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Subject: **Submittal of Response to Portion of NRC Request for Additional Information Letter Nos. 310 and 313 Related to ESBWR Design Certification Application Chapter 18 - Human Factors Engineering - RAI Number 18.5-35 through 18.5-40, 18.11-37 S01.**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) responses to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAIs) sent by NRC letter No. 310, dated February 26, 2009 (Reference 1) and NRC letter No. 313, dated March 9, 2009 (Reference 4).

RAI 18.11-37 S01 was requested by Reference 1 and was preceded by a response in Reference 2 as requested by Reference 3. RAIs 18.5-35 through 18.5-40 were requested by Reference 4.

Enclosure 1 provides the GEH responses to the subject RAIs as requested in References 1 and 4. Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box.

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

Sincerely,

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 09-151 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 310 Related To ESBWR Design Certification Application, dated February 26, 2009*
2. MFN 08-088 - *Response to Portion of NRC Request for Additional Information Letter Nos. 125 and 135 Related to ESBWR Design Certification Application – Human Factors Engineering - RAI Numbers 18.2-10 S02, 18.2-18, 18.6-13, 18.11-8 S01, 18.11-13 S01, 18.11-25 S01, 18.11-28 S01, 18.11-35, 18.11-37, 18.12-4 S02, and 18.12-7*, dated March 8, 2008
3. MFN 08-038 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH*, Request For Additional Information Letter No. 135 Related To ESBWR Design Certification Application, dated January 14, 2008*
4. MFN 09-178 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 313 Related To ESBWR Design Certification Application*, dated March 9, 2009

Enclosures:

1. MFN 09-264 – Response to Portion of NRC Request for Additional Information Letter Nos. 310 and 313 Related to ESBWR Design Certification Application Chapter 18 - Human Factors Engineering - RAI Number 18.5-35 through 18.5-40, 18.11-37 S01
2. MFN 09-264 – Markups for Response to Portion of NRC Request for Additional Information Letter Nos. 310 and 313 Related to ESBWR Design Certification Application Chapter 18 - Human Factors Engineering - RAI Number 18.5-35 through 18.5-40, 18.11-37 S01

cc:

AE Cubbage	USNRC (with enclosure)	
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eDRF Section	0000-0100-1362	RAI 18.11-37 S01
	0000-0099-5422	RAI 18.5-35
	0000-0099-5424	RAI 18.5-36
	0000-0099-5426	RAI 18.5-37
	0000-0099-5427	RAI 18.5-38
	0000-0099-5428	RAI 18.5-39
	0000-0099-5431	RAI 18.5-40

Enclosure 1

MFN 09-264

Response to Portion of NRC Request for

Additional Information Letter No. 310 and 313

Related to ESBWR Design Certification Application

Human Factors Engineering

RAI Numbers 18.5-35 through 18.5-40, 18.11-37 S01

NRC RAI 18.5-35

MFN 09-024, Enclosure 2 (the ESBWR Design Comparison to BWROG [BWR Owners' Group] EPG [Emergency Procedure Guidelines] (Delta Document)), Page 2-3 contains a table titled "Reference Plant Systems for EPG Comparison." The BWR Reference Plant systems are listed in Col. 1 and the corresponding ESBWR systems listed in Col. 2. However, the apparent corresponding systems don't always lineup properly and there are some BWR systems with no notation next to them in Col. 2. This needs to be clarified so one can, without ambiguity, tell which BWR system corresponds to which ESBWR system. Adding rows to the table, and the use of "none" when there is no corresponding system, would be one way to clarify this.

GEH Response

The Reference Plant Systems for EPG Implementation table is not intended to show a one-for-one relationship between BWR and ESBWR systems. The table reflects the equivalence to EPG/SAG system lists by function – RPV Level Control, Pressure Control and ATWS Mitigation. This comparison is done to identify ESBWR systems that could be used for that function based category of action. EPG/SAG systems that are capable of RPV injection and used to maintain reactor water level in RC/L are provided on one side of the table. Likewise ESBWR systems that are capable of RPV injection are provided on the ESBWR side of the table. The comparison is at the EPG level, not at the design level.

