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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 68 – Electric Power – RAI Numbers 8.3-1 through 8.3-46 and 8.3-48**

Enclosure 1 contains GE's response to the subject NRC RAIs 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

D068

Reference:

1. MFN 06-379, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 68 Related to ESBWR Design Certification Application*, October 10, 2006

Enclosure:

1. MFN 06-449 – Response to Portion of NRC Request for Additional Information Letter No. 68 – Related to ESBWR Design Certification Application –Electric Power – RAI Numbers 8.3-1 through 8.3-46 and 8.3-48

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRF 0000-0060-7979

Enclosure 1

MFN 06-449

Response to Portion of NRC Request for

Additional Information Letter No. 68

Related to ESBWR Design Certification Application

Electric Power

RAI Numbers 8.3-1 to 8.3-46 and 8.3-48

NRC RAI 8.3-1:

Bus Transfer – Power Generation (PG). DCD Tier 2, Rev. 1, Section 8.3.1.1, Description, refers to the transfer of power sources for the PG buses. Describe the type of transfer scheme for the 13.8 kV PG buses from normal preferred to alternate preferred off-site power source (i.e., fast bus transfer, dead bus transfer, etc.). Describe if the transfer has the capability of transferring back to the original source.

GE Response:

In Revision 2 to DCD Tier 2 Chapter 8, Subsection 8.3.1.1, a clarification was added to both the PG and PIP buses that describe a fast bus transfer from UAT to RAT. On restoration of UAT power, a manually selected fast bus transfer back to the respective UAT may be performed for both PG and PIP buses.

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

NRC RAI 8.3-2:

Bus Transfer – PIP. Please confirm whether the fast transfer from preferred normal to preferred alternate source at 6.9 kV PIP buses is backed by the delayed transfer before automatic transfer to the standby diesel generators.

GE Response:

DCD Subsection 8.3.1.1.1 Revision 2 no longer includes a delayed transfer. As described in RAI 8.3-1, the transfer is a fast transfer. If a LOPP or LOCA is sensed, the diesels start as described in Subsection 8.3.1.1.7.

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

NRC RAI 8.3-3:

Voltage and Frequency Protection. In DCD Tier 2, Rev. 1, Section 8.1.5.2.1, it is stated that input power voltage and frequency is monitored at Class 1E Isolation Power Centers, and the input breaker tripped if either voltage or frequency is out of the specified limits for predetermined time. DCD Tier 2, Rev. 1, Section 8.3.1.1.2, Low Voltage AC Distribution System, describes the Isolation Power Centers as provided with electrical protection and isolation devices, which prevent degradation of the Class 1E power system by the non-Class 1E power system.

Provide the following details:

(1) At what exact location of the Class 1E Isolation Power Centers where the voltage and frequency are measured.

(2) Details of the transfer scheme at 480 volt (V) double-ended power centers, normal to alternate source.

(3) Details of protection and isolation devices which prevent degradation of the Class 1E power system by the non-Class 1E power system.

GE Response:

The following information addresses the requested numbered details above:

(1) The voltage and frequency protective relays will be at the line side of each of the eight Isolation Power Center incoming feeder breakers.

(2) The normal source will fast transfer to the alternate source on either under voltage or under frequency. Transfer back to the normal source will be a manual fast transfer.

(3) In Revision 2 to Chapter 8, Subsections 8.3.1.1.2 and 8.3.1.1.6 were clarified to reflect that no 480 VAC loads are safety-related. The low voltage or frequency issue is resolved through isolation by the battery chargers, rectifiers and diodes within the UPS for each division of safety-related power. All safety-related loads are powered from DC to AC inverters at 120 VAC.

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

NRC RAI 8.3-4:

In DCD Tier 2, Rev. 1, Section 8.3.1.2, Low Voltage ac Power Distribution, states that a transportable ac generator can be connected to each PIP 480V isolation power center. Provide the details of the transportable ac generator(s) such as whether one generator for each PIP isolation power center; fuel details; generator rating and basis for the rating; whether located on the site; allowable time delay before the Ac generator will be available for its operation in a working condition after a design basis accident to allow the battery chargers to supply the safety-related instrument type loads when the onsite non-safety related 6.9 kV diesel generators are not available.

GE Response:

The transportable AC generator referenced in Subsection 8.3.1.1.2, Isolation Power Centers and Subsection 8.3.2.2.1, Class 1E DC Power Centers, will be deleted from the ESBWR design and will be reflected in Revision 3 to DCD Tier 2. Figure 8.3-1 will also be revised to delete the "Portable Diesel Generator, emergency power train main circuit breaker and plug-in connections".

