a Pipe Rupture Occurring in an Open Space

The blast wave in an open space is considered as spherically expanding wave front. The blast wave pressure intensity is determined based on the pressure difference between pipe internal pressure prior to the pipe break and surrounding air at the break point, and the pressure attenuation occurs based on the radius cubed of the spherically expanding wave front.

Blast Wave Due to a Pipe Rupture Occurring in an Enclosed Space

Blast wave in an enclosed space experiences the propagation of shock wave and reflected wave effects. As the shock wave continues to propagate outward along the enclosed surface, a front known as the Mach front is formed by the interaction of the incident wave and the reflected wave. The reflected wave represents the incident wave that has been reinforced by the surrounding surface. Computational fluid dynamic analysis models analyze these phenomena and blast intensities farther from a pipe break location are determined.

Appendix A of Reference 3.6-10 provides a report that evaluates a blast wave induced by a high-energy line break at the feedwater nozzle inside containment. The blast wave propagates into the annular region between the RPV and the shield wall, and reflects between the boundaries of the annulus. This report establishes that a two-dimensional approximation of the annulus is conservative by comparing two-dimensional pressure amplitudes with those computed using a three-dimensional model. The report also establishes that the mesh discretization used is conservative by comparing pressures and velocities to those from a model generated with a coarser mesh. The methodology used in this report is representative of the methodology that will be used for breaks for which a blast wave calculation is performed.