



GE Energy

David H. Hinds
Manager, ESBWR

PO Box 780 M/C L60
Wilmington, NC 28402-0780
USA

T 910 675 6363
F 910 362 6363
david.hinds@ge.com

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**Subject: Response to NRC Request for Additional Information Letter No. 28
Related to ESBWR Design Certification Application – Human Factors
Engineering – RAI Numbers 18.2-1 through 18.2-17**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter. This completes GE's response to RAI Letter No. 28.

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

Reference:

1. MFN 06-150, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 28 Related to ESBWR Design Certification Application*, May 9, 2006

Enclosure:

1. MFN 06-163 – Response to NRC Request for Additional Information Letter No. 28 Related to ESBWR Design Certification Application – Human Factors Engineering – RAI Numbers 18.2-1 through 18.2-17

cc: WD Beckner USNRC (w/o enclosures)
AE Cabbage USNRC (with enclosures)
LA Dudes USNRC (w/o enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRF 0000-0054-6141

ENCLOSURE 1

MFN 06-163

Response to NRC Request for Additional Information

Letter No. 28 for the ESBWR

Design Certification Application

Human Factors Engineering

RAI Numbers 18.2-1 through 18.2.17

NRC RAI 18.2-1

In NEDO-33217, 10/05, page 8, please explain the difference between the M-MIS Implementation Plan and the HFE Program Plan.

GE Response

These are the same document. The document will be referred to as “Man-Machine Interface System and Human Factors Engineering Implementation Plan” or abbreviated as “M-MIS and HFE Implementation Plan”. GE will review this and other ESBWR HFE documentation for “HFE Program Plan or HFE Program Management Plan” and will update the nomenclature during the next revision of each affected HFE document.

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

NRC RAI 18.2-2

In NEDO-33217, 10/05, page 18, please provide examples of “output processing equipment”.

GE Response

Output processing equipment includes electrical devices and circuitry such as, signal conversion equipment, i.e., Analog/Digital (A/D) and Digital/Analog (D/A) converters, local converters not part of the actuators; remote multiplexing units (RMUs), system logic units (SLUs), network interface modules (NIMs), which provide signals to plant equipment. See Tier 2, Figure 7.9-1 for a typical loop circuit.

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

NRC RAI 18.2-3

In NEDO-33217, 10/05, Section 3.1, 2) states that assumptions and constraints will be identified. However, since the control room design is already underway, it is the staff's expectation that the plan would identify known assumptions and constraints. Please identify the assumptions and constraints that apply to the ESBWR design.

GE Response

An assumption or constraint is an aspect of the design such as specific staffing plan or the use of specific Human System Interface (HSI) technology, that is an input to the HFE program rather than the result of HFE analysis and evaluations. Design assumptions and constraints are identified in Tier 2, Rev. 01, Section 18.1.4 "Control Room Standard Design Features."

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

NRC RAI 18.2-4

In NEDO-33217, 10/05, Section 3.2.1 describes the M-MIS team's responsibilities on page 24. Each of the responsibilities identified in the review criteria [2.4.2 (1)(a) through (e)] are specified in the plan with the exception of item (f), scheduling of activities and milestones. Please clarify how this responsibility is accomplished.

GE Response

The sequence of HFE activities in general terms is shown on Figure 1-2 "ESBWR M-MIS Implementation Plan Process Flow Chart" in NEDO-33217 and controlled by NEDO-33217 and other applicable HFE program plans. General Electric has the lead responsibility for the schedule of HFE project activities and milestones. The M-MIS and HFE Implementation Plan (NEDO-33217) will be updated to include item (f) from 2.4.2 (1), scheduling of activities and milestones, in the list of responsibilities for the M-MIS team during the next revision of this HFE document.

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

NRC RAI 18.2-5

In NEDO-33217, 10/05, Section 3.2.1 describes the M-MIS team's organizational placement and authority in general terms, consistent with that specified in the NUREG-0711 review criterion 2.4.2(2). Please provide details that illustrate how the team can achieve these responsibilities.

