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Subject: Response to Portion of NRC Request for Additional Information Related  
to ESBWR Design Certification Application Letter No. 65 – Electric  
Power – RAI Numbers 8.4-1 through 8.4-10

Enclosure 1 contains GE's response to the subject NRC supplemental RAI transmitted  
via the Reference 1 letter.

If you have any questions about the information provided here, please let me know.

Sincerely,

*Kathy Sedney for*

David H. Hinds  
Manager, ESBWR

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Reference:

1. MFN 06-353, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 65 Related to ESBWR Design Certification Application*, September 26, 2006

Enclosure:

1. MFN 06-484— Supplemental Response to Portion of NRC Request for Additional Information Letter No. 76 – Related to ESBWR Design Certification Application — RAI Number 7.7-1 s01

cc: AE Cabbage USNRC (with enclosures)  
GB Stramback GE/San Jose (with enclosures)  
eDRF 0000-0061-7570

**Enclosure 1**

**MFN 06-484**

**Response to Portion of NRC Request for**

**Additional Information Letter No. 65**

**Related to ESBWR Design Certification Application**

**Electric Power**

**RAI Numbers 8.4-1 through 8.4-10**

**NRC RAI 8.4-1**

*The Acronym Lists include ASD, Adjustable Speed Drive. Chapter 8 fails to identify any ASDs. Identify all ASDs and identify any special design requirements such as grounding, filtering, electrical protection and neutral conductor sizing required by ASDs. List the appropriate IEEE Standards.*

**GE Response**

There are three applications of ASDs for the ESBWR. They will be employed for the Reactor Feedwater System Pump Motors, Fuel and Auxiliary Pool Cooling System Pump Motors and the RWCU/SDC Pump Motors (Reactor Water Cleanup/Shutdown Cooling System). To assure the ASDs do not produce detrimental effects like harmonic currents that could affect other equipment and systems, the OEM (original equipment manufacturer) recommendations are utilized and mitigating features are designed into the electrical distribution system based on engineering analysis. IEEE-519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems," is used for guidance.

**DCD/LTR Impact**

DCD Tier 2, Table 8.3-2 will be revised to include IEEE-519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems," in Revision 3.

**NRC RAI 8.4-2**

*Confirm that the effects of conductive and radiated electro-magnetic interference generated by solid-state adjustable speed drives have been factored into the design requirements for the digital instrumentation and control systems.*

**GE Response**

The design of the electrical distribution system for ASDs as stated in the response to RAI 8.4-1 ensures that EMI will not affect any of the ESBWR systems or components. Additionally, the instrumentation and control systems are qualified and installed to prevent EMI from causing detrimental effects of their operation, (see ESBWR DCD Tier 2 Subsection 7.1.2.3.3.)

**DCD/LTR Impact**

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

**NRC RAI 8.4-3**

*Adjustable Speed Drives - Identify any medium voltage and large low voltage power penetrations. Identify the loads that are associated with these large power penetrations.*

**GE Response**

It is assumed that, by penetrations, it is meant the electrical penetrations into the primary containment. None of the ASD cables/loads are located in the Drywell so there are no ASD cables that are associated with the medium or large low voltage power electrical penetrations.

**DCD/LTR Impact**

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

**NRC RAI 8.4-4**

*DCD Tier 2, Rev. 1, Section 8.4.3, Power Lockout to Motor-Operated Valves. Identify any electrically operated valves which require removal of power consistent with the guidelines of BTP ICSB-18 (PSB)? BTP ICSB-18 states that all valves that require power lockout to meet the single-failure criterion in the fluid systems and their required positions be listed in the TS, and that the position indications for these valves meet the single-failure criterion.*

**GE Response**

The ESBWR does not have any valves that require removal of power. In DCD, Tier 2, Rev. 2 see Subsection 8.1.5.2.4 and Table 8.1-1 addressing BTP ICSB – 18.

