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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 348 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Numbers 9.2-26, 9.2-27, 9.2-28 and 9.4-54**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Requests for Additional Information (RAIs) 9.2-26, 9.2-27, 9.2-28 and 9.4-54 sent by NRC Letter 348, Reference 1.

GEH responses to RAI Numbers 9.2-26, 9.2-27, 9.2-28 and 9.4-54 are addressed in Enclosure 1. Enclosure 2 contains the DCD markups associated with this response.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 09-396, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request for Additional Information Letter No. 348 Related to ESBWR Design Certification Application*, June 5, 2009.

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 348 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Numbers 9.2-26, 9.2-27, 9.2-28 and 9.4-54

2. Response to Portion of NRC Request for Additional Information Letter No. 348 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Numbers 9.2-26, 9.2-27, 9.2-28 and 9.4-54 – DCD Markups

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Enclosure 1

MFN 09-497

Response to Portion of NRC Request for Additional Information Letter No. 348 Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Numbers 9.2-26, 9.2-27, 9.2-28 and 9.4-54

NRC RAI 9.2-26

Means must be provided for monitoring effluent discharge paths and the plant environs for radioactivity. 10 CFR 52.47(a)(6) and 10 CFR 20.1406, "Minimization of Contamination," require applicants for standard plant design certifications to describe how facility design and procedures for operation will minimize contamination of the facility and the environment. The staff's review criteria (NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 9.2.1, "Station Service Water System," Paragraph III.3.D) specifies that provisions should be provided to detect and control leakage of radioactive contamination into and out of the plant service water system (PSWS). The design is considered to be acceptable by the staff if the PSWS Piping and Instrumentation Diagrams (P&IDs) show that radiation monitors are located on the PSWS discharge and at components that are susceptible to leakage, and if the components that are susceptible to leakage can be isolated. However, the staff noted that radiation monitors (including alarm functions) are not described in Design Control Document (DCD) Tier 2 Section 9.2.1 and are not shown on the P&ID for the PSWS and that the DCD does not describe that component which are susceptible to leakage can be isolated; the NRC regulations in this regard have not been adequately addressed. Therefore, the applicant needs to revise DCD Tier 2 Section 9.2.1 and the P&ID as appropriate to address the NRC requirements referred to above.

GEH Response

As discussed in response to RAI 9.2-8 S02 (MFN 06-417 Supp. 4 dated Oct 29, 2007), means are provided for monitoring effluent discharge paths and the plant environs for radioactivity. DCD Tier 2, 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 (i.e. one detector could monitor the combined effluent of PSWS and the Circulating Water System). The portions of PSWS that are not a part of the ESBWR Standard Plant consist of the heat rejection facilities, Normal Power Heat Sink (NPHS) and Auxiliary Power Heat Sink (AHS), which are dependent on actual site conditions. The COL Applicant will describe provisions for monitoring wastewater systems in the plant specific Offsite Dose Calculation Manual under COL Applicant Item COL 11.5-2-A.

GEH response to RAI 9.2-8 S01(MFN 06-417 Supp. 2 dated May 9, 2007) discusses the provisions provided to detect and control leakage of radioactive contamination into and out of the Plant Service Water System (PSWS). The PSWS, as part of the ESBWR Standard Plant design, provides cooling to RCCWS and TCCWS heat exchangers. The RCCWS interfaces with many systems through heat exchangers and cooling coils and this secondary system 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. 5, Subsection 11.5.3.2.6 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 at the interface 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. 5, Subsection 9.2.2.2). Consequently, there is essentially no potential for plate failure and cross contamination.

DCD Tier 2 Subsection 9.2.1.2 describes that the PSWS design detects and alarms in the MCR any potential gross leakage and permits the isolation of any such leak in a sufficiently short period of time to preclude extensive plant damage. Means are provided to detect leakage into the PSWS from the RCCWS, which may contain low levels of radioactivity.

DCD Tier 2 Subsection 9.2.2.2 describes that the RCCWS provides cooling water to nonsafety-related components in the Nuclear Island and provides a barrier against radioactive contamination of the PSWS. DCD Tier 2 Subsection 9.2.2.5 describes that RCCWS surge tank levels are used to monitor losses of cooling water, and detect intersystem leakage intrusions into RCCWS. The level transmitters in the surge tank standpipes in combination with low-low surge tank level automatically initiate a train shut down. A train shutdown signal will trip off all pumps in the train and close all isolation, bypass, and flow control valves. RCCWS radiation monitors are provided for monitoring radiation levels and alerting the plant operator of abnormal radiation levels.