GE Response

The HFE Manager has responsibility for the implementation of the HFE M-MIS program and Plans and reports directly to the ESBWR Engineering Manager. The ESBWR Engineering Manager directs the ESBWR engineering design effort and the HFE activities within the ESBWR engineering design process. A number of directives from the ESBWR Engineering Manager are underway to assure the incorporation of HFE design activities into the design process. These include:

- A Baseline Review is underway to review the HFE efforts in the predecessor plant to determine what information and data is available and how this can be applied to the ESBWR design effort. A July 2006 report is expected.
- NP-2010 COL Demonstration Project- Project Management Manual (NEDE-33273) which establishes project work scope, inputs and outputs, and requirements (currently under modification), will list the M-MIS and HFE Implementation Plan as one of the base documents comprising core processes.
- The ESBWR engineering process has been adapted to incorporate the requirements and needs of the HFE program. A plan for the roll out of the process to the ESBWR design staff and responsible design organizations is underway and training is expected in June 2006.

The detailed objectives and approaches for each HFE area are described in HFE implementation plans. For example, NEDO-33276, Rev. 0, May 2006, "HFE Verification and Validation Implementation Plan" contains the program scope, process, procedures and project management, whereas, Table 1 "HFE V&V Team Composition" describes the minimum qualifications and expertise requirements. Description of personnel assignments, are defined in RAI 18.2-6 and -7 responses below.

NEDO-33226, Rev. 0 "Software Management Plan", submitted March 2006 and the associated subordinate plans also contain organization and responsibility details and how HFE/M-MIS is an integral part of the ESBWR design, software and hardware development process.

A skills matrix demonstrating how the team skills are deployed to match the needs of the HFE activities is provided in Attachment A.

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

NRC RAI 18.2-6

In NEDO-33217, 10/05, Section 1.3 states that GE's approach includes the execution of HFE plans up through the turn over to the COL applicant. In addition, section 3.2.1 further describes the team, indicating that an M-MIS team exists. The same section identifies areas of expertise included in the design team. This list is consistent with that provided in the Appendix of NUREG-0711. Please provide the specific qualifications of individuals comprising the team.

NRC RAI 18.2-7

In NEDO-33217, 10/05, section 3.2.1, please address the NUREG-0711 criterion 2.4.2(4) of team staffing.

GE Response to 18.2-6 & -7

A qualification cross-matrix has been developed which identifies the team members and their areas of expertise. See Attachment B. Additional details are on file and available for review.

Recently submitted NEDO-33276, Rev. 0, May 2006, "HFE Verification and Validation Implementation Plan" lists the specific qualification requirements in Table 1.

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

NRC RAI 18.2-8

In NEDO-33217, 10/05, Section 3.3.1, please identify the specific “reference ABWR plants” cited as a “design basis for the M-MIS implemented under this plan.

GE Response

The reference ABWR plant is the Lungmen project (Taiwan Power). Other ABWR plants in Japan include, Kashiwazaki-Kariwa 6 & 7 (TEPCO), Hamaoka 5 (Chubu Electric), and Shika 2 (Hokuriku Electric Power).

Lungmen has been selected as the baseline record plant because other ABWRs (Kashiwazaki-Kariwa Nuclear Power Station, K6 & K7 in Japan) used older analog technology to support the human system interface (HSI). Lungmen has digital control for many systems, good human factors documentation, and a design for flat screen interfaces for each system. The Lungmen HSI design has been set up on the full scope training simulator. Modification requests from the simulator testing are being documented in a simulator database. The changes requested will be reviewed and disposition by the ESBWR HFE team.

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

NRC RAI 18.2-9

In NEDO-33217, 10/05, the GE HFE Implementation Plan in Section 3.2.2(1), addresses general process procedures. While that item does address the process procedures identified in review criteria, no details are provided. Reference is made to information contained in the ESBWR Program Management Plan and the GEEN QA Plan. Please provide these documents to allow for completing the evaluation of this criterion.

GE Response

The GEEN QA Plan, NEDO-33181, Rev. 1, "NP-2010 COL Demonstration Project Quality Assurance Plan" was submitted in October 2005.

Details about the ESBWR Program Management Plan are contained in Tier 2, Rev. 01, Section 18.2.2(3). As stated in response to RAI 18.2-1, the ESBWR Program Management Plan and this plan, NEDO-33217, "M-MIS and HFE Implementation Plan" are one and the same.

