October 11, 2006

Mr. David Hinds, Manager, ESBWR
General Electric Company
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 74 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Hinds:

By letter dated August 24, 2005, General Electric Company (GE) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter. This RAI concerns Chapters 9, 10, 11 and 18 of the ESBWR Design Control Document.

Chapter 9:	9.3-27 through 9.3-35
Chapter 10:	10.3-10, 10.4-10 through 10.4-11
Chapter 11:	11.1-4
Chapter 14:	14.3-85 through 14.3-91
Chapter 18:	18.9-1 through 18.9-10, 18.10-1 through 18.10-2, 18.11-1 through 18.11-33, 18.12-1 through 18.12-7, 18.13-1 through 18.13-5

To support the review schedule, you are requested to respond to this RAI by November 22, 2006.

If you have any questions or comments concerning this matter, you may contact me at (301) 415-207 or lnq@nrc.gov, or Amy Cubbage at (301) 415-42875 or aec@nrc.gov.

Sincerely,

/RA/

Lauren Quiñones, Project Manager
ESBWR/ABWR Projects Branch
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 52-010

Enclosure: As stated

cc: See next page

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ACCESSION NO. ML062830028

OFFICE	NRBA/PM	NRBA/BC
NAME	LQuinones	JColaccino
DATE	10/10/2006	10/11/2006

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Distribution for DCD RAI Letter No. 74 dated October 11, 2006

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Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD) Chapter 9

RAI Number	Reviewer	Question Summary	Full Text
9.3-27	Jones S	Provide drawings showing the layout of the EFDS.	DCD Section 3.4.1.3 states that protective features used to mitigate or eliminate the consequences of internal flooding include drainage systems. DCD Section 9.3.3.2 states that safety divisions are provided with a separate drain line connecting to the main drainage piping and leading to an appropriate sump in the Reactor Building and each drain line is provided with a normally open isolation valve, which is automatically closed to prevent flooding of multiple safety divisions due to backflow. DCD Section 9.3.3.1 states that radioactively contaminated or potentially contaminated liquids are collected by completely separate systems (e.g. no cross connections) from those that collect non-radioactive liquids. Provide drawings showing how the layout of the EFDS will incorporate these design features including connections to areas containing safety-related equipment and connections to noncontaminated drain systems.
9.3-28	Jones S	Describe how the administrative procedures to assure routine removal of debris that might plug floor drain openings will be tracked for incorporation by the COL applicant.	DCD Section 3.4.1.4 states that provisions for internal flood protection include administrative procedures to assure routine removal of debris, which might plug the floor drain openings. Describe how the administrative procedures to assure routine removal of debris that might plug floor drain openings will be tracked for incorporation by the COL applicant.

9.3-29	Jones S	Clarify the design classification of equipment and floor drain piping that performs an essential function in protecting safety-related equipment from flooding.	DCD Section 9.3.3.2 states that designated safety area drain line isolation valves are safety-related, but DCD Table 3.2-1 and DCD Tier 1 Section 2.16.4 indicate that only portions of the system that support the containment isolation function are safety-related. SRP 9.3.3, Rev. 2, 1981, Criterion III.2.b states that essential portions of the of the EFDS should be classified Quality Group C or higher and seismic Category I. Clarify the design classification of equipment and floor drain piping that performs an essential function in protecting safety-related equipment from flooding.
9.3-31	Jones S	Describe how the sizing and layout of the EFDS supports essential functions of draining liquids from areas containing safety-related equipment.	DCD Section 3.4.1.4.1 states that, for the control building, the main source of floodwater is from the fire protection standpipe hose stations (2 hoses discharging for one hour), and the analysis assumes the water propagates to the lowest floor of the control building by flowing, in part, through embedded drains. Other analyses also appear to credit drain flow in determining flood levels. Consistent with SRP 9.3.3, Rev. 2, 1981, Criterion III.4, describe how the sizing and layout of the EFDS supports essential functions of draining liquids from areas containing safety-related equipment at a rate such that water does not accumulate to the point safety-related equipment could be damaged.
9.3-32	Jones S	Identify all important-to-safety valves supplied by the station service air, instrument air, or high pressure nitrogen supply system that are modeled in the ESBWR PRA for any mode of operation.	Identify all important-to-safety valves supplied by the station service air, instrument air, or high pressure nitrogen supply system that are modeled in the ESBWR PRA for any mode of operation. Describe the valve position necessary to satisfy the success criteria in the PRA and whether this position corresponds to the position of the valve upon loss of pneumatic pressure. Address the importance of these non-safety related compressed gas supplies relative to the criteria for special regulatory treatment of non-safety systems.