For example, by design, one would list RCIC as the system that provides vessel makeup when the condenser is isolated, and there is no primary leak. One ESBWR system that provides similar function is the isolation condenser as it requires no AC power and although used as a pressure control system, allows for cooldown with limited loss of coolant. As an injection source, HP CRD is a better equivalent system, but it requires AC power to operate and therefore is not effective given station blackout conditions. HP CRD is listed as an injection system. ICS is listed as a pressure control system. RCIC is listed on the EPG side as both injection and pressure control. The comparison at the function level is more appropriate because the application is the symptomatic direction of the EPG/SAG.

No changes to the subject Enclosure 2, ESBWR Design Comparison to BWROG EPG/SAG Revision 2 (Delta Document), will be made in response to this RAI.

DCD Impact

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

NRC RAI 18.5-36

The Delta Document in MFN 09-024, Enclosure 2 appears to not be completed. Examples are given here:

1. Pages 4-4 and 4-5, Step RC/L-2, under ESBWR Design Differences states that "The list of injection systems will be changed to meet the design- specific attributes of the ESBWR."

2. Page 11-8, Step C4-2.2, under ESBWR Design Differences states that "ESBWR design- specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance."

In these cases, the ESBWR-specific systems were not provided for these steps. This information is needed for the MI determination but is not given here. Please explain why this was not done and how it impacts the MI determination.

GEH Response

ESBWR systems for performing the symptomatic functions of the BWROG EPG are discussed at the beginning of the ESBWR Design Comparison to BWROG EPG/SAG Revision 2 to avoid unnecessary repetition.

For item 1, ESBWR level control systems are found in the Reactor Level Control section of Reference Plant Systems for EPG Implementation table. These systems are reflected in the MI through inclusion of RPV level indication (level used in lieu of individual system flows as explained in Attachment A of MFN 09-024) and the indication and controls associated with ECCS systems.

For item 2, the complete text of the comparison statement reads, “ESBWR design-specific set points, elevations, and systems will be used as the reference plant for the ESBWR guidance. The ESBWR design does not require guidance to isolate RCIC, HPCI and RHR steam condensing isolations.” The first part of the comparison statement indicates that step C4-2.2 applies to the ESBWR adjusted for setpoints, elevations and systems. Given BWRs and ESBWR possess SRVs, there is limited difference in the application of the qualifying (the “if” clause) portion of Step C4-2.2. The significant difference in application of the step is reflected in the statement “The ESBWR design does not require guidance to isolate RCIC, HPCI, and RHR steam condensing isolations” because there are no RCIC, HPCI or RHR steam condensing isolations in the ESBWR design.

Use of the approach to evaluate system function generically at the beginning of the ESBWR Design Comparison to BWROG EPG/SAG Revision 2 has no impact on MI, as all systems listed in the Reference Plant Systems for EPG Implementation table were evaluated.

No changes to the subject Enclosure 2, ESBWR Design Comparison to BWROG EPG/SAG Revision 2 (Delta Document), will be made in response to this RAI.

DCD Impact

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

NRC RAI 18.5-37

A discrepancy was identified between the MI process (MFN 09-024, Att. A) and the Delta Document (MFN 09-024, Enclosure 2). On Page 5-5, Step SP/T-1, of the Delta Document the ESBWR Design Differences states that "The ESBWR active LPCI [low pressure coolant injection] system function, and suppression pool cooling function is provided by FAPCS [fuel and auxiliary pool cooling system] not RHR [reactor heat removal]." The MI process would seem to imply that controls and displays for FAPCS components should be on the MI list (new DCD Tier 1 Table 3.3-2 and DCD Tier 2 Table 18.1), but they are not there. Please explain.

GEH Response

The referenced BWROG EPG/SAG Step, SP/T-1, is associated with a suppression pool cooling function. In the ESBWR design, the Suppression Pool Cooling Function of FAPCS is initiated automatically, and does not require additional operator cues (alarms) or tools for manual initiation (controls and indications). Successful initiation can be verified by the Suppression Pool temperature response, and additional indications, controls, and alarms are not required.

DCD Impact

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

NRC RAI 18.5-38

The MI list (new DCD Tier 1 Table 3.3-2 and DCD Tier 2 Table 18.1) does not provide alarms for some 4-20mA analog signals such as containment water level, wet well pressure, containment radiation, gravity driven pool level and standby liquid control accumulator level. Please provide the basis for why alarms are not required.