This nomenclature will be updated at the next revision of each affected HFE document.

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

NRC RAI 18.2-10

In NEDO-33217, 10/05, the GE HFE Implementation Plan in Section 3.2.2(2) addresses general process management tools. The plan identifies these tools as the subject of later documents. Does GE plan to submit these documents for design certification?

GE Response

GE will provide summary reports as part of the design certification process as defined in the applicable ESBWR HFE Licensing Topical Reports and implementation plans. The process management tools and techniques referred to in these documents will utilize review forms and/or checklists to ensure HFE requirements have been correctly implemented and verified. These forms/checklists will not be submitted for design certification but the results will be included in the summary reports.

Any HFE discrepancies identified shall be added to the Human Factors Engineering Issues Tracking System (HFEITS) that will ensure the issue is reviewed, evaluated, and addressed through design, procedures or training. This tracking system will be utilized from the beginning of the design process through the installation, testing and turnover to the COL applicant. This ensures that all HFE issues identified during the design and validation process are traceable and available for review/ verification. Upon completion of the project, the HFEITS design data is turned over to the COL applicant to maintain the HFE program integrity for the life of the plant.

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

NRC RAI 18.2-11

In NEDO-33217, 10/05, the GE HFE Implementation Plan in Section 3.2.2(6) addresses subcontractor efforts. It specifies that each subcontractor includes the HFE requirements and that these requirements are verified in accordance with GEEN QA. However, the item does not specify what the HFE requirements are. Further, the GEEN QA will have to be reviewed to determine the verification procedure before the evaluation of this criterion can be completed. Please clarify and provide the applicable QA procedure for review.

GE Response

As stated in response to RAI 18.2-9, the GEEN QA Plan, NEDO-33181, Rev. 1, "NP-2010 COL Demonstration Project Quality Assurance Plan" was submitted in October 2005.

HFE requirements will be specified in subcontractor procurement documents. These will include any identified HFEITS issues for the equipment/location as identified by HFE implementation plans.

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

NRC RAI 18.2-12

The OER element of NUREG-0711 specifies that "The OER should provide information on the past performance of predecessor designs. It also notes that the "...OER can contribute to review and evaluation considerations as well as system design considerations." NUREG-0711 criterion 3.4.1(1) of OER describes the review of Predecessor/Related Plant Systems and states that, "The review should include information pertaining to the human factors issues related to predecessor plant..."

For the ESBWR there are three predecessor ABWR plants that have been operating for several years and three additional ABWR's are under construction. The overview of the OER implementation plan in Section 3.6 of the HFE Implementation Plan does not address operating experience for ABWR's beyond that for the M-MIS. Section 3.6 also does not address the conduct of personnel interviews to determine operating experience related to the ABWR predecessor plants or systems. This does not fully meet the intent of the OER element as described above. Also, Section 3.6 in discussing lessons learned from previous nuclear plant M-MIS designs refers to DCD Chapter 18E-1, which is not in the current DCD Chapter 18. Section 3.6 states that recognized industry HFE issues (e.g., NUREG/CR-4600) would be reviewed. This should be NUREG/CR-6400.

GE Response

It is the intent of the OER implementation plan to perform reviews of predecessor plant(s) or highly similar plants to identify HFE-related issues and plant personnel interviews if authorized/allowed. This would include, but not limit the review to, related HFE Technology used in the Man-Machine Interface System (M-MIS) elements for the ESBWR. The later paragraphs of section 3.6 of the M-MIS and HFE Implementation Plan further describe the various reviews of industry documents, reports, proceedings, etc., that will be performed to identify HFE issues.

GE has attempted to obtain OER information from the Japanese K6 & K7 plants for use on the Lungmen Project. The data and documentation obtained was top-level literature typically provided to the general public and consisted of a comparison between the K6/K7 and Lungmen, Main Control Rooms and Remote Shutdown Panels. GE also requested OER data from Technatom, S.A., the Lungmen HFE supplier headquartered in Spain. This OER reviewed three Spanish plants, two PWR's and one BWR. The only data and documentation obtained was for a new alarm prioritization program being installed in two of the three plants. GE will continue to review, implement or resolve any HFE issues from OER data collected during the design phase of the ESBWR project.

