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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 275 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.1-50 S02**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC Letter 275 dated December 11, 2008, Reference 1. The previous supplemented response was submitted via Reference 2 in response to Reference 3. The original RAI response was submitted to the NRC via Reference 4 in response to Reference 5. GEH response to RAI Number 9.1-50 S02 is addressed in Enclosure 1.

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

Sincerely,

Richard E. Kingston

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Vice President, ESBWR Licensing

References:

1. MFN 08-967, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 275 Related to ESBWR Design Certification Application,* December 11, 2008**.**
2. MFN-08-557, Response to Portion of NRC Request for Additional Information Letter No. 201 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.1-50 S01.
3. MFN 08-499, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 201 Related to ESBWR Design Certification Application,* May 28, 2008.
4. MFN 08-439, Response to Portion of NRC Request for Additional Information Letter No. 158 Related to ESBWR Design Certification Application – Auxiliary Systems – RAI Number 9.1-50, May 1, 2008.
5. MFN 08-209, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 158 Related to ESBWR Design Certification Application,* February 29, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 275 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.1-50 S02

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	eDRF	0000-0095-5340

Enclosure 1

MFN 09-169

Response to Portion of NRC Request for

Additional Information Letter No. 275

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.1-50 S02

For historical purposes, the original text of RAIs 9.1-50 and 9.1-50 S01 and the GEH response is included, except for any attachments or DCD mark-ups.

NRC RAI 9.1-50

DCD Tier 2, Rev. 4, Section 9.1.4.5 states that there are interlocks in the refueling machine to ensure that the grapple, in its retracted position, provides sufficient water shielding over the active fuel during transit. Please revise DCD Tier 2 to include the actual height of water above the top of active fuel that will be provided by the interlocks to ensure adequate shielding.

GEH Response

DCD Tier 2, Subsections 9.1.4.1 and 9.1.4.5 will be revised in Revision 5 to include the actual height of water 2591 mm (8.5 ft.) above the top of active fuel that is provided by the interlock to ensure adequate shielding.

DCD Impact

DCD Tier 2, Subsections 9.1.4.1 and 9.1.4.5 will be revised as noted in the attached markup.

NRC RAI 9.1-50 S01

The response to this RAI cites an irradiated fuel safe shielding level of 2591 mm (8.5 feet). Justify the discrepancy with SRP 9.1.2 and RG 1.13 level of 3 meters (10 feet).

GEH Response

SRP 9.1.2 and RG 1.13 both state that the minimum pool depth for shielding should be 3 meters (10 feet) above the top of the stored fuel assemblies. The Fuel Building spent fuel storage racks are used for storing both new and spent fuel assemblies. The Reactor Building spent fuel racks in the deep pit in the buffer pool are used for temporary storage of spent fuel assemblies. In the Fuel Building, the distance from the normal water level to the top of the spent fuel rack is at least 10 meters (32.8 feet). In the Reactor Building, the distance from the normal water level to the top of the spent fuel racks in the deep pit in the buffer pool is at least 12 meters (39 feet). The storage of fuel assemblies in the Fuel Building spent fuel storage racks and the Reactor Building spent fuel racks in the deep pit in the buffer pool comply with the requirements of SRP 9.1.2 and RG 1.13.

As stated in the response to RAI 9.1-50, 2591 mm (8.5 ft.) is the actual height of water above the top of active fuel that is provided with the normal full up interlock installed on either the refueling and/or fuel handling machine to ensure acceptable shielding over the active fuel region of a single fuel assembly during its transit from/to the reactor vessel and/or the spent fuel storage racks. This interlock height installed on GEH refueling and fuel handling machines has been successfully used in commercial nuclear power plant operations since the 1970s. A shielding calculation has been performed for the GE14 fuel bundle referenced in the ESBWR design and fuel handling accident calculations using this interlock height to verify 2591 mm (8.5 ft.) of water above the top of active fuel of a single fuel assembly provides adequate shielding during the transit of a single fuel assembly from/to the reactor vessel and/or the spent fuel storage racks.

DCD Impact

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

NRC RAI 9.1-50 S02

Regulatory Guide 1.13 provides guidance that the minimum safe water shielding depth associated with spent fuel assemblies is 3.05 meters (10 feet). In Section 9.1.4.1, "Design Bases," and 9.1.4.5, "Refueling Equipment," for the refueling machine and the fuel handling machine, the applicant states that a safe water shielding depth of 2.59 meters (8.5 feet) is always maintained during transit of radioactive equipment/fuel over active fuel. Please modify the minimum shielding depth or identify the differences between the design features, analytical techniques, and procedural measures proposed for the ESBWR design and the NUREG-0800, "Standard Review Plan," (SRP) acceptance criteria and address how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with NRC regulations.

