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**Subject: Response to Portion of NRC Request for Additional Information
Letter No. 129, Related to ESBWR Design Certification Application
– Human Factors Engineering - RAI Numbers 18.9-1 S02, 18.9-6
S02, and 18.9-8 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 (RAI) Requests for Additional Information (RAI) NRC letter 129, dated December 19, 2007 (Reference 1).

RAIs 18.9-1 S02 and 18.9-6 S02 were requested by Reference 1, and were previously responded to in Reference 2 as requested in Reference 3. Reference 2 provided the first supplemental response. Note that Reference 2 was requested in Reference 4. Reference 5 provided our original response to the NRC's original request (Reference 3).

RAI 18.9-8 S01 was requested by Reference 1 and was previously responded to in Reference 5 as requested in Reference 3.

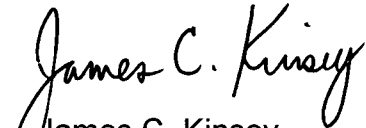
Enclosure 1 contains GEH's response to RAIs 18.9-1 S02, 18.9-6 S02, and 18.9-8 S01.

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Also note that these RAI responses correspond to and answer several open items listed in Reference 6. Please consider these open items to be addressed by this letter.

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

Sincerely,



James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

References:

1. MFN 07-701 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 129 Related To ESBWR Design Certification Application*, dated December 19, 2007
2. MFN 07-334 - Submittal of "ESBWR DCD Chapter 18, Human Factors Engineering - RAI to DCD Roadmap Document", dated June 27, 2007
3. MFN 06-386, *Request for Additional Information Letter No.74 Related to ESBWR Design Certification Application*, dated October 11, 2006
4. Email from AE Cabbage to DL Lewis, *List of Chapter 18 RAIs for Roadmap Request*, dated May 18, 2007
5. MFN 06-444, *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 18.9-1 through 18.9-10*, dated November 18, 2006
6. 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 08-155 -Response to Portion of NRC Request for Additional Information Letter No. 129 Related to ESBWR Design Certification Application - Human Factors Engineering - RAI Numbers 18.9-1 S02, 18.9-6 S02, and 18.9-8 S01

Attachment:

1. MFN 08-155 – Attachment - Markups and Added Text for RAI 18.9-8 S01

cc: AE Cabbage USNRC (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
eDRF 0000-0081-2527

Enclosure 1

MFN 08-155

**Response to Portion of NRC Request for Additional
Information Letter No. 129 Related to ESBWR Design**

Certification Application

Human Factors Engineering

RAI Numbers

18.9-1 S02, 18.9-6 S02 and 18.9-8 S01

For historical purposes, the original text of RAIs 18.9-1, 18.9-6, and 18.9-8 and their supplements and the GEH responses are included, except for any attachments or DCD mark-ups.

NRC RAI 18.9-1

- A. *Ch. 18, App. A, of DCD states that the ESBWR emergency procedure guidelines (EPG)/severe accident guidelines (SAG) were derived from Rev. 2 of the BWROG Emergency Procedure and Severe Accident Guidelines. Section 3.1.1 of NEDO-33274 states that ESBWR adapted EOPs from previous ABWR designs. Section 3.3 also mentions adapted procedures from "previous ABWR procedures." Also, the use of the Rev. 2 of the BWROG EPGs to develop the first version of the ESBWR EPGs is not shown in Figure 2 of NEDO-33274 nor is it discussed in the text of NEDO-33274. Please clarify.*
- B. *Section 3.1.1 of NEDO-33274 states that the "...ESBWR EOPs are the result of applying ...OERs [Operational Experience Review] to modify previous procedures..." Which OERs are referred to here? Are they available for NRC review?*
- C. *Section 3.1.2 states that "The EPGs, contained in Appendix 18A of the Chapter 18 of the DCD, provide a basis for human factors evaluations of emergency operations." However, Figure 2 shows the HFE evaluations on the right side of the Figure as being applied to the EOPs rather than the EPGs. Please clarify.*
- D. *The last two sentences of Section 3.1.2 mention EOPs and procedures. It appears that it should be EPGs. Please, clarify.*
- E. *Section 3.2.1.6 states that "... emergency procedures displays are continuously updated." Please clarify "continuously".*
- F. *Section 3.3.3 discusses an error tracking system, but it is not clear if this system is to be used or not, or how the decision will be made as to its use. Please clarify.*
- G. *Section 4.4 discusses alarm response procedures for dedicated fixed-position alarm tiles. Since the HSI Design Plan, NEDO-33268, notes that only selected important alarms are fixed-position on the Wide Display Panel (WDP). Please clarify whether all alarms will have ARPs or just the subset that are fixed position.*
- H. *Figure 1 of NEDO-33274 has a block labeled "Emergency Procedure and Response Guidelines" but the term "Response Guidelines" has not been used in the text. Also, the phrase "All HSIs conform to HFE Guidelines" is under both "HSI Task Support Verification" and "HFE Design Verification" of Figure 1, and HFE guidelines are typically not relevant to task support verification. Also, Procedure Development is apparently missing from Figure 1. And, the input of PRA/HRA and Task Analysis to procedures is not shown. Please clarify Figure 1.*