9.3-33	Jones S	Provide diagrams of safety-related pressurized gas supplies.	DCD Section 9.3 states that the accumulators and valves associated with the main steam isolation, automatic depressurization, and isolation condenser isolation valves are part of the respective systems. However, the DCD sections describing those systems do not include drawings or detailed descriptions regarding the safety-related pressurized gas supplies for operation of those valves. Provide diagrams of safety-related pressurized gas supplies, including separation from the normal nonsafety-related supply of pressurized gas, to all safety-related valve operators, including the following valves: main steam isolation, automatic depressurization, and isolation condenser isolation valves.
9.3- 34	Jones S	Clarify the classification of valves, piping, and pressure vessels that provide the pneumatic pressure essential to operation of safety-related valves.	DCD Section 9.3 states that the accumulators and valves associated with the main steam isolation, automatic depressurization, and isolation condenser isolation valves are part of the respective systems. However, the DCD sections describing those systems do not include drawings or detailed descriptions regarding the safety-related pressurized gas supplies for operation of those valves. Clarify the classification of valves, piping, and pressure vessels that provide the pneumatic pressure essential to operation of the following safety-related valves: main steam isolation, automatic depressurization, and isolation condenser isolation valves.

9.3-35	Jones S	Describe how the piping, valves and pressure vessels that provide the essential pneumatic pressure for operation of safety-related valves are protected against dynamic effects associated with design basis accidents.	DCD Section 9.3 states that the accumulators and valves associated with the main steam isolation, automatic depressurization, and isolation condenser isolation valves are part of the respective systems. However, the DCD sections describing those systems do not include drawings or detailed descriptions regarding the safety-related pressurized gas supplies for operation of those valves. Describe how the piping, valves and pressure vessels that provide the essential pneumatic pressure for operation of safety-related valves are protected against dynamic effects associated with design basis accidents such that, concurrent with a postulated single active failure, the necessary number of safety-related valves actuate to the correct position.
14.3-90	Jones S	Provide appropriate ITAAC to verify the sizing and layout of the EFDS to perform essential functions.	DCD Tier 1 Section 2.16.4 states that, other than containment isolation, the EFDS does not perform any safety-related function, nor is it required to achieve or maintain safe shutdown of the plant. The proposed ITAAC in DCD Tier 1 Table 2.16.4-1 are consistent with this statement, and fail to address safety functions described in DCD Sections 3.4 and 9.3.3 related to draining of flood water and prevention of backflow into areas containing safety-related equipment. Provide appropriate ITAAC to verify the sizing and layout of the EFDS and the functionality of valves to perform these essential functions.
14.3-91	Jones S	Provide specific ITAAC regarding the capability of each safety-related portion of the compressed gas systems to perform its safety function.	DCD Tier 1, Table 2.4.1-1, Item 12, lists a test and the associated acceptance criteria for the capacity of the accumulators for the isolation condenser isolation valves. However, DCD Section 5.4.6 does not clearly describe the basis for the specified capacity, and DCD Tier 1, Table 2.1.2-2, does not include similar ITAAC regarding the design capability of of the compressed gas accumulators for the main steam isolation valves and the safety relief valves. Provide specific ITAAC regarding the capability of each safety-related portion of the compressed gas systems to perform its safety function and the design basis for the capability.

Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD) Chapter 10

RAI Number	Reviewer	Question Summary	Full Text
10.3-10	Hernandez J	Clarify conformance to topical report on MSIV leakage alternate leakage treatment	On March 3, 1999, the staff issued "Safety Evaluation on GE Topical Report, NED-3185P, Revision 2, "BWROG Report For Increasing MSIV Leakage and Elimination of Leakage Control Systems"," (ADAMS Accession No. ML010640286). The staff determined that in order to take credit for the alternate leakage treatment (ALT) pathway, the licensees or applicants referencing the topical report should provide assurance that valves required to open the ALT path to the condenser are provided with highly reliable power sources, so that an operator can establish the flow path assuming a single active failure. In addition, the staff requested that valves which are required to open the ALT path should be included in the plant in-service testing (IST) program. a. Demonstrate how the ESBWR design provides reliable power sources to ensure ALT flow paths can be established to process MSIV leakage through the drain lines or through the turbine bypass valves to the main condenser. b. Clarify whether these valves will be included in the COL applicant IST program.

