HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

MFN 07-165
Supplement 3

Docket No. 52-010

March 8, 2008

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 140 Related To ESBWR Design Certification Application - DCD Chapter 8 - Electrical Power - RAI 8.3-52 Supplement 4**

The purpose of this letter is to submit a portion the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC Letter 140, dated January 11, 2008, Reference 1. GEH's response to the RAI 8.3-52 Supplement 4 is addressed in Enclosure 1. Supplement 3 was previously responded to in Reference 2. The previous supplemented response dated June 18, 2007 was submitted via Reference 3 in response to Reference 4. The Supplement 1, response dated May 15, 2007 (Reference 5), was requested by NRC in Reference 6. The original RAI response was submitted on March 12, 2007 to the NRC, via Reference 7, in response to NRC Letter No. 92 (Reference 8).

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

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

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References:

1. MFN 08-031, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 140 Related To ESBWR Design Certification Application*, dated January 11, 2008
2. MFN 07-555, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 109 Related To ESBWR Design Certification Application*, dated October 12, 2007
3. MFN 07-165 Supplement 1, Letter from James C. Kinsey to U.S. Nuclear Regulatory Commission, *Response to RAI 8.3-52 Supplement 2 Related to ESBWR Design Certification Application – DCD Section 8 – Electrical Power*, dated June 18, 2007
4. Email from AE Cubbage (NRC to JC Kinsey (GEH), Supplement 2 to RAI 8.3-52, dated June 5, 2007
5. MFN 07-165, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Response to RAI 8.3-52 Supplement 1, and Submittal of Editorial Clarifications Related to ESBWR Design Certification Application – DCD Section 8 – Electrical Power*, dated May 15, 2007
6. Email from I. Berrios (NRC) to D. Lewis, *Sup RAO Ch 8*, dated May 4, 2007
7. MFN 07-143, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Summary Report - RAI Resolutions Incorporated in ESBWR Design Control Document, Revision 3, and RAI Response Schedule*, dated March 12, 2007
8. MFN 07-105, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 92 Related to ESBWR Design Certification Application*, dated January 31, 2007

Enclosure:

1. MFN 07-165, Supplement 3, Response to Portion of NRC Request for Additional Information Letter No. 140 Related to ESBWR Design Certification Application - RAI Number 8.3-52 S04

cc:	AE Cubbage	USNRC (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	eDRF	0000-0080-5696

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Enclosure 1

Response to Portion of NRC Request for

Additional Information Letter No. 140

Related to ESBWR Design Certification Application

RAI Number

8.3-52 S04

For historical purposes, the original text of RAI 8.3-52 and any previous supplemental text and GE responses are included preceding each supplemental response. Any original attachments or DCD mark-ups are not included to prevent confusion.

RAI 8.3-52 (Reference MFN 07-143, Enclosure 1)

Address battery load profile. DCD Tier 2, Table 8.3-6 should identify an ESBWR common design load profile rather than defer the information as a COL item.

Original GE Response

Deleted T8.3-6, "Class 1E Battery Loading Profile." This information is covered in ITAAC 2.13.3-1, 3a.

Also, deleted T8.3-7, "Amp. Hour Load Table for 72 Hour Battery Rate." This information is covered in ITAAC 2.13.3-1, 3a.

RAI 8.3-52, Supplement 1

Provide loading profile for safety-related DC power systems based on each of safety-related UPS buses, Bus Nos. 11, 12, 21, 22, 31, 32, 41, and 42.

GE Response

As clarification, RAI 8.3-52 was responded to in the change list that was provided with DCD Chapter 8 Revision 3 and later summarized in MFN 07-143.

In response to the above RAI 8.3-52 S01 received Friday, May 4, 2007, GE provides the following: The loading profile will not be provided until the DCIS loads are established. The DRAFT safety-related DCIS loads are currently scheduled for approximately Sept. 2008 with confirmed loads not being known until 12/2011 to 6/2012, based on having actual procured vendor loads for the load profile. The Subsection **8.3.2.1.1 Safety-Related Batteries**, states that "the two batteries in each division are rated to exceed 72 hours and are **sized for the DC load in accordance with IEEE Standard 485 (Reference 8.3-2) with an expected 20-year service life**." The same subsection, under **Inspection, Maintenance, and Testing** states that "battery capacity tests are conducted in accordance with IEEE 1188 (Reference 8.3-8). These tests ensure that the battery has the capacity to meet safety-related load demands." The final load profile will have an analyses performed and tested in accordance with ITAAC Table 2.13.3-1, 3a. & 3b. Acceptance Criteria.

