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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 340 - Related To ESBWR Design Certification Application - RAI Number 14.3-441 Supplement 1**

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 the Reference 1 NRC letter. GEH response to RAI Number 14.3-441 Supplement 1 is addressed in Enclosures 1 and 2. The DCD markups in Enclosure 2 include previous revisions that are not associated with this RAI response. The markups related to RAI 14.3-441 Supplement 1 are enclosed within text boxes.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 09-397, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request For Additional Information Letter No. 340 Related To ESBWR Design Certification Application*, dated June 9, 2009.

Enclosures:

1. MFN 09-405 – Response to Portion of NRC Request for Additional Information Letter No. 360 - Related To ESBWR Design Certification Application – RAI Number 14.3-441 S01
2. MFN 09-405 – Response to Portion of NRC Request for Additional Information Letter No. 340 - Related To ESBWR Design Certification Application – RAI Number 14.3-441 S01 – DCD Markups

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Enclosure 1

MFN 09-405

Response to Portion of NRC Request for

Additional Information Letter No. 340

Related to ESBWR Design Certification Application

RAI Number 14.3-441 S01

NRC RAI 14.3-441

Table 9.1-5 "Reference Codes and Standards" of the ESBWR DCD, Revision 5 states that NUREG-0554, "Single Failure Proof Cranes for Nuclear Power Plants," is "[a]pplicable to the RB and FB overhead cranes. Applicable to the hoist on the refueling and fuel handling machines that handles the combined fuel support and control blade grapple." The ESBWR DCD, Tier 1 Section 2.16.1, "Cranes, Hoists, and Elevators," and Table 2.16.1-1, "ITAAC For The Cranes, Hoists and Elevators" do not list "single failure proof" as certified design information with ITAAC for the RB crane, the FB crane, the hoist for the refueling machine or the hoist for the fuel handling machine. The staff believes that "single failure proof" design criteria for the above listed cranes and hoists should be listed in Tier 1 as described below. One design criteria, among several design criteria for Tier 1 information, is that it should include features and functions that could have a significant effect on the safety of a nuclear plant or are important in preventing or mitigating severe accidents. A drop of the reactor vessel head or a spent fuel cask could affect plant safety. Therefore, design features that reduce the risk and/or analyses that provide assurance of safety after a dropped load are important to safety.

The staff considers "single failure proof" design criteria for the RB crane and the FB crane as Tier 1 safety significant design criteria. As a minimum, the following analyses would have to be performed in order to not consider "single failure proof" design criteria as safety significant criteria for the RB crane and the FB crane:

- *A heavy load analysis proving that a heavy load drop in safety related areas of the plant will not be the cause any of Items I through IV of section 5.1 of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."*
- *SRP 9.1.5, "Overhead Heavy Load Handling Systems," Subsection III. 4, states that without "single failure proof design criteria, analyses are required for a dropped load on the reactor vessel, among other analyses. The DCD does not describe results of this analysis.*
- *Regulatory Guide 1.13, Regulatory Position C.5 states that an alternative to an "single failure proof crane is that the spent fuel cask loading area be designed to withstand a drop of the heaviest load at the maximum height. As a minimum, the following analysis would have to be performed in order to not consider "single failure proof' design criteria as safety significant criteria for the containment equipment hatch hoist and the containment maintenance hatch hoist: A heavy load analysis proving that a heavy load drop in safety related areas of the plant will not be the cause any of Items I through IV of Section 5.1 of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."*

Without the analyses and design criteria stated above, the "single failure proof" design feature for the RB crane, FB crane, the hoist for the refueling machine and the hoist for the fuel handling machine becomes safety significant design criteria.

Please justify why the applicant did not include "single failure proof" design criteria and ITAAC in Tier 1 of the DCD, which are safety significant design criteria, for the RB crane, FB crane, the hoist for the refueling machine, and the hoist for the fuel handling machine.

