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Subject: **Response to NRC Request for Additional Information Letter No. 30 Related to ESBWR Design Certification Application – Human Factors Engineering - RAI Numbers 18.3-1 through 18.3-21**

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. 30.

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

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

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Enclosure:

1. MFN 06-192 - Response to NRC Request for Additional Information Letter No. 30 for the ESBWR Design Certification Application - NEDO-33262, "Operational Experience Review (Human Factors) Implementation Plan" - RAI Numbers 18.3-1 through 18.3-21

Reference:

1. MFN 06-165, Letter from U. S. Nuclear Regulatory Commission to Mr. David H. Hinds, *Request for Additional Information Letter No. 30 Related to ESBWR Design Certification Application,* June 1, 2006

cc: WD Beckner USNRC (w/o enclosures)
AE Cubbage USNRC (with enclosures)
LA Dudes USNRC (w/o enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRF 0000-0055-4830

ENCLOSURE 1

MFN 06-192

Response to NRC Request for Additional Information

Letter No. 30 for the ESBWR

Design Certification Application

NEDO-33262, "Operational Experience Review (Human Factors) Implementation Plan"

RAI Numbers 18.3-1 through 18.3-21

NRC RAI 18.3-1

Section 1.2, Scope, notes that an OER was performed as part of the first-of-a-kind engineering (FOAKE) effort for the ABWR and that results are documented in the ABWR system functional requirements analysis (SFRA) reports for each system. Older BWRs use Isolation (or Emergency) Condensers. Current BWR fleet experience with isolation condenser systems would not have been applicable to the ABWR, but their experience will be pertinent to ESBWR. Please clarify whether this area will be included in the ESBWR OER and that the ABWR SFRA reports will be provided as part of the OER results.

GE Response

Operational experience gained from previous BWRs with isolation condensers will be included in the ESBWR Operational Experience Review. As stated in Section 1.2, GE will identify applicable issues from the FOAKE OER effort as well as previous BWR/ ABWR design reviews. The ABWR SFRA reports for each system are available for review but will not be provided with the ESBWR OER results.

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

NRC RAI 18.3-2

Section 1.3, Definition of Terms. There are two different definitions for the term "Diagnosis." Please clarify.

GE Response

The second definition of "diagnosis: A cognitive ....." is not required. The ASME PRA Standard definition is correct as used in this plan. This will be deleted at the next revision to NEDO-33262.

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

NRC RAI 18.3-3

For the ESBWR there are three predecessor ABWR plants that have been operating for several years and three additional ABWRs are in design and construction stages. NEDO-33262 does not specifically address the important area operating experience for ABWRs. Please address.

GE Response

Execution of the OER implementation plan will perform reviews of ABWR predecessor plant(s) or highly similar plants to identify HFE-related issues through the evaluation of events and interviews of plant personnel, if authorized/allowed. This includes focused reviews of similar systems including the ABWR experience related technology used in the Man-Machine Interface System (MMIS) elements for the ESBWR. Other review sources, that would include ABWR operating experience, are described in Section 3.2 of the OER plan (e.g., reviews of industry documents, reports, proceedings, etc).

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

NRC RAI 18.3-4

Section 2.1, does not identify supporting documents for previously cited ABWR lessons-learned material. Please explain/include.

GE Response

ABWR OER/lessons learned material in question, are contained in the previously cited Reference 2.1.7 - GE ABWR First-Of-A-Kind-Engineering (FOAKE), Operational Experience/Lessons Learned Evaluation, 24156-1A10-6110-0001, Sept 1996.

In general, Section 2.1 provides references to documents for use in the development and application of NEDO-33262, OER Implementation Plan. The sources of OER information to be screened for HFE related issues are identified in Section 3.2.

Additional ABWR OER/lessons learned source documents are referenced in GE ABWR FOAKE Simulator Evaluation Report, 24156-1A41-4808, May 1996, Lungmen System Functional Requirements Analysis (SFRAs) and Supplier Change Requests (SCRs). These documents will be referenced in the next revision to NEDO-33262.