3a). Analyses reports of the as-built batteries exist and conclude that two sets of safety-related batteries in each division have the capacity, as determined by the vendor performance specification, to supply its rated constant current, for a minimum of 72 hours without recharging.

3b). Test report(s) conclude that the capacity of each as-built safety-related battery equals or exceeds the analyzed battery design duty cycle capacity.

The selected batteries are capable of being sized to meet the above stated criteria without expansion of the current rooms designated for each division's batteries. A preliminary battery size has been selected to meet the estimated maximum design load profile with the ability to increase the battery size by 50% of the estimated size if necessary.

DCD Impact

No additional DCD Tier 2 changes will be made in response to this RAI.

NRC RAI 8.3-52, Supplement 2

In MFN-07-165, dated May 15, 2007, GE provided supplement 1 of the response to RAI 8.3-52. The associated DCD markup provided stated:
"8.3.2.1.1 Safety-Related Station Batteries and Battery Chargers 250V Safety-Related DC Systems Configuration Figure 8.1-3 shows the overall 250 VDC system provided for safety-related Divisions 1, 2, 3 and 4. Divisions 1, 2, 3 and 4 consist of two separate battery sets for each division. Each set supplies power to the safety-related inverters for at least 72 hours following a design basis event. The DC systems are operated ungrounded for increased reliability."

The response also stated:
"The final load profile will have an analyses performed and tested in accordance with ITAAC Table 2.13.3-1, 3a. & 3b. Acceptance Criteria.

3a). Analyses reports of the as-built batteries exist and conclude that two sets of safety-related batteries in each division have the capacity, as determined by the vendor performance specification, to supply its rated constant current, for a minimum of 72 hours without recharging.
3b). Test report(s) conclude that the capacity of each as-built safety-related battery equals or exceeds the analyzed battery design duty cycle capacity."

Both of these sections of the response refer to "two sets of safety-related batteries in each division." It is the staff's understanding that the design consists of just one set (of two) safety related batteries per division with the set of batteries supplying power for 72 hours. Please clarify this RAI response.

GHNEA Response

DCD Tier 2 Chapter 8 states at Subsection 8.3.2.1.1, under Safety Related Batteries, "In division 1,2,3 and 4 the two 250 volt safety-related batteries per division are each rated to exceed 72-hour station blackout conditions."

The same Subsection 8.3.2.1.1, first paragraph, second sentence, states, "Divisions 1, 2, 3 and 4 consist of two separate battery sets for each division." GE will revise this second sentence and the following third sentence to: "Divisions 1,2, 3 and 4 consist of two separate batteries in each division." "Each battery supplies power to its safety-related inverter for at least 72 hours following a design bases event." The word "sets" or "set" have been removed from both sentences as an editorial correction. They caused confusion and misunderstanding.

The Tier 1 ITAAC Table 2.13.3-1, 3a) states "Analyses reports of the as-built batteries exist and conclude that two sets of safety-related batteries in each division have the capacity, as determined by the vendor performance specification, to supply its rated constant current, for a minimum of 72 hours without recharging." This will be revised to

delete the words "sets of" and will replace "its" with "their". This editorial correction will ensure that the Tier 1 reflects the design described within Tier 2.

Table 8.3-2, Battery Duty Cycles, show two batteries per each safety related division. Each safety-related battery is 250 volts and has a 72-hour duty cycle. Each safety-related division has 72-hours of DC power available when two 72-hour batteries are operable per division.

In support of our June 4, 2007 teleconference, also refer to DCD Revision 3, Chapter 16B, Bases discussion supporting the Technical Specification requirement for operability of the DC Source Divisions. The Bases discussion for the LCO subsection states: "Each required division is required to have two DC Sources, with each DC source consisting of the 250 V battery, the associated battery charger (either the normal or the standby charger), and all the associated control equipment and interconnecting cabling." Technical Specification 3.8.1 Actions apply equally for inoperability of one or both DC sources.

DCD Impact

Tier 1 and Tier 2 DCD Sections will be revised as shown above and reflect the marked-up attachments to this DCD.

NRC RAI 8.3-52 Supplement 3

In Supplements 1 and 2 of the responses to RAI 8.3-52, GE stated that a battery size has been selected to meet the estimated maximum design load profile with the ability to increase the battery size by 50% of the estimated size. The load profile for safety-related dc power systems based on each of safety-related UPS buses will have an analyses performed and tested in accordance with ITAAC. Update the DCD to include the load profile for each UPS bus and the associated battery size.