RAI Number	Reviewer	Question Summary	Full Text
10.4-10	Hernandez J	Revise figure 10.4-3 to include connections from the cross-around and the main steam supply	DCD Tier 2, Revision 1, Section 10.4.2.2 states that during normal power operations, the steam jet air ejectors (SJAEs) are normally driven by cross-around steam, with the main steam supply on automatic standby. The main steam supply, however, is normally used during startup and low load operation, and auxiliary steam is available for normal use of the SJAEs during early startup, as an alternative to the main steam or if the mechanical vacuum pumps are unavailable. However, the connections from the cross-around and the main steam supply are not shown on DCD Tier 2, Figure 10.4-3. Revise DCD Tier 2, Figure 10.4-3 to include the location of these connections.
10.4-11	Hernandez J	Provide information that describes how the fail-safe attributes of the Class 1E position sensors preclude a failure of the RPS to function.	DCD Tier 2 Section 10.4.4 states: "The [Turbine Bypass System] TBS will not perform or support any safety-related function. There is no safety-related equipment in the vicinity of the TBS, except four Class 1E position sensors at each bypass valve that provide valve status to the RPS logic. These Class 1E bypass valve position sensors are fail safe such that they cannot prevent actuation of the reactor protection function. All high-energy lines of the TBS are located in the turbine building." Provide supporting information that describes how the fail-safe attributes of the Class 1E position sensors preclude a failure of the RPS to function. Provide specific information that describes how they meet GDC 4 by allowing a safety shutdown despite a failure of the turbine bypass system.

Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD) Chapter 11

RAI Number	Reviewer	Question Summary	Full Text
11.1-4	McGuire J	Clarify Section 11.1 description of coolant source term	DCD Section 11.1 describes ESBWR coolant source term. Comparing this information with ANS 18.1, most nuclides have been adjusted in a conservative manner with the exception of the noble gases and Zn-65. Please clarify if this is due to the power vs. steam flow for the noble gases and DZO (depleted zinc oxide) that adds for the Zn-65. Update the DCD to document clarification.

Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD) Chapter 14 and 18

RAI Number	Reviewer	Question Summary	Full Text
18.9-1	Bongarra J	Provide clarification of Procedure Development Plan	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."

RAI Number	Reviewer	Question Summary	Full Text
18.9-1 (cont.)			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.
18.9-2	Bongarra J	Clarify issues regarding SRP Section 13.5	A. DCD Chapter 13.5 and this plan discuss the scope of the procedure program for the ESBWR. Ch. 13.5 commits to ANS 3.2 (no revision provided). However, it does not commit to RG 1.33 (which endorses ANSI/ANS 3.2 but also provides additional guidance). The most current version of ANSI/ANS 3.2 is 1994 (Reaffirmed 1999). Please address. B. DCD Section 13.5.3.4 lists procedures to be covered by the Procedure Development Plan. These are all addressed in NEDO-33274 except for Radiation Control, Calibration, and Inspection procedures. Please address.
18.9-3	Bongarra J	Clarify scope of NEDO-33274	A. Section 1.2, Scope of NEDO-33274, in Item 1.a, appears to limit the scope of the plan to “..representative procedures for important tasks..” This plan should apply to all procedures within the categories described. Please, clarify.

RAI Number	Reviewer	Question Summary	Full Text
18.9-3 (cont.)			B. Section 4 of NEDO-33274," Integrated Operating Procedures Included in Scope of Plan" does not include maintenance procedures. Please add, or justify why they are not included. C. Section 4.2 "System Operating Procedures" applies SOPs to systems important to safety. This should be clarified to include those BWR systems in RG 1.33 plus analogous ESBWR systems. Please clarify.
18.9-4	Bongarra J	Clarify Writers Guide applicability to maintenance procedures.	Section 3.2 limits the use of the Procedure Writers Guide to Normal Operating Procedures and Emergency Procedures. According to the acceptance criterion of NUREG-0711, the Writers Guide should apply to all procedures within the scope of NEDO-33274, which would also include maintenance procedures. Please clarify whether the appropriate items in Section 3.2 and Section 4 also apply to maintenance procedures.
18.9-5	Bongarra J	Clarify references to Regulatory Guidance: NUREG-0700 and ANSI/ANS.	A. Section 1.2.2, Emergency procedures, discusses the content of ARPs, but does not include setpoints as an item to be included. This section should refer to all of the guidance in NUREG-0700, Rev. 2, Section 4.5, which includes setpoints. Please address. B. Section 3.2.1.7 states that procedures displayed in the HSI conform to industry and regulatory guidelines regarding HFE principles for computer displayed controls and procedures. This should refer specifically to NUREG-0700, Rev. 2 (plus errata), Section 8. Also, please specify which industry guidelines. C. The commitment to ANSI/ANS 3.2 should be clarified to apply to the latest version of ANS 3.2, which is currently 1994 (Reaffirmed 1999).