GEH Response

The minimum inventory list was developed using the framework and process described in MFN 09-024, Attachment A, which states: "Alarms should be used to alert the operator regarding abnormal or degrading conditions that require the operator response." To address the request for a basis for why specific alarms are not required, the following is provided:

Containment Water Level- There is no directed operator action described in the BWROG EPG that applies to the ESBWR design that relies on a specific setpoint for containment water level. A display is provided as a tool for determining correct system performance.

Wetwell Pressure- Wetwell pressure is tied directly to drywell pressure, and there is no directed operator action described in the BWROG EPG that applies to the ESBWR design that relies on a specific setpoint for wetwell pressure. A display is provided as a tool for determining correct system performance.

Containment Radiation- There is no directed operator action described in the BWROG EPG that applies to the ESBWR design that relies on a specific setpoint for containment radiation level. It is employed in the performance of the Severe Accident Management Guidelines, however that is beyond the scope identified in the determination of the Minimum Inventory.

Gravity Driven Cooling Pool Level- There is no directed operator action described in the BWROG EPG that applies to the ESBWR design that relies on a specific setpoint for Gravity Driven Cooling Pool Level. Successful initiation of GDCS can be determined by the response of reactor level. A display is provided as a tool for determining correct system performance.

Standby Liquid Control Accumulator Level- Although there is a potential directed operator action described in the BWROG EPG that applies to the ESBWR design that relies on a specific setpoint for Standby Liquid Control Accumulator Level (verify accumulator isolation on low level), it is manifested in the MI list as the alarm function of the accumulator isolation valves. Successful initiation of SLC can be determined by the response of reactor power, pressure and level. A display is provided as a tool for determining correct system performance.

DCD Impact

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

NRC RAI 18.5-39

As described in MFN 09-024, Enclosure 3, "Isolation Condenser System" with alarm, display, and control functions is included in the MI Tier 1 Table 3.3-2b for the remote shutdown system (RSS), but it's not included in the MI Tier 1Table 3.3-2a for the main control room (MCR) which instead lists "Isolation

Condenser Valves" with display and control functions. The same difference also occurs in similar tables in section 18.1. Please explain this difference.

GEH Response

For the remote shutdown system (RSS), the MI goal is to attain and maintain safe stable shutdown condition. Manual control from the remote Shutdown Panel is assumed for the Isolation Condenser System (ICS), and therefore the ability to initiate and operate the ICS, and to control plant cooldown rate makes the inclusion of alarms, display, and control functions necessary.

For the main control room, the use of ICS is driven by automatic initiation, and verification of operation is performed by observation of reactor level and pressure response. ICS valve position indication and control functions are provided to ensure system automatic isolation functions are completed.

DCD Impact

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

NRC RAI 18.5-40

In Page 4-2 of ESBWR Design Comparison to BWROG EPG, Rev 0 (MFN 09-024, Enclosure 2),

The document has the following steps:

BWROG EPG/SAG Step: RC/L-1

RC/L-1 Initiate each of the following which should have initiated but did not:

• Isolation

• ECCS

[• Emergency diesel generator]

ESBWR Design Differences

None

ESBWR Emergency Core Cooling System (ECCS) is a passive system, which includes the Gravity-Driven Cooling System (GDCS), the Isolation Condenser System (ICS), the Standby Liquid Control System (SLCS) and the Automatic Depressurization System (ADS). Once the ECCS initiates, no operator actions are needed and GDCS will recover the reactor pressure vessel (RPV) level and you do not need the next step (RC/L-2) to restore and maintain RPV water level. ESBWR design philosophy is different than the operating BWR. Justify why ESBWR Design Differences are "None" as you stated for the above step RC/L1.

GEH Response

The implementation of this step in ESBWR will be the same as it is for existing plants. The nature of the step suggests that something has failed to initiate – "Initiate each of the following which should have initiated but did not". Consequently, any of the listed systems which should have actuated on a reactor vessel level signal but did not, should be initiated by the operator. That action is independent of the design and is the reason why ESBWR Design Differences are "None".

ECCS does not initiate for all sequences that result in an EPG entry. Given the reactor level entry condition is Level 3, no ECCS systems should have initiated. For this sequence, RC/L-2 establishes the appropriate level control band and is appropriate for ESBWR.