The PSWS and RCCWS are designed with provisions to detect and control leakage of radioactive contamination into and out of the plant service water system and minimize contamination of the facility and the environment.

DCD Impact

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

NRC RAI 9.2-27

Means must be provided for monitoring effluent discharge paths and the plant environs for radioactivity. 10 CFR 52.47(a)(6) and 10 CFR 20.1406, "Minimization of Contamination," require applicants for standard plant design certifications to describe how facility design and procedures for operation will minimize contamination of the facility and the environment. The design is considered to be acceptable by the staff if the RCCWS Piping and Instrumentation Diagrams (P&IDs) show that radiation monitors are located on the RCCWS components that are susceptible to leakage, and if the components that are susceptible to leakage can be isolated. However, the staff noted that radiation monitors (including alarm functions) are not described in detail in the Design Control Document (DCD) Tier 2 Section 9.2.2 and are not shown on the P&ID for the RCCWS and that the DCD does not describe that component which are susceptible to leakage can be isolated; the NRC regulations in this regard have not been adequately addressed. Therefore, the applicant needs to revise DCD Tier 2 Section 9.2.2 and the P&ID as appropriate to address the NRC requirements referred to above.

GEH Response

As discussed in response to RAI 9.2-13 S02 (MFN 06-417 Supp. 4 dated Oct 29, 2007), design provisions are provided to detect RCCWS in-leakage of possible radioactive contamination using permanently installed RCCWS radiation monitors provided for monitoring radiation levels and alerting the plant operator of abnormal radiation levels. RCCWS radiation detectors, located at the discharge of the RWCU/SDC heat exchangers, are shown on DCD Tier 2, Figure 9.2-2b, Reactor Component Cooling Water System. Note: Response to RAI 9.2-24 (MFN 09-289 dated April 30, 2009) added the radiation detector missing on the B RCCWS train. These radiation detectors are described in DCD Tier 2, Subsection 11.5.3.2.6, Reactor Component Cooling Water Intersystem Leakage, and shown in Table 11.5-1 and Table 11.5-4. DCD Tier 2, Subsection 9.2.2.5 states "RCCWS radiation monitors are provided for monitoring radiation levels and alerting the plant operator of abnormal radiation levels".

DCD Tier 2 Subsection 9.2.2.2 describes that the RCCWS provides cooling water to nonsafety-related components in the Nuclear Island. DCD Tier 2 Subsection 9.2.2.5 describes that RCCWS surge tank levels are used to monitor losses of cooling water, and detect intersystem leakage intrusions into RCCWS. The level transmitters in the surge tank standpipes in combination with low-low surge tank level automatically initiate a train shut down. A train shutdown signal will trip off all pumps in the train and close all isolation, bypass, and flow control valves. This will isolate any leaking component and minimize train cross contamination.

DCD Impact

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

NRC RAI 9.2-28

Means must be provided for monitoring effluent discharge paths and the plant environs for radioactivity. Also, 10 CFR 52.47(a)(6) and 10 CFR 20.1406, "Minimization of Contamination," require applicants for standard plant design certifications to describe how facility design and procedures for operation will minimize contamination of the facility and the environment.

Section 9.2.7.1, "Design Bases" states, "the heat exchangers associated with the Offgas System (OGS) handle potentially radioactive material at an operating pressure lower than the pressure of the water that cools it. Any tube leakage, therefore, results in a flow from the chilled water system (CWS) to the OGS."

a. *Describe the pressures differences of the CWS and OGS (during normal and abnormal operations) and in the event of an OGS to CWS leak describe the process of determining that the CWS has been contaminated.*

b. *Describe in Section 9.2.7 and the location on the piping and instrumentation diagrams (P&IDs) for any radiation monitors and or monitoring points (for example, grab samples).*

c. *Describe that component which are susceptible to leakage can be isolated.*

GEH Response

As noted in DCD, Tier 2 Subsection 9.2.7, the Chilled Water System (CWS) design ensures that the chilled water does not become radioactive during normal operation.

The offgas cooler-condenser will cool the offgas effluent to a maximum temperature of 18.3ºC (65ºF) (ref. DCD Table 11.3-1). The maximum saturation pressure associated with this waste stream is less that 20 psig. The CWS maximum operating pressure is approximately 125 psig with a nominal pressure greater than 60 psig. Therefore, any postulated leakage during normal operating conditions will be from the CWS to the Offgas System (OGS). Leakage of CWS fluid into the OGS waste stream will be detected by an increased conductivity in condensate drain stream as described in DCD Table 11.3-3, Equipment Malfunction Analysis. The OGS consists of two redundant trains of offgas cooler-condensers as shown on DCD Figure 11.3-1, Offgas System. Therefore an OGS train (offgas process fluid and CWS) could be isolated if leakage was detected at the offgas cooler-condenser.

