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MFN 06-417 Supplement 4
October 29, 2007

Docket No. 52-010

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. 62 Related to ESBWR Design Certification Application - Auxilary Systems - RAI Numbers 9.2-8 S02 and 9.2-13 S02**

The purpose of this letter is to submit the GE-Hitachi Nuclear Energy Americas (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC e-mail dated June 26, 2007 (Reference 1). Previous supplemented responses were submitted via References 2, 3, and 4. The original RAI responses were submitted to the NRC in response to Reference 5. GEH response to RAI Numbers 9.2-8 S02 and 9.2-13 S02 are addressed in Enclosure 1.

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

Sincerely,

Kathy Sedney for

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. E-mail request from L. Quinones (NRC) 06/26/07.
2. MFN 06-417 Supplement 2– Response to Portion of NRC Request for Additional Information Letter No. 62 – RAI Numbers 9.2-8 S01 and 9.2-13 S01 Supplement 2.
3. E-mail request from L. Quinones (NRC) to F. White (GE) dated February 2, 2007. Subject: Supplement request for sections 9.2, 9.5, and 10.3. (ACN: ML 070670449).
4. MFN 06-417, Letter from David Hinds to the U.S. Nuclear Regulatory Commission, Partial Response to NRC Request for Additional Information Letter No. 62 Related to ESBWR Design Certification Application – Reactor Component Cooling Water and Plant Service Water Systems - RAI Numbers 9.2-6, -8, -9, -11 and 9.2-13, December 1, 2006.
5. 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 Related to ESBWR Design Certification Application - Letter No. 62 - Auxiliary Systems - RAI Numbers 9.2-8 S02 and 9.8-13 S02.

| | | |
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**Enclosure 1**

**MFN 06-417 Supplement 4**

**Response to Portion of NRC Request for**

**Additional Information Letter No. 62**

**Related to ESBWR Design Certification Application**

**Auxiliary Systems**

**RAI Numbers 9.2-8 S02 and 9.2-13 S02**

**For historical purposes, the original text of RAIs 9.2-8 and 9.2-13 and their Supplements with GE responses are included. The original attachments and DCD mark-ups are not included to prevent confusion.**

## NRC RAI 9.2-8

*Demonstrate the capability for detection, control, and isolation of PSWS leakage, including radioactive leakage into and out of the system and prevention of accidental releases to the environment. Describe allowable operational degradation (e.g., pump leakage) and the procedures to detect and correct these conditions when they become excessive.*

## GE Response

The PSWS is designed to detect, control, and isolate non-radioactive leakage by monitoring system flow rate through the piping. Flow rate reductions would indicate possible system water losses or pump degradation. If any such losses adversely impact operation, then the flow loss portion of PSWS could be isolated, identified and repaired without immediately impacting plant operations.

Radioactive leakage into PSWS can only occur following three consecutive failures:

1. RCCWS can only become contaminated by the interface with either RWCU/SDC or FAPCS, which could occur only by cross-contamination through the heat exchangers associated with those systems;

2. The RCCWS is equipped with radiation detectors (Reference DCD Tier 2, Rev. 2, Subsection 11.5.3.2.8 and Table 11.5-5). If these detectors alarm, the applicable train and/or equipment is isolated. If these alarms fail, a third failure is required to contaminate PSWS; and

3. After these two foregoing failures have occurred, a leak from the RCCWS process water into the PSWS cooling water in the RCCWS heat exchangers would then have to occur.

This type of consecutive failure scenario is highly unlikely. However, the PSWS design includes provisions for obtaining a grab sample in the unlikely event that there is leakage. The COL holder will also provide provisions for sampling the cooling tower blowdown (Reference Table 11.5-5).

No additional DCD Tier 2 changes will be made in response to this RAI.

