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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 178 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-23 S01**

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 dated May 6, 2008, Reference 1. GEH response to RAI Number 9.2-23 S01 is addressed in Enclosure 1. The original response was transmitted via Reference 2 in response to Reference 3.

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.

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

Sincerely,

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 08-460, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 178 Related To ESBWR Design Certification Application*, dated May 6, 2008
2. MFN 08-342, Response to Portion of NRC Request for Additional Information Letter No. 164 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-23, dated April 11, 2008.
3. MFN 08-237, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 164 Related to the ESBWR Design Certification Application,* dated March 10, 2008

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 179 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.2-23 S01

cc: AE Cubbage USNRC (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)
eDRF 0000-0085-3284

Enclosure 1

MFN 08-473

*Response to Portion of NRC Request for

Additional Information Letter No. 178

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.2-23 S01

*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 9.2-23 and the GEH response is included.

NRC RAI 9.2-23

SRP Section 9.2.1 provides guidance to verify that PSWS pumps have sufficient net positive suction head (NPSH) at the pump suction locations considering low water levels. Information is needed to specify what the minimum NPSH requirement is for the PSWS pumps and how this compares to the actual minimum NPSH that is assured for the approved ESBWR design, including the basis for this determination and the limiting assumptions that were used (e.g., water level, maximum temperature, maximum flow rate, number of pumps operating, vortex effects). Also, because the PSWS is a RTNSS system, information is needed to describe control room indication and alarms and regulatory oversight that will be established to assure that the limiting assumptions continue to be valid over the life of the plant, and confirmatory testing that is necessary to demonstrate that the minimum NPSH requirement for the PSWS pumps is satisfied. Please include this information in the DCD or identify a new COL information item for COL applicants to provide the information that is needed.

GEH Response

The Plant Service Water System is designed to ensure that system parameters such as pump developed head and pump net positive suction head required (NPSHR) are sufficient and appropriate for the system to function under various operating conditions. The NPSHR varies for many reasons including pump manufacturer and pump type. Vertical, wet-pit type pumps are specified for PSWS (DCD Tier 2, Subsection 9.2.1.2 and Table 9.2-1). Wet pit pumps are affected by the required submergence (distance from liquid surface to suction bell) determined by the pump basin pit to prevent surface vortices development and ensure NPSH is available. The required dimensions for the pump basin to ensure proper PSWS pump parameters are maintained will be determined under detail design of the basin and pump pit by considering such things as deep approaches, guide vanes, anti-vortexing devices, or reducing approach velocity.

The vertical, wet-pit type pumps, which are inherently less susceptible to NPSH problems, are included as part of the ESBWR Standard Plant. However, the heat removal facility and basin design are considered as Conceptual Design Information (CDI).

Per RAI 9.2-16 (MFN 08-150), 10CFR Part 52 allows a DCD applicant to provide a representative conceptual design for those portions of the plant for which the application does not seek certification, to aid the NRC in its review of the FSAR and to permit assessment of the adequacy of the interface requirements. RG 1.206 discusses the need for COL applicants to address CDI "in addition" to addressing COL action items

(refer to section C.III.1.8). Hence, it is unnecessary to assign COL action items to CDI in the DCD since the need to address this information is specified in RG 1.206.

Therefore, DCD changes (including the addition of a COL Applicant item) are not required for this issue.

Instrumentation is provided within the PSWS to facilitate annunciation for low water level and indication of water level within the Main Control Room (MCR) as described in RAI 9.2-10 (MFN 07-039).

The required regulatory oversight for PSWS is described in DCD Tier 2, Chapter 19A. PSWS has low risk significance and provides support (component cooling) for RTNSS systems that provide active mitigation functions. Treatment of support systems relative to the systems they support is described in the Availability Control Manual (ACM). The ACM describes a system's availability when all necessary instrumentation, controls, power, cooling, etc that is required for the system to perform its function(s).

DCD Impact

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

NRC RAI 9.2-23 S01

The response to RAI 9.2-23 indicates that the requested information on the Plant service Water System (PSWS) pump net positive suction head (NPSH) is considered as Conceptual Design Information (CDI).

However, the staff finds that the description of the CDI in DCD Tier 2, Revision 4, Section 9.2.1.2 under "Detailed System Description" is not clear what information is conceptual and what information is part of the standard plant as related to PSWS pump NPSH.

As discussed during a conference call on April 30, 2008, the staff understood that the pumps are in the design certification scope and the basin is part of the CDI. The pump NPSH information may need the information of basin level and the choice of system design to be determined by the COL applicants. Therefore, the DCD description for the CDI should clarify that the NPSH for the PSWS pumps is within the scope of the conceptual design information.

GEH Response

A description of the Plant Service Water System (PSWS) is provided in DCD Tier 2, Subsection 9.2.1.2. This description, in conjunction with Figure 9.2-1, is intended to define the interface between standard plant design for the ESBWR and conceptual design to be addressed by COL applicants. However, to better define this interface with respect to net positive suction head requirements for the PSWS pumps, Subsection 9.2.1.2 will be clarified to include consideration of NPSH requirements under worst case conditions.