**DCD/LTR Impact**

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

**NRC RAI 8.4-5**

*DCD Tier 2, Rev. 1, Section 8.4.4, Submerged Class 1E Electrical Equipment as a Result of a Loss-of-Coolant-Accident. Is safety-related electrical and mechanical equipment qualified for submergence resulting from flooding/wetting? Or, as an alternative to protecting the equipment, will the equipment be evaluated to show that failure of the equipment because of flooding/wetting is acceptable, if its safety-related function is not required or has otherwise been accomplished?*

**GE Response**

See the below listed DCD Tier 2 subsections for information pertaining to the environmental qualification of safety-related electrical and mechanical equipment:

- 3.11, Environmental Qualification of Mechanical and Electrical Equipment,
- Appendix 3H, Equipment Qualification Design Environmental Conditions,
- 8.3.1.2.3, Environmental Considerations

**DCD/LTR Impact**

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

**NRC RAI 8.4-6**

*DCD Tier 2, Rev. 1, Appendix 1C-1. The following Generic Letters (GL), generic issues and operational experiences are either not addressed or information provided is incomplete:*

- *GL 80-013*
- *GL 80-016*
- *GL 80-035*
- *GL 80-082*
- *GL 80-043*
- *GL 82-04*
- *GL 84-24*
- *GL 86-15*
- *GL 88-07*
- *GL 2006-2*
- *II.K.3(25)*

*Provide a discussion how the above GLs, and Three Mile Island Action Plan item are incorporated in to the ESBWR design.*

**GE Response**

The generic issues referred to in the RAI are listed in the table below with an evaluation pertaining to the ESBWR:

<b>Generic Issue</b>	<b>Title</b>	<b>ESBWR Evaluation/Response</b>
GL 80-13	Qualification of Safety-Related Electrical Equipment	This letter does not apply to the ESBWR, the EQ program will meet 10 CFR 50.49 and NUREG-0588. See DCD Tier 2 subsection 3.11.
GL 80-16	Environmental Qualification of Class 1E Equipment	This letter does not need to be addressed by the ESBWR as stated in NRC document DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," dated 9/06. See DG-1145 section C.IV.8.
GL 80-35	Effect of a DC Power Supply Failure on ECCS Performance	This issue applies to the BWR 3 and 4 designs; it does not apply to the ESBWR.

<b>Generic Issue</b>	<b>Title</b>	<b>ESBWR Evaluation/Response</b>
GL 80-82	Environmental Qualification of Class 1E	This letter does not need to be addressed by the ESBWR as stated in NRC document DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," dated 9/06. See DG-1145 section C.IV.8.
GL 80-43	Cracking in Core Spray Spargers	The ESBWR does not have a Core Spray System.
GL 82-04	Use of INPO See-in Program, TMI item I.C.5	See response to TMI item I.C.5, DCD Tier 2, Chapter 1, Table 1A-1, TMI Action Plan Items.
GL 84-24	Certification of Compliance to 10 CFR 50.49, Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants	This letter does not need to be addressed by the ESBWR as stated in NRC document DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," dated 9/06. See DG-1145 section C.IV.8.
GL 86-15	Information Relating to Compliance with 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants"	This letter does not need to be addressed by the ESBWR as stated in NRC document DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," dated 9/06. See DG-1145 section C.IV.8.
GL 88-07	Modified Enforcement Policy Relating to 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants"	This letter does not need to be addressed by the ESBWR as stated in NRC document DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," dated 9/06. See DG-1145 section C.IV.8.
GL 2006-02	Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power	This item is applicable to the ESBWR and will be added to Chapter 1, Table 1C-1. It will be assigned to the COL applicant/holder.
II.K.3.25	Reactor Coolant Pump Seal damage.	This issue applies to PWR Reactor Coolant Pump Seal damage; it does not apply to the ESBWR.

**DCD/LTR Impact**

DCD Tier 2, Chapter 1, Appendix 1C, Table 1C-1 will be revised in Revision 3 to add GL 2006-02 as noted above.