NRC RAI 8.3-5:

DCD Tier 2, Rev. 1, Section 8.2.1.2, Offsite Power System, addresses the interrupting capability of the generator breaker. DCD Tier 2, Rev. 1, Section 8.3.1.1.5, Class 1E Electric Equipment Considerations, addresses motor control centers. Confirm that low voltage switchgear (power centers), medium voltage switchgear (6.9 kV and 13.8 kV) switchgear will also have the interrupting capacity at least equal to the maximum available fault current to which it can be exposed to under all modes of operation, and whether the actual switchgear ratings will be provided as part of COL application.

GE Response:

DCD Tier 2, Revision 2, revised Subsection 8.3.1.1.6 Circuit Protection, Bus Protection, to state, "Bus protection for non-Class 1E and Class 1E are as follows". This revision reflects adequate bus protection throughout the ESBWR design for all medium and low voltage buses. The switchgear rating is part of the standard ESBWR design and will not change for individual COL applicants.

The standard design switchgear rating adequately accommodates site-specific load differences required for cooling towers and circulating water pumps for different plant locations. The individual MCC loads of the balance of plant equipment will be part of the detailed design for each plant location and will be provided by each COL applicant.

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

NRC RAI 8.3-6:

DCD Tier 2, Rev. 1, Section 8.3.1.1.3, UPS System. Describe the over-current protection for the Class 1E vital ac inverters. Describe how the capability of the over-current protection is verified.

GE Response:

The ESBWR N-2 design change resulted in the removal of 480 VAC safety-related loads. The inverters are designed to the maximum 1E-DCIS platform and RMU loads for each division of power. Over load protection is provided at each 120 VAC load breaker and on each inverter to distribution panel supply breaker as currently described within Section 8.3.

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

NRC RAI 8.3-7:

Confirm that the electric distribution system single line diagrams (plant specific bus arrangements and relaying schemes) showing the location of the instrument current transformers, voltage transformers, relays described in DCD Tier 2, Rev. 1, Section 8.3.1.1.6 will be a requirement for the COL applicant to provide as part of the application.

GE Response:

Extensive changes were made in Revision 2 to the Tier 2 DCD, Subsection 8.3.1.1.6 that are described in the "Bus Protection" area. The standard ESBWR detailed design now shows the protective relay layout for the major switchgear buses. Further, the description of this area now describes the protection used at the Isolation Phase Buses, considering that the ESBWR design has no 480 VAC safety-related loads.

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

NRC RAI 8.3-8:

In DCD Tier 2, Rev. 1, Section 8.3.1.1.7, it is stated that in case of loss of offsite power (LOOP), should the bus voltage decay to below 70 percent of its nominal rated voltage for a pre determined time, the large pump motor breakers are tripped. Please confirm the allowable time at 70 percent voltage and the basis on which this value is determined.

GE Response:

In Revision 2 to DCD Tier 2 Chapter 8, the time delay and the above concern has been resolved with the removal of all 480 VAC safety-related loads from the ESBWR design.

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

NEC RAI 8.3-9:

Restoring Normal Preferred Power to PIP Buses. In DCD Tier 2, Rev. 1, Section 8.3.1.1.7, it is stated that upon restoration of off-site power, the 6.9 kV PIP buses can be transferred back to the off-site source by manual operation only. Please confirm mode of the manual transfer back to the preferred power source – whether dead bus transfer or live bus through synchronization.

GE Response

The last sentence of DCD Tier 2, Revision 2, Subsection 8.3.1.1.7, LOPP, now states: "Transfer back to the preferred power source is a synchronized live bus closure of the feeder breaker by manual action to the selected source." This confirms the mode of the manual transfer back to the preferred power source.

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

NRC RAI 8.3-10:

The description of the protection against 6.9 kV degraded voltage is provided in DCD Tier 2, Rev. 1, Section 8.3.1.1.7. However, in Section 8.3.4.4, this protection at 6.9 kV buses is described as a COL item. Please resolve the conflict. Also, describe the basis for the 90 percent undervoltage setpoint. Provide the basis for the "Predetermined" time delay.

GE Response

The description of protection in DCD Tier 2, Revision 2, Subsection 8.3.1.1.7, removed the 90 % undervoltage setpoint and the predetermined time delay. Subsection 8.3.4.4 was also revised to reflect that BTP PSB1 is no longer applicable to the ESBWR design since no safety-related motors are required for the safe shutdown of the ESBWR. Degraded voltage does not affect the Class 1E systems as all Class 1E systems are powered from batteries.