The CWS pressure will also exceed the drywell pressure associated with the drywell cooling loads for the CWS during all anticipated operations. Therefore, any intersystem leakage will be out of chilled water into the drywell. DCD Subsection

9.4.8.5 describes that the condensate discharge flow from the upper and lower drywell air coolers is provided to LD&IS for monitoring and alarming. As shown in DCD Figure 9.4-13, DCS Simplified Diagram, An upper or lower drywell FCU can be isolated (CWS and drywell air/nitrogen flow) upon CWS leakage to isolate the component. Upon the occurrence of high drywell pressure, the CWS containment isolation valves will shut isolating the CWS from potential contamination sources.
.
Therefore, based on these system design considerations, the CWS does not require installed radiation monitors to prevent contamination of the facility and the environment.

The CWS surge tank levels are used to monitor losses of chilled water, and detect inter-system leakage or intrusions into CWS. Low-low surge tank level will alarm in the Control Room. This alarm indicates that system leakage has exceeded makeup water capacity. High-high surge tank level alarms in the Control Room. This alarm indicates that there is inter-system leakage into CWS. While the CWS is not expected to become contaminated, design provisions are included to allow periodic grab samples that could be analyzed to determine CWS activity levels. The location of the CWS monitoring points is beyond the level of detail provided in the CWS simplified diagram provided as DCD Tier 2, Figure 9.2-3.

DCD Impact

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

NRC RAI 9.4-54

In consideration of Regulatory Guide 4.21 which provides guidance in meeting the objectives of 10 CFR Part 20.1406, provide, in the appropriate sections of 9.4 of the DCD, provisions that are made to monitor and collect condensate that may form at coolers or in HVAC ducts that may contain or may potentially contain contamination. Include provisions made for underground HVAC ducts and piping, if any, to monitor, contain, and control contaminated liquid and gaseous effluents that may form in or be carried through the system. Include any functions/commitments associated with the above issues that will be the responsibility of the COL applicant in DCD Sections 12.3.1.5 or 12.5, as appropriate.

GEH Response

Design provisions for ESBWR HVAC systems prevent uncontrolled release through ventilation systems with condensation from all coolers handling potentially contaminated air collected and routed to a monitored liquid effluent discharge.

The ESBWR HVAC systems, described in DCD Section 9.4, employ either a recirculation system or utilize a once-through system:

> The recirculation air conditioning and ventilation systems draw air mainly from the space / building: (with provisions for a percentage of outside air mixed in). The system then conditions the air and re-supplies it to the building spaces.
>
> The once-through air conditioning and ventilation systems draw outside air into the air handlers, conditions the air and discharges it to the building. The exhaust from these systems is discharged to the outside atmosphere. This air when it is discharged from a potentially contaminated building is discharged to the building stack as a monitored discharge.

The ESBWR HVAC system gaseous effluents are discussed in detail in DCD Section 11.5, Process Radiation Monitoring System.

The cooling coils for the HVAC system air handler units produce condensate when the dew point temperature of the coil inlet air is above the cooling coil temperature (Chilled Water). This condensate is collected in drain pans within the air handler units with the drain pan discharge (condensate) routed to a floor drain located within the room. These floor drains (part of the HVAC system's design scope) connect to the applicable Equipment and Floor Drain System (EFDS) subsystem. Depending upon the building, the air conditioning and ventilation subsystem, and type of system (once-through or recirculation), the cooling coil condensate is routed to one of the following waste streams, as described in DCD Chapter 9 Subsection 9.3.3:

- High Conductivity Waste (HCW) Drain Subsystem
- Low Conductivity Waste (LCW) Drain Subsystem
- Clean Drain Subsystem

The EFDS collects and directs these waste streams to the Liquid Waste Management System (LWMS). Liquid waste is processed by the monitored LWMS system as described in Section 11.2. Process and effluent radiological monitoring systems are described in Section 11.5 and illustrated on Figure 11.2-1, Liquid Waste Management System Processing Diagram.

DCD Chapter 9 Subsection 9.4.10, Subsection 9.3.3 and Table 12.3-18 are updated under revision 6 to reflect the above response.

The standard ESBWR design includes no HVAC ducts or HVAC system piping routed underground. Therefore, no provisions are required to be provided to monitor, contain, and control contaminated liquid and gaseous effluents that may form in or be carried through underground HVAC ducts or HVAC system piping.