**NRC RAI 8.4-7**

*Operating experience review results summary (DCD Tier 2, Rev. 1, Table 1C-1) for GL 91-06 refers to DCD Tier 2, Rev. 1, Section 8.3.2 for evaluation result, however this Section does not discuss evaluation result for GL 91-06. Similarly, evaluation result of GL 91-11 refers to Action Plane Issue 128, however the discussion for issue 128 is incomplete in that it does not address interlocks and limited conditions for operation for Class 1E bus tie breakers. Please provide information.*

**GE Response:**

**GE Response for Generic Letter 91-06:**

The questions from Generic Letter 91-06 are presented verbatim in italics with the ESBWR responses following:

*GL 91-06, Resolution of Generic Issue A-30, "Adequacy of Safety Related DC Power Supplies," Pursuant to 10 CFR 50.54(f), request answers to the following eight (8) questions.*

*GL 91-06 Question 1. Unit*

**GE Response to GL 91-06 Question 1:**

The unit is the ESBWR.

*GL 91-06 Question 2.a. The number of independent divisions of Class 1E or safety-related dc power for this plant is (Include any separate Class 1E or safety-related dc, such as any dc dedicated to the diesel generator.)*

**GE Response to GL 91-06 Question 2.a:**

The ESBWR has four independent and redundant divisions of Class 1E, safety-related dc power. See DCD Tier 2, Rev. 2 subsection 8.2.3.1.

*GL 91-06 Question 2.b. The number of functional safety-related divisions of dc power necessary to attain safe shutdown for this unit is.*

**GE Response to GL 91-06 Question 2.b:**

Two divisions of Class 1E, safety related dc power are required to attain safe shutdown. See DCD Tier 2, Rev. 2 subsections 8.1.4, 8.1.5.2.1 and 8.3.2.1.1.

*GL 91-06 Question 3.a.1 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*a.) alarms*

*1) Battery disconnect or circuit breaker open?*

**GE Response to GL 91-06 Question 3.a.1**

The ESBWR will have an alarm indicative of this condition.

*GL 91-06 Question 3.a.2 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*a.) alarms*

*2.) Battery charger disconnect or circuit breaker open (both input ac and output dc)?*

**GE Response to GL 91-06 Question 3.a.2:**

Loss of battery charger input voltage is alarmed. See DCD Tier 2 subsection 8.3.2.1.1. The ESBWR will also have an alarm indicative of loss of dc output.

*GL 91-06 Question 3.a.3 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*a.) alarms*

*3.) dc system ground?*

**GE Response to GL 91-06 Question 3.a.3:**

A DC system ground is alarmed in the control room. See DCD Tier 2 subsection 8.3.2.2.1.

*GL 91-06 Question 3.a.4 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*a.) alarms*

*4.) dc bus undervoltage?*

**GE Response to GL 91-06 Question 3.a.4:**

DC low bus under voltage is alarmed in the control room. See DCD Tier 2 subsection 8.3.2.2.1.

*GL 91-06 Question 3.a.5 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*a.) alarms*

*5.) dc bus overvoltage?*

**GE Response to GL 91-06 Question 3.a.5:**

An alarm for battery charger high voltage shutdown is alarmed in the main control room. See Subsection 8.3.2.1.1 of DCD Tier 2, Rev.-2.

*GL 91-06 Question 3.a.6 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*a.) alarms*

*6.) Battery charger failure?*

**GE Response to GL 91-06 Question 3.a.6:**

The alarms in #4 & 5 above are indicative of battery charger failure/malfunction.

*GL 91-06 Question 3.a.7 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*a.) alarms*

*7.) Battery discharge?*

**GE Response to GL 91-06 Question 3.a.7:**

The ESBWR will have a float voltage current alarm, which is indicative of this condition.

*GL 91-06 Question 3.b.1 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*b.) Indications*

*1.) Battery float charge current?*

**GE Response to GL 91-06 Question 3.b.1:**

The ESBWR will have indication of battery float charge current.

*GL 91-06 Question 3.b.2 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*b.) Indications*

*2.) Battery circuit output current?*

**GE Response to GL 91-06 Question 3.b.2:**

The ESBWR will have indication of battery circuit output current.