GEH Response

- A. The DCD Tier 2, Chapter 18, Appendix A, EPGs/SAGs were derived from the BWROG EPGs/SAGs Rev. 2. The DCD Chapter 18, Appendix B, documents the differences between the generic ESBWR EPG/SAGs and the BWROG EPGs/SAGs Rev. 2. NEDO-33274 Figure 2 will be updated to reflect that the BWROG EPG/SAG Rev. 2 is an input in the HFE *Program* during HSI procedure design and text will be added in the NEDO description regarding EPG/SAG Rev. 2 use in the Procedure Development Implementation Plan.

Also, the second sentence of section 3.1.1 of NEDO-33274, where it states, “As described in Chapter 18 of the DCD, the ESBWR procedure development process adapted EOPs from previous ABWR designs” will be deleted. In addition, section 3.3, first paragraph, 4th sentence of NEDO-33274 will be revised to read, “They are adapted to the ESBWR using engineering evaluation and analysis to support the adequacy of each ESBWR deviation from previous BWR and ABWR procedures”.

- B. The initial ESBWR EPGs in DCD Tier 2 Chapter 18 were developed based on previous experience on BWR, ABWR Plant Specific EPGs as well as the BWR Owner’s Group EPGs. Operational Experience Reviews (OERs) of previous BWR and ABWR EPGs and Emergency Procedures are based on potential ESBWR customers in-use plant procedure transmittals and use of a GE sub-contracted emergency procedure designer that has designed or assisted in the design of various BWR product lines including using common EOP flow chart templates as a starting point, with refinements based on plant specific design features, licensed operator feed back, procedure validations, and NRC operator licensed exam results.

Additionally, potential ESBWR owners with existing units, will provide their operational experience with their own procedure designs. The ESBWR EOPs will be derived from the generic ESBWR EPGs with HFE inputs based on the HFE Procedures Development Implementation Plan. For clarification, in NEDO-33274 Rev. 0, section 3.1.1, the paragraph’s second and third sentences will be revised to read:

“As described in Chapter 18 of the DCD, the ESBWR procedure development process will adapt EOPs from previous BWR and ABWR designs. The initial ESBWR EOPs will be the result of applying the generic ESBWR EPGs considering the unique ESBWR design features and operational experience reviews (OERs) of previous BWR and ABWR emergency procedures, to modify the previous procedures as needed to address system and component differences from the BWR and ABWR.”

- C. The Emergency Procedure Guidelines (EPGs) evolve into Emergency Operating Procedures (EOPs), procedures that are used by the plant operations personnel. It is correct that the right side of Figure 2 should show the EOPs for the HFE evaluations.
- D. In this case, the usage should refer to EPGs as the EPGs are compared to the BWROG EPGs. The Task Analysis is for EPGs as the EPGs direct tasks that are performed in the plant Emergency Operating Procedures and support procedures.
- E. Section 3.2.1.6 paraphrases the Utility Requirements Document, Chapter 10, Instrumentation, Control, and Man Machine Interface System, section 3.4.2.2.2 where it states that the power plant parameters and status presented as part of the procedure displays shall be continuously updated, in regards to practices for electronically displayed procedures. At this stage of the ESBWR design, the Emergency Procedures displays may be flow chart or logic format and the plant parameters and statuses presented are used either directly or in support of the plant Emergency Procedures, such as dynamic limit curves, which display the safe and unsafe zone of plant operation, and the plant trends in those zones.
- F. The error tracking system will exist and will be the HFE Issue Tracking System. Section 3.3.3 third paragraph, last sentence, is referring to an example tracking system, regarding simulator tests of an early BWR tracking system as discussed in the second sentence of the same paragraph.
- G. The dedicated fixed-position alarms tiles are associated with system level annunciator alarms. The alarm response procedures will address all system level annunciator alarms.
- H. The text, "Emergency Procedure and Response Guidelines" is associated with the same text used in NUREG 0711 Rev. 2, Figure 7.1. The text box of Figure 1 of NEDO-33274 will be revised to read, "Emergency Procedure Guidelines" as there is no discussion of Emergency Response Guidelines in the document. In Figure 1 of NEDO-33274, remove the text "All HSI conform to HFE Guidelines" under header HSI Task Support Verification column will be removed. In Figure 1 of NEDO-33274, the figure will be revised to add the text, "Procedure Development" in the appropriate location as well as revise the figure to show PRA/HRA and Task Analysis as input to procedure development.