GEH Response

Per the telephone call between GEH and the NRC on February 19, 2009, both GEH and the NRC agreed that the single failure proof design criteria and an ITAAC should be included in DCD Tier 1 of Revision 6, for the Reactor Building overhead crane, the Fuel Building overhead crane, the refueling machine hoist and fuel handling machine hoist. Because the single failure proof design criteria and an ITAAC are being included in the DCD Tier 1, additional heavy load analyses are not needed. DCD Tier 1 is being revised in Revision 6 to add these ITAACs.

DCD Impact

DCD Tier 1, Subsections 2.5.5, 2.16.1 and Tables 2.5.5-1 and 2.16.1-1 are being revised in Revision 6 as noted in the attached markup.

NRC RAI 14.3-441S01

Table 9.1-5 "Reference Codes and Standards," DCD, Revision 5, states that NUREG-0554, "Single Failure Proof Cranes for Nuclear Power Plants," is "Applicable to the [Reactor Building] RB and [Fuel Building] FB overhead cranes," and "Applicable to the hoist on the refueling and fuel handling machines that handles the combined fuel support and control blade grapple." The ESBWR DCD, Tier 1 Section 2.16.1, "Cranes, Hoists, and Elevators," and Table 2.16.1-1, "ITAAC For The Cranes, Hoists and Elevators" do not list "single failure proof" as certified design information with ITAAC for the RB crane, the FB crane, the hoist for the refueling machine or the hoist for the fuel handling machine. The staff believes that "single failure proof" design criteria for the above listed cranes and hoists should be listed in Tier 1. In RAI 14.3-441, the staff asked the applicant to justify why it did not include "single failure proof" design criteria and ITAAC in Tier 1 of the DCD, which are safety significant design criteria, for the RB crane, FB crane, the hoist for the refueling machine, and the hoist for the fuel handling machine. In its response dated March 17, 2009, the applicant stated it would revise the DCD Tier 1 in Revision 6 to state that the single failure design criteria are applicable to the Reactor Building and Fuel Building overhead cranes, the refueling machine hoist, and the fuel handling machine hoist.

In addition, the level of detail in the ITAAC for single failure proof cranes needs to be enhanced. These ITAACs are needed for the Reactor and Fuel Building overhead cranes, the refueling machine hoist, and the fuel handling machine hoist. The minimum set of tests (ITA column) should include:

(1) Nondestructive examination (NDE) of critical welds in the crane structure (Paragraph 4251.4 of ASME NOG-1 or Article 2.6 of NUREG-0554) with acceptance criteria from AWS D1.1;

(2) static and dynamic load testing (Paragraph 7422 of ASME NOG-1 or Articles 8.2 and 8.4 of NUREG-0554) with acceptance criteria related to bridge design deflection under load, ability to manually lower load, ability of holding brakes to individually stop and hold rated load, and proper operation of limiting and safety devices; and

(3) no-load test of two-blocking protection (either independent tests of redundant upper limit switches or test of energy absorbing device) (Paragraph 7421 of ASME NOG-1 or Article 8.3 of NUREG-0554).

The inspection of certain crane components should be limited to non-redundant components (rope drum, sheeve blocks, and hook) and the wire rope. The acceptance criteria should be that the component dimensions and materials match the design specifications and that the wire rope is correctly reeved.

GEH Response

DCD Tier 1, Subsections 2.5.5 and 2.16.1 and Tables 2.5.5-1 and 2.16.1-1 are being revised in Revision 6 to incorporate the additional level of detail needed for single failure proof cranes in the ITAAC for the Reactor Building and Fuel Building overhead cranes and the refueling machine and fuel handling machine hoists (the mast and fuel grapple).

DCD Impact

DCD Tier 1, Subsections 2.5.5 and 2.16.1 and Tables 2.5.5-1 and 2.16.1-1 are being revised in Revision 6 as noted in the attached markups.

Enclosure 2

MFN 09-405

Response to Portion of NRC Request for

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Related to ESBWR Design Certification Application

RAI Number 14.3-441 S01

DCD Markups

2.5.5 Refueling Equipment

The ESBWR is supplied with a Reactor Building (RB) refueling machine for fuel movement and a fuel handling machine used for fuel servicing and transporting tasks in the Fuel Building (FB).