The OER Results Summary Report will include a list of source documents reviewed.

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

NRC RAI 18.3-5

Section 2.2, references IEEE-STD 1023 that was revised in 2004. Please cite most recent version.

GE Response

The correct revision date of 2004 for IEEE-STD 1023 will be added at next revision to NEDO-33262.

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

NRC RAI 18.3-6

Section 4.2, p. 21. Please explain what is meant by the sentence. "The functional and physical designs of these systems will be ***segmented*** *to inhibit the propagation of failures across major functions."*

GE Response

By segmented we mean "software will be modularized into discreet modules or tasks along with hardware design features" which will not allow failures to propagate across other software modules or hardware devices affecting major functions. As stated in the first paragraph of Section 4.2, "The MMIS will also be designed so that failures or problems in one function or device will not propagate into failures of other functions or devices." In addition, a physical separation will also be used between MMIS safety and non-safety systems for both hardware and software. This is specified in applicable Section 7 topics of the DCD and will be carried forward into the system design specifications, system design description documents and other applicable HFE design documents.

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

NRC RAI 18.3-7

Section 4.1. Please explain the derivation and definition of "mean time between MMIS equipment failures..." Explain if there is a design standard or precedent for the five-year value.

GE Response

There is no design standard or precedent for the five-year value as stated. In GE procurements, the hardware vendors are asked to provide an estimated Mean-Time-Between-Failure for their hardware components (systems). This permits the COL Holder to define replacement schedules for these components. For example, the replacement schedule might be, i.e., five/ten/fifteen years or so, depending on the estimated MTBF. Maintenance, routine testing and reliability programs ensure that these components provide high system availability during their lifetime.

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

NRC RAI 18.3-8

Appendix A of NEDO-33262. Example identification of Human Interactions from Event Experience Related to BWRs, provides a detailed example of an OER of current BWR plants related to shutdown operations. Please explain how this has been or will be applied to the ESBWR.

GE Response

The ESBWR design is an extension of the ABWR design that is an extension of the BWR design. Previous OER's were reviewed and actions were taken to minimize or eliminate identified human interaction deficiencies at BWR/ABWR plants. This philosophy will continue with the ESBWR design.

Appendix A links events that have occurred during shutdown conditions at nuclear power plants involving human interactions. This work was compiled in 1992-1993 from NRC reports, LERs, EPRI reports, PRA models and information from INPO provided by EPRI. The lessons learned and recommendations from this study along with other OER results will be reviewed by the ESBWR HFE design team and applicable items entered into the Human Factors Engineering Issues Tracking System (HFEITS) for resolution. This process will provide input into the ESBWR design, operator training and procedure improvements.

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

NRC RAI 18.3-9

Appendix A-1, page 26. The sentence that begins "These events are directly related to losses..." appears incomplete. Please clarify.

GE Response

The sentence should read as follows, "These events are directly related to losses of coolant inventory and could lead to boiling in the reactor core, no operator recovery actions were taken." This will be corrected at the next revision to NEDO-33262.

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

NRC RAI 18.3-10

Appendix A.3.2, page 31. Please explain references to INPO O&MR-272, 365, etc. Reference to these citations do not appear in the references section of the Appendix.

GE Response

Information and insights in the Appendix A INPO references O&MR-272 and -365 are redundant to NUREG 1410, and will be deleted from the Appendix A.3.2 reference listing during the next revision to NEDO-33262.

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

NRC RAI 18.3-11

In discussing lessons learned from a review of previous nuclear power plant MMIS designs, both Section 1.2, Scope, and Section 3, Methods for Review of Operating Experience, refer to Attachment 1 to DCD Chapter 18 Table 18E-1. However, the referenced attachment is not included in revision 1 of DCD Chapter 18. Appendix 18E has the following statement: This appendix is now replaced with the GEEN Report, NEDO-33217 provided under separate cover. Please clarify if NEDO-33217 includes Attachment 1 to DCD Chapter 18 Table 18E-1. If yes, please provide correct reference and update the OER plan.