RAI Number	Reviewer	Question Summary	Full Text
18.9-6	Bongarra J	Clarify V & V of procedures	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?
18.9-7	Bongarra J	Clarify computer-based procedures	A. Section 3.1 states that the types of electronic procedures displays range from fully interactive to viewable pdf files. Other sections of the document and the DCD seem to imply that interactive CBPs will be used. Please clarify. B. Section 4.6 states that "Computer support for using the EOPs is considered during the design development." Also, Items 6 through 10 used the words "if adapted" for CBPs. DCD Tier 2, Revision 1, Section 18.9 seems to state that this decision has already been made to use CBPs for the EOPs. DCD Tier 2, Section 18.9 also provides six characteristics/requirements of the CBP system that is only qualified with the possibility of simulation revealing deficiencies and the possible need for a different implementation in some of these requirements. Please clarify.

RAI Number	Reviewer	Question Summary	Full Text
18.9-8	Bongarra J	Clarify availability of sufficient laydown space for hard copy procedures	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.
18.9-9	Bongarra J	Update minimum inventory discussion on section 3.2.2.	Section 3.2.2 of NEDO-33274 discusses the determination of the minimum inventory. The discussion in NEDO-33274 should be updated based on the response to RAI 18.7-7.
18.9-10	Bongarra J	Update SPDS locations discussion on section 3.2.3.	Section 3.2.3 of NEDO-33274 notes that SPDS will not necessarily be in the TSC and EOF. The discussion in NEDO-33274 should be updated based on the response to RAI 18.7-5.
14.3-85	Bongarra J	Update DCD Tier 1, ITAAC for Procedure Development	DCD, Tier 1, Table 3.3-1, Item 10.a. states "A Procedure.. Implementation Plan is developed which establishes that ..procedures are developed..." This plan has already been completed and is being reviewed as part of design certification of the ESBWR. Therefore 10.a does not belong in the ITAAC. Item 10.b relates to the implementation of the Procedure Development Plan and is appropriate, but should be modified to be similar, perhaps, to the HFE ITAAC used for AP 1000.
18.10-1	Bongarra J	Clarify scope of training program to be certified	Training requires significant input from the plant designer, yet is classified as an operational program under the ultimate responsibility of an ESBWR COL licensee. The areas in NEDO-33275, Section 3.4, that address the content of the training program appear to be primarily a COL holder's responsibility. Is GE proposing to certify these aspects of training as well? Please clarify which aspects of Training Program Development that GE is requesting be design certified.

RAI Number	Reviewer	Question Summary	Full Text
18.10-2	Bongarra J	Clarify a few aspects of the Plan NEDO-33275	A. NEDO-33275, Section 1.1, appears to limit the plan and training program to operators, while other parts, Section 3.1 and Table 1, are more appropriately complete. Please clarify. B. NEDO-33275, Section 2.2, Codes and Standards, list the 1976 version of ANS 3.2 but should refer to the current 1994 version (reaffirmed 1999). C. Reg Guide 1.149 on simulators is addressed in NEDO-33275, Section 3.2, but is not in the reference section 2.3. Please clarify these discrepancies.
14.3-86	Bongarra J	Update DCD Tier 1, ITAAC for Training Program Development	DCD Tier 1, ITAAC for Training Development, Table 3.3-1, Item 11.a. states "A Training Program Development Implementation Plan is developed which establishes..." This plan has already been completed and is being reviewed as part of design certification of the ESBWR. Therefore 11.a does not belong in the ITAAC. Item 11.b relates to the implementation of the training program itself. Since the training is an operational program, this ITAAC is not needed.
18.11-1	Bongarra J	Clarify V&V methodology	A. Relationship to GEEN EOPs - NEDO-33276, p. 7 indicates that the V&V plan is used to supplement the GEEN EOPs. Please clarify the parts of the GEEN EOPs that are supplemented by this document as they may be needed by the staff to complete its review. B. Safety critical LCSs - NEDO-33276, p. 8 indicates that the scope of the plan includes "LCSs that all critical to plant safety." Identify the criteria used to select the LCSs to be included. C. Applicable documents - NEDO-33276, pp. 10-13 lists documents that are applicable to the plan. Some of these documents are quite old and may not be suitable to support V&V activities of a modern, computer-based control room. Examples of such documents include the two EPRI documents and NUREG CR–4227. The guidance contained in these documents does not