GEH agrees that the design philosophy of the ESBWR is different from operating BWRs including use of passive systems that require no operator action and no reliance on AC

power for 72 hours. However, the philosophy of plant operation during emergencies will be consistent with the BWROG EPG/SAG. The BWROG EPG/SAG Introduction summarizes this philosophy below:

“The symptom-based response strategies prescribed in the EPGs/SAGs maintain the reactor plant in a safe condition without requiring diagnosis of the initiating event. No risk or probability threshold is defined; every effort has been made to address any mechanistically possible condition with appropriate generic operational guidance to minimize the impact on public health and safety. “

No changes to the subject Enclosure 2, ESBWR Design Comparison to BWROG EPG/SAG Revision 2 (Delta Document), will be made in response to this RAI.

DCD Impact

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

NRC RAI 18.11-37 S01

In RAI 18.11-37, the staff requested GEH to replace NEDE-33217P with NEDO-33276 as a reference since NEDE-33217P contained redundant and potentially conflicting information with NEDO-33276. GEH streamlined NEDE-33217P Revision 4 such that it can now be referenced. Accordingly, DCD Tier 2 Chapter 18 states in all sections except 18.11 that the human factor engineering processes are conducted in accordance with (by reference)NEDE-33217P and the corresponding implementation plan. However, NEDE-33217P also identifies HFE process requirements applicable to human factors verification and validation and therefore should also be referenced Section 18.11. Provide a reference to NEDE 33217P in DCD Tier 2 Section 18.11.

GEH Response

DCD Tier 2, Section 18.11 will be revised to include the appropriate reference statements regarding NEDE-33217P, ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan.

DCD Impact

DCD Tier 2, Section 18.11 will be revised as noted in the attached markup.

Enclosure 2

MFN 09-264

Markups for Response to Portion of NRC Request for Additional Information Letter No. 310 and 313 Related to ESBWR Design Certification Application Human Factors Engineering RAI Numbers 18.5-35 through 18.5-40, 18.11-37 S01

18.11 HUMAN FACTORS VERIFICATION AND VALIDATION

The HFE V&V process is conducted in accordance with References 18.11-1 and 18.11-2. This section describes the six main activities of HFE V&V:

(1) HSI inventory and characterization;

(2) HSI task support verification;

(3) HFE design verification;

(4) Operational condition sampling;

(5) Integrated system validation; and

(6) Human engineering discrepancy resolution.

18.11.1 Human Factors Verification and Validation Implementation

The ESBWR HFE Verification and Validation Implementation Plan, Reference 18.11-2~~1~~, establishes:

(1) Human factors V&V methods and criteria consistent with accepted HFE practices and principles;

(2) The scope of the evaluations of the HSI including:

a. The interface of the operator with the HSI equipment hardware and the interface of the operator with the HSI equipment's software-driven functions;

b. Plant operating procedures;

c. HSI work environmental conditions; and

d. Aspects of the HFE design process that impact human interface with the HSI including procedures, training, and staffing and qualification.

(3) The process for producing a characterized list of HSIs that accurately describes the HSI alarms, controls, indications, and related equipment to be verified;

(4) The process for verifying that the characterized inventory of HSI equipment implementing the alarm, control, and indication requirements identified in the task analyses are designed per accepted HFE guidelines and principles;

(5) The process for verifying that the HSI equipment providing the alarms, controls, and indications supporting the performance of tasks meets the personnel task performance requirements identified in task analysis;

(6) The process for identifying and selecting operational conditions to be incorporated into V&V;

(7) The process for validating that the integrated system design acceptably supports the safe and efficient operation of the plant;

(8) The process by which human engineering discrepancies are identified and resolved; and

(9) The process for documenting and retaining the detailed verification and validation results.

18.11.2 Results of HFE V&V

The results of the HFE V&V activity are summarized in a RSR. The content of the HFE V&V RSR is described in Reference 18.11-2~~1~~.

18.11.3 COL Information

None.

18.11.4 References

18.11-1 [*GE Hitachi Nuclear Energy, "ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan," NEDE-33217P, Class III (Proprietary), Revision 4, May 2008, and NEDO-33217, Class I (Non-proprietary), Revision 4, May 2008.*]*

18.11-~~1~~2 [*GE Hitachi Nuclear Energy, "ESBWR HFE Verification and Validation Implementation Plan," NEDO-33276, Class I (Non-proprietary), Revision 2, May 2008.*]*

* References that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change Tier 2* information.