*Received by e-mail from L. Quinones (NRC) to F. White (GE) dated February 2, 2007 (ACN: ML070670449).*

*The staff has determined that supplementary information is required to complete its review of ESBWR design control document (DCD) Tier 2, Section 9.2, 9.5 and 10.3. Please provide supplementary RAI responses for the following RAIs:*

**NRC RAI 9.2-8 S01**

*The radiation monitoring and sampling provisions provided in DCD Tier 2, Table 11.5-5 for the PSWS are not consistent with Table 2 of SRP Section 11.5, Revision 3, which indicates provisions of continuous radiation monitoring/sampling for the service water system. In addition, the response states that the COL holder will also provide provisions for sampling the cooling tower blowdown. Please, provide reference the specific COL Action Item.*

**GE Response**

The PSWS is consistent with Table 2 of SRP Section 11.5, Revision 4 in regards to grab sampling. GE recognizes the inconsistency between DCD Tier 2, Table 11.5-5 for the PSWS and Table 2 of SRP Section 11.5, Revision 4 in regards to continuous effluent sampling. This difference is that the SRP requires continuous radiation monitoring on PSWS effluent. The DCD requires continuous effluent monitoring, but it can be either directly on the effluent of PSWS or another downstream process effluent (i.e.; one detector could monitor the combined effluent of PSWS and Circulating Water).

Additional details are as follows:

The PSWS, as part of the ESBWR Stand Plant design, provides component cooling to RCCWS and TCCWS heat exchangers. The RCCWS interfaces with many systems through heat exchangers and cooling coils and cannot become contaminated unless there is a passive failure. Therefore the RCCWS acts as a barrier for the PSWS to protect against cross-contamination.

Radioactive leakage into PSWS from the RCCWS can only occur following these three independent failures:

1. RCCWS can only become contaminated by the interface with either RWCU/SDC, Post Accident Sampling program coolers and Process Sampling system (PSS) coolers or FAPCS, which could occur only by failure through the heat exchangers associated with those systems.

2. The RCCWS is equipped with continuous radiation monitors (Reference DCD Tier 2, Rev. 3, Subsection 11.5.3.2.7 and Table 11.5-5). If these detectors alarm, the applicable train and/or equipment will be isolated. If these alarms fail and isolation of the affected RCCWS loop is not performed, a third failure is required to contaminate PSWS.

3. In addition to these two failures, a leak from the RCCWS process water into the PSWS cooling water in the RCCWS heat exchangers would have to occur. RCCWS is designed using plate heat exchangers and leakage through holes or cracks in the plates is not considered credible based on industry experience with plate type heat exchangers. These heat exchangers are also designed such that any gasket leakage from either RCCWS or PSWS drains to the Equipment and Floor Drain System (Reference DCD Tier 2 Rev. 3, Subsection 9.2.2.2). Consequently, there is essentially no potential for plate failure and cross contamination.

This consecutive failure scenario is highly unlikely. However, the PSWS design includes provisions for obtaining a grab sample in the event that there is a RCCWS radiation monitor alarm. The COL holder will also provide provisions for monitoring, sampling, or analyzing the cooling tower blowdown (Reference Table 11.5-5) to ensure monitoring prior to release to the environment.

In regards to the COL holder item, the COL Action Item will be provided in DCD Tier 2, Revision 4, Subsections 11.5.7.3 and Subsection 9.2.4 as shown in attached markup.

**DCD Impact**

Revision 4 to DCD Tier 2 will provide the COL Action Item in Subsections 11.5.7.3 and Subsection 9.2.4 as shown in attached markup.

**NRC RAI 9.2-8 S02**

*In RAI 9.2-8 S01, the NRC staff indicated that the radiation monitoring and sampling provisions in the DCD are not consistent with SRP Section 11.5 with respect to the continuous monitoring/sampling for the service water system.*

*GE response states the DCD requires continuous effluent monitoring, but it can be either directly on the effluent of the PSWS or another downstream process effluent. It discussed the reasons that the radioactive leakage into PSWS is highly unlikely. Further, it states that the PSWS design includes provisions for obtaining a grab sample in the event that there is a RCCWS radiation monitor alarm; and that the COL Holder will also provide provisions for monitoring, sampling, or analyzing the cooling tower blowdown to ensure monitoring prior to release to the environment. The markups of COL Applicant item in Section 9.2.4 and COL Holder item in Section 11.5.7.3 of the DCD Tier 2 are provided.*

