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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 119 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-15 S01**

Enclosure 1 contains GEH's response to the subject RAI transmitted via Reference 1. The original response was transmitted via Reference 2 in response to Reference 3.

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

Sincerely,

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 07-657, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 119 Related to the ESBWR Design Certification Application,* December 5, 2007.
2. MFN 07-591, *Response to Portion of NRC Request for Additional Information Letter No. 111 Related to ESBWR Design Certification Application –Auxiliary Systems– RAI Number 9.2-15,* November 8, 2007.
3. 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.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 119 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-15 S01.

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	0000-0076-7731, Revision 2

Enclosure 1

MFN 08-178

Response to Portion of NRC Request for

Additional Information Letter No. 119

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.2-15 S01

For historical purposes, the original text of RAI 9.2-15 and the GEH response is included.

NRC RAI 9.2-15

The Chilled Water System (CWS) is identified as RTNSS systems in the response to RAI 14.3.69. Electrical power is assumed to be unavailable for 72 hours and then returned to service for RTNSS systems. Restarting the CWS presents an opportunity for dynamic effects associated with water hammer. Describe how water hammer has been addressed in the design of the CWS so that the CWS can meet its post 72 hour cooling RTNSS cooling function.

GE Response

Proper system engineering design, along with operation and maintenance procedures are used to assure sufficient measures are taken to avoid water hammer. Surge tanks are located in the upper turbine building within the CWS, which provide NPSH to the CWS pumps. Surge tanks and air separators mitigate voiding. In addition, CWS is a closed-loop that does not drain down when isolated.
These design features to mitigate potential water hammer effects are addressed in DCD Tier 2, Revision 4, Subsections 9.2.7.2 and 9.2.7.5.

DCD Impact

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

NRC RAI 9.2-15 S01

The information referred in the RAI response cannot be found in the DCD for Chilled Water System (CWS). There is no mention of water hammer mitigation in DCD Tier 2 Revision 4, Sections 9.2.7.2 and 9.2.7.5. Section 9.2.7.2 states that the surge tank is designed for thermal expansion. Section 9.2.7.5 discusses the instrumentation requirements, which have nothing to do with water hammer. The operation and maintenance procedures for mitigating water hammer for the CWS cannot be found in the two referenced sections. In its RAI response, GEH stated that there are no DCD changes needed. However, water hammer mitigation for CWS is not addressed in the DCD. Therefore, the RAI response is not acceptable.
Furthermore, it is not clear whether the CWS has any high point venting in the design and how the surge tank alone is adequate for mitigating water hammer.

GEH Response

The CWS is a closed-loop system. Proper system engineering design of closed-loop systems precludes system pressure from falling below the vapor pressure of the fluid being transported. Surge tanks used within the CWS provide NPSH to the CWS pumps and maintain system pressure above vapor pressure to mitigate voiding. The tanks are located a minimum of three feet above the highest system point and the use of sloped piping minimizes the potential for air binding. This allows for proper line filling prior to system operation.

System high point vents ensure the system is completely filled with water with no air pockets, which can cause water hammer. High point vents need to be open during initial system water fill, or subsequent to system maintenance or repair actions requiring partial or complete system re-fill only. High point vents do not need to be open prior to or during system re-start to maintain proper system volume to avoid water hammer.

Design conditions preclude water from flashing to steam anywhere in the system during all anticipated operating conditions, transients, and design basis accidents.

These design and operation considerations are used to avoid water hammer conditions and effects. Consequently, any applicant, incorporating the DCD Tier 2 Sections 9.2.7.1 and 9.2.7.2 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, the system is not subject to water hammer during restart after a 72-hour LOPP isolation.

DCD Impact

DCD Tier #2, Subsections 9.2.7.1 and 9.2.7.2 will be revised in Revision 5, as noted in the attached markup.