DCD/LTR Impact

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

LTR NEDO-33274 Rev. 0 will be revised as described above.

NRC RAI 18.9-1 Supplement 1

Items C & D: responses are acceptable, but NEDO-33274, Section 3.1.2 should be updated to reflect response.

Item F: response is acceptable, but NEDO-33274, Section 3.3.3 should be updated to reflect response.

Item E did not answer what "continuously" means in Section 3.2.1.6. It apparently refers to an update rate, but the actual rate is not given. Please provide. Or if not yet available, discuss how it will be determined and verified to be acceptable for operator performance.

Item G: Response is unacceptable. Section 4.4.4 should indicate that all control room alarms will have ARPs and not just the system level alarms.

GEH Response

Chapter 18 Roadmap Document

RAI NO	SEC	#	NRC Supplemental	DocName/Q uestion	Resolved	Plan	Section	Resolution Description
18.9-1	9	1	Y	Clarification of Procedure Development Plan	From GE response	33274	3.1.3 3.1.5(2) 4.1.2(4) Fig 2 3.1.3 it 6 4.1.4.4 Fig 1	RAI 18.9-1a RAI 18.9-1b Changed to reflect both BWR and ABWR EOP procedures and OE input into ESBWR EOPs RAI 19.9-1c RAI 19.9-1d RAI 19.9-1e Clarified that the specifics of 'continuously updated' would be defined by the Operational Analysis and HSI Design portions of the HFE process. RAI 18.9-1g RAI 18.9-1h Added Procedure development with inputs from system engineer, HRA/PRA, and task analysis. Removed HFE guideline statement from HSI task verification header
18.9-1	9	1a	N	LTR NEDO-33274	From GE response	33274	3.1.3 3.1.5(2) 4.1.2(4) Fig 2	3.1.1 deleted, 3.3 para 1 deleted. Added analysis of ESBWR EOP deviations from those of previous BWRs and ABWR RAI 18.9.1a Added EPG/SAG Rev 2 as an input to the HFE program during HSI procedure development

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
18.9-1	9	1b	N	LTR NEDO-33274	From GE response	33274	3.1.3	Incorporated analysis of differences in content between the ESBWR and generic BWROG guidance
18.9-1	9	1c	Y	LTR NEDO-33274	From GE response	33274	4.1.2(4)	Process for adapting EPGs described
18.9-1	9	1d	Y	LTR NEDO-33274	From GE response	33274	4.1.2(4)	Process for adapting EPGs described
18.9-1	9	1e	Y	LTR NEDO-33274	From GE response	33274	3.1.3(6)	Term continuously updated is qualified to how it is determined
18.9-1	9	1f	Y	LTR NEDO-33274	From GE response	33274	4.1.3.4	Section revised to clarify an EOP place-keeping system and the reference to HFEITS is not present to remove confusion
18.9-1	9	1g	Y	LTR NEDO-33274	From GE response	33274	4.1.4.4	Clarified that ARPs will be developed for all control room annunciators

NRC RAI 18.9-1 Supplement 2

GEH's response to part A of this RAI is outdated in that it refers to DCD Chapter 18, Appendix A and B that are now deleted. Revision 2 of NEDO-33274 is still not clear on the development and use of ESBWR-specific EPGs and their submittal to NRC. Please provide more detail on the development process for the ESBWR-specific EPGs, and a schedule for their completion. If not planned for design certification, provide a justification as to why the EPGs are not required for design certification.

GE Response

Revision 2 of NEDO-33274 provides a high level presentation of how ESBWR EPGs and SAMGs are to be generated. The NEDO commits to deriving ESBWR EPGs/SAGs from BWROG EPG/SAG, Rev 2. Additionally, the NEDO commits to implementing the HFE top-down operational analysis process contained in NUREG-0711, Rev 2 to develop the ESBWR EPGs/SAGs and the EOPs and SAMGs developed from their requirements. Appendix A of NEDO-33274, Rev 2 provides amplifying detail regarding this process.