*GL 91-06 Question 3.b.3 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*b.) Indications*

*3.) Battery discharge?*

**GE Response to GL 91-06 Question 3.b.3:**

The ESBWR will have a float voltage current indication which is indicative of this condition.

*GL 91-06 Question 3.b.4 Does the control room at this unit have the following separate, independently annunciated alarms and indication of dc power?*

*b.) Indications*

*4.) Bus voltage?*

**GE Response to GL 91-06 Question 3.b.4:**

The ESBWR will have Bus voltage indication.

*GL 91-06 Question 3.c. Does the unit have written procedures for response to the above alarms and indications?*

**GE Response to GL 91-06 Question 3.c:**

This will be part of the COL holders responsibility to have procedures. See DCD Tier 2 subsection 13.5.

*GL 91-06 Question 4. Does this unit have indication of bypassed and inoperable status of circuit breakers or other devices that can be used to disconnect the battery and battery charger from its dc bus and the battery charger from its ac power source during maintenance or testing?*

**GE Response to GL 91-06 Question 4:**

The ESBWR will have this indication.

*GL 91-06 Question 5. If the answer to any part of question 3 or 4 is no, then provide information justifying the existing design features of the facility's safety-related dc systems, \* See note below.*

**GE Response to GL 91-06 Question 5:**

Not applicable the answer to questions 3 & 4 is yes.

*GL 91-06 Question 6*

*(1) Have you conducted a review of maintenance and testing activities to minimize the potential for human error causing more than one dc division to be unavailable?*

*and*

*(2) Do plant procedures prohibit maintenance or testing on redundant dc divisions at the same time?*

**GE Response to GL 91-06 Question 6:**

The maintenance, surveillance and test procedures regarding station dc systems will be addressed by the COL applicant. See DCD Tier 2 subsection 13.5 for plant procedures.

*GL 91-06 Question 7.*

*Are maintenance, surveillance and test procedures regarding station batteries conducted at this plant? Specifically:*

*a. At least once per 7 days are the following verified to be within acceptable limits:*

*1. Pilot cell electrolyte level?*

*2. Specific gravity or charging current?*

*3. Float voltage?*

*4. Total bus voltage on float charge?*

*5. Physical condition of all cells?*

*b. At least once per 92 days, or within 7 days after a battery discharge, overcharge, or if the pilot cell readings are outside the 7-day surveillance requirements are the following verified to be within acceptable limits:*

*1. Electrolyte level of each cell?*

*2. The average specific gravity of all cells/*

*3, The specific gravity of each cell?*

*4. The average electrolyte temperature of a representative number of cells?*

*5. The float voltage of each cell?*

*6. Visually inspect or measure resistance of terminals and connectors (including the connectors at the dc bus)?*

- c. *At least every 18 months are the following verified:*
1. *Low resistance of each connection (by test)?*
  2. *Physical condition of the battery?*
  3. *Battery charger capability to deliver rated ampere output to the dc bus?*
  4. *The capability of the battery to deliver its design duty cycle to the dc bus?*
  5. *Each individual cell voltage is within acceptable limits during the self test?*
- d. *At least every 60 months, is capacity of each battery verified by performance of a discharge test?*
- e. *At least annually, is the battery capacity verified by performance discharge test, if the battery shows signs of degradation or has reached 85% of the expected service life?*

**GE Response to GL 91-06 Question 7:**

The operating, maintenance, surveillance and test procedures regarding dc systems will be addressed by the COL applicant. See DCD Tier 2 subsection 13.5 for plant procedures. See DCD Tier 2 Chapter 16 for the battery surveillances applicable to the ESBWR.

- GL 91-06 Question 8. Does this plant have operational features such that following loss of one safety-related dc power supply or bus:*
- a. *Capability is maintained for ensuring continued and adequate core cooling?*
  - b. *Reactor coolant system integrity and isolation capability are maintained?*
  - c. *Operating procedures, instrumentation (including indications and annunciators), and control functions are adequate to initiate systems as required to maintain adequate core cooling?*

**GE Response to GL 91-06 Question 8 a, b & c:**

The ESBWR has four independent divisions of Class 1E, safety-related dc power and any two divisions of Class 1E, safety-related dc power are required to attain safe shutdown. See DCD Tier 2 subsections 8.1.4, 8.1.5.2.1 and 8.3.2.1.1.