GE Response

NEDO-33217 does not include Attachment 1 to DCD Chapter 18 Table 18E-1. NEDO-33217 only contains the headings for the eighteen topics discussed. See Appendix B, Attachment D, Section 5.1, A.1 through A.18. The Table in question, "Results of OER of Previous Nuclear Power Plant HSI Designs" is relevant and will be included in the ESBWR OER Results Summary Report.

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

NRC RAI 18.3-12

In several places, NEDO-33262 contains parenthetical references, such as: [TJ9] and [GWH10], that are not discussed or defined. Please clarify the purposes of these references.

GE Response

These are GE internal reviewer's initials. These notations (typos) will be removed at the next revision to NEDO-33262.

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

NRC RAI 18.3-13

There is not a clear commitment in NEDO-33262 to perform personnel interviews to obtain operating experience information nor is it clear who will actually be interviewed. NEDO-33262 also does not address personnel interviews to specifically determine the operating experience related to the ABWR plants or systems. Please provide this information.

GE Response

The HFE design team will interview plant operations and previous HFE team members and/or personnel from the ABWR Lungmen predecessor plant and previous BWR plants. The Lungmen plant is currently not operational and therefore has no operating experience. The HFE design team will interview operators that are involved with the full-scale simulator training for additional OER input.

A new Section 3.1.3 Personnel Interviews will be added to more clearly define the approach to personnel interviews at the next revision to NEDO-33262.

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

NRC RAI 18.3-14

NEDO-33262 discusses risk-important human actions briefly in Sections 4.3 and 5.1. Section 4.3 notes that the human factors engineering (HFE) issue tracking system (ITS) will capture support data for the risk-important human actions, but it is not clear how this will be done. Please elaborate.

Section 5.1 discusses events in the HFE tracking system, how they will be evaluated during the design process, and the development of a human action evaluation report. However, please clarify how and what information related to the risk important actions will be gathered during the OER.

GE Response

NEDO-33267, HFE HRA Implementation Plan describes how the risk-important actions are identified and used in the HFE process. The OER contribution to the HFE process is shown in Figure 2 of the OER plan. The HRA output list of potentially risk important human interactions will be an input to the OER task. Once the risk important Human Actions (HAs) are identified, any support data from the OER relevant to these HAs are communicated to Task Analysis, Human Reliability Analysis, Staffing & Qualifications. This is an on-going iterative process during the entire HFE design and implementation phase. No new information will be gathered as a result of the HA input information.

HFE issues, unresolved by standard documentation, are entered into HFEITS until closed by incorporation into the relevant design documents. This database/ report is turned over to the COL holder for continued use during the operational (lifetime) phase as part of the Human Performance Monitoring Implementation Plan, NEDO-33277.

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

NRC RAI 18.3-15

Section 5.1 "Events Tracking System," of NEDO-33262 states that, "Events in the tracking system will be compared with the probabilistic risk assessment (PRA)/human reliability analysis (HRA) for Risk-Important Human Actions that have been identified as different from the PRA analysis or where interpretation errors have occurred." Please clarify or explain this statement.

GE Response

The statement refers to a feedback check for the PRA and HRA analysis. The PRA and HRA analyses use various contexts, modeling techniques, assumptions, quality and quantity of data, etc., to define and quantify HAs. The PRA and HRA can be enhanced, by reviewing the issues entered into the HFEITS, to ensure they are also considered in the PRA and HRA modeling. For example, if there is a problem experienced by the operators in a previous similar design (as expressed through issues entered in HFEITS), it is expected that the corresponding PRA and HRA analyses would reflect the issue. If this is not the case, a review will probe the various contexts, modeling techniques, input assumptions, data, etc. as well as the validity of the HFEITS issue to reconcile the discrepancy.

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

NRC RAI 18.3-16

Section 3.3.2 of NEDO-33262 is titled "Classification." Please clarify what is being classified, the purpose of the classification, and the levels to be used in the classification scheme.