Using the processes described in NEDO-33274, Rev 2 and all the requirements and regulations noted in it, the following EOP development actions will be performed:

- ESBWR specific Appendix C calculations will be developed from the BWROG EPG/SAG, Rev 2 Appendix C adapted using ESBWR plant specific design input, analyses, instrument set points, vendor input, and other system data.
- ESBWR specific EPG/SAGs will be developed from the BWROG EPG/SAG, Rev 2 using the ESBWR specific Appendix C calculations, ESBWR plant specific Design input, PRA input, ESBWR philosophy of operation, and HFE operational analysis.
- ESBWR specific EOP writer's guide will be developed using EPG/SAG Rev 2 guidance, industry examples, HFE design team input, and ESBWR HSI design inputs. The ESBWR EOP writer's guide will provide details of the specific methods for translating and transcribing the ESBWR specific EPG/SAGs into EOPs and SAMGs.
- ESBWR EOP and SAMG flow charts and supporting emergency procedures will be generated using the ESBWR specific writer's guide, EPG/SAGs, and Appendix C calculations discussed above.

It is desired that the process used for their development be certified.

Because they are written using, and benefit from, the top-down design process outlined in NUREG-0711, Rev 2, the ESBWR specific EPG/SAGs and the EOPS and SAMGs developed from them will not be available for submittal to the NRC prior to design certification. The ESBWR HFE operational analysis process will be completed in three phases (design, detailed, and economic). The design analysis is currently in progress and analyzes the operation of the ESBWR and its systems with everything functioning as

designed. The detailed analysis phase takes place following the completion of design phase analysis and analyzes the operation of the ESBWR and its systems during alarm, abnormal, and emergency conditions. ESBWR EPGs will be developed during the detailed phase of operational analysis. ESBWR EPGs and the EOPs derived from them will be complete and available for NRC review.

Because ESBWR EPGs are integral to the development of ESBWR EOPs they will be complete and available for NRC review no later than the completion date for DCD Tier 1, Table 3.3-1 ITAAC 7a.

ITAAC item 7a will be delivered at least 3 months prior to initial operator training as required by NUREG-0800, Rev 1 – November 2005, section 13.5.2.1 Item I.C and Reg. Guide 1.206, June 2007, section C.I.13.5.2.1.

DCD Impact

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

No changes to LTR NEDO-33274 will be made in response to this RAI.

NRC RAI 18.9-6

- A. Section 3.3.3, ESBWR Incorporation of As-Built Procedures, states that identified issues are incorporated into procedures if risk important. While the use of risk insights is important and encouraged, it is not necessary nor does not appear appropriate here. Identified procedure enhancements should all be incorporated without a risk screening. Please explain the rationale for using risk screening to incorporate information into procedures.*
- B. Section 4 states that selected samples of normal plant operating and emergency procedures are validated using a talk/walk through. Please, clarify why only "samples" are validated using talk/walk through, i.e., how are the remaining procedures validated.*
- C. The Section 3 lead-in material states that HSI Task Support Verification applies to normal operating procedures and that HFE Design Verification applies to emergency procedures. Per NUREG-0711 both of these activities should apply to HSIs that are contained in both normal and emergency procedures. Also, does this statement refer to HSIs, computer-based procedures, or both?*

GE Response

- A. Section 3.3.3 of NEDO-33274, last paragraph, last sentence, pertains to issues from the operational training program and that if risk important issue are identified in the HFEITS, any proposed changes to the procedures or HSI are evaluated. However for clarity section 3.3.3 of NEDO-33274, last paragraph, last sentence will be revised to read, "Each issue undergoes the same type of analysis and if risk important or otherwise a procedure enhancement, proposed changes in the procedures or HSI will be evaluated and incorporated if appropriate."
- B. All normal operating procedures are to be validated. For clarity, section 4 of NEDO-33274, second paragraph, last sentence will be revised to read, "All normal plant operating and emergency procedures will be validated through simulator testing where applicable, or through talk/walk through."
- C. The premise of the HFE Procedures Development Plan was a top down approach starting first with the EPGs/EOPs, followed by the Normal Plant Operating Procedures. Section 3, fifth paragraph, numbered items 1, 2, and 3 are revised to have numbered items 1 and 2 reversed in order. The initial HFE Design Verification would be for the emergency procedures, followed by HSI Task Support Verification of normal plant operating procedures, then Integrated System Design Validation of all normal plant operating and emergency procedures.

DCD/LTR Impact

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

LTR NEDO-33274 Rev. 0 will be revised as described above.

NRC RAI 18.9-6 Supplement 1

Item C: The Section 3 lead-in material on p.18 of NEDO-33274 states that HSI Task Support Verification applies to normal operating procedures and that HFE Design Verification applies to emergency procedures. The RAI response provides a similar restriction in scope. Per NUREG 0711, Element 11, both of these activities should apply to HSIs that are contained in both normal and emergency procedures. The actual tests and verification would be selected using operational condition sampling of the V&V program. Please provide for verification of procedures per the regulatory guidance.