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

NRC RAI 8.3-11:

Standby Onsite ac Power Safety Supply Classification (8.3.1.1.8). DCD Tier 2, Rev. 1, Section 8.3.1.1.8 of the DCD indicates that the standby On-site ac Power Supply System performs no safety-related function. Confirm that the 24-hour and 72-hour safety-related batteries must be recharged after 24 and 72 hours following their discharge. If dc power is required to maintain safe shutdown after 72 hours then the standby on-site power supply does perform a safety function.

GE Response

Revision 2 of DCD Tier 2 Subsection 8.3.1.1.8 reflects the N-2 division ESBWR design changes. The standby diesel-generators are not required for safe shutdown. The non-safety standby diesel-generators will be maintained to ensure availability to recharge the four divisions of 72-hour batteries when they have been discharged to their minimum capacity if a source of preferred AC power is not available. The ESBWR enters the active cool-down phase when a source of preferred or standby power becomes available. Once the N-2 safe shutdown systems are placed into service, the return of AC power after 72-hours is not required to maintain safe shutdown, because an alternate means of core cooling is available that does not require AC power.

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

NRC RAI 8.3-12:

Diesel Generator Capability. In DCD Tier 2, Rev. 1, Section 8.3.1.1.8, it is stated that voltage and frequency will be restored to within 10 and 20 percent, respectively, in no more than 60 percent of the planned load sequence time interval following a load step of 110 percent greater than the most severe load step in its profile. Confirm the frequency will be restored to within 2 percent, (20 percent stated in the DCD appears to be a typo).

GE Response

Revision 2 to DCD Tier 2, Subsection 8.3.1.1.8, deleted the above referenced typo and the complete sentence.

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

NRC RAI 8.3-13:

Confirm the continuous and short-term rating of the standby diesel generator. Provide the basis for selecting short term rating of the Diesel Generator instead of the continuous rating equal to the sum of the loads of its load group of PIP loads and safety-related battery chargers. Please confirm the calculation for sizing the diesel generator will be required COL information and provided as part of the COL application.

GE Response:

The diesel-generator proposed for the ESBWR will have 15.130 MVA rating at 0.8 pf. The current continuous loads are approximately 10 MVA. The diesel-generators were selected to ensure that their continuous rating would always exceed the required design load. Revision 2 to DCD Tier 2 has added a COLA requirement in Subsection 8.3.4.3 for diesel-generator loads and sequencing.

DCD Tier 2, Revision 3 will delete the term 'short-term' power rating in Subsection 8.3.1.1.8 and will replace it with the "continuous" power rating.

NRC RAI 8.3-14:

Standby Onsite ac Power Supply Loading (DCD Tier 2, Rev. 1, Section 8.3.1.1.8). Identify the detailed loading of the standby on-site ac power supply including the safety-related loads, important-to-safety loads, PIP loads and any other class of loads connected to the PIP buses. Confirm that the largest combination of loads is less than the continuous rating of the power supply (e.g., the diesel-generator continuous rating.)

GE Response

GE's response to RAI 8.3-13 answers this RAI.

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

NRC RAI 8.3-15:

Standby Onsite ac Power Supply Loading (DCD Tier 2, Rev. 1, Section 8.3.1.1.8). Clarify why it takes 600 minutes to load the standby onsite ac power supply.

GE Response:

The typo was found and corrected in DCD Tier 2, Revision 2. Table 8.3-4 is now reflects the COLA loading and sequencing of the standby diesel-generators.

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

NRC RAI 8.3-16:

Standby Onsite ac Power Supply Consensus Standards (DCD Tier 2, Rev. 1, Section 8.3.1.1.8). Identify the industry consensus standards that will be used for the design, installation, pre-op testing, operation maintenance and surveillance testing. In particular, address each of the surveillance requirements of IEEE 387 and Regulatory Guide 1.9.

GE Response:

Revision 2 to DCD Tier 2, Subsection 8.3.1.1.8 was revised and clarified to reflect a diesel-generator design with defense in depth and COL applicant requirement tables were added for loading and sequencing. The ESBWR standard design does not credit safety-related diesel-generators; thus, the surveillance requirements of IEEE 387 and Regulatory Guide 1.9 is not applicable to the ESBWR standard design. The standby onsite AC Power system will be designed, constructed, maintained and tested to ensure that it is reliable and available. Refer to Chapter 14 for ESBWR pre-op testing.