GE Response

The individual OER information file(s) will be screened and classified for the human factors aspects of operating experience, according to a scheme and/or framework to be developed (Section 1.2). The scheme will reflect the commonality between the combined issues from the various sources. The classification scheme will consider the critical tasks identified in NEDO-33221, the HRA risk informed decision making identified in NEDO-33267, and other HFE activities. The purpose of the classification is to place issues into categories that can facilitate their disposition. For example, there may be a number of specific responses relating to problems and suggestions for improvements assigned to the classification for nuisance alarming during emergency events.

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

NRC RAI 18.3-17

*Section 3.3.3 should clarify whether the OER analysis will identify enhancements for all aspects of human performance and not just the human-system interaction *(HSI), such as plant design, procedures and training.*

GE Response

NEDO-33262 will be updated at the next revision to state that the analysis will identify enhancements for all aspects of human performance, including, Human System Interface (HSI) design, procedures, personnel training and control room staffing and qualifications.

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

NRC RAI 18.3-18

Section 5.3, "Summary of Results," of NEDO-33262 states the following "Reports that summarize the various report documenting the analysis of operating experience in the tracking system, which identifies the human performance issues, problems and sources of human error, will describe the design elements that support and enhance human performance." The meaning of this sentence is not clear. Please clarify.

GE Response

Section 5.3, "Summary of Results" will be changed as follows: "A complete results summary report will be issued, summarizing the results of the operating experience reviews that identify human performance issues, and the HFE solutions that support human performance improvements. The report will be broken down into the three areas of review:

a) Review of MMIS equipment/technologies,
b) Review of nuclear and other industry summary documents, and
c) Personnel interviews.

The report will summarize for each issue:

a) A statement of the issue,
b) Issue source
c) Potential human performance impact,
d) Classification,
e) Priority, and
f) Human performance improvements.

This change will be reflected in the next revision to NEDO-33262.

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

NRC RAI 18.3-19

Section 5.3, "Summary of Results," seems to limit the OER Summary Report to describing what is in the HFE Issue Tracking System. The report should be broader in that it describes the OER that was performed and the results of this review. For example, a few items noted in the text of the NEDO that would be appropriate to include are:

1. *"A Review of this FOAKE OER will be used to identify those OER issues already incorporated through the experience of previous BWR and ABWR designs, and those issues, which need additional attention."*
2. *"...OER information to help allocate human factor issues to manual, shared or automated for those cases that have been illuminated by past events."*
3. *"...recognized industry HFE issues such as those documented in NEDO-0933 and NUREG/CR-4600 will be addressed."*
4. *"Bulleted items in Section 1.2, Scope.*

Provide a commitment to a complete summary report.

GE Response

See response to RAI 18.3-18 above.

NRC RAI 18.3-20

Throughout NEDO-33262, various issues that will be input into the HFE ITS are mentioned. However, there does not appear to be any one place that specifically defines what the criteria will be used to decide what will go into the ITS. This should be clearly stated, for example in Section 3.3.3, please provide this information.

GE Response

The criteria for what issues will go into HFEITS should be addressed in NEDO 33217, M-MIS and HFE Implementation Plan. Currently Section 4.2 of NEDO 33217 directs that the HFE team will prepare a procedure for the administration of the HFE Issue Tracking System. The items listed to be addressed by the procedure, do not include the criteria to decide what will go into the tracking system.

The HFE design team will develop the criteria for what issues will go into HFEITS along with the other items to be addressed in the administrative procedure.

Changes will be made to the administrative procedure, Section 4.2 of NEDO-33217 to add the criteria for establishing issues in HFEITS. NEDO-33262 will be revised to reference the administrative procedure at the next revision.

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

NRC RAI 18.3-21

DCD Chapter 18 currently does not address the full scope of an OER as explained in NEDO-33262 and in NUREG-0711. Chapter 18 should be modified to agree with NEDO-33262 and to address changes that may be made in response to the other OER RAIs.

GE Response

Tier 2, Section 18.3 will be modified (revised) accordingly to agree with NEDO-33262 (next revision).