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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 97 Related to ESBWR Design Certification Application – Technical Specifications – RAI Numbers 16.2-122 and 16.2-123**

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) responses to the subject NRC RAIs transmitted via the Reference 1 letter.

If you have any questions or require additional information regarding 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. MFN 07-292, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 97 Related to ESBWR Design Certification Application,* May 10, 2007

Enclosures:

1. MFN 07-601 – Response to Portion of NRC Request for Additional Information Letter No. 97 Related to ESBWR Design Certification Application – Technical Specifications – RAI Numbers 16.2-122 and 16.2-123

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH (with enclosures)
	RE Brown	GEH (with enclosures)
	eDRFs	69-3512, 69-3513

Enclosure 1

MFN 07-601

Response to Portion of NRC Request for

Additional Information Letter No. 97

Related to ESBWR Design Certification Application

- Technical Specifications -

RAI Numbers 16.2-122 and 16.2-123

NRC RAI 16.2-122

Limiting condition for operation (LCO) 3.8.3.D and SR 3.8.3.4 include Required Actions and Surveillance Requirements for battery room temperature. Explain basis for battery room temperature and why the DCD or TS Bases does not require continuous monitoring of the battery room temperature with alarms in the main control room when room temperature is below or above established design limits.

Since battery cell temperature could change for reasons other than ambient conditions (e.g., power flow, resistivity issues/internal shorts, etc.), a new LCO should be specified for the battery pilot cells and connected cells. The surveillance frequency associated with these LCO's should specify that the battery pilot cell temperature measurements at the negative post be performed every 31 days and every 92 days for connected cells.

GEH Response

DCD 9.4.6.5 and Table 9.4-8 document ESBWR design requirements for continuous control room monitoring of battery room temperature, including associated high and low level alarms.

Performance of valve-regulated lead-acid batteries is dependent on battery temperature. As indicated in Section 7.4, "Capacity Test Methods," of IEEE 1188-2005, "Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid Batteries for Stationary Applications," the battery capacity will increase as battery temperature increases. However, as indicated in Annex B.3 of IEEE 1188-2005, *continuous prolonged* elevated battery temperatures will shorten VRLA battery life. This is consistent with projections for decreased battery life based on maximum annual average battery temperature presented in Section 4.3 of the manufacturer's "Installation and Operating Instructions." However, elevated temperatures, even those well above those that might be experienced during normal standby service, will not adversely affect the ability of the battery to perform its design function as discussed in the responses to RAI 16.2-123, RAI 8.3-47, including Supplement 1, (MFN 07-309, June 13, 2007 and MFN 07-405, July 24, 2007) and RAI 8.5-14, Supplement 1 (MFN 07-405, July 24, 2007).

Based on the above, LCO 3.8.3, revision 4, changed SR 3.8.3.4 from verifying temperature is "less than the maximum" design limit to verifying temperature is "greater than or equal to minimum" design limit. This change recognizes that low battery temperature reduces battery capacity and may affect operability but high temperature results only in accelerated battery aging with no immediate impact on operability. *Continuous prolonged* elevated battery temperatures are prevented by control room monitoring of battery room temperature, including associated high and low level alarms, as described in DCD 9.4.6.5 and Table 9.4-8. Additionally, SR 3.8.3.6 implements recommendations in IEEE 1188-2005 for a battery performance test every 24 months. Verification and trending of changes in battery capacity every 24 months will ensure timely identification of accelerated battery aging, including accelerated aging due to *continuous prolonged* elevated temperatures. Therefore, periodic measurement of temperature at the negative post of each battery cell is a normal monitoring and maintenance verification, but not an essential parameter for verification of battery operability.

The periodic measurement of temperature at the negative post of each battery cell being recommended in this RAI is performed as part of routine battery maintenance and monitoring in accordance with the recommendations in IEEE 1188-2005, Section 5.2, "Inspection." The

purpose of these measurements is to identify early symptoms of conditions in individual cells that "if allowed to persist for extended periods, can reduce battery life."

DCD Impact

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

NRC RAI 16.2-123

Explain how battery room temperature will be maintained during loss of ac power. Battery performance is dependent on battery temperature. Provide assurance that the battery will perform its intended function without ac power to the battery room ventilation and AC systems. Discuss battery margins (i.e., aging margin, design margin, temperature correction factor, float current monitoring uncertainty for 100 percent state of charge) and potential for thermal runaway.

GEH Response

Battery room temperature during design basis events were analyzed and the results are described in the responses to RAI 8.3-47, including Supplement 1, (MFN 07-309, June 13, 2007 and MFN 07-405, July 24, 2007) and RAI 8.5-14, Supplement 1 (MFN 07-405, July 24, 2007). These responses documented the conclusion that battery room temperature would not exceed 43.5°C (110°F), which is less than the maximum allowable equipment qualification temperature. Additionally, as indicated in IEEE 485, "IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations," Section 6.2.1, "Temperature Correction Factor," battery capacity increases as battery temperature increases. The increased capacity at higher temperatures will provide additional capacity margin for a battery being operated in the conditions described in these accident analyses. Therefore, the peak battery room temperature during the design basis events without the battery room ventilation system will not prevent the batteries from performing their safety-related design function.

As indicated in Design Control Document (DCD), Tier 2, Section 8.3.2.1.1, battery sizing calculations are performed in accordance with IEEE 485. IEEE 485, Section 6.2, "Additional Considerations," ensures that sizing calculations include appropriate allowances for aging, design margin, and temperature correction factors for a Valve Regulated Lead Acid (VRLA) battery.

Current monitoring is the only method for confirming the state of charge (SOC) of a VRLA battery that is described in IEEE Standard 1188-2005, "Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid Batteries for Stationary Applications." RAI 16.2-55, Supplement 1, states that "if float current monitoring does not indicate 100% SOC, the COL applicant must commit to additional design margins in the battery sizing calculations to compensate for measurement uncertainty." Therefore, the response to RAI 16.2-55, Supplement 1, will address the need for additional design margin in the battery sizing calculations to compensate for possible SOC measurement uncertainty. GEH is working with the VRLA battery manufacturer to confirm the uncertainty associated with current monitoring techniques in determining SOC for VRLA batteries.

Thermal runaway is described in Annex C.2 of IEEE 1188, which explains that thermal runaway occurs when a fully charged VRLA battery is on float or overcharge and the overcharge energy results in heat generation at a rate that cannot be dissipated to ambient. As battery temperature rises, more current will be required to maintain the float voltage, which will result in even higher battery temperatures. SR 3.8.3.3 limits battery terminal voltage to a maximum established temperature-compensated design limit. Temperature compensation requires that terminal voltage be reduced as battery temperature increases, which eliminates the first of the two conditions needed for thermal runaway. SR 3.8.3.1 limits battery float current to a value associated with a fully charged battery, which eliminates the second of the two conditions needed for thermal runaway. DCD 9.4.6.5 and Table 9.4-8 document ESBWR design requirements for control room monitoring of battery room temperature, including associated high and low level alarms. These alarms will alert operators if battery room temperature is not being maintained within recommended limits for proper dissipation of battery heat, further minimizing the potential for thermal runaway. These features minimize the potential for and ensure the prompt detection of conditions that create a potential for thermal runaway.

DCD Impact

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