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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 173 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-11 S04**

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 NRC Letter 173 dated March 28, 2008, Reference 1. The previous Supplement 03 was transmitted via Reference 2 in response to Reference 3. The previous Supplement 02 was transmitted via Reference 4 in response to Reference 5. The previous Supplement 01 was transmitted via Reference 6 in response to Reference 7. The original response was transmitted via Reference 8 in response to Reference 9.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.

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NRO

Should you have any questions about the information provided here, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

References:

1. MFN 08-173, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 173 Related to the ESBWR Design Certification Application,* March 28, 2008.
2. MFN 08-187, *Response to Portion of NRC Request for Additional Information Letter No. 145 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-11 S03,* February 29, 2008.
3. MFN 08-075, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 145 Related to the ESBWR Design Certification Application,* January 22, 2008.
4. MFN 06-417, Supplement 5, *Response to Portion of NRC Request for Additional Information Letter No. 111 Related to ESBWR Design Certification Application –Auxiliary Systems– RAI Number 9.2-11 S02,* December 4, 2007.
5. MFN 07-556, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 111 Related to the ESBWR Design Certification Application,* October 15, 2007.
6. MFN 06-417, Supplement 3, *Response to Portion of NRC Request for Additional Information Letter No. 62 Related to ESBWR Design Certification Application –Auxiliary Systems– RAI Number 9.2-11 S01,* June 18, 2007.
7. E-mail from L. Quinones (NRC) to F. White (GE), ACN: ML070670449, February 2, 2007.
8. MFN 06-417, *Partial Response to NRC Request for Additional Information Letter No. 62 Related to ESBWR Design Certification Application – Auxiliary Systems– RAI Number 9.2-11,* December 1, 2006.
9. MFN 06-380, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 62 Related to the ESBWR Design Certification Application,* September 29, 2006.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 173 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-11 S04.

cc:

AE Cubbage	USNRC (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
GB Stramback	GEH/San Jose (with enclosure)
eDRF	0000-0076-7688, Revision 2

Enclosure 1

MFN 08-421

*Response to Portion of NRC Request for

Additional Information Letter No. 173

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.2-11 S04

***Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.**

For historical purposes, the original text of RAI 9.2-11, 9.2-11 S01, 9.2-11 S02, and 9.2-11 S03 and the GEH responses are included. The historical responses do not include any attachments or DCD mark-ups.

NRC RAI 9.2-11

Discuss the potential for water hammer as well as operating and maintenance procedures for avoidance of water hammer in the PSWS and RCCWS.

GEH Response

The system is designed to minimize the potential for water hammer with features to mitigate water hammer should it occur. Specifically, water hammer is mitigated through the use of various system design and layout features, including:

- Minimize high points in the system
- Provide for venting at all high points
- Procedural requirements ensuring proper line filling prior to system operation and following maintenance operations will be addressed by the COL applicant.
- Valve actuation times that are slow enough to prevent water hammer.
- Use of check valves at pump discharge to prevent backflow into the pump.

DCD Subsections 9.2.1 and 9.2.2 will be revised in the next revision to state PSWS and RCCWS meets GDC 4 with respect to water hammer.

NRC RAI 9.2-11 S01

The response is acceptable, but cannot be considered "resolved" until the staff sees the DCD revision (a DCD markup was not provided with the RAI response)

GEH Response

DCD Tier 2, Revision 3, Subsections 9.2.1.1, 9.2.1.2 and 9.2.2.1 provide a discussion of the design features to minimize water hammer events for the PSWS and RCCWS.

Please note that because of the design differences between the RCCWS and PSWS, the DCD write-ups are different for the following reasons.

Design features to minimize water hammer differ between open and closed-loop water systems. For the ESBWR conceptual design, the PSWS is an open-loop system, while the RCCWS is a closed-loop system. The use of Air Release/Vacuum valves is common in open-loop systems such as Service Water (or Circulating Water) systems with cooling towers or once-through design. Service Water systems are typically filled by starting their pumps. The Air Release/Vacuum valves are automatic and function to vent the system when these service water pumps are started.

Unlike open-loop systems, closed-loop systems, such as the RCCWS, are filled in a slower manner with makeup water systems. High point vents are controlled manually to allow filling and venting.