Design Description

The functional arrangement of the RB refueling machine is that it is a gantry-type crane that spans the reactor vessel cavity and fuel and storage pools to handle fuel and perform other ancillary tasks. It is equipped with a traversing trolley on which is mounted a telescoping mast and integral fuel grapple. The machine is a rigid structure built to ensure accurate and repeatable positioning during the refueling process.

The functional arrangement of the FB fuel handling machine is that it is equipped with a traversing trolley on which is mounted a telescoping mast and integral fuel grapple. The machine is a rigid structure built to ensure accurate and repeatable positioning while handling fuel.

(1) The functional arrangement of the RB refueling machine is as described in the Design Description of this Subsection 2.5.5.

(2) The RB refueling machine is classified as nonsafety-related, but is designed as Seismic Category I.

(3) The RB refueling machine has an auxiliary hoist with sufficient load capability.

(4) The RB refueling machine is provided with controls interlocks.

(5) The functional arrangement of the FB fuel handling machine is as described in the Design Description of this Subsection 2.5.5.

(6) The FB fuel handling machine is classified as nonsafety-related, but is designed as Seismic Category I.

(7) The FB fuel handling machine has an auxiliary hoist with sufficient load capability.

(8) The FB fuel handling machine is provided with controls interlocks.

(9) The RB refueling machine hoist (the mast and fuel grapple) is designed such that a single failure will not result in the loss of the capability to safely retain the load.

(10) The FB fuel handling machine hoist (the mast and fuel grapple) is designed such that a single failure will not result in the loss of the capability to safely retain the load.

(11) The FB fuel handling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.

(12) The RB refueling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.5.5-1 provides a definition of the inspection, test, and/or analyses, together with associated acceptance criteria for the refueling ~~machine~~equipment.

Table 2.5.5-1

ITAAC For The Refueling ~~Machine~~Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The FB fuel handling machine has an auxiliary hoist with sufficient load capability.	Load tests on the as-built auxiliary hoists will be conducted.	Report(s) ~~document~~ exist and conclude that a successful load test of the as-built auxiliary hoist has been performed at 125% of rated load capacity.
8. The FB fuel handling machine is provided with controls interlocks.	Test will be performed with actual or simulated signals to demonstrate that the as-built interlocks function as required.	Report(s) ~~document~~ exist and conclude that the tests have been completed and results demonstrate that the required interlocks function as follows: • ~~a.~~ Prevent collision with fuel pool walls or other structures; • ~~b.~~ Limit travel of the fuel grapple; • ~~c.~~ Interlock grapple hook engagement with hoist load and hoist up power; and • ~~d.~~ Ensure correct sequencing of the transfer operation in the automatic or manual mode.
9. The RB refueling machine hoist (the mast and fuel grapple) is designed such that a single failure will not result in the loss of the capability to safely retain the load.	Inspection of the as-built RB refueling machine hoist (the mast and fuel grapple) design documents will be performed for completion of the following inspections and tests:	Report(s) exist and conclude the following tests have been successfully completed for the as-built RB refueling machine hoist (the mast and fuel grapple) so that a single failure will not result in the loss of the capability to safely retain the load:

Table 2.5.5-1

ITAAC For The Refueling ~~Machine~~Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	i. Nondestructive Examination on the welded structural connections of the RB refueling machine will be performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4.	i. Nondestructive Examination on the welded structural connections of the RB refueling machine performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4.
	ii. The RB refueling machine hoist will be static load-tested to 125% of the manufacturer's rated load.	ii. The RB refueling machine hoist has been static load-tested to 125% of the manufacturer's rated load.
	iii. A Full-Load Test on the RB refueling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraph 7422.	iii. A Full-Load Test on the RB refueling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraph 7422.
	iv. A No-Load Test on the RB refueling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.	iv. A No-Load Test on the RB refueling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.
	v. Inspection of the rope drum, sheeve blocks, and hook component dimensions and material composition has been completed.	v. Inspection records show the rope drum, sheeve blocks, and hook component dimensions and material compositions match design specifications.
	vi. Inspection of the wire rope(s) for proper reeving has been completed.	vi. Inspection records show the wire rope (s) are correctly reeved.