There are no functions/commitments associated with the ESBWR HVAC systems described in DCD section 9.4 that will be the responsibility of the COL applicant. Therefore, no COL applicant items are included in DCD Sections 12.3.1.5 or 12.5.

DCD Impact

DCD Tier 2, Subsection 9.3.3, Equipment and Floor Drains System, is revised in Revision 6 as shown on the attached markup.

DCD Tier 2, Subsection 9.4.10, HVAC Component Information, is revised in Revision 6 as shown on the attached markup.

DCD Tier 2, Table 12.3-18, Regulatory Guide 4.21 Design Objective and Applicable DCD Subsection Information, is revised in Revision 6 as shown on the attached markup.

Enclosure 2

MFN 09-497

Response to Portion of NRC Request for Additional Information Letter No. 348 Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Numbers 9.2-26, 9.2-27, 9.2-28 and 9.4-54

DCD Markups

Detailed System Description

The system includes the major equipment listed in Table 9.3-2.

The EFDS equipment is primarily located in the areas where the drains are collected. Capability is provided to sample the liquids collected in each sump.

Containment isolation valves and piping are classified as safety-related. All other EFDS equipment and components are nonsafety-related.

The EFDS interfaces with numerous systems from which drains are collected. The collected liquids are discharged to the clean waste system or the Liquid Waste Management System, as appropriate.

Ventilation system Air Handling Unit (AHU) cooling coil condensate, collected in drain pans within the AHU, is routed to a floor drain where it connects to the applicable EFDS subsystem depending upon the building, the air conditioning and ventilation subsystem, and type of system (once-through or recirculation).

System Operation

Liquid wastes drain by gravity from various floors and equipment drains to the appropriate sumps. Each sump has two pumps. One pump operates as required and the other is in standby. The lead sump pump starts automatically when the liquid reaches a predetermined level in the sump and stops at a predetermined low level. Both pumps operate simultaneously if one pump cannot accommodate the rate of accumulation of liquids in the sump. Contaminated or potentially contaminated liquids are transferred to the Liquid Waste Management System for processing. Drywell sumps transfer collected liquids by pumping to the LCW or HCW collection tanks in the ~~Radwaste Building~~RW.

9.3.3.3 Safety Evaluation

The EFDS does not have any safety-related function, other than containment isolation functions.

Subsection 6.2.4 provides details of containment isolation functions.

Containment isolation functions are protected against internally and externally generated missiles and the postulated effects of high and moderate-energy line breaks as defined in Sections 3.5 and 3.6 respectively.

Failure of the EFDS does not prevent safety-related equipment from performing their safety-related functions. Section 3.4, Water Level (Flood) Design, presents analyses demonstrating that safety-related equipment in areas drained by the EFDS is not affected by drain or flood water backing up in the drainage system because of malfunction of active components, blockage, or the probable maximum flood.

9.3.3.4 Testing and Inspection Requirements

The EFDS is designed to permit periodic inspection and testing of important components, such as valves, motor operators, and piping, to verify their integrity and capability. Equipment layout provides easy access for inspection and maintenance.

tested per ASTM D3803 to meet the requirements of RG 1.52 for ESF systems and RG 1.140 for Non-ESF systems.

General

Guidance for the design, installation, operation, and maintenance of air filtration systems is per the National Air Filtration Association Manual (see Table 9.4-17).

Air Handling Units

Each air handling unit consists of an inlet area, filters (as specified by the system), heating elements (coils), cooling coils (as required) and the respective fans (supply or exhaust). The Air-Cleaning Units and Components are designed in accordance with ASME/ANSI AG-1-2003 Code on Nuclear Air and Gas Treatment.

9.4.10.2 Supply and Exhaust Fans

The various building ventilation systems are provided with supply and exhaust fans. These fans are either centrifugal or axial fans depending on the suitability to the specific system. The fans are designed, manufactured and supplied in accordance with the standards of AMCA (Air Movement and Control Association International). Fans in various areas are equipped with Variable Frequency / Speed Drive mechanisms to control airflows for the specific system application. See Table 9.4-17 for applicable codes and standards.

9.4.10.3 Heating Coils/Elements

Various Air Handling Units are equipped with electrical heating coils/elements. Electric coils are designed and supplied to the requirements of UL-1995, Heating and Cooling Equipment. The use of a Heat Reclamation System may be employed for those 100% outside air systems to reduce or eliminate the use of purely resistance heating coils/elements. This system entails recovering heat from the building exhaust air for use in preheating the supply / outside air. Typical systems use secondary water-air coils (in both the supply and exhaust ductwork) and a closed recirculation water loop with electric supplemental heat provided on an atmospheric expansion tank.

