HITACHI

GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

PO Box 780 M/C A-65
Wilmington, NC 28402-0780
USA

T 910 819 6192
F 910 362 6192
rick.kingston@ge.com

MFN 09-743, Revision 2

Docket No. 52-010

January 28, 2010

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

Subject: **Revised Response to Portion of NRC Request for Additional Information Letter No. 391 Related to Design Control Document (DCD) Revision 6 - RAI Number 8.3-67**

Enclosure 1 contains the revised GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) 8.3-67 (Reference 1). The original response for this RAI was transmitted in Reference 2 and revised in reference 3. This revision is in response to NRC staff questions on the revised response.

If you have any questions about the information provided, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 09-725, Letter from the U.S. Nuclear Regulatory Commission to Jerald G. Head, Request for Additional Information Letter No. 391, Related To Design Control Document (DCD) Revision 6, dated November 9, 2009
2. MFN 09-743, Letter from Richard E. Kingston to the U.S. Nuclear Regulatory Commission, "*Response to Portion of NRC Request for Additional Information Letter No. 391 Related to Design Control Document (DCD) Revision 6 - RAI Number 8.3-67*" dated November 24, 2009.
3. MFN 09-743, Revision 1,Letter from Richard E. Kingston to the U.S. Nuclear Regulatory Commission, "Revised *Response to Portion of NRC Request for Additional Information Letter No. 391 Related to Design Control Document (DCD) Revision 6 - RAI Number 8.3-67*" dated December 15, 2009.

Enclosures:

1. Revised Response to Portion of NRC Request for Additional Information Letter No. 391 Related to Design Control Document (DCD) Revision 6 - RAI Number 8.3-67
2. Revised Response to Portion of NRC Request for Additional Information Letter No. 391 Related to Design Control Document (DCD) Revision 6 - RAI Number 8.3-67 – DCD Markups

cc:

AE Cubbage	USNRC (with enclosures)
J G Head	GEH/Wilmington (with enclosures)
DH Hinds	GEH/Wilmington (with enclosures)
PM Yandow	GEH/Wilmington (with enclosures)
eDRF Section	0000-0112-0558

Enclosure 1

MFN 09-743, Revision 2

Revised Response to Portion of NRC Request for

Additional Information Letter No. 391

Related to Design Control Document (DCD) Revision 6

RAI Numbers 8.3-67

NRC RAI 8.3-67

DCD Section 8.3.3.2 does not address the use of underground cables or cables in a wetted environment. Operating experience has shown that cross-linked polyethylene (XLPE) or high-molecular-weight polyethylene insulation materials are most susceptible to water tree formation. Cable failures have a variety of causes: manufacturing defects, damaged caused by shipping and installation and exposure to electrical transients or abnormal environmental conditions during operation. Electrical cables in nuclear power plants are usually located in dry environments, but some cables are exposed to moisture from condensation and wetting in inaccessible locations such as buried conduits, cable trenches, cable troughs, above ground and underground duct banks, underground vaults, and direct buried installations. Since underground cables are susceptible to moisture, identify the cables that are inaccessible or routed underground that support equipment and other systems that are within the scope of 10 CFR 50.65 (the Maintenance Rule). Indicate whether there are any plans to implement a program for inaccessible or underground power, control, and instrumentation cables for testing and inspection in accordance with Generic Letter 2007-01; and indicate the frequency for such testing and inspection or provide justification for not developing such program.

GEH Response

Maintenance Rule and Generic Letter 2007-01 are both addressed to holders of operating licenses for nuclear power plants. New plants are covered by the COL activities during the formation of their Maintenance Rule applicability matrix for components and systems determined to be within the Rule for the new design.

ESBWR standard plant design cables are routed in tunnels and raceway designed to remain dry and not be susceptible to flooding and moisture intrusion. The cables in the buried conduit routed from the cable tunnels between the Electric Building and the Turbine, Control and Reactor buildings that branch off from the tunnel to the Fire**water Service Complex** are in sealed metal conduit, buried in a poured concrete raceway with no manholes. Therefore flooding is not an issue.

The standard ESBWR plant design will have its principal plant structures, as listed in Section 1.2.1, connected by a series of tunnel structures that will enable the routing of cables and raceway in areas not subject to water intrusion. For other ESBWR structures not listed in Section 1.2.1 as well as site specific structures requiring electric power, the detail design is owners yard scope, not considered part of the standard plant design and is covered by the COL applicants. An example is; Section 9.2.1.2 Summary Description of the **Plant Service Water System** (PSWS) third sentence states, "The portions of PSWS that are not part of the ESBWR Standard Plant consist of the heat rejection facilities (NPHS and AHS), which are dependent on actual site conditions." Figure 9.2-1 shows the PSWS Simplified Diagram that is outside the scope of the standard plant. **After review of the entire ESBWR design, the only other system**

whose cables might be susceptible to environmental conditions mentioned in Generic Letter 2007-01 is the DG Fuel Oil Transfer system that supplies fuel oil to the SDG day tanks as it is also outside the standard plant design on a site specific design location. The owner yard scope include**s** such items as piping, cables and their raceway that connect to the outlying systems and structures that are outside the standard plant design and **site specific**.