*The staff reviewed the response including the DCD markups for Sections 9.2.4 and 11.5.7.3, but still can not confirm in the revised DCD on the statement in GE response that it requires continuous radiation monitoring either directly on the effluent of the PSWS or another downstream process effluent. Clarify where in the DCD says that it requires continuous radiation monitoring.*

## GEH Response

DCD Tier 2, Rev 4, Table 11.5-5 Line Item #2, Service Water System, requires continuous radiation sampling and analysis either directly on the effluent of the PSWS or another downstream process effluent via Note 6 (i.e.; one detector could monitor the combined effluent of PSWS and Circulating Water). This meets the requirement of SRP Section 11.5, Table 2 for continuous radiation monitoring of Service Water System (revision 4 to SRP section 11.5 revised this line item to Service Water System and/or Circulating Water System).

However, Table 11.5-5 Line Item #2 should reference Note 4 versus Note 8. Note 4 identifies that the COL Applicant will provide design of wastewater effluent systems that monitor cooling tower blowdown (COL 11.5-2-A). DCD Tier 2, Table 11.5-5 will be revised to correct the Note.

In addition, GEH provided a markup to DCD Tier 2 Section 9.2.4 with the response to Supplement 1. This markup was to be included in DCD revision 4. However, GEH decided Note 4 and COL Applicant Item 11.5-2-A were more appropriate and did not include the DCD subsection 9.2.4 markup in DCD revision 4.

## DCD Impact

DCD Tier 2, Table 11.5-5 will be updated in revision 5 as noted in the attached markup.

## NRC RAI 9.2-13

*Describe design provisions to detect RCCWS leakage of radioactive or chemical contamination and the locations of radioactivity and conductivity monitors.*

## GE Response

Intersystem leakage in to RCCWS is monitored through four methods. First, if the system intrusion is radioactive, the RCCWS monitors will detect the increase in radioactivity. The RCCWS has radiation monitoring in each cooling water train at the pump suction return line upstream of the cross-tie header (reference attached mark up of DCD Tier 2, Rev 2 Subsection 11.5.3.2.8). Second, the flow of RCCWS water is constantly monitored throughout the system to provide detection of leakage from or to RCCWS. Third, using the chemical contamination level to detect intersystem leakage would not be an effective method for systems cooled by RCCWS because the water quality is equal to or better than that of RCCWS, so even if there were an intrusion from one of these systems, it would not adversely affect the water quality of RCCWS. A conductivity monitor could detect PSWS inleakage, but any leakage into RCCWS would result in the surge tank level increasing, and an increase in surge tank level without the makeup line in use indicates that there is an intrusion to RCCWS and corrective actions need to be taken.

Provisions are made for grab sampling capability to monitor for any potential chemical contamination. The locations of the grab samples will be determined based on actual plant system routing. Therefore, the minimal benefit from adding conductivity monitors is not warranted to detect intersystem leakage into RCCWS. Revision 3 to DCD Tier 2 Subsection 11.5.3.2.8 will reflect the radiation monitor locations as noted on the attached markup.

**NRC RAI 9.2-13 S01**

*Received by e-mail from L. Quinones.*

*The staff has determined that supplementary information is required to complete its review of ESBWR design control document (DCD) Tier 2, Section 9.2, 9.5 and 10.3. Please provide supplementary RAI responses for the following RAIs:*

*The response states that intersystem leakage in to RCCWS is monitored through four methods. Clarify the third and forth method. It is not clear whether the third method, using the chemical contamination, is adopted or not for the ESBWR design. It is not clear which one is the forth method and whether it is used by the ESBWR design.*

**GE Response**

The chemical contamination method is not adopted for the ESBWR design. The minimal benefit from adding conductivity monitors is not warranted to detect intersystem leakage into RCCWS in the ESBWR design. The previous response should have stated there were three methods. The previous response is clarified as follows:

Intersystem leakage into RCCWS is monitored through three methods.

1. If the system intrusion is radioactive, the RCCWS monitors will detect the increase in radioactivity. The RCCWS has radiation monitoring in each cooling water train to detect intersystem radiation leakage into the respective RCCWS loop. (Reference DCD Tier 2, Rev 3 Subsections 9.2.2.5 and mark-up of Subsection 11.5.3.2.7).