9.2.7 Chilled Water System

The Chilled Water System (CWS) consists of the Nuclear Island Chilled Water Subsystem (NICWS) and the Balance of Plant Chilled Water Subsystem (BOPCWS).

9.2.7.1 Design Bases

Safety (10 CFR 50.2) Design Bases

The Chilled Water System (CWS) does not perform or ensure any safety-related function, and thus, has no safety design basis, except for the containment isolation valves.

The CWS meets GDC 2, by compliance with Regulatory Guide (RG) 1.29. The applicable sections of RG 1.29 include Position C.1 for safety-related portions and Position C.2 for nonsafety-related portions. The seismic and quality group classifications are identified in Table 3.2-1.

The potential for water hammer is mitigated through the use of various system design and layout features, such as high point vents, valve cycle times, and surge tanks. Additionally, CWS operation and maintenance procedures incorporate necessary steps, such as proper line filling, to avoid water hammer.

The nonsafety-related portions of NICWS have Regulatory Treatment of Non-Safety Systems (RTNSS) functions to provide post 72-hour cooling for HVAC. Appendix 19A provides the level of oversight and additional requirements to meet the RTNSS functions.

Power Generation Design Bases

The CWS is designed to provide chilled water to the plant facilities equipment at maximum demand.

The NICWS is designed to operate during a Loss of Preferred Power (LOPP) and can receive power from the onsite diesel-generators.

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 CWS to the OGS.

The CWS is designed to Seismic Category II criteria when located in Seismic Category I buildings to preclude damage to safety-related equipment in a seismic event, except for the containment penetrations and isolation valves that are designed to Seismic Category I.

9.2.7.2 System Description

Summary Description

The CWS consists of two independent subsystems: the NICWS and the BOPCWS. The CWS provides chilled water to the cooling coils of air handling units and other coolers in the Reactor Building, Control Building, Turbine Building, Radwaste Building, Service Building, Electrical Building, Diesel Generator Building, Fuel Building, Technical Support Center and Hot Machine

Shop. The chilled water absorbs the rejected heat from these coolers and is pumped through the chillers where the heat is transferred to RCCWS and TCCWS.

The components of both chilled water subsystems have the same design features. The following applies to both subsystems:

- The chiller units are packaged designs, including compressor, condenser, evaporator, refrigerant piping, relief valve, instrumentation, controls, and control panel; and
- The chiller units are capable of operating at partial capacity; varying from less than 25% to 100%.

The surge tanks provide a constant pump suction head and allow for thermal expansion/contraction of the chilled water inventory. Surge tanks also provide NPSH to the CWS pumps and maintain system pressure above vapor pressure to mitigate voiding. The tanks are located a minimum of three feet above the highest system point and the use of sloped piping minimizes the potential for air binding. Makeup to the chilled water inventory is from the Makeup Water System through an automatic level control valve to the surge tanks.

The CWS component design characteristics are listed in Table 9.2-11. The CWS simplified diagram is shown in Figure 9.2-3.

Detailed NICWS Description

The NICWS consists of two 100% capacity redundant and independent trains (Train A and Train B) with crossties between their chilled water piping. The isolation valves in the crosstie lines upstream and downstream of the evaporators are normally open. Each NICWS train consists of parallel pumps, parallel chillers, one surge tank, an air separator, startup strainer, piping, valves, and instrumentation. A chemical feed tank for each train is installed in parallel with the loads for corrosion inhibitor addition to the chilled water. Each train is powered from separate buses.

The following units are cooled by the NICWS:

- Fuel Building HVAC air handling units;
- Control Building HVAC air handling units;
- Reactor Building HVAC air handling units;
- Drywell Air Coolers;
- RCCWS equipment room HVAC fan coil units in Turbine Building;
- Service air compressors room HVAC fan coil units in Turbine Building;
- NICWS chillers room HVAC fan coil units in Turbine Building;
- Diesel Generator Control Equipment Room;
- Technical Support Center in Electrical Building; and
- Electrical Building HVAC air handling units.