GEH Response

During the telephone call between GEH and the NRC on February 19, 2009, the following actions have been agreed upon:

- GEH will make available its proprietary shielding calculation, *Dose Rate Calculation Using a GE14 Fuel Bundle During ESBWR Fuel Handling Operations* (eDRF Section 0000-0084-1484), to the NRC for review. This calculation determined the dose rate from a single fuel bundle with a minimum height of 2591 mm (8.5 feet) of water above the top of active fuel of a single grappled fuel bundle in transit from/to the reactor vessel and/or the spent fuel storage racks. The calculated dose rate was determined to be acceptable based on allowances for increasing dose rates during transfer of spent fuel in the radiation zone maps shown in DCD Tier 2 Subsection 12.3.1.3.

  Based on the results of the GEH shielding calculation titled above, 2591 mm (8.5 feet) provides acceptable shielding during the transit of a single grappled fuel bundle. This calculation used the following conservative assumptions:

  (a) a safety factor for calculational uncertainty
  (b) considered only the active fuel region in the calculation
  (c) the curie values at 24 hours post-shutdown, to calculate the worst-case worker deep dose equivalent (DDE) rates.
- GEH is including the resulting dose rate from the shielding calculation in DCD Tier 2, Revision 6, Subsection 12.3.2.2.3.
- The NRC will review the shielding calculation and determine if the GEH calculation and justification is acceptable.

DCD Impact

DCD Tier 2, Subsection 12.3.2.2.3 is being revised in Revision 6 as noted in the attached markup.

Reactor Building - In general, the shielding for the reactor building is designed to maintain open areas at dose rates less than 6 µSv/hr (0.6 mrem /hr).

Penetrations of the containment wall are shielded to reduce radiation streaming. Localized dose rates outside these penetrations are limited to less than 50 µSv/hr (5 mrem/hr). The penetrations through interior shield walls of the reactor building are shielded using a lead-loaded silicone sleeve to reduce the radiation streaming. Penetrations are also located so as to minimize the consequences of radiation streaming into surrounding areas.

The components of the RWCU/SDC are located in the reactor building. Both the RWCU regenerative and nonregenerative heat exchangers are located in shielded cubicles separated from the other components of the system. Neither cubicle needs to be entered for system operation.

Process piping between the heat exchangers and the demineralizers is routed through shielded areas or embedded in concrete to reduce the dose rate in surrounding areas. The RWCU/SDC demineralizers are located in separate shielded cubicles. This arrangement allows maintenance of one unit while operating the other. The dose rate in the adjoining demineralizer cubicle from the operating unit is less than ~~60~~ 250 µSv/hr (~~6~~ 25 mrem/hr). Entry into the demineralizer cubicle, which is required infrequently, is via ~~a labyrinth entryway~~shielded hatches. The bulk of the piping and valves for the filter demineralizers is located in an adjacent shielded valve gallery. Backfilling and resin application of the filter demineralizers are controlled from an area where dose rates are less than 10 µSv/hr (1 mrem/hr).

The ESBWR employs a passive cooling system in addition to the RWCU/SDC for cooling the core and vessel. Access into the cubicles is not required to operate the systems. All such components that could become contaminated in the event of an accident are located in the containment except those components that would be used as part of the RWCU/SDC.

Fuel Storage - The fuel storage pool is designed to ensure the dose rate around the pool area is less than 25 µSv/hr (2.5 mrem/hr). In the event of an anticipated operational occurrence where the fuel sustains significant damage, such as a fuel drop accident, airborne dose rates in the pool area could significantly exceed this dose rate.

Fuel Handling – A safe water shielding depth of at least 2591 mm (8.5 ft.) is always maintained over the active fuel during transit of a single grappled fuel bundle from/to the reactor vessel and/or the spent fuel racks. Under these conditions, the dose rate is calculated to be less than 267 µSv/hr (27 mrem/hr) at the water surface.

Control Room - The dose rate in the control room is limited to 6 µSv/hr during normal reactor operating conditions. The outer walls of the Control Building are designed to attenuate radiation from radioactive materials contained within the Reactor Building and from possible airborne radiation surrounding the Control Building following a LOCA. The walls provide sufficient shielding to limit the direct-shine exposure of control room personnel following a LOCA to a fraction of the 5 rem limit as is required by 10 CFR 50 Appendix A, GDC 19.

Main steam tunnel - The main steam tunnel extends from the primary containment boundary in the Reactor Building up to the turbine stop valves. The primary purpose of the steam tunnel is to shield the plant complex from N-16 gamma shine in the main steam lines. The tunnel walls provide sufficient shielding to limit the direct-shine exposure from the main steam lines in any point that may be inhabited during normal operations.