Also, it is not clear if this statement refers both HSIs and computer-based procedures. Please clarify.

GEH Response

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/ Question	Resolved	Plan	Section	Resolution Description
18.9-6	9	6	Y	V & V of procedures	From GE response	33274	4.1.3.5 4.1.3.3 4.1.4	Clarified that all appropriate procedure enhancements will be incorporated, not just those that are risk significant RAI 18.9-6a Clarified that all normal and emergency operating procedures will be validated. RAI 18.9-6b
	9	6	Y	V & V of procedures	From GE response			

NRC RAI 18.9-6 Supplement 2

Supplemental RAI for Part C of original RAI only.

In response to Item C, GEH provides a restriction in scope similar to NEDO-33274, Rev.0. Per NUREG-0711, Element 11, both the HSI Task Support Verification and the HFE Design Verification should apply to HSIs that are contained in both normal and emergency procedures. The actual tests and verification would be selected using operational condition sampling of the V&V program. In the Purpose section, NEDO-33274, Rev. 2, does include Task Support Verification, but it does not appear in the methodology portion. Revision 2 also specifies that procedures are developed using an appropriate writer's guide, however, there doesn't seem to be a selective design verification that would check or verify the application of HGFE principles into procedures when they are completed. Please provide for verification of procedures per the V&V guidance of NUREG-0711.

GEH Response

NUREG-0711 Rev 2, Element 11 provides guidance regarding human factors verification and validation. It presents four major activities: operational condition sampling, design verification, integrated system validation, and human engineering discrepancy resolution. NEDO-33274 Rev 2, ESBWR HFE Procedures Development Implementation Plan presents the process used to generate ESBWR procedures. While the document focuses primarily on the generation of procedures, it also presents supporting processes that either input to, or receive input from, procedures development. NEDO-33274 Rev 2 commits to Verification and Validation for normal, abnormal, and emergency procedures.

NEDO-33276 Rev 1 ESBWR HFE Verification and Validation Implementation Plan presents the process used to Verify & Validate (V&V) the results of the other HFE processes including: training, HSI design, and procedures. The processes presented in NEDO-33276 Rev 1 implement the V&V guidance and requirements contained in NUREG-0711 Rev 2, Element 11. NEDO-33276 presents five key elements of V&V in detail that accomplish the following objectives:

- Use of operational condition sampling to guide the selection of HSIs to review.
- Assure that HSI functions and components are based on HFE analyses by applying Human-System Interface (HSI) inventory and task support verification.
- Check that HFE requirements are met by performing HFE design verification.
- Confirm proper operability of humans and HSI using integrated system validation.
- Resolve identified HF issues by performing human factors issue resolution verification.

DCD/LTR Impact

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

No changes to the subject LTR will be made in response to this RAI.

NRC RAI 18.9-8

NEDO-33274 states in Section 4.6 that "Sufficient laydown space is provided for hard copies of EOPs, other procedures and other documents required by the operators during accident management and the performance of their regular duties. However, it is not clear if this applies to the main control room only or if it also applies to the remote shutdown facility and appropriate local control stations. Please clarify. Also, while the loss of CBPs is noted in Operational Conditional Sampling in the V & V Plan, in item 4.3.1.4.1.1.b, it should be addressed in the Procedure Development Plan.

GE Response

The main control room will have a lay down space for hard copies of EOPs and other procedures or documents required by the operators during accident management and the performance of their regular duties. The remote shutdown panel area and local control stations do not have dedicated lay down areas for plant procedures, but empty area room space is available for temporary procedure carts, work tables, or other devices for procedure use.

Section 4.3.1.4.1.1.b of NEDO-33276, HFE Validation and Verification Implementation Plan, HSI failures, lists loss of processing and/or display capabilities for computer-based procedures. The original intent was to have back-up hard copies of all plant procedures for such a scenario when the computer based procedures were not available. The use of hard-copy paper procedures is discussed in section 3.1 of NEDO-33274.

DCD/LTR Impact

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

No changes to the subject LTR will be made in response to this RAI.

NRC RAI 18.9-8 Supplement 1

NEDO-33274 states in Section 4.6 that "Sufficient laydown space is provided for hardcopies of EOPs, other procedures and other documents required by the operators during accident management and the performance of their regular duties." However, it is not clear if this applies to the main control room only or if it also applies to the remote shutdown facility and appropriate local control stations. Please clarify. Also, while the loss of CBPs is noted in Operational Conditional Sampling in the V&V Plan, in item 4.3.1.4.1.1.b, it should be addressed in the Procedure Development Plan.