No additional DCD Tier 2 changes will be made to Chapter 8 in response to this RAI.

NRC RAI 8.3-17:

Standby Onsite ac Power Supply Starting Circuits (DCD Tier 2, Rev. 1, Section 8.3.1.1.8). Clarify the time response of the standby diesel generator (SDG). The DCD states that the SDG will come up to speed within one minute. It also states that the loads will be applied and accelerated in sequence "within the time requirements." Identify where these time requirements are defined and identify the maximum motor acceleration time.

GE Response

In Revision 2 to DCD Tier 2, Subsections 8.3.1.1.7 and 8.3.1.1.8 were clarified by adding tables to address the COL applicant responsibilities for the standby onsite diesel-generators. The diesel-generators will be 514 RPM, 16V46, 975 kW/cyl units which are currently used as both marine and power plant base load engines and also used in Europe for standby backup units. The units are also designed for low emissions that will meet the EPA's National Ambient Air Quality Standards in the U.S. The motors are rapid start and almost at speed when started even though the safety-related systems do not require an AC source for 72 hours.

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

NRC RAI 8.3-18:

In DCD Tier 2, Rev. 1, Section 8A.3.1, the applicant described the electrical heat tracing system. Provide a list of safety-related and non safety-related components which needs to be heat traced, and also provide the corresponding Class 1E and Non-Class 1E power sources for the electric heat tracing.

GE Response:

There are no known safety-related systems that require heat tracing. For non-class systems in outlying buildings, any heat tracing that may be required will be identified on a case-by-case basis in the appropriate sections of the Tier 2 DCD. As stated in Subsection 8A.3.1, "Non-Class 1E heat tracing is supplied from the same power center or MCC as the components protected."

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

NRC RAI 8.3-19:

Electrical Penetration Protection. Please provide a listing of electrical circuits (other than instrumentation) which will pass through containment penetrations and which will be protected by primary and backup protection.

GE Response:

All Class 1E penetrations are addressed in DCD Tier 2, Revision 2, Subsection 8.3.4.7, including Figures 8.3-2 and 8.3-3 that reference COL unit-specific requirements.

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

NRC RAI 8.3-20:

In DCD Tier 2, Rev. 1, Section 8A.1.1, it is stated that the plant's main generator is grounded with a neutral grounding device. The impedance of that device limits the maximum phase current under short-circuit conditions to a value not greater than that for a three-phase fault at its terminals. Typically per industry practice, the neutral of main generator is grounded through a neutral grounding transformer which limits the single phase to ground fault to a few amperes. Please confirm the design of main generator neutral grounding.

GE Response

DCD Tier 2, Revision 2, Figure 8.1-1, Sheet 1 of 3, currently shows the neutral grounding transformer that will limit the single-phase ground fault to a few amperes. Further Revision 2 to Subsection 8A.1.1 clarified the limiting function of the neutral grounding with reference to other potential grounds that can degrade a generator. Neutral ground current is monitored and action taken if the current increases.

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

NRC RAI 8.3-21:

In DCD Tier 2, Rev. 1, Section 8A.1.1, it is stated that the neutral point of the low-voltage ac distribution systems is either solidly or impedance grounded, as necessary, to ensure proper coordination of ground fault protection. This statement is different from that in Section 8.3.1.12 which states that the low voltage (480 V and lower) ac system is solidly grounded. Please confirm the design of low voltage ac system grounding. Confirm if this will be required COL Information to be supplied by the COL applicant.

GE Response:

The location of the above statement credited to Subsection 8.3.1.12 is actually contained in DCD Tier 2, Revision 2, Subsection 8.3.1.1.6.

Revision 3 to DCD Tier 2, Subsection 8.3.1.1.6, Grounding, will include the following revision: "The ESBWR grounding will comply with guidelines provided in Section 8A (IEEE-665 and IEEE-1050, References 8A-3 and 8A-8)".

NRC RAI 8.3-22:

In DCD Tier 2, Rev. 1, Section 8A.1.2, it is stated that no SRP or regulatory guidance is provided for grounding and lightning protection. RG 1.204 for lightning protection was issued by the U.S. Nuclear Regulatory Commission (NRC) in November 2005. Describe your conformance to RG 1.204 for the lightning protection design.

GE Response:

DCD Tier 2, Revision 2 Subsection 8A.1.2 added a reference for RG 1.204 conformance. The ESBWR standard design now requires lightning protection to be in accordance with the RG 1.204.