NRC RAI 18.2-12 (Cont)

The following corrections will be made at the next revision to NEDO-33217:

- 1) Reference to DCD Chapter 18E-1 will be removed, and
- 2) NUREG/CR-4600 will be corrected to NUREG/CR-6400.

Recently submitted NEDO-33262, "ESBWR Operational Experience Review (Human Factors) Implementation Plan" contains additional details and addresses the criterion specified in NUREG-0711R2.

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

NRC RAI 18.2-13

Procedure Development

An overview of the ESBWR System Procedural Development process is provided in Section 4.9 of the GE HFE Implementation Plan. This provides a brief summary of the Procedural Development process for the ESBWR and includes discussion of both hard copy and computerized procedures. A number of areas that should be included were not addressed in this section: discussion of generic technical guidelines for EOPs; inclusion of maintenance procedures within scope of procedure development program; use of a procedure writer's guide; use of symptom-based EOPs; a plan for procedure maintenance and control of procedure updates; and physical access by operators for the hard copy procedures.

GE Response

NEDO-33274, Rev. 1, June 2006, "ESBWR HFE Procedures Development Implementation Plan contains additional details on the procedures development process. Section 1.2.2; 3; 3.1.1; 3.1.2 and 4.6 discuss Emergency Operating Procedures (EOPs). Section 1.2.1; 3; 3.2; 4 and 4.3 discuss Surveillance Test Procedures (STPs), i.e., maintenance procedures. Section 1.1; 3 and 3.2 discuss use of procedure writer's guide. Section 3.2.3 discusses symptom-based EOP's.

Also NEDO-33276, Rev. 0, May 2006, "ESBWR HFE Verification and Validation Implementation Plan" is used to validate both the electronic and hard copy procedures in the baseline/full scope simulator to ensure ease of access and lay down area availability for hard copy procedures.

The plan for procedure control and updates is a COL responsibility, which is currently addressed in Tier 2 Section 5.4, Administrative Control for Procedures. Since we would like to complete the ITACC item for HFE procedures development following the HFE V&V, and the control and update of procedures follows this time frame, the maintenance (control and update) of procedures as addressed in Tier 2 Section 5.4, captures the scope of this effort.

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

NRC RAI 18.2-14

Design Implementation

Section 5 of the GE HFE Implementation Plan is titled Design Implementation Process, HFE Infrastructure (Hardware and Software). This contains much material that relates to the various software plans. However, it was not clear where the items in NUREG-0711 Section 12.4.6 Final Plant HFE Design Verification are addressed.

GE Response

Details for final plant HFE design verification are contained in recently submitted NEDO-33278, Rev. 1, June 2006, "ESBWR HFE Design Implementation Plan."

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

NRC RAI 18.2-15

The GE HFE Implementation Plan describes HFE requirements that will be utilized in Sections 2.2 and 2.3, a fairly expensive [sic] listing of the documents from the nuclear industry, including NRC documents is included. A footnote indicates that some of the documents have not yet been published. Please clarify which documents these are and indicate how they will be provided to the staff for review.

GE Response

IEEE Draft Standard 1574, “Best practices for Conducting Human Reliability Analysis” is the only draft reference and is currently under IEEE committee and USNRC review. Applicable portions of this document were extracted and incorporated into the plan methodology.

This draft standard will be removed from the Referenced document section, if not approved, by the next revision to NEDO-33217.

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

NRC RAI 18.2-16

Use of standard plant detailed design information - NEDO-33217,10/05, Section 3.4.1, indicates that the design will utilize the design of the ABWR reference plants, and the US standard plant design. Deviations from the reference M-MIS design will be made to accommodate a list of items including regulatory requirement updates since the HFE development of the ABWR reference plants. In the area of HFE and control room design, the ABWR design certification contained very little design detail. Please clarify the statements in Section 3.4.1.

GE Response

Although the NRC has little detail concerning the certification of the Lungmen design, the Taiwan Power Co. and the Taiwan government applied criteria from NUREG-0711 for the review to certify the plant design. This information will be apparent in the results of the Baseline Review Record (BRR), which will become an official project document.