DCD Impact

DCD Tier #2, Subsection 9.2.1.2 will be revised Revision 5 as noted in the attached markup.

Power Generation Design Bases

The PSWS provides 100% of the required cooling to the Reactor Component Cooling Water System (RCCWS) and Turbine Component Cooling Water System (TCCWS) heat exchangers.

The PSWS is designed so that neither a single active nor single passive component failure results in a complete loss of nuclear island cooling and/or plant dependence on any safety-related system. This is achieved by redundant components, automatic valves and piping cross-connects for increased reliability.

The PSWS is designed for ease of restoration of its function after a component failure without plant operating mode or power level change.

The PSWS is designed to operate during a Loss of Preferred Power (LOPP).

The PSWS is designed for remote operation from the main control room (MCR).

The RCCWS utilizes plate type heat exchangers to mitigate cross-contamination of either RCCWS or PSWS.

9.2.1.2 System Description

Summary Description

The PSWS rejects heat from nonsafety-related RCCWS and TCCWS heat exchangers to the environment. The source of cooling water to the PSWS is from either the normal power heat sink (NPHS) or the auxiliary heat sink (AHS), while the heat removed is rejected to either the NPHS or to the AHS. The portions of PSWS that are not a part of the ESBWR Standard Plant consist of the heat rejection facilities (NPHS and AHS), which are dependent on actual site conditions. The conceptual design utilizes a natural draft cooling tower for the NPHS and mechanical draft cooling towers for the AHS with a crosstie line to permit routing of the plant service water to either heat sink.

A simplified diagram of the PSWS is shown in Figure 9.2-1.

The above conceptual design information for the heat rejection facilities of the PSWS will be replaced with site-specific design information.

Detailed System Description

The PSWS consists of two independent and 100% redundant trains that continuously circulate water through the RCCWS and TCCWS heat exchangers.

Each PSWS train consists of two 50% capacity vertical pumps taking suction in parallel from the plant service water basin. Discharge is through a check valve, a self-cleaning ~~duplex~~ strainer, and a motorized discharge valve at each pump to a common header. Each common header supplies plant service water to each RCCWS and TCCWS heat exchanger train arranged in parallel. The plant service water is returned via a common header to the mechanical draft cooling towers (AHS) in each train or to the natural draft cooling tower (NPHS). Remote operated isolation valves and a crosstie line permit routing of the plant service water to either heat sink. The RCCWS and TCCWS heat exchangers are provided with remotely operated isolation valves. ~~Manual balancing~~Flow control valves are provided at each heat exchanger outlet.

The PSWS pumps are located at the plant service water basin. Each pump is sized for 50% of the train flow requirement for normal operation. The pumps are low speed, vertical wet–pit designs with allowance for increase in system friction loss and impeller wear. The design of the heat rejection facilities and PSWS pumps have sufficient available net positive suction head (NPSH) under worst case conditions. Basin water level is monitored to ensure sufficient NPSH at design flow is provided to the PSWS pumps.

The pumps in each train are powered from redundant electrical buses. During a LOPP, the pumps are powered from the two nonsafety-related standby diesel-generators.

Where needed, valves are provided with hard seats to withstand erosion. The valves are arranged for ease of maintenance, repair, and in-service inspection. During a LOPP, the motor-operated valves are powered from the two, nonsafety-related standby diesel-generators.

The AHS provided for each PSWS train is a separate, multi-celled, 100% capacity mechanical draft cooling tower, with the fans in the tower from each train supplied by one of the two redundant electrical buses. During a LOPP, the fans are powered from the two, nonsafety-related standby diesel-generators. Each tower cell has an adjustable-speed, reversible motor fan unit that can be controlled for cold weather conditions to prevent freezing in the basin. A full flow bypass is provided to return water directly to the PSWS basin to allow ease of cold weather startup. Mechanical and electrical isolation allows maintenance on one tower, including complete disassembly, during full power operation. The Station Water System provides makeup for blowdown, drift, and evaporation losses from the basin. Refer to Subsection 9.2.10 for Station Water System discussion. The COL Applicant will determine material selection and provide provisions to preclude long-term corrosion and fouling of the PSWS based on site water quality analysis (COL 9.2.1-1-A).

In the event of a LOPP, the PSWS supports the RCCWS in bringing the plant to cold shutdown condition in 36 hours assuming the most limiting single active or a passive component failure.

The ESBWR Standard Plant PSWS design heat loads are shown in Table 9.2-1. The PSWS component design characteristics are shown in Table 9.2-2.

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.

The potential for water hammer is mitigated through the use of various system design and layout features, such as automatic air release/vacuum valves installed at high points in system piping and at the pump discharge, proper valve actuation times to minimize water hammer, procedural requirements ensuring proper line filling prior to system operation and after maintenance operations, and the use of a check valve at each pump discharge to prevent backflow into the pump.

The above conceptual design information for the heat rejection facilities of the PSWS will be replaced with site-specific design information in the COLA FSAR.