For the procedures in 8.c, the operating, maintenance, surveillance and test procedures regarding station dc systems will be addressed by the COL applicant, see Subsection 13.5 for plant procedures.

*GL 91-06 Question 9*

*If the answer to any part of question 6, 7 or 8 is no, then provide your basis for not performing the maintenance, surveillance and test procedures described and/or the bases for not including the operational features cited. \*See note below.*

*Note: For questions involving supporting type information (question numbers 5 and 9) instead of developing and supplying the information in response to this letter, you may commit to further evaluate the need for such provisions during the performance of your individual plant examination for severe accident vulnerabilities (IPE).*

**GE Response to GL 91-06 Question 9:**

Questions 6, 7 and 8 for the most part address plant procedures. Therefore, the final resolution of question 9 will be part of the COL applicant's action for procedures as stated in DCD Tier 2 subsection 13.5. Question 8 also addresses plant design. The ESBWR conforms to the requirements.

**DCD/LTR Impact**

No DCD changes will be made in response to this RAI for Generic Letter 91-06.

**GE Response for Generic Letter 91-11:**

GL 91-11 addresses the concern of connecting redundant safety-related buses through tie breakers. The ESBWR design does not have this capability in its design. The four divisions of class 1E, safety-related power are designed without any design features that would allow cross connecting redundant buses. This is confirmed by the absence of the mention of tie breakers in DCD Tier 2.

**DCD/LTR Impact**

No DCD changes will be made in response to this RAI for Generic Letter 91-11.

**NRC RAI 8.4-8**

*Are there any non-safety loads connected to safety-related batteries? If there are, identify these loads and describe how these non-safety loads satisfy the recommendations of Regulatory guide 1.75 with regard to isolation and physical separation. Also, demonstrate that connecting non-safety loads would not degrade Class 1E batteries.*

**GE Response**

There are no nonsafety-related loads connected to a safety-related battery.

**DCD/LTR Impact**

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

**NRC RAI 8.4-9**

*The resolution of Task Action plan Item B-53 (Load break switch) described in DCD Tier 2, Rev. 1, Table 1.11-1 is incomplete. Provide a discussion how ESBWR design satisfy the resolution of this issue.*

**GE Response**

A main generator circuit breaker has been added to the ESBWR design as referenced by Task Action Plan item B-53 and discussed in SRP 8.2, Appendix A. The addition of this device has been incorporated in of DCD Tier 2 Rev 2. issued to the NRC by GE letter MFN 06-0630, dated 9/29/06.

**DCD/LTR Impact**

DCD Tier 2, Table 1.11-1. Item B-53, Load Break Switch will be revised to reference Subsections 8.1.2.2, 8.1.5.2.1, and 8.2.1.2.

**NRC RAI 8.4-10**

*Justify charging the Class 1E batteries from chargers which are powered from non-safety-related diesel generators in the event of a loss of offsite power (LOOP). The staff believes that Class 1E batteries should be powered from a GDC 17 qualified source during normal operation and from a Class 1E power source in the event of a LOOP.*

**GE Response**

The Isolation Power Centers, figure 8.1-3, will supply the 480 Vac power to the battery chargers. The Isolation Power Centers are powered by the non-safety-related PIP buses, which are supplied power from the non-safety-related Standby Diesel Generators during a loss of offsite power (see figure 8.1-1, sheets 2 & 3). If offsite power is available, the PIP buses will be powered through the UAT's or RAT's (see figure 8.1-1, sheet 1).

This RAI requests the identification of the safety-related power supply that will be the source for the recharge. The source is not required to be a safety-related power supply, since, the battery will not require recharging until after the first 72 hours of an event. In accordance with SECY-95-132, the active systems required after the first 72 hours of an event can be nonsafety-related.

**DCD/LTR Impact**

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