Additionally, "proper valve actuation times" "and check valves at the pump discharge" are applied to Service Water systems, which have cooling components at high elevations and provide long legs (risers) of drain down back to the basin or cooling pond at lower elevations.

Because the RCCWS is a closed-loop system, the mechanism and flow path for drain down of risers is not available for a properly filled and vented system. Proper system engineering design of closed-loop systems precludes system pressure from falling below vapor pressure of the fluid being transported. Surge tanks are also used per DCD Tier 2, Revision 3, Subsection 9.2.2.2 within the RCCWS, which provide NPSH to the RCCWS pumps and maintain system above vapor pressure to mitigate voiding.

NRC RAI 9.2-11 S02

In RAI 9.2-11, the staff asked the applicant to discuss the potential for water hammer as well as operating and maintenance procedures for avoidance of water hammer in the PSWS and RCCWS. In its response, the applicant listed provisions to mitigate water hammer and included in DCD tier 2 Revision 3. The staff finds the above responses acceptable. However, the applicant has not identified a COL holder Item in the DCD to address the procedures discussed in the DCD.

The staff looked into DCD Section 13.5.3, a COL information item for plant operating procedures; it refers to Section 13.5.3.4 of the DCD, which refers to the procedures as delineated in ANSI/ANS-3.2. RG 1.33 endorses ANS-3.2, and its Appendix A listed typical safety-related activities that should be covered by written procedures. Service water system and component cooling water system are listed in the Appendix A to RG 1.33.

However, the PSWS and RCCWS in ESBWR are not safety-related, so the above generic COL information item may not cover the nonsafety-related systems such as PSWS and RCCWS in the ESBWR. If GEH decides to refer the generic COL information in DCD Section 13.5.3 as the resolution to RAI 9.2-11, some clarification or modification of DCD Section 13.5.3.4 would be needed to ensure the general plant operating procedures will include the PSWS and RCCWS.

GEH Response

The original RAI response to 9.2-11, in regards to operational and maintenance procedures, stated the following:

- Procedural requirements ensuring proper line filling prior to system operation and following maintenance operations will be addressed by the COL applicant.

This original response was misleading, suggesting that a COL item was to be provided.

DCD Tier 2 Sections 9.2.1.1 and 9.2.2.1, PSWS and RCCWS respectively, state that operation and maintenance procedures are used as part of measures to avoid water hammer. Consequently, any applicant, incorporating the DCD Tier 2 Sections 9.2.1.1 and 9.2.2.1 standard design by reference, must have operation and maintenance procedures in place to assure that water hammer is avoided, in addition to the design measures provided.

Therefore, a COL Holder Item to address procedures for avoidance of water hammer is not required. Additionally, clarification of DCD Tier 2 Section 13.5.3.4 is not required.

NRC RAI 9.2-11 S03

The staff disagrees with the response provided by GEH.

DCD Tier 2, Rev. 4, Section 13.5.2 states that the implementation of the Plant Operating Procedures Development Plan shall establish "requirements that the procedures developed shall include, as necessary, the elements described in American National Standards Institute (ANSI) / American Nuclear Society (ANS) 3.2-1994: R 1999, (Reference 13.5-2), as endorsed by Regulatory Guide 1.33, Rev. 2 (Reference 13.5-5)." And also states that "The following procedures shall be included in the scope of the Plant Operating Procedures Development Plan described above: System Procedures - Procedures as delineated in Section A3 of ANSI / ANS 3.2-1994; R 1999 (Reference 13.5-2), as endorsed by Regulatory Guide 1.33, Rev. 2, shall be prepared as appropriate."

As stated in the staff's RAI 9.2-11, Supp 2, the Appendix to RG 1.33, Rev. 2, lists refers to "typical safety-related activities" that should be covered by written procedures. PSWS and RCCWS are not safety-related in the ESBWR design. It is the staff's position that clarification is needed in the DCD to ensure that procedures for these systems and other RTNSS systems will be addressed by COL action items 13.5.4-A and 13.5.5-A.

GEH Response

COL items 13.5-4-A and 13.5-5-A both refer to subsection 13.5.2 for procedure development. GEH will add clarification to subsection 13.5.2 that procedures for RTNSS systems are included within the scope of ESBWR HFE Procedures Development and Implementation Plan (NEDO-33274) which describes ESBWR compliance with RG 1.33 Rev. 2.

