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MFN 08-281

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Subject: **Response to Portion of NRC Request for Additional Information  
Letter Nos. 125 Related to ESBWR Design Certification  
Application – Human Factors Engineering - RAI Number 18.11-21  
S01**

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) NRC Letter No. 125 (Reference 1), dated December 14 2007.

RAI 18.11-21 S01 was requested by NRC letter No. 125 (Reference 1). Reference 2 provided the original response. Reference 3 provided the original request by the NRC for this RAI.

GEH's response to RAI 18.11-21 S01 is addressed in Enclosure 1.

Also note that this RAI response corresponds to and answers an open item listed in Reference 4. Please consider this open item to be addressed by this letter.

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

Sincerely,

James C. Kinsey  
Vice President, ESBWR Licensing

*DOGB*  
*NRO*

## References:

1. MFN 07-702 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 125 Related To ESBWR Design Certification Application*, dated December 14, 2007
2. MFN 06-446, *Response to Portion of NRC Request for Additional Information Letter No. 74 – ESBWR Human Factors Engineering, NEDO-33276, Rev. 0 HFE Verification and Validation Implementation Plan – RAI Numbers 18.11-1 through 18.11-33*, dated November 22, 2006
3. MFN 06-386, *Request for Additional Information Letter No.74 Related to ESBWR Design Certification Application*, dated October 11, 2006
4. MFN 08-194 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Economic Simplified Boiling Water Reactor (ESBWR) Chapter 18 Open Items*, dated February 28, 2008

## Enclosure:

1. MFN 08-281 -Response to Portion of NRC Request for Additional Information Letter No. 125 Related to ESBWR Design Certification Application - Human Factors Engineering - RAI Number 18.11-21 S01

## Attachment:

1. MFN 08-281- Enclosure 1, Attachment 1 - Markups and Added Text for RAI 18.11-21 S01

cc: AE Cubbage USNRC (with enclosure)  
RE Brown GEH/Wilmington (with enclosure)  
DH Hinds GEH/Wilmington (with enclosure)  
GB Stramback GEH/San Jose (with enclosure)  
eDRF 0000-0082-1590

**Enclosure 1**

**MFN 08-281**

**Response to Portion of NRC Request for Additional  
Information Letter No. 125, Related to ESBWR Design**

**Certification Application**

**Human Factors Engineering**

**RAI Number**

**18.11-21 S01**

**For historical purposes, the original text of RAI 18.11-21 and any previous supplemental text and GE responses are included preceding each supplemental response. Any original attachments or DCD mark-ups are not included to prevent confusion.**

**NRC RAI 18.11-21**

*NEDO-33276, Section 4.3.4.3 discusses participants in validation exercises. The section simply states that V&V teams will be made up of GE personnel, GE subcontractors, and COL holder personnel. However, this section does not describe the types of personnel that will actually serve as operating crews for the simulations. Nor is any information provided on how the sample of participants will be constructed. Please provide information as to what types of personnel will participate in validation tests and how they will be sampled.*

**GE Response**

The HFE V&V teams performing qualitative validation of display usability for a wide range of tasks in the mockup, part task and full scope simulators will include GE personnel, COL Holder personnel (operations, maintenance, training, QA, etc.), and GE subcontractors. The personnel selected for the validation will include BWR/ABWR/ESBWR trainers, people with SRO licenses at various nuclear plants, start up engineers, I&C engineers, PRA/HRA engineers and Human Factors engineers. The crews will include former SROs and people training to be ESBWR operators and SROs. For mock ups and part task simulations one simulated crew member at a time might be sufficient to test the MMIS for a single system. In the case of a full scope simulator a minimal crew of three would be used to test the MMIS.

The observers will be selected as appropriate from HFE staff experienced in Human Factors, C&I, Nuclear Engineering, System Engineering, Plant Operation, Computers, Procedures, Training, PRA/HRA, SPDS, System Safety Engineering, Maintainability, and Reliability.

**DCD/LTR Impact**

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

LTR NEDO-33276, Rev 0 section 4.3.4.3 will be revised as described above at the next revision.

**NRC RAI 18.11-21 S01**

*NEDO-33276, Rev 1, Section 4.4.3 generally discusses participants in validation exercises. However, several aspects of participant selections are not identified in the plan:*

- *how the sample of participants will account for human variability*
- *how minimum and normal crew configurations will be assembled and what they will consist of*
- *how sampling bias will be prevented*

*NEDO-33276 should be revised to provide the information or indicate that the detailed V&V implementation plan will address these participant sampling considerations.*

**GEH Response**

Validation testing as discussed in NEDO-33276, Section 4.4 applies to testing and validation of the integrated system to ensure that it can adequately support plant personnel in the safe operation of the plant.

The following changes will be made to NEDO-33276, Rev 1:

- A. In section 4.4.3, first paragraph, second sentence, change the word “the” to “integrated system”
- B. The second paragraph will be revised as noted in the attached markup.
- C. The following paragraphs will be added to NEDO-33276, Section 4.4.3 to address the question “How the sample of participants will account for human variability”:

“A full scope simulator is used to test the HSI of multiple systems. For full scope simulator tests, all participants have previously undergone ESBWR operator training. To properly account for human variability, the sample of participants used in testing reflects the characteristics of the population from which the sample is drawn.