RAI Number	Reviewer	Question Summary	Full Text
18.11-1 (cont.)			reflect current control and display technology. Please clarify how such documents will be used. D. Facilities included within the scope of V&V - the facilities identified as being addressed by the plan are not consistently identified throughout the document. For example, p. 7 states that the plan addresses the NCR, RSS, and LCS designs. On p. 9, the plan identifies the FB, rad waste building, TSC, and EOF as within the scope. On p. 14, indicates that the FB, Rad waste building, TSC, and EOF are included to the extent they directly involve actions critical plant safety. Please provide a clear and unambiguous statement as to the facilities addressed by this plan.
18.11-2	Bongarra J	Clarify the role of operational condition sampling sections	NEDO-33276, Sections 4.3.1 addresses implementation of operational conditions sampling. This section contains four subsections that do not seem to be related to this topic. They are: 4.3.1.5, Test and Evaluation Condition, 4.3.1.6. Acceptance Criteria, 4.3.1.7, Performance Measures, and 4.3.1.8, Data Collection and Analysis. Please clarify what role each of these topics plays in implementation of operational conditions sampling.
18.11-3	Bongarra J	Describe operational conditions sampling methodology	NEDO-33276, Sections 4.2.1 and 4.3.1.4.1 describes the sampling dimensions and indicates that a “multidimensional sampling strategy” (p. 18) will be used. Section 4.3.1.4.1, Items 1 through 3 largely restate the dimensions listed in NUREG-0711 (as presented in the sections below). While this is acceptable, the methodology or strategy that will be used to identify the sample of operational conditions that will reflect these dimensions is not identified. In the absence of such methodology, the staff has no basis to determine whether the sample characteristics described will be achieved. Please describe the method that will be used to the select the set of operational conditions along the sampling dimensions described in NEDO-33276.

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18.11-4	Bongarra J	Describe scenario identification methodology	NEDO-33276, Section 4.3.1.4.2 describes the identification of scenarios. The section restates the two criteria from NUREG-0711. While this is acceptable, the methodology that will be used to develop the scenarios is not identified. In the absence of such methodology, the staff has no basis to determine whether the scenarios developed will acceptably meet the criteria. Please describe the method that will be used to develop the scenarios reflect the scenario characteristics described in NEDO-33276.
18.11-5	Bongarra J	Clarify scope of task support verification	NEDO-33276, Section 4.2.2 indicates that task support verification will be applied to safety critical tasks identified by task analysis, PRA/HRA, and emergency operating procedure analysis. However, Section 4.3.2.1 identifies the scope of the task support verification as panel and layout drawings and computer-generated displays. However, the scope of this type of verification should be defined by the operational conditions and their associated tasks by HSI's. Please clarify the scope of task support verification and describe the criteria for identifying tasks as safety critical.
18.11-6	Bongarra J	Clarify the role of task support verification subsections	NEDO-33276, Sections 4.3.2 addresses Task Support Verification. This section contains four subsections that do not seem to be related to this topic. They are: 4.3.2.5, Test and Evaluation Condition ,and 4.3.1.7, Performance Measures. Please clarify what role each of these topics plays. Section 3.3.1.7 states "Performance measures associated with detailed HSI Task Support Verification are the performance requirements (e.g., from applicable hardware/software design specifications) and HFE design guidelines (e.g., Style Guide for Graphical User Interfaces." This statement is unclear. There are no real performance measures associated with task support verification and it is not clear what role HFE design guidelines play. Please clarify.