GEH Response

As discussed in the teleconference with the Staff held October 15, 2007, GEH has completed a calculation for the safety-related battery nominal load profile and will revise DCD Tier 2, Revision 5 to include a table of nominal load requirements for each safety-related division.

The loads assumed for each divisional battery are estimated nominal values. These nominal loads are based on assumed equipment vendor information, using equipment vendor data with the highest load information, and loading of Remote Multiplexing Unit (RMU) cabinets based on best engineering load estimates. In addition, the loads for the RMUs powering solenoid valves were determined based on the conservative assumption that the solenoid valves would remain energized for 72 hours and all of the squib valves were considered to fire at the same time. This would conservatively encompass all design basis scenarios.

In addition, the responses to RAIs 8.3-52, 8.3-52 S01, and 8.3-52 S02 referenced Tier 1 ITAAC Table 2.13.3-1, #3a and #3b. Revision 4 of DCD Tier 1 re-ordered the ITAAC tables and the referenced ITAAC was changed to Table 2.13.3-3, ITAAC #6 and re-worded. To maintain continuity with the previous RAI responses and the Staff's drafted SER, Revision 5 of DCD Tier 1 will change the referenced ITAAC back to the original wording and will be re-numbered as #3a and #3b. However, the ITAAC will remain in Table 2.13.3-3. The ITAAC tables were re-numbered in Revision 4 as an administrative change because additional content was added to the table. The numbering of the ITAAC table does not affect this ITAAC or its content.

DCD Impact

DCD Tier 2, Table 8.3-3 will be added as noted in the attached markup.

DCD Tier 1, Text and Table 2.13.3-3 will be changed as noted in the attached markup.

NRC RAI 8.3-52 Supplement 4

The information that GEH provided in Table 8.3-3, "250 V DC Safety-Related Battery Load Requirements," is not enough to review the battery capacity associated with the UPS. Provide additional information for the following related to the UPS:

A. *Battery capacity in unit of ampere-hour (Ah) including factors (e.g., aging factor, extra margin)*
B. *Charger specification including the continuous current, float voltage, and equalizing charge voltage*
C. *Rectifier specification*
D. *Inverter specification including voltage regulation, frequency variation, and total harmonic distortion (THD)*
E. *Regulating transformer specification including capacity and voltage regulation*
F. *UPS protective scheme against faults (e.g., overcurrent, fault current, undervoltage, underfrequency)*

GEH Response

As agreed to during the GEH-NRC clarifying teleconference held 1/10/2008, GEH will add Table 8.3-4 to Revision 5 of DCD Tier 2, Chapter 8. The new Table 8.3-4 will include nominal values for battery capacity, charger specification, inverter specification, and regulating transformer specification. Please note that the inputs for the given sizing's and specifications are the estimated nominal safety-related loads given in Table 8.3-3 and the response to RAI 8.3-52 S03. The UPS rectifier specification is considered to be included as part of the overall UPS, as its sizing and specification are dictated by the UPS (inverter) specification found in the new Table 8.3-4.

The safety-related UPS is protected against overvoltage, undervoltage, overfrequency, underfrequency, overcurrent and fault current. The UPS protection features are integral to the unit and will be set based on calculations performed as part of ESBWR detailed design.

DCD Impact

DCD Tier 2, Table 8.3-4 will be added as noted in the attached markup.

Table 8.3-4

Safety-Related DC and UPS Nominal Component Data

a.	**Batteries** Two 250 VDC batteries per division, 120 valve regulated lead acid cells per battery, 6000 Ah. per battery (8 hour rate to 1.75 V/cell @77°F)
b.	**Charger** AC input - 480 VAC, 3-phase, 60 Hz DC output - 250 VDC, 400 A continuous - float voltage 2.20 V/cell @90°F or above to 2.35 V/cell @40°F or below (temperature compensated from 2.24 V/cell @77°F) - equalizing charge voltage 2.35 V/cell @77°F
c.	**Uninterruptible Power Supply (UPS)** i) Inverter - 40 kVA with 250 VDC input and 208/120 VAC, 3-phase, 4-wire, 60 Hz output - AC output voltage regulation of ±1% steady state - output frequency variation within ±0.1% of nominal 60 Hz - total harmonic distortion <5% ii) Regulating Transformer 40 kVA 480-208/120 VAC, 3-phase, 4-wire, ±1%

Notes:

(1) See Figures 8.1-3 and 8.1-4 for the configurations of the safety-related DC and UPS systems.