The characteristics expected to contribute to system performance variation are specifically identified. These characteristics are taken into account during sampling to ensure that variation along those dimensions is included in the validation. These characteristics are determined from operator experience and task analysis and include:

1. License and qualifications
2. Skill and experience

3. Age
4. General demographics”

D. The following paragraphs will be added to NEDO-33276, Section 4.4.3 to address the question “How minimum and normal crew configurations will be assembled and what they will consist of”:

“In the case of full scope simulator HSI testing, a minimum crew configuration of two and a normal crew configuration of three are tested.

In the full scope simulator, a normal crew of three is used to test the HSI, as determined in NEDO-33266. This crew consists of: two licensed Reactor Operators and one Senior Reactor Operator (SRO). The first licensed Reactor Operator is assigned to normal control actions at the MCR HSI. The second licensed Reactor Operator is assigned to control of testing, surveillance and maintenance activities. This crew operates the ESBWR during all phases of normal plant operation, abnormal events, and emergency conditions.

A minimal crew of two is used to test HSI capabilities in a condition in which one of the normal crew licensed reactor operators has become incapable of performing operating procedures due to accident, illness, etc. This crew consists of one SRO and one licensed Reactor Operator.”

E. The following paragraphs will be added to NEDO-33276, Section 4.4.3 to address the question “How sampling bias will be prevented”:

“Randomized sampling should be used to select participants from a population representative of the plant personnel who interact with the HSI. To prevent sampling bias, use of the following should be avoided:

1. Participants who are part of the design organization.
2. Participants who were involved in prior design evaluations.  
(However, participants may perform a training evaluation following ESBWR operator training.)
3. Participants who were selected for some specific characteristic  
(selecting only good or experienced crews.)”

More detailed information regarding participant sampling and crew configurations will be provided in the HFE Verification and Validation work instructions.

### **DCD Impact**

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

LTR NEDO-33276, Rev 1 will be revised as noted in the attached markup.

**MFN 08-281**

**Enclosure 1**

**Attachment 1**

**Markups and Added Text**

**For RAI**

**18.11-21 S01**

#### **4.4.3 Participants, Test Subjects, and Observers**

The HFE V&V teams performing qualitative validation of display usability for a wide range of tasks in the mockup, part task, and full scope simulators include GE personnel, COL applicant personnel (operations, maintenance, training, QA, etc.), and GE subcontractors. The personnel selected for ~~the integrated system~~ validation include BWR/ABWR/ESBWR trainers, people with SRO licenses at various nuclear plants, start up engineers, I&C engineers, PRA/HRA engineers and Human Factors engineers. The crews include former SROs and people training to be ESBWR operators and SROs.

For mockups and part task simulations one simulated crew member at a time might be sufficient to test the HSI for a single system; these participants are selected from any of the categories mentioned above. ~~In the case of a full scope simulator, a minimal crew of three is used to test the HSI.~~

A full scope simulator is used to test the HSI of multiple systems. For full scope simulator tests, all participants have previously undergone ESBWR operator training. To properly account for human variability, the sample of participants used in testing reflects the characteristics of the population from which the sample is drawn.

The characteristics expected to contribute to system performance variation are specifically identified. These characteristics are taken into account during sampling to ensure that variation along those dimensions is included in the validation. These characteristics are determined from operator experience and task analysis and include:

1. License and qualifications
2. Skill and experience
3. Age
4. General demographics

In the case of full scope simulator HSI testing, a minimum crew configuration of two and a normal crew configuration of three are tested.

In the full scope simulator, a normal crew of three is used to test the HSI, as determined in NEDO-33266. This crew consists of: two licensed Reactor Operators and one Senior Reactor Operator (SRO). The first licensed Reactor Operator is assigned to normal control actions at the MCR HSI. The second licensed Reactor Operator is assigned to control of testing, surveillance and maintenance activities. This crew operates the ESBWR during all phases of normal plant operation, abnormal events, and emergency conditions.

A minimal crew of two is used to test HSI capabilities in a condition in which one of the normal crew licensed reactor operators has become incapable of performing operating procedures due to accident, illness, etc. This crew consists of one SRO and one licensed Reactor Operator

Randomized sampling should be used to select participants from a population representative of the plant personnel who interact with the HSI. To prevent sampling bias, use of the following should be avoided:

1. Participants who are part of the design organization.
2. Participants who were involved in prior design evaluations. (However, participants may perform a training evaluation following ESBWR operator training.)
3. Participants who were selected for some specific characteristic (selecting only good or experienced crews.)

The observers are selected as appropriate from staff experienced in HFE, I&C, Nuclear Engineering, System Engineering, Plant Operation, Computers, Procedures, Training, PRA/HRA, SPDS, System Safety Engineering, Maintainability, and Reliability.