Revision 3 to DCD Tier 2 Subsection 8A.1.2 will include a minor editorial clarification to remove the words, "and lightning" to indicate that no regulatory guidance is provided for grounding protection. Section 8A does provide IEEE guidance to be used in the standard design for grounding.

NRC RAI 8.3-23:

Low Voltage Power Cable. According to the description provided for Class 1E Electric Equipment Arrangement in DCD Tier 2, Rev. 1, Section 8.3.1.4.1, both V3 and V2 raceways appear to carry 250 volts direct current (Vdc) and 120 Vac control power cables. Provide the criterion to distinguish between the V3 and V2 cables.

GE Response:

The criterion to distinguish between V3 and V2 has been addressed in DCD Tier 2 Revision 2, Subsection 8.3.1.4.1. All references to V1, V2 and V3 were deleted. All Class 1E loads are now 120 VAC with separation conformance to RG 1.75.

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

NRC RAI 8.3-24:

DCD Tier 2, Rev. 1, Section 8.3.1.4.1, Power Systems, states for cable routing in potentially harsh environmental area, the circuits of different safety-related divisions will not be routed through the same potentially harsh environmental area, with the exception of main steam line instrumentation and control circuits, and main steam line isolation valves circuits, which can be exposed to possible steam line break and turbine missiles, respectively. Describe what measures will be taken in case of main steam line instrumentation and control circuits, and main steam line isolation valves circuits, so that different safety-related divisions will not be subjected to simultaneous failures.

GE Response:

Chapter 7 of the DCD Tier 2, Revision 2, now reflects the N-2 design, including a description of the different divisions that perform redundant and backup safety-related actuation of valves. Turbine missiles are not credible due to the location of the steam tunnel with relation to the position of the turbine. DCD Tier 2, Subsection 8.3.1.4.1, Other Safety-Related Systems (3) states: "Inboard and outboard isolation valves (MSIVs) are redundant to each other so that they are made independent of and protected from each other to the extent that no single active failure can prevent the operation of at least one of an inboard/outboard pair."

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

NRC RAI 8.3-25:

Medium Voltage Switchgear (DCD Tier 2, Rev. 1, Section 8.3.1.1.1). Identify the industry consensus standards used in the selection and specification of the medium voltage switchgear. Identify the type of medium voltage switchgear, the circuit breaker momentary and interrupting ratings and the capability to resist internal arcing faults.

GE Response:

The medium voltage switchgear for the ESBWR PIP buses will be non-safety, built to withstand a seismic DBE, and mounted in a seismic category II structure. The switchgear will conform to the IEEE standards shown on DCD Tier 2, Revision 2, Table 8.3-2, which currently lists the IEEE Standards for "Metal-clad Switchgear" that ensure a reliable breaker is available to support plant operation, cool down, shutdown and refueling. The circuit momentary and interrupting ratings will be based on final short circuit calculations performed during detail design, based on the final load characteristics.

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

NRC RAI 8.3-26:

Loss of Preferred Power (LOPP) (DCD Tier 2, Rev. 1, Section 8.3.1.1.7). The Design Control Document indicates that there is a time delay with the bus voltage below the 70 percent LOPP setpoint. At this value most induction motors will stall and trip on overcurrent. Justify the use of a time delay.

GE Response:

DCD Tier 2, Revision 2 amended the sub-titles (including LOPP) in Subsection 8.3.1.1.7 to reflect low voltage trip as the protection for all motors. The time delays were eliminated.

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

NRC RAI 8.3-27:

Loss-of-Coolant Accident (LOCA) Following LOPP. Confirm that the LOPP loads already running on the standby diesel generator are the same loads required for a LOCA. If this is not the case, describe the load shedding and re-sequencing of LOCA required loads onto the standby diesel generator.

GE Response:

The continuous loads that are sequenced on the diesel-generator due to a LOPP are the same loads sequenced for a LOCA. As stated in response to RAI 8.3-26, Subsection 8.3.1.1.7 was clarified in DCD Tier 2, Revision 2.

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

NRC RAI 8.3-28:

LOPP During Standby On-site Power Source Paralleling Test. Describe how the standby diesel generator responds before the preferred power supply breaker opens and clears the path to the grid. Confirm that the diesel will not trip on overcurrent, underfrequency or overexcitation.

GE Response:

Diesel generator response was clarified in "The LOPP During Standby Onsite Power Source Paralleling Test" section of Subsection 8.3.1.1.7 in DCD Tier 2, Revision 2, as described in GE's response to RAI 8.3-26.

