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Subject: **Response to NRC Request for Additional Information Letter No. 184 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.1-28 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 dated April 11, 2008, Reference 1. GEH response to RAI Number 9.1-28 S02 is addressed in Enclosure 1. The previous supplemented request was received via Reference 3 and responded to via Reference 2. The original response was transmitted via Reference 4 in response to Reference 5.

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

Sincerely,

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 08-376, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 184 Related To ESBWR Design Certification Application*, April 11,2008.
2. MFN 08-231, *Response to Portion of NRC Request for Additional Information Letter No. 107 Related to ESBWR Design Certification Application – Auxiliary Systems – RAI Number 9.1-28 S01,* March 17, 2008.
3. MFN 07-492, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 107 Related to the ESBWR Design Certification Application,* August 31, 2007.
4. MFN 07-354, *Response to Portion* of *NRC Request for Additional Information Letter No.* 96 *-Auxiliary Systems- RAI Number* 9.1-28, June 28, 2007.
5. MFN 07-231, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No.* 96 *Related to the ESBWR Design Certification Application,* April 12, 2007.

Enclosure:

1. Response to NRC Request for Additional Information Letter No. 184 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.1-28 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	0000-0084-1947

Enclosure 1

MFN 08-423

Response to NRC Request for

Additional Information Letter No. 184

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.1-28 S02

For historical purposes, the original text of RAI 9.1-28 and 9.1-28 S01 and the GE/GEH responses are included.

NRC RAI 9.1-28

Sastre-Fuente E: Provide details of the program for monitoring the effectiveness of the neutron poison present in the neutron absorbing panels. Reference: Generic Letter 96-004, "Boraflex Degradation in Spent Fuel Pool Storage Racks." Section 9.1.2 states that the spent fuel racks will be constructed in accordance with a quality assurance program that ensures the design, construction and testing requirements are met. Please provide a description of the program used for monitoring the effectiveness of the neutron poison present in the neutron absorbing panels.

GE Response

Boraflex shall not be used in the fabrication of ESBWR spent fuel storage racks. Therefore, Generic Letter 96-004 does not apply.

The design shall include sample coupons. These coupons are to be provided for periodic in-service surveillance throughout the 60-year life of the spent fuel storage racks.

The sample coupons shall be fabricated from the same borated stainless steel (BSS) material used in construction of the interlocking panels. This BSS material will be UNS S30467 in accordance with ASTM A887, "Standard Specification for Borated Stainless Steel Plate, Sheet, and Strip for Nuclear Application".

DCD Impact

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

NRC RAI 9.1-28 S01

It is still not clear to the staff what type of neutron absorbing panels GEH will be using in the SFP. In the RAI response, GEH stated that the sample coupons are fabricated from the same borated stainless steel (BSS) material used in construction of the interlocking panels.

1. Identify the material specification for the BSS, e.g., ASTM Standard. Identify your plans to use composite materials such as Boral or Metamic.

2. Please provide the composition and physical properties of BSS and / or the composite materials, the manufacturing process, the results of long-term stability and corrosion testing, the resistance to radiation damage, and the minimum poison content.

3. For the material you plan to use as your neutron absorbing panel, please provide the following for your material testing program:

a. the size and types of coupons to be used,

b. the technique for measuring the initial elemental boron or boron carbide content of the coupons,

c. the frequency of coupon sampling and its justification,

d. the tests to be performed on the coupons (e.g., weight measurement, measuement of dimensions (length, width, and thickness), and poison content). These tests should also address, as a minimum, any bubbling, blistering, cracking, flaking, or areal density changes of the coupons, any dose changes to the coupons, and

e. the effects of any fluid movement and temperature fluctuations of the pool water on long term stability.

GEH Response

The applicable specification for the Type 304B7 Borated Stainless Steel (BSS) to be used in fabrication of the ESBWR spent fuel storage racks is ASTM A 887, "Standard Specification for Borated Stainless Steel Plate, Sheet, and Strip for Nuclear Application." There are no plans to use composite materials such as Boral or Metamic as a neutron absorbing material in the spent fuel pool. The BSS is the composite material used as the neutron absorbing material in the spent fuel pool.

Per standard ASTM A 887, the maximum chemical composition requirements and physical properties for the Type 304B7 BSS are as follows:

Carbon composition:	0.08%
Manganese composition:	2.00%
Phosphorous composition:	0.045%
Sulfur composition:	0.030%
Silicon composition:	0.75%
Chromium composition:	18.00 – 20.00%
Nickel composition:	12.00 –15.00%
Boron composition:	1.75 – 2.25%
Cobalt composition:	0.2% or lower
Nitrogen composition:	0.10%
Tensile strength:	75 ksi (515 MPa) (minimum)
Yield strength:	30 ksi (205 MPa) (minimum)
Elongation (in 2" or 50 mm)	17% (Class A), 6% (Class B) (minimum)
Hardness	241 (Brinell), 100 (Rockwell B) (maximum)

The BSS is solution-annealed to meet the mechanical property requirements of the reference specification. This process consists of heating the BSS to a temperature of 1900°F minimum then rapidly cooling.