Table 2.5.5-1

ITAAC For The Refueling ~~Machine~~Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10. The FB fuel handling machine hoist (the mast and fuel grapple) is designed such that a single failure will not result in the loss of the capability to safely retain the load.	Inspection of the FB fuel handling machine hoist (the mast and fuel grapple) design documents will be performed for completion of the following inspections and tests:	Report(s) exist and conclude the following tests have been successfully completed for the as-built FB fuel handling machine hoist (the mast and fuel grapple) so that a single failure will not result in the loss of the capability to safely retain the load:
	i. Nondestructive Examination on the welded structural connections of the FB fuel handling machine will be performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4.	i. Nondestructive Examination on the welded structural connections of the FB fuel handling machine will be performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4.
	ii. The FB fuel handling machine hoist will be static load-tested to 125% of the manufacturer's rated load.	ii. The FB fuel handling machine hoist has been static load-tested to 125% of the manufacturer's rated load.
	iii. A Full-Load Test on the FB fuel handling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraph 7422.	iii. A Full-Load Test on the FB fuel handling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraph 7422.
	iv. A No-Load Test on the FB fuel handling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.	iv. A No-Load Test on the FB fuel handling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.

Table 2.5.5-1

ITAAC For The Refueling ~~Machine~~Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	v. Inspection of the rope drum, sheeve blocks, and hook component dimensions and material composition has been completed. vi. Inspection of the wire rope(s) for proper reeving has been completed.	v. Inspection records show the rope drum, sheeve blocks, and hook component dimensions and material composition match design specifications. vi. Inspection records show the wire rope (s) are correctly reeved.
11. The FB fuel handling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.	Tests will be conducted of the as-built FB fuel handling machine.	Report(s) exist and conclude that the FB fuel handling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.
12. The RB refueling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.	Tests will be conducted of the as-built RB refueling machine.	Report(s) exist and conclude that the RB refueling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.

2.16 STRUCTURES AND SERVICING SYSTEMS/EQUIPMENT

2.16.1 Cranes, Hoists and Elevators

Design Description

Cranes and hoists are used for maintenance and refueling tasks. The reactor building (RB) crane, fuel building (FB) crane and associated lifting devices, such as hoists, and elevators in various areas of the plant are nonsafety-related.

(1) The RB crane has a lifting capacity greater than its heaviest expected load.

(2) The FB crane has a lifting capacity greater than its heaviest expected load.

(3) The RB crane is interlocked to prevent movement of heavy loads over new or spent fuel in the RB.

(4) The FB crane is interlocked to prevent movement of heavy loads over spent fuel in the FB.

(5) The RB crane is classified as Seismic Category I to maintain crane structural integrity.

(6) The FB crane is classified as Seismic Category I to maintain crane structural integrity.

(7) The RB crane passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.

(8) The FB crane passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.

(9) Heavy load equipment other than the RB crane, FB crane, fuel handling machine and refueling machine are designed or interlocked such that movement of heavy loads is restricted to areas away from stored fuel.

(10) The RB crane is designed such that a single failure will not result in the loss of the capability of the crane to safely retain the load.

(11) The FB crane is designed such that a single failure will not result in the loss of the capability of the crane to safely retain the load.

(12) The GDCS system is not susceptible to a load drop that could result in the GDCS not meeting the Technical Specifications for modes 5 and 6.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.16.1-1 provides a definition of the inspections, test and/or analyses, together with associated acceptance criteria for the Cranes, Hoists and Elevators.