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

NRC RAI 8.3-29:

GDC 17, Electric Power Supply (Loss of the Transmission System). The DCD states that loss of the transmission system does not affect the ability of the main generator... to provide power to the Class 1E system. Confirm that the main generator will not trip on a 100 percent load rejection. Also address loss of the common switchyard which, from DCD Tier 2, Rev. 1, Figure 8.1-1, appears to be required for the main generator to power either auxiliary transformer.

GE Response:

Figure 8.1-1, Sheet 1 of 4, was revised in DCD Tier 2, Revision 2. The main generator "Island Mode" is discussed in Chapter 10, DCD Tier 2, and provides the basis for the unit to support the Island Mode of operation. Although the main generator is yet another source of power to the Class 1E system, it is not required to support the safe shutdown during a LOPP. The main generator will be the sole source of power to the UATs during a LOPP as provided by the Island Mode. If the main generator breaker trips free due to a protective relay signal, the safety-related loads are powered by DC sources until another AC source is available at the PIP buses or one of two sources of offsite power is available.

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

NRC RAI 8.3-30:

GDC 17, Electric Power System (Loss of the Main Generator). Describe any limits on the main generator MVAR output such that loss of the main generator will not result in unacceptable voltage in the local switchyard. Describe any auxiliary transmission system equipment, such as capacitor banks, that may be required to offset loss of MVAR support on loss of the main generator.

GE Response:

Subsection 8.2.4.10 of DCD Tier 2, Revision 2, states, "The Reliability and Stability Study, will be provided in the COL application as a supporting document to the COLA."

Currently, the ESBWR clients are providing the data required by FERC, to the grid owners, for the first phase of the feasibility study.

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

NRC RAI 8.3-31:

Physical Identification of Safety-Related Equipment (DCD Tier 2, Rev. 1, Section 8.3.1.3). Clarify the discussion on cable separation implies that there will be nine raceway separation classes: four Divisions, four Division-Associated and one non-Class 1E raceway.

GE Response:

DCD Tier 2, Revision 2, Subsection 8.3.1.3 deletes any discussion of nine raceway separation classes.

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

NRC RAI 8.3-32:

Cable Identification (DCD Tier 2, Rev. 1, Section 8.3.1.3). The discussion refers to the identification of non-fiber cables. No discussion was provided for cable identification of fiber-optic cables. Describe how different divisions of fiber-optic cables will be identified.

GE Response:

The routing and identification of fiber strands in the ESBWR will not involve cables, but will utilize the latest fiber technology using colored strands blown into special fiber tubes and point to point optical verification during termination. See DCD Tier 2, Revision 2, Subsection 8.3.1.4 for a discussion on Control, Relay, and Instrument Panel/Racks and Isolation Devices. Fibers of different divisions of safety-related 1E-DCIS will not be routed together. As further explained in Subsection 8.3.1.3.1, all divisional components will be color-coded. The fiber tubes within each division will be identified by the divisional color and, as explained in Subsection 8.3.1.4, will be used as the isolation between safety-related and nonsafety-related circuits.

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

NRC RAI 8.3-33:

DCD Tier 2, Rev. 1, Section 8.3.1.4.1, Power Systems. Identify the loads that are associated with the medium and low voltage power penetrations.

GE Response:

The loads associated with penetrations are identified as a COLA responsibility per Subsection 8.3.4.7, DCD Tier 2, Revision 2.

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

NRC RAI 8.3-34:

Class 1E Batteries (DCD Tier 2, Rev. 1, Section 8.3.2.1.1). The design control document states that the batteries are sized so that the sum of the required loads does not exceed 80 percent of the battery ampere-hour rating, or warranted capacity at end-of-installed-life with 100 percent design demand. Batteries are sized for the dc load in accordance with IEEE Standard 485. Confirm that the battery sizing will also contain specific margins for minimum temperature and design margin (as defined in IEEE 485).

GE Response:

The battery sizing will also include specific margins for temperature, ageing and a design margin as specified in IEEE Standard 485. Margin will be based on the design characteristics of the final battery selected for the ESBWR standard design.

The reference to 80% of the battery ampere-hour rating will be deleted in Revision 3 to DCD Tier 2 Subsection 8.3.2.1.1. Qualifications for GNB Absolyte XL Series batteries, if selected for use, will also meet IEEE Standard 344 and IEEE Standard 323.

NRC RAI 8.3-35:

Class 1E Batteries. Provide the basis for the dc minimum battery terminal voltage at the end of the discharge period (i.e., 210 volts).