9.4.10.4 Cooling Coils

The Tubular fin type cooling coils are designed, constructed and installed in accordance with ASHRAE 33, Methods of Testing Forced Circulation Air Cooling and Air Heating Coils, and ANSI/ARI 410 and UL-1995.

Cooling coil condensate is collected in drain pans within the air handler units with the drain pan discharge (condensate) routed to a floor drain located within the room. These floor drains connect to the applicable EFDS subsystem. Depending upon the building, the air conditioning and ventilation subsystem, and type of system (once-through or recirculation), the cooling coil condensate is routed to one of the following waste streams, as described in Subsection 9.3.3:

- High Conductivity Waste (HCW) drain subsystem
- Low Conductivity Waste (LCW) drain subsystem
- Clean Drain Subsystem

Table 12.3-18

Regulatory Guide 4.21 Design Objective and Applicable DCD Subsection Information[BMO304]

Design Objective 1: Minimize leaks and spills and provide containment in areas where such events may occur	
DCD Chapter Section/Subsection	**Description of design feature in DCD to meet design objective**
9.4.8 Drywell Cooling System	The ESBWR: • Meets GDC 60 by suitably controlling the release of gaseous radioactive effluents to the environment. During normal operation, the DCS re-circulates air with no connection to any HVAC system outside containment. Only during DW purge operations, is the containment air connected with the CONAVS subsystem of RBVS. During DW purge operations, the containment purge fan can be used to discharge containment air to the CONAVS subsystem. The CONAVS system has RB HVAC Purge Exhaust Filter Units that are designed, tested and maintained in accordance with Regulatory Guide 1.140.
9.4.8.2 Drywell Cooling System Description	The DCS is a closed loop recirculating air/nitrogen cooling system with no outside air/nitrogen introduced into the system except during refueling.
9.4.10.4, Cooling Coils	Cooling coil condensate is collected in drain pans within the air handler units with the drain pan discharge (condensate) routed to a floor drain located within the room. These floor drains connect to the applicable EFDS subsystem. Depending upon the building, the air conditioning and ventilation subsystem, and type of system (once-through or recirculation), the cooling coil condensate is routed to one of the following waste streams, as described in Subsection 9.3.3: • High Conductivity Waste (HCW) drain subsystem • Low Conductivity Waste (LCW) drain subsystem • Clean Drain Subsystem
10.2	Steam and Power Conversion System: Turbine Generator
10.2.3.4 Turbine Design	• The expected reactor water quality exceeds the turbine manufacturer's requirements for steam and condensate purity.
10.3	Steam and Power Conversion System: Turbine Main Steam System

Table 12.3-18
Regulatory Guide 4.21 Design Objective and Applicable DCD Subsection Information

Design Objective 6: Minimize the generation and volume of radioactive waste during both operation and during decommissioning (by minimizing the volume of components and structures that become contaminated during plant operation).

DCD Chapter Section/Subsection	Description of design feature in DCD to meet design objective
9.4	Auxiliary Systems: Heating, Ventilation, and Air Conditioning
9.4.7 Electrical Building HVAC System	• Meets GDC 60 because the EER, TSC and Diesel Building HVAC Systems have no source of radioactive materials in either particulate or gaseous form. The exhaust systems have no provision for filtration or adsorption because these areas are clean.
9.4.10.4, Cooling Coils	Cooling coil condensate is collected in drain pans within the air handler units with the drain pan discharge (condensate) routed to a floor drain located within the room. These floor drains connect to the applicable EFDS subsystem. Depending upon the building, the air conditioning and ventilation subsystem, and type of system (once-through or recirculation), the cooling coil condensate is routed to one of the following waste streams, as described in Subsection 9.3.3: • High Conductivity Waste (HCW) drain subsystem • Low Conductivity Waste (LCW) drain subsystem • Clean Drain Subsystem
11.2	Radioactive Waste Management: Liquid Waste Management System
11.2.2.1 Summary Description	The LWMS is divided into several subsystems, so that the liquid wastes from various sources can be segregated and processed separately, based on the most economical and efficient process for each specific type of impurity and chemical content. Cross-connections between subsystems provide additional flexibility in processing the wastes by alternate methods and provide redundancy if one subsystem is inoperative.
11.2.3.2 Radioactive Releases	During liquid processing by the LWMS, radioactive contaminants are removed and the bulk of the liquid is purified and either returned to the condensate storage tank or discharged to the environment. The radioactivity removed from the liquid waste is concentrated on filter media, RO membrane, ion exchange resins, and concentrated waste.
11.3	Radioactive Waste Management: Gaseous Waste Management System