In the United States, the BSS storage racks are currently installed only at the R. E. Ginna Nuclear Power Plant. R. E. Ginna Nuclear Power Plant does have a program for monitoring the long-term performance of the BSS neutron absorber material. Limited test data has identified no degradation of the BSS neutron absorber material.

Based on 30 years of industry experience in nuclear power plants worldwide, the BSS storage racks have exhibited long-term stability and no evidence of degradation in the spent fuel pool water environment. Numerous European utilities have discontinued their BSS monitoring programs based on the long-term stability of this neutron absorbing material.

Per the GEH Fuel Storage Rack Design Specification, the neutron absorbing material is capable of being irradiated to a level of 1 x 10^{11} rads gamma without significant degradation of its properties.

The boron content of Type 304B7 BSS can range from 1.75% to 2.25% according to ASTM A 887 specification. DCD Section 9.1 Reference 9.1-2 documents a K-eff less than 0.95 for spent fuel storage with a minimum poison (boron) content of 1.80%. Therefore, the fabricated BSS boron composition is specified as 1.80% or greater, which is consistent with the range provided in the ASTM A 887 specification.

The surveillance test coupons to be placed in the reactor and fuel building spent fuel storage racks are a rectangular type coupon that can be handled and have the following dimensions – 152.4 x 76.2 x 3.4 mm (6.0 x 3.0 x 0.1 in.).

Chemical properties of raw BSS material are verified to comply with Table 1 of ASTM A887, for Type 304B7. A boron uniformity test for Type 304B7 BSS, as identified in ASTM A887, is used for measuring the boron content of the raw materials, ensuring uniform boron distribution and neutron absorption. This raw material is used to fabricate both the neutron absorbing panels in the fuel storage racks and the surveillance test coupons to be used for monitoring degradation. Sampling of the raw BSS material is determined by QA personnel to assure compliance with the requirements of 10 CFR 50, Appendix B.

Based on previous industry experience at R. E. Ginna, recording surveillance coupon test data occurs after the completion of the first operating cycle following installation of the racks and no less often than the completion of every third additional operational cycle thereafter.

Visual comparison, thickness measurements, and weight measurements are the tests performed to detect evidence of degradation such as blistering, bubbling, cracking, flaking etc. Surveillance coupons that have been in the spent pool environment are compared with those coupons that have not been exposed to the spent fuel pool water environment.

The thermal hydraulic report, contained in DCD Revision 4 Reference 9.1-1, analyzed the spent fuel storage racks in both the fuel and reactor building pool water and concluded they are suitable for the analyzed normal and potential abnormal conditions that could be encountered during the lifetime of the spent fuel storage racks. The effects of temperature fluctuations and fluid movement in the reactor building and fuel building pool water were analyzed and the results showed the storage racks remain capable of performing their intended function with no evidence of storage rack and BSS degradation was noted. The surveillance test coupons are fabricated from the same BSS material used in the construction of the interlocking panels of the spent fuel storage racks and are also installed in the fuel and reactor building pool water experiencing the same environment as the spent fuel storage racks. Analyzed temperature fluctuations and fluid movements of the pool water are not expected to have an impact on the performance of the surveillance test coupons, which are expected to allow for testing over the 60-year life of the plant.

DCD Impact

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

NRC RAI 9.1-28 S02

GEH, in its response to NRC RAI 9.1-28 S01, indicated that ASTM A-887 Type 304B7 borated stainless steel (BSS) material will be used in the construction of the ESBWR spent fuel storage rocks [sic racks]. Because of its high boron content (1.75 - 2.25 percent), BSS requires special care during fabrication and welding. Clarify whether welding will be used during the fabrication of BSS and identify how the spent fuel storage rocks [sic racks] are attached to the spent fuel pool liner.

GEH Response

As stated in DCD Section 9.1 Reference 9.1-1, subsections 1.4.1 and 2.4.1, the borated stainless steel (BSS) plates are not welded. During the fabrication process, slots are machined into the BSS plates. These slotted BSS plates are then interlocked together during the assembly process similar to an egg crate design. The BSS plates are non-structural components of the spent fuel storage racks and used only as a neutron poison. The welded stainless steel (non-borated) plates are the structural component of the spent fuel storage racks that supports the entire structure.

As stated in DCD Section 9.1, Reference 9.1-1, subsections 1.4.1 and 2.4.1, the BSS spent fuel storage racks are attached with anchor bolts that are embedded in the spent fuel pool liner.

DCD Impact

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