The HFE design team will develop the BRR to provide information on previous ABWR designs for the ESBWR design engineers. Lungmen has been selected as the primary baseline record plant because other ABWRs (Kashiwazaki and Kariwa Nuclear Power Station, K6 & K7 in Japan) used older analog technology to support the human system interface. Lungmen has digital control for many systems, good human factors documentation, and presentation templates for flat screen interfaces for each system. In systems where a particular design has become an established standard through many BWR versions, documentation on elements of the design might use plant information other than Lungmen.

The design engineers will use the BRR as a starting point to change systems (e.g., eliminate the RCIC system and replace with Gravity Driven Core Cooling system), to update function allocations to automatic or manual, modify screen interfaces, etc. The HFE process evaluates the changes against the HFE check lists, customer requirements, and operational experience.

The following clarifications, numbered to their corresponding paragraphs in Section 3.4.1 are provided:

1. Regulatory updates, such as NUREG 0700 Rev 2, 2002; NUREG 0711 Rev 2, 2004; and NUREG 0800 Rev 1, 2004, which were issued after ABWR design certification and design of reference ABWR's.

NRC RAI 18.2-16 (Cont)

2. Differences in operational needs, human factors considerations, and industry standards, codes, and regulations that exist between reference ABWR's and the identified ESBWR Baseline Review Record (BRR), which may need to be reflected in design of the ESBWR M-MIS.
3. HFE analysis that is specific for ESBWR, such as allocation of function and task analysis, which may be different from ABWR reference plants, and which would need to be reflected in design of the ESBWR M-MIS.
4. Differences in DCIS vendor equipment designs and capabilities between vendors for ABWR reference plants, and ESBWR DCIS vendor equipment.

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

NRC RAI 18.2-17

Stage of completion - It was the staff's expectation that the M-MIS and HFE Engineering Implementation Plan would be complete. However, many aspects of the plan are written in a way that suggests the details will be completed at some future time. As such, a review of the HFE implementation plan cannot be completed. Please clarify how and when such details will be completed (e.g., Section 4.12.2.3, "Participants, Tests Subjects, and Observers," Section 4.12.2.5, "Test and Evaluation (T&E) Conditions.")

GE Response

The overall set of implementation plans is being developed in a top down manner. Rev 0 of this plan "M-MIS and HFE Implementation Plan" was developed prior to each of the individual implementation plans. The individual plans provide more detail about how the HFE activities address regulatory requirements and are incorporated into the design process. For example, NEDO-33276, Rev. 0, May 2006, "ESBWR HFE Verification and Validation Implementation Plan" and NEDO-33278, Rev. 1, June 2006, "ESBWR HFE Design Implementation Plan" provide details in those specific areas.

The M-MIS and HFE Implementation Plan, Sections 4.12.2.3 and 4.12.2.5 will be updated to reference NEDO-33276 at the next revision.

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

Attachment A

Skills Matrix for HFE Activities

Activity	Resource Technical Project Mgmt	System Engineer	Nuclear Engineer	C & I Engineer	Architect Engineer	Human Factors	Plant Operations	Computer System Engineer	Plant Procedure Developmt	Personnel Training	System Safety Engineer	Maintainability / Inspectability Engineer	Reliability / Availability Engineer	QA
Operating Experience Review	x		x			x	x							
System Functional Requirements Analysis	x	(1)				x								
Allocation of Function	x	(1)				x								
Task Analysis	x	(1)				x	x (5)		x					
Staffing and Qual	x					x	x			x				
Human Reliability Analysis	x					x	x						x (2)	
HSI Design	x			x	x	x	x	x			x	x	x	x
Procedure Development	x					x			x (3)					
Training Development	x					x				x (3)				
HF Verification & Validation	x	x		x	x	x	x	x	x (4)	x (4)	x	x		x
Design Implementation	x	x				x			(3)	(3)				x
HP Monitoring	x	x				x				x (4)				

x HFE Core Team

(1) Responsible System Engineers

(2) PRA Expertise

(3) COL Training/Procedure Support

(4) COL Simulator and Training/Procedure Support

(5) BWR Operations Support