GE Response:

When the minimum discharge is reached at the end of life, the battery voltage will have decreased to 210 VDC and will be 1.75 VDC at each individual cell. This limit provides the margin of safety established by sizing the batteries in accordance with IEEE Standard 485.

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

NRC RAI 8.3-36:

Class 1E Batteries. Provide the basis for the maximum equalizing charge voltage for the Class 1E batteries (i.e., 280 volts).

GE Response:

The reference to 280 volts in Subsection 8.3.2.1.1 will be deleted in Revision 3 to DCD Tier 2, and replaced with: "will be specified by the battery vendor". The actual method of equalizing or maintaining a fresh battery will be determined by the ESBWR battery charger selected.

NRC RAI 8.3-37:

Class 1E Batteries. Describe the preoperational testing requirements for initial Class 1E battery installation and future battery replacements.

GE Response:

Preoperational tests for the Class 1E batteries are listed in DCD Tier 2, Chapter 14, and future battery replacements will be the responsibility of the COL holder.

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

NRC RAI 8.3-38:

Class 1E Batteries. Provide the type (e.g., vented lead-acid), ampere-hour capacity, and load profiles for each Class 1E battery.

GE Response:

The battery type will be selected based on the results of certified qualification tests required for Class 1E batteries and meet IEEE 485 for sizing capacity. The ESBWR design is currently evaluating the use of GNB Absolyte XL Series batteries instead of standard vented lead-acid batteries. The battery qualifications meet IEEE Std. 344 and IEEE Std. 323 at a minimum.

Safety-related batteries will be supplied by qualified vendors in accordance with 10CFR50 Appendix B, 10CFR21 and ASME NQA-1 Quality Assurance Program. The batteries are designed to meet elevated seismic levels, absorb 95% of the hydrogen during charging, and do not require acid level or specific gravity testing. The final ampere-hour capacity and load profiles are a COL applicant item that is required by DCD Tier 2 Subsection 8.3.4.8, Tables 8.3-6 and 8.3-7.

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

NRC RAI 8.3-39:

Class 1E Batteries. List the safety-related loads, with ratings, that will be supplied power by the Class 1E batteries during the design basis accident.

GE Response:

The E DCIS and Main Control Room emergency lights are the only safety related loads being powered by the Class-1E, 4 divisions of safety-related power. All system component actuation devices required for safe shutdown are provided with Class 1E power, with E-DCIS system parameters monitoring.

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

NRC RAI 8.3-40:

Class 1E Battery Chargers Capability (DCD Tier 2, Rev. 1, Section 8.3.2.1.1). The design control document states that the Class 1E battery chargers are capable of recharging its battery from the design minimum charge to 95 percent of fully charged condition within 12 hours. Confirm that the battery chargers also have the capacity and capability to carry the dc system load while at the same time recharging the discharged batteries.

GE Response:

The third paragraph in Subsection 8.3.2.1.1 was revised in DCD Tier 2, Revision 2 to state: "Each battery charger is capable of recharging its battery from the design minimum charge to 95% of fully charged condition within 24 hours while supplying the full load associated with the individual battery."

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

NRC RAI 8.3-41:

Class 1E Battery Chargers Voltage (DCD Tier 2, Rev. 1, Section 8.3.2.1.1). The design control document states that the Class 1E battery chargers are capable of maintaining a constant voltage in the range of 240 Volts up to 290 Volts. Confirm that the connected dc equipment is designed to operate up to this maximum voltage.

GE Response:

The connected DC equipment is not required to operate up to 290 VDC. This is the adjustable range of the battery charger. It allows the standby battery charger voltage to be set for equalizer charge while the battery is disconnected from loads. The range is also higher then the maximum listed equalizer voltage and will be procedurally controlled by the COL holder. With the use of Absolyte XL batteries, the ESBWR design is investigating using a battery charging system that will maintain each cell at its fully charged state and eliminate equalizer charging.

No Tier 2 change will be made in response to this RAI.

NRC RAI 8.3-42:

Class 1E Battery Chargers. IEEE Standard 308, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," as endorsed by Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants," recommends that the size (i.e., capacity and capability) of the safety-related battery chargers be based on the largest combined demands of the various steady-state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during which these demands occur. Describe and justify any differences between the proposed ESBWR safety-related battery charger sizing criterion and IEEE Standard 308.

GE Response:

As shown on Table 8.1-1, to DCD Tier 2, Revision 2, no exception is taken to RG 1.32 or IEEE 308, the battery chargers will supply the total combined load and recharge the batteries. With the ESBWR N-2 design and the elimination of 480 VAC loads and motors, the capacity of the safety-related chargers to be selected will not be challenged by conformance to the IEEE Class 1E Standard Criteria endorsed by Regulatory Guide 1.32.