GE Response: The main control room will have a lay down space for hard copies of EOPs and other procedures or documents required by the operators during accident management and the performance of their regular duties. The remote shutdown panel area and local control stations do not have dedicated lay down areas for plant procedures, but empty area room space is available for temporary procedure carts, work tables, or other devices for procedure use. Section 4.3.1.4.1.1.b of NEDO-33276, HFE Validation and Verification Implementation Plan, HSI failures, lists loss of processing and/or display capabilities for computer-based procedures. The original intent was to have back-up hard copies of all plant procedures for such a scenario when the computer based procedures were not available. The use of hard-copy paper procedures is discussed in Section 3.1 of NEDO-33274.

Partially acceptable. The aspects related to lay-down space are acceptable. Further clarification is needed on how loss of CBPs will be addressed procedurally and in NEDO-33274.

GEH Response

To ensure alignment with the requirements of DI&C-ISG-05 criterion 25 thru 30, NEDO-33274 Rev 2 ESBWR HFE Procedures Development Implementation Plan will be revised as follows:

- 1) Section 1 Overview will have the following added to the end of the final paragraph:

“Hard copy procedures are developed and maintained for use in the event that the CBP system is lost. CBP and hard copy procedures are developed and written in a coordinated manner to facilitate the smooth transition between the two presentation mediums.”
- 2) Section 1.2 Scope will have the following added to the third paragraph after the first sentence:

“Additionally, the verification and validation process assures the efficacy of hard copy backup procedures through their use and through transitioning between them and CBPs.”

- 3) Section 4.1.3.1 Writer’s Guides will have the following added to the first paragraph after the fourth sentence:

“Writer’s Guide requirements and guidelines will insure that CBP and hard copy procedures are developed and written in a coordinated manner to facilitate the smooth transition between the two presentation mediums.”

- 4) Section 4.1.3.2 Procedure Format will have the following added to the end of the final paragraph:

“CBP and hard copy procedures are developed and written in a coordinated manner to facilitate the smooth transition between the two presentation mediums.”

- 5) Section 4.1.3.3 Procedure V&V will have the following paragraph added between paragraphs 2 and 3:

“V&V testing and evaluations insure that both CBPs and hard copy procedures can be effectively performed as written. CBPs and hardcopy procedures for the same tasks are verified to be similarly written, presented, and performed. The philosophy and methods of transitioning between CBPs and hardcopy procedures that are built into the HSI are verified to support smooth transitions. This verification includes both planned transitions to and from CBPs and unplanned transitions from CBPs to hardcopy procedures due to CBP system degradation or failure.”

DCD/LTR Impact

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

LTR NEDO-33274, Rev 2 will be revised as noted in the attached markup (see Attachment).

MFN 08-155

Attachment

Markups and Added Text for

RAI

18.9-8 S01

In the ESBWR, opportunities for human factor improvements in the way procedures are used are enhanced through both the passive design and the use of digital computer systems. Digital control, computer, and monitoring systems have advanced capabilities for monitoring progress in implementing procedure steps based on the controlling cue for a procedure, equipment status, and monitored variables. For example, computers can call up procedures for routine testing based on an established schedule. Additionally, computers can present the procedures that operators need to use for checking plant conditions and taking recovery if specific variables exceed preset conditions. Such Computer-Based Procedures (CBPs) are carefully designed, verified, and installed to ensure that residual faults and design errors do not mask or prevent any required safety action. Hard copy procedures are developed and maintained for use in the event that the CBP system is lost. CBP and hard copy procedures are developed and written in a coordinated manner to facilitate the smooth transition between the two presentation mediums.

1.1 Purpose

The purpose of this plan is to provide the processes, methods, and criteria for generating procedures and verifying that the integrated plant procedures are consistent with accepted HFE practices and principles. The HFE design team ensures that human factor principles are incorporated into the development and updating of procedures using applicable requirements from NUREG-0800 Section 13.5 and NUREG-0711 Rev 2.

The procedure development process shows how the HFE design team uses the outputs from operational analysis and the HSI design to develop initial ESBWR procedures. These procedures are inputs to other steps in the overall HFE process (as shown in Figure 1) where enhancements are identified resulting in revisions to the procedures. Such improvements reduce the potential for human error and produce procedures that are compatible with the ESBWR Emergency Procedure Guidelines (EPGs), design, and the operating philosophy for the HSI.