2. The flow rate of RCCWS water is constantly monitored throughout the system to provide detection of leakage to or from the RCCWS. In addition, other monitored system parameters can be used to detect intersystem leakage. Low pump discharge header pressure, high or low head tank level and excessive makeup valve opening time are alarmed/annunciated in the MCR.

3. Using chemical contamination monitoring to detect intersystem leakage would not be an effective method for systems cooled by RCCWS because the water quality of these systems is equal to or better than that of RCCWS. Therefore, even if there were an intrusion from one of these systems, it would not adversely affect the water quality of RCCWS. A conductivity monitor could detect PSWS inleakage, but any leakage into RCCWS would result in the surge tank level increasing and subsequent high head tank level alarm

(reference subsection 9.2.2.5). A high level alarm would indicate corrective actions are required. Provisions for obtaining grab samples to monitor for any potential chemical or radiological contamination are provided. The locations of the grab samples will be determined based on actual plant system routing. Therefore, the minimal benefit from adding conductivity monitors is not warranted to detect intersystem leakage into RCCWS.

The original response to this RAI provided a mark-up of Chapter 11 to clarify the location of the RCCWS radiation monitor. The intent is to isolate the contaminated train and prevent contamination of both trains. The mark-up did not convey this intent and the DCD will be revised to delete the descriptive location.

**DCD Impact**

Revision 4 to DCD Tier 2 Subsection 11.5.3.2.7 will delete the descriptive location of the radiation monitor as noted on the attached markup.

**NRC RAI 9.2-13 S02**

*In the RAI response (page 4 of 6), GE intended to restate RAI 9.2-13 and its initial response, but misused the content from RAI 9.2-9 instead of RAI 9.2-13.*

*Clarify the third method. Is it the grad (sic) sampling method following a high level alarm from the surge tank?*

**GEH Response**

The original text was miscopied from RAI 9.2-9 instead of RAI 9.2-13 in the response to supplement 1. The original text from RAI 9.2-13 is provided for historical purposes.

The third method available to detect RCCW leakage is the high level alarm from the head tank (reference DCD Tier 2, Rev 4, subsection 9.2.2.5). Grab sampling should be performed any time potential chemical or radiological inleakage is suspected. A high level alarm would indicate a malfunction. The malfunction could be intersystem leakage, such as, inleakage from one of the RCCWS cooling loads or a leaking makeup water valve. Grab sampling can be used in identifying the source of inleakage.

**DCD Impact**

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

**Table 11.5-5**

**Provisions for Sampling Liquid Streams**

| No. | Process Systems as listed in NUREG-0800, SRP 11.5 Table 2 (Draft Rev. 4) | ESBWR System (s) that Perform the Equivalent SRP 11.5 Function (Note 1) | In Process | In Effluent | |
|---|---|---|---|---|---|
| | | | Grab Notes 2 & 7 | Grab Notes 2 & 7 | Continuous Notes 2 & 7 |
| 1. | Liquid Radwaste (Batch) Effluent System Note 3 | Equipment (Low Conductivity Drain Subsystem, Floor (High Conductivity) Drain Subsystem | S&A | S&A, H3 | - |
| 2. | Service Water System | Plant Service Water System | - | S&A, H3 | (S&A) Notes 4 & 6 |
| 3. | Component Cooling Water System | Reactor Component Cooling Water System | S&A | S&A, H3 | (S&A) Notes 6 & 8 |
| 4. | Spent Fuel Pool Treatment System | Spent Fuel Pool Treatment System | S&A | S&A, H3 | (S&A) Notes 6 & 8 |
| 5. | Equipment & Floor Drain Collection and Treatment Systems | LCW Drain Subsystem,<br>HCW Drain Subsystem,<br>Detergent Drain Subsystem,<br>Chemical Waste Drain Subsystem,<br>Reactor Component Cooling Water System (RCCWS) Drain Subsystem | - | S&A, H3 | (S&A) Notes 6 & 8 |
| 6. | Phase Separator Decant & Holding Basin Systems | Equipment (Low Conductivity) Drain Subsystem,<br>Floor (High) Drain Subsystem | - | S&A, H3 | (S&A) Notes 6 & 8 |