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

NRC RAI 8.3-43:

Class 1E Chargers. Describe the separation scheme that will be provided for the connection of the Class 1E battery chargers to the non-safety-related buses.

GE Response:

The separation scheme of Class 1E battery chargers is described in Subsection 8.3.1.1.3, "Uninterruptible AC Power Supply System", DCD Tier 2, Revision 2. The Isolation Phase Bus for each division is Class-1E and separated in accordance with RG 1.75. Figure 8.1-1 sheets 2 and 3 show the dual breaker and isolation transformer supplying power to the Isolation Phase Buses from either PIP Bus A or B. The Class 1E battery chargers are connected to the Class 1E Isolation Phase Buses. There is no connection of safety-related batteries to nonsafety-related buses.

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

NRC RAI 8.3-44:

Regulatory Requirements – RG 1.129 (Battery Monitoring) (DCD Tier 2, Rev. 1, Section 8.3.2.2.2). Describe the minimum design limits for battery electrolyte level, temperature and individual cell voltage. Describe your justification that the batteries will remain capable of performing their minimum designed safety function at these limits.

GE Response:

The anticipated use of Absolyte XL batteries can eliminate minimum design limits for electrolyte level. However, Battery Technical Specifications, Section 3.8, provide the Design Basis and Surveillances for the battery temperature and individual cell voltage. DCD Tier 2, Revision 2, Subsection 8.3.4.14 requires the COL holder to comply with RG 1.129, IEEE 450 and perform periodic testing of batteries in accordance with Technical Specification Section 3.8. Once the loads are established, the batteries will be designed in accordance with IEEE standards 323 and 344 such that the minimum safety function is assured

No DCD Tier 2 changes will be made in response to this RAI unless a revised design battery is incorporated in the ESBWR design.

NRC RAI 8.3-45:

Battery Monitoring (DCD Tier 2, Rev. 1, Section 8.3.2.2.2). Describe how the safety-related batteries will be instrumented for continuous on-line monitoring.

GE Response:

DCD Tier 2, Rev. 1, Section 8.3.2.2.2 does not state that the batteries will be instrumented for continuous online monitoring nor does Subsection 8.3.2.1.1, Class 1E Station Batteries and Battery Chargers indicate that battery chargers with the battery management or battery maintenance feature will be used as part of the ESBWR design. If these features are included in the ESBWR design they will have to comply with the appropriate approved IEEE standards required for selection of battery chargers. Revision 2 does not commit to continuous online monitoring for safety-related batteries either.

No Tier 2 change will be made in response to this RAI.

NRC RAI 8.3-46:

Cables and Raceways (DCD Tier 2, Rev. 1, Section 8.3.3.2). The design control document states that the cable tray fill will be limited to 40 percent for power cables. Clarify why it is your intent to apply this restriction on cable tray fill for large 600 V power cables (e.g., greater than 250 kcm) or medium voltage cables, and not to maintain a physical separation (e.g., one cable diameter) and a single layer of cables to restrict heat buildup in the cable tray.

GE Response:

A change was made in DCD Tier 2, Revision 2, Subsection 8.3.3.2, first paragraph to add References 8.3-5, 8.3-6 and 8.3-7 to clarify the acceptable standards/methods for separation and spacing consideration for large power cables in open top cable trays.

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

NRC RAI 8.3-48:

Voltage Analysis (DCD Tier 2, Rev. 1, Section 8.3.4.8). The safety-related batteries are described on page 8.3-35 as having a 24 and 72 hour required discharge capability (Table 8.3-3, Battery Duty Cycle). The design control document requires the battery manufacturer's 2-hour ampere-hour rate, the 8-hour ampere-hour rate and the 1-minute ampere rating be provided. Describe the significance of providing the 1-minute ampere rating and 2 and 8-hour ampere-hour rates when the Class 1E batteries are to be sized to accommodate 24 and 72-hour duty cycles. Provide the 24 hour and 72 hour tested discharge rates for the type of Class 1E batteries proposed for this service.

GE Response:

DCD Tier 2, Revision 2 Table 8.3-3 shows all Safety-Related battery duty cycles as being 72 hours and all non-safety batteries as a 2-hour duty cycle. Class 1E battery loading profile and the ampere hour load table for 72 hour battery rates will be provided by the COL applicant in accordance with DCD Tier 2, Revision 2, Tables 8.3-6 and 8.3-7.

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