DCD Impact

DCD Tier 2, Subsection 13.5.2 will be revised in Revision 5 as noted on the attached markup pages.

NRC RAI 9.2-11 S04

The proposed revision of DCD Tier 2 Section 13.5.2 is not acceptable because it refers the procedures for RTNSS to a procedure development and implementation plan (NEDO-33274), which does not have procedure contents dealing with water hammer. Please clarify this revision by referring directly to the second bullet (ANSI/ANS-3.2) of the next paragraph by expanding the applicability of the industry standard to the RTNSS systems of PSWS, RCCWS, and CWS because ANSI/ANS-3.2 includes procedures explicitly dealing with water hammer. The following would be acceptable to the staff to address this issue.

1. *Delete the second sentence from the following paragraph:*
   The development of Operating and Maintenance Procedures is the responsibility of the COL Applicant (COL 13.5-2-A). Development of Operating and Maintenance Procedures for RTNSS systems, as described in Subsection 19A, are included within the scope of ESBWR HFE Procedure Development and Implementation Plan, NEDO-33274 (Reference 13.5-8).

2 *Revise the following bullet adding the second sentence:*
   Requirements that the procedures developed shall include, as necessary, the elements described in American National Standards Institute (ANSI/ANS-3.2-1994: R1999, (Reference 13.5.2), as endorsed by Regulatory Guide 1.33 Rev 2 (Reference 13.5-5). Elements of ANSO/ANS-3.2-1994: R1999 addressing water hammer shall be applied in the development of procedures for RTNSS Systems.

GEH Response

COL items 13.5-4-A and 13.5-5-A both refer to subsection 13.5.2 for procedure development. GEH will add clarification to Subsection 13.5.2 that procedures for RTNSS systems are included within DCD Subsection 19A; and include water hammer procedure development.

DCD Impact

DCD Tier 2, Subsection 13.5.2 will be revised in Revision 5 as noted on the attached markup.

13.5 PLANT PROCEDURES

13.5.1 Administrative Procedures

An Administrative Procedures Plan shall be generated and describe administrative procedures that provide administrative control over activities that are important to safety for operation of the facility. These procedures include those, which provide the administrative controls in respect to procedures, and those, which define and provide controls for operational activities of the plant staff.

The COL Applicant shall develop the Administrative Procedures (COL 13.5-1-A).

13.5.2 Operating and Maintenance Procedures

The development of Operating Procedures is generally described in Section 18.9 Procedure Development.

A Plant Operating Procedures Development Plan shall be generated and have the following attributes:

- That the scope encompassed by the procedures development process includes those operating procedures defined in Subsection 13.5.2, which direct operator actions during normal, abnormal and emergency operations. The procedure development process will also include consideration of plant operations during periods when plant systems/equipment are undergoing test, maintenance or inspection.
- The procedure development process will address methods and criteria for the development, verification and validation, implementation, maintenance and revision of procedures. The methods and criteria shall be in accordance with TMI I.C.1, NUREG-0737 (Reference 13.5-3).

The development of Operating and Maintenance Procedures is the responsibility of the COL Applicant (COL 13.5-2-A).

Implementation of the Plant Operating Procedures Development Plan shall establish:

- Procedures that are consistent with the requirements of 10 CFR Part 50 and the TMI requirements described in NUREG-0737 (Reference 13.5-3) and Supplement 1 to NUREG-0737 (Reference 13.5-7).
- Requirements that the procedures developed shall include, as necessary, the elements described in American National Standards Institute (ANSI)/American Nuclear Society (ANS)-3.2-1994;~~-~~R1999, (Reference 13.5-2), as endorsed by Regulatory Guide 1.33 Rev. 2 (Reference 13.5-5). Elements of ANSI/ANS-3.2-1994; R1999 addressing water hammer shall be applied in the development of procedures for RTNSS systems.
- That the operator basis for plant operating procedures shall use actions identified in the operational task analysis and Probabilistic Risk Assessment (PRA) efforts in support of the Standardized Design certification, Standardized Plant Design Emergency Procedure Guidelines and consideration of plant-specific equipment selection and site-specific elements such as the service water intake structure.