At the end of the overall MMIS HFE implementation process, the design engineers and procedure writers provide approved procedures ready for verification. The MMIS implementation plan includes V&V steps that provide assurance that all functions and tasks assigned to be human actions or human backup are included in the integrated procedures. The MMIS implementation process also includes validation of the procedures using mockups, part-task simulators, and full-scope simulator facilities to simulate operations, transients, and accidents. The HFE design team provides evidence of the acceptable incorporation of HFE principles through sign off on the procedures.

1.2 Scope

The scope of this implementation plan is to describe the process for ESBWR plant operating procedure development stressing the interface with other HFE tasks. The procedures include normal, abnormal, and emergency operating procedures used by the control room operators to manage plant operation and safety.

Normal, abnormal, and emergency operating procedures that match the HSI design are provided to the COLOG at the end of the overall process. The MMIS design implementation includes steps that verify all functions and tasks assigned to human action or human backup (as a result of

operational analysis) are included in the normal, abnormal, or emergency operating procedures. This includes procedures used to accomplish normal operation, maintenance, radiation control, calibration, inspection and testing, and emergency actions performed at the operator interface in the Main Control Room (MCR), the Remote Shutdown Systems (RSSs), and risk significant Local Control Stations (LCSs). The MMIS implementation process also includes validation of plant procedures using mockups, walk throughs, part-task and full-scope simulator facilities.

Procedure development evaluation includes verification and validation covering a full range of risk significant plant operating modes, including startup, normal operations, abnormal operations, transient conditions, low power, and shutdown conditions. Additionally, the verification and validation process assures the efficacy of hard copy backup procedures through their use and through transitioning between them and CBPs. The HFE evaluation also addresses risk significant personnel tasks during periods of maintenance of plant systems and equipment including the HSI equipment. As the maintenance, radiation control, and calibration, inspection, and testing procedures become available, they are validated through mockups, walk throughs, part-task and full-scope simulator facilities.

The details of the scope are described as follows:

1. Procedure development process incorporates human tasks through the following:
 - Identification of procedure tasks from the areas of normal, abnormal, and emergency operations
 - Evaluation of procedures for a full range of plant operating modes, including startup, low-power, normal operations, shutdown, abnormal, transient, and emergency operating conditions
 - Inclusion of Human Actions (HAs) that have been found to affect plant risk by means of Human Reliability Analysis (HRA)/Probabilistic Risk Assessment (PRA) importance in the appropriate procedures
 - The generation of procedures that are linked to controls in the HSI
2. The procedure development process addresses issues such as the following:
 - Procedure content and layout adheres to recommendations in the procedure writer's guides
 - Procedures exist to address the safety related cues from the HSI
 - Parameter readings for variables named in procedures match the scales and units in the HSI (as presented at the MCR, RSSs, and risk significant LCSs)
 - System and component names in the procedure match the names in the HSI and plant (e.g., it is easy to select the correct procedure)
 - Procedures match assumptions used for HRA quantifications of the Human Error Probability (HEP)

The procedure development process receives inputs from the operational analysis process, which incorporates inputs from the HRA/PRA, Baseline Record Review (BRR), Operating Experience

processes. Once V&V is complete, the validated procedures are issued for use. ESBWR procedures continue to be revised over time as the HPM analysis process identifies enhancements necessary for safe operation of the plant. The procedures are also maintained and updated as the plant is modified.

4.1.3.1 Writer's Guides

Writer's guides are developed for all classes of procedures. Common writer's guides govern procedures of similar content and structure. Development of the guides starts with similar procedures from previous BWRs and ABWRs. These initial writer's guides are refined and updated by the HFE design team to ensure they address all the procedure development requirements for both paper and computer based procedures. Writer's Guide requirements and guidelines will insure that CBP and hard copy procedures are developed and written in a coordinated manner to facilitate the smooth transition between the two presentation mediums. The completed writer's guides approved by the HFE design team support a structured approach for developing and refining procedures that support the ESBWR design and operating philosophy.

The writer's guides establish the process for developing technical procedures that are complete, accurate, consistent, and easy to understand and follow. The writer's guides contain objective criteria so that procedures developed in accordance with it are consistent in organization, style, and content. The guides are used for all procedures within the scope of this element. The guides provide instructions for procedure content and format including the writing of action steps and the specification of acceptable acronym lists and terms for use in ESBWR procedures.