Cable insulation that was used during the 1960's, 70's and 80's for medium voltage **polyethylene** cables was found to have been subject to water-tree formation. **Polyethylene c**ables now being manufactured for medium voltage usage in nuclear power plant duct banks are of new designed **polyethylene** insulation material that has a water-tree formation retardant additive added. Further advances in cable insulation curing now use a dry cure process instead of the past practice of steam curing that lead to further aggravating the water-treeing process which lead to early cable failure in a flooded location. **Subsection 8.3.3.2 will have additional cable requirements added as described in this paragraph and attached below.**

Monitoring of the **only two ESBWR systems (PSWS and DG Fuel Oil Transfer system for the SDG) with accident mitigating functions that have power and control** cables that are in a potentially wetted environment due to manholes are in the owners yard scope and covered by the COL Applicant per the Maintenance Rule. ESBWR RTNSS systems, components and functions are within the scope of the Maintenance Rule and have "Maintenance Rule availability controls per Table 19A-2 (Note)". COL Applicant responsibilities as stated in DCD Subsection 8.1.5.2.4 for RG 1.160; "Maintenance Rule is addressed in Table 1.9-21 and Subsection 13.5.2 for Operating and Maintenance Procedures." **Therefore new paragraph 7 will be added to Subsection 8.3.3.2 to point to new COL Information item 8.3.4-2-A**. **Table 1.10-1, Summary of COL Items, has new Item No. 8.3.4-2-A added per this RAI response.**

DCD Impact

See attached Changes to Subsection 8.3.3.2, new COL Information item 8.3.4-2-A and Table 1.10-1 updated to show the new COL-A item 8.3.4-2-A.

MFN 09-743, Revision 2

Revised Response to Portion of NRC Request for

Additional Information Letter No. 391

Related to Design Control Document (DCD) Revision 6

RAI Numbers 8.3-67

DCD Markups

8.3.3.1 Resistance of Cables to Combustion

The electrical cable insulation is designed to resist the onset of combustion by choice of insulation and jacket materials, which have flame-resistive and self-extinguishing characteristics. Polyvinyl chloride and neoprene cable insulation are not used in the ESBWR. Each power, control, and instrumentation cable is specified to pass the vertical tray flame test in accordance with IEEE 1202 (Reference 8.3-11). All cable trays are fabricated from noncombustible material.

8.3.3.2 Cables and Raceways

Power and control cables are specified for continuous operation at conductor temperature not exceeding 90°C (194°F) and to withstand an emergency overload temperature of up to 130°C (266°F) in accordance with ICEA S-95-658/NEMA WC-70 (Reference 8.3-5). The base ampacity rating of the cables is established as published in IEEE 835 (Reference 8.3-6) and ICEA P-54-440/NEMA WC-51 (Reference 8.3-7).

Cables are specified to continue to operate at 100% relative humidity with a service life expectancy of 60 years. Safety-related cables are designed to survive the LOCA ambient condition at the end of the 60-year life span. A water-tree formation retardant is specified when polyethylene cable insulation is selected for medium voltage use. A dry cure process is specified for cable insulation. Certified proof tests are performed on cables to demonstrate 60-year life, and resistance to radiation, flame, and the environment. Refer to IEEE 383 (Reference 8.3-4) and ICEA S-95-658/NEMA WC-70 (Reference 8.3-5). The testing methodology ensures such attributes are acceptable for the 60-year life.

All cables specified for safety-related systems and circuits are moisture and radiation resistant, are highly flame resistant and evidence little corrosive effect when subjected to heat or flame, or both. Certified proof tests are performed on cable samples to:

- Certify 60-year life by thermal aging;
- Prove the radiation resistance by exposure of aged specimens to integrated dosage;
- Prove mechanical/electrical tests of cable for environmental conditions specified;
- Prove flame resistance by the vertical tray, 70,000 Btu/hr flame test for 20 minutes (minimum); and
- Show acceptable levels of gas evolution by an acid gas generation test.

Cable tray fill is limited to 40% of the cross-sectional area for trays containing power cables (600V or less); and 50% cross-sectional area for trays containing control and instrumentation cables. If tray fill exceeds the above maximum fills, the tray fill is justified and documented. Medium voltage cable tray fill is single layer maintained.

Cable splices in raceways are prohibited. Cable splices are only made in manholes, boxes or suitable fittings. Splices in cables passing through the containment penetration assemblies are made in terminal boxes located adjacent to the penetration assembly. (See Regulatory Guide 1.75 for splice exception.)