Table 2.16.1-1

ITAAC For ~~The~~ Cranes, Hoists and Elevators

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The RB crane passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.	Tests will be conducted of the as-built RB crane.	Report(s) exist and conclude that the RB crane passes over the expected locations of the centers of gravity of heavy loads included in the certified design that are to be lifted.
8. The FB crane passes over the centers of gravity of heavy loads included in the certified design that are to be lifted.	Tests will be conducted of the as-built FB crane.	Report(s) exist and conclude that the FB crane passes over the expected locations of the centers of gravity of heavy loads included in the certified design that are to be lifted.
9. Heavy load handling equipment other than the RB crane, FB crane, fuel handling machine and refueling machine are designed or interlocked such that movement of heavy loads is restricted to areas away from stored fuel.	Inspections of as-built heavy load handling equipment will be performed.	Report(s) exist and conclude that heavy load handling equipment are designed or interlocked such that movement of heavy loads is restricted to areas away from stored fuel.
10. The RB crane is designed such that a single failure will not result in the loss of the capability of the crane to safely retain the load.	Inspection of the as-built RB crane design documents will be performed for completion of the following inspections and tests:	Report(s) exist and conclude the following tests have been successfully completed for the as-built RB crane so that a single failure will not result in the loss of the capability of the crane to safely retain the load:

Table 2.16.1-1

ITAAC For ~~The~~ Cranes, Hoists and Elevators

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	i. Nondestructive Examination on the welded structural connections of the RB crane will be performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4.	i. Nondestructive Examination on the welded structural connections of the RB crane performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4
	ii. The RB crane will be static load-tested to 125% of the manufacturer's rated load.	ii. The RB crane has been static load-tested to 125% of the manufacturer's rated load.
	iii. A Full-Load Test on the RB crane will be performed in accordance with ASME NOG-1, 2004, Paragraph 7422.	iii. A Full-Load Test on the RB crane performed in accordance with ASME NOG-1, 2004, Paragraph 7422.
	iv. A No-Load Test on the RB crane will be performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.	iv. A No-Load Test on the RB crane performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.
	v. Inspection of the rope drum, sheeve blocks, and hook component dimensions and material composition has been completed.	v. Inspection records show the rope drum, sheeve blocks, and hook component dimensions and material compositions match design specifications.
	vi. Inspection of the wire rope (s) for proper reeving has been completed.	vi. Inspection records show the wire rope (s) are correctly reeved.

Table 2.16.1-1

ITAAC For ~~The~~ Cranes, Hoists and Elevators

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. The FB crane is designed such that a single failure will not result in the loss of the capability of the crane to safely retain the load.	Inspection of the as-built FB crane design documents will be performed for completion of the following inspections and tests: i. Nondestructive Examination on the welded structural connections of the FB crane will be performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4. ii. The FB crane will be static load-tested to 125% of the manufacturer's rated load. iii. A Full-Load Test on the FB crane will be performed in accordance with ASME NOG-1, 2004, Paragraph 7422. iv. A No-Load Test on the FB crane will be performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.	Report(s) exist and conclude the following tests have been successfully completed for the as-built FB crane so that a single failure will not result in the loss of the capability of the crane to safely retain the load: i. Nondestructive Examination on the welded structural connections of the FB crane performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4 ii. The FB crane has been static load-tested to 125% of the manufacturer's rated load. iii. A Full-Load Test on the FB crane performed in accordance with ASME NOG-1, 2004, Paragraph 7422. iv. A No-Load Test on the FB crane performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.

Table 2.16.1-1

ITAAC For ~~The~~ Cranes, Hoists and Elevators

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	v. Inspection of the rope drum, sheeve blocks, and hook component dimensions and material composition has been completed. vi. Inspection of the wire rope (s) for proper reeving has been completed.	v. Inspection records show the rope drum, sheeve blocks, and hook component dimensions and material compositions match design specifications. vi. Inspection records show the wire rope (s) are correctly reeved.
12. The GDCS system is not susceptible to a load drop that could result in the GDCS not meeting the Technical Specifications for modes 5 and 6.	Inspection and analysis of the GDCS piping will be performed.	Report(s) exist and conclude that GDCS components are not susceptible to a load drop that could result in the GDCS not meeting the Technical Specification for modes 5 and 6.