Some of the groups of procedures governed by the writer's guides described in this section include:

1. EOPs for addressing plant transients leading to safe shutdown
2. GPPs for normal operation (including startup, power, shutdown, and refueling operations) and SOPs for system level operations
3. AOPs to help operators restore abnormal plant variable indications to normal conditions
4. Calibration, inspection, and testing procedures verify equipment is operable and reliable
5. ARPs to help operators respond to alarms
6. Maintenance and modification procedures for performing preventative and corrective maintenance
7. Radiation control procedures for monitoring and release of solids, liquids, and gasses, access controls, area radiation monitoring, and the ALARA program

4.1.3.2 Procedure Format

The basic content and format of both paper and computer based procedures used in the ESBWR are set forth by the applicable writer's guide and includes, but is not limited to the following:

1. Title and identifying information, such as number, revision, and date
2. Statement of applicability, purpose, and level of use
3. Precautions (including warnings, cautions, and notes)
4. Prerequisites
5. Limitations and actions
6. Important human actions
7. Acceptance criteria
8. Check off lists
9. Reference material

In addition to the requirements set forth above, the EOPs and SAMGs should be symptom-based with clearly specified entry conditions.

Formatting requirements relating to computer based procedures are specified in applicable writer's guides and include any automation, auditory cues, visual cues, supplemental information, screen presentations, plant equipment controls imbedded or linked to procedure steps, and feedback presentations. CBP and hard copy procedures are developed and written in a coordinated manner to facilitate the smooth transition between the two presentation mediums.

4.1.3.3 Procedure V&V

The purpose of the V&V process is to verify that the procedures are correct, meet HFE requirements, and can be carried out as stand alone procedures. Additionally, it is verified that they do not conflict with other procedures and processes that may be taking place in parallel with the tasks governed by the procedure being validated. All normal, abnormal, and emergency operating procedures are validated through simulator testing where applicable, or through talk/walk through. NUREG-0711, Rev 2 sets forth test objectives and testbed validation requirements that are discussed further in NEDO-33276 ESBWR HFE V&V implementation plan.

As shown in Figure 1, the V&V process supports HFE evaluation of the HSI design, all normal, abnormal, and emergency operating procedures and their CBP equivalents, and the output of the training plan. V&V is performed using a variety of means including part-task simulators, talk through evaluations, walk through evaluations using mock-ups, and full scope simulators. In addition to testing stand-alone procedures, a test process is developed to verify that the separate procedures have been converted into an integrated set of procedures. These procedures have a common language and the names of systems and components are consistent throughout the

procedure set. The test process includes dynamic simulation of startup, power operation, and shutdown. During power operation the ARPs and AOPs are simulated to verify that trained operators can respond properly.

V&V testing and evaluations insure that both CBPs and hard copy procedures can be effectively performed as written. CBPs and hardcopy procedures for the same tasks are verified to be similarly written, presented, and performed. The philosophy and methods of transitioning between CBPs and hardcopy procedures that are built into the HSI are verified to support smooth transitions. This verification includes both planned transitions to and from CBPs and unplanned transitions from CBPs to hardcopy procedures due to CBP system degradation or failure.

Any issues identified during the V&V process are provided as feedback to the originating process for resolution. Based upon the nature of the issue procedures, may be revised, HSI design is either modified to address the issue by changing the procedure interface content, display or software decision support, or the issue becomes an input to the training program so that operators are taught the conditions they need to consider in selecting a procedure path. The priority for modifying the procedure interface design in response to a human factor discrepancy is guided by an assessment of risk impact from the HRA/PRA interface.

If a V&V issue cannot be resolved using the iterative processes shown in Figures 1 & 2, then it is input into the HFEITS process for resolution.

Resolutions to procedure issues are developed using the same processes and writer's guides used in procedure development. The V&V process is again used to evaluate the revised procedure.

4.1.3.4 Computer-Based Procedures

The ESBWR plant design and operating philosophy support the use of CBPs. Unless the iterative operational analysis, HSI design, procedure development, training, and V&V processes shown in Figure 2 dictate otherwise, CBPs are the normal presentation medium for all plant procedures. Duplicate paper based procedures are created and used as back up in the event CBPs are not available. Both CBPs and paper-based procedures are created, revised, and validated using the same processes presented in this document.

If during the HFE process it is identified that the use of paper based procedures for a particular task or evolution improve procedure utilization or reduce operating crew errors related to procedure use, than the analysis is documented and paper based procedures are generated for the normal performance of the evolution. Analysis of plans and alternatives put in place in the event of loss of CBPs are performed and documented. Specific HSI requirements supporting CBP presentation are specified in the ESBWR style guide discussed in NEDO-33268 ESBWR Human System Interface Implementation plan while the CBP formatting and content requirements are specified in the appropriate writer's guide.

Computer based presentation of procedures produces a wide range of aids and enhancements. One example is the use of a tracking system while implementing EOPs. The objective of the EOP tracking system is to provide a listing of unresolved conditions to help the operators organize their back checks on the plant status, so as not to take any decision making control