The cable installation is such that direct impingement of fire suppressant does not prevent safe reactor shutdown.

ESBWR standard plant design cables are routed in tunnels and raceway designed to remain dry and not be susceptible to flooding and moisture intrusion. The COL Applicant will verify that owner yard scope site specific underground or inaccessible power and control cable runs to the PSWS and DG Fuel Oil Transfer System that have accident mitigating functions and are susceptible to protracted exposure to wetted environments or submergence as a result of tidal, seasonal, or weather event water intrusion are adequately identified and monitored for appropriate corrective actions (see COL 8.3.4-2-A).

8.3.3.3 Localization of Fires

In the event of a fire, the installation design localizes the physical effects of the fire by preventing its spread to adjacent areas or to adjacent raceways of different divisions. Floors and walls are effectively used to provide vertical and horizontal fire-resistive separations between redundant cable divisions. Localization of the effect of fires on the electric system is accomplished by independence and separation of redundant cable/raceway systems and equipment as described in Subsection 8.3.1.4.

Three hour fire rated concrete barriers are used between the RATs, the UATs and the main transformers and spare main transformer as described in Subsection 9A.4.7, "Yard", and include containment/collection of transformer oil.

In any given fire area, equipment is typically from only one safety-related division. This design objective is not always met due to other overriding design requirements. However, ESBWR always complies to Regulatory Guide 1.75 which endorses IEEE 384 (Reference 8.3-10) as described in Subsection 8.1.5.2.4 and Table 8.1-1. In addition, an analysis is made and documented in Appendix 9A to ascertain that the requirement of being able to safely shut down the plant with complete burnout of the fire area without recovery of the equipment is met. The fire detection, fire suppression, and fire containment systems provided, as described in Appendix 9A, assure that a fire of this magnitude does not occur.

8.3.4 COL Information

8.3.4-1-A Safety-Related Battery Float and Equalizing Voltage values

The COL Applicant will specify the safety-related battery float voltage and equalizing voltage values in Table 8.3-4 (Subsection 8.3.2.1.1).

8.3.4-2-A Identification and Monitoring of Underground or Inaccessible Power and Control Cables to the PSWS and DG Fuel Oil Transfer System Equipment That Have Accident Mitigating Functions.

The COL Applicant will verify that owner yard scope site specific underground or inaccessible power and control cable runs to the PSWS and DG Fuel Oil Transfer System that have accident mitigating functions and are susceptible to protracted exposure to wetted environments or submergence as a result of tidal, seasonal, or weather event water intrusion are adequately identified and monitored for appropriate corrective actions (Subsection 8.3.3.2).

8.3.5 References

8.3-1 IEEE 946, "Recommended Practice for the Design of DC Auxiliary Power Systems for Generating Stations."

Table 1.10-1

Summary of COL Items

Item No.	Subject / Description of Item	Section
6.4-1-A	Control Room Habitability Area (CRHA) Procedures and Training	6.4.4
6.4-2-A	Toxic Gas Analysis	6.4.5
6.6-1-A	Preservice Inspection (PSI) and Inservice Inspection (ISI) Program Description	6.6
6.6-2-A	PSI/ISI NDE Accessibility Plan Description	6.6
8.2.4-1-A	Transmission System Description	8.2.1.1
8.2.4-2-A	Switchyard Description	8.2.1.2.1
8.2.4-3-A	Normal Preferred Power	8.2.1.2
8.2.4-4-A	Alternate Preferred Power	8.2.1.2
8.2.4-5-A	Protective Relaying	8.2.1.2.1
8.2.4-6-A	Switchyard DC Power	8.2.1.2.1
8.2.4-7-A	Switchyard AC Power	8.2.1.2.1
8.2.4-8-A	Switchyard Transformer Protection	8.2.1.2.1
8.2.4-9-A	Stability and Reliability of the Offsite Transmission Power Systems	8.2.2.1
8.2.4-10-A	Interface Requirements	8.2.1.1
8.3.4-1-A	Safety-Related Battery Float and Equalizing Voltage Values	8.3.2.1.1
8.3.4-2-A	Identification and Monitoring of Underground or Inaccessible Power and Control Cables to the PSWS and DG Fuel Oil Transfer System Equipment That Have Accident Mitigating Functions	8.3.3.2
8A.2.3-1-A	Cathodic Protection System	8A.2.1
9.1-1-H	Dynamic and Impact Analyses of Fuel Storage Racks	Deleted
9.1-2-H	Fuel Storage Racks Criticality Analysis	Deleted
9.1-3-H	Fuel Racks Load Drop Analysis	Deleted
9.1-4-A	Fuel Handing Operations	9.1.1.7
9.1-5-A	Handling of Heavy Loads	9.1.5.8
9.2.1-1-A	Material Selection	9.2.1.2
9.2.5-1-A	Post Seven Day Makeup to Ultimate Heat Sink (UHS)	9.2.5