RAI Number	Reviewer	Question Summary	Full Text
18.11-7	Bongarra J	Clarify criteria to be used for task support verification	NEDO-33276, Section 4.3.2.4 discusses the methods and procedures for conducting task support verification. This section states "Task performance requirements (e.g., HSI Design Implementation Plan, Style Guide for Graphical User Interfaces, and Display Primitives Design Specification) are imposed on the various HSI hardware and software components. These requirements are included (directly or by reference) in hardware and software specifications (e.g., DCIS Hardware/Software Specification)." (p. 33) The documents listed as performance requirements seem to be HSI requirements rather than task driven-requirements. However, on the same page, the plan indicates that HSIs and their characteristics will be compared to the personnel task requirements identified in the task analyses. Please clarify the criteria to be used in task support verification.
18.11-8	Bongarra J	Clarify task support verification methodology	NEDO-33276, Section 4.3.2.4.1 describes the review of panel drawings as part of task support verification. The section states "HSI Task Support Verification of panel drawings is achieved through an iterative process of reviews by several groups and organizations." Please clarify what process these groups use to perform the verification. Also, why are there only sections for drawings and for computer generated displays? How are the other HSI's evaluated?
18.11-9	Bongarra J	Identify the HFE issue entry criteria for task support verification	NEDO-33276, Section 4.3.2.9 discusses the documentation of task support verification results. This section indicates that HED's will be logged into the HFEITS if it matches at least one of the HFE issue entry criteria. The section does not indicate what those criteria are, or specifically what information will be logged into the system. Please identify the HFE issue entry criteria and specifically what information will be logged into the system.

RAI Number	Reviewer	Question Summary	Full Text
18.11-10	Bongarra J	Clarify HFE design verification scope	NEDO-33276, Section 4.2.3 states that "HFE Design Verification verifies that each HSI component design meets personnel task requirements and operational considerations, and reflects HFE guidelines, standards, and principles reflected in the ESBWR style guide." Please explain why personnel task requirements are included in this verification when a separate HSI task support verification exists. Section 4.3.3.1 discusses the scope of an HFE design verification. The section notes that the HFE analyses are within the scope of HFE design verification. Please clarify what is meant by the statement. Methods for applying HFE design verification to HFE analyses is further described in Section 4.3.3.4.1. The description in this section, seems more appropriate to a QA process than to HFE design verification. Please clarify.
18.11-11	Bongarra J	Clarify HFE design verification objectives	NEDO-33276, Section 4 .3 .3 .2 discusses the objectives of an HFE design verification. The section notes that the objectives include that the HFE analyses meet QA requirements and that they are accomplished in accordance with the implementation plan requirements for the respective analyses. Please clarify the role that these two objectives play in HFE design verification. The listed objectives are followed by five numbered items. These items seem to be related to defining sample characteristics of operational conditions. Please clarify the role of this information.
18.11-12	Bongarra J	Clarify HFE Design verification test conditions -	NEDO-33276, Section 4.3.3.5 describes a number of testbeds including mockups, the general electric test system, the baseline simulator, and the full scope simulator. Yet the role of each in HFE design verification is not discussed. Please clarify.

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18.11-13	Bongarra J	Clarify HFE design verification methodology	NEDO-33276, Section 4.2.3 states "Designs are compared to HFE guidelines to determine whether they account for human characteristics and capabilities. Deviations from accepted HFE guidelines, standards, and principles are documented as HEDs for resolution/correction and acceptably justified on the basis of documented rationale such as trade study results, literature-based evaluations, demonstrated operational experience, tests and experiments." This definition is consistent with the staff's review guidance. Further, Section 4.3.3.6, Acceptance Criteria, states that HFE guidelines are the criteria for verifying the design. But the method described in Section 4.3.3.4 seems to discuss evaluations outside the scope of this definition. Specific concerns are identified below: A. NEDO-33276, Section 4.3.3.4.2 discusses HFE design verification for panel anthropometrics. This section indicates that measurements from a sample of COL holder personnel will be used. Collecting such measurements in such a way as to be representative of the user population is a tedious and expensive process. HFE design guidelines already provide information suitable for this process. Please clarify precisely how this evaluation is to be performed. B. NEDO-33276, Section 4.3.3.4.3 discusses design verification for operating procedures. However, the numbered items identified as what procedures are checked for do not involve HFE guidelines. C. NEDO-33276, Section 4.3.3.4.3 discusses HFE design verification of HSI components. This section starts off by saying these checks are that the components are built as specified. This would appear to more appropriately fall within the scope of final design verification, as it is defined in Section 4.2.6. D. NEDO-33276, Section 4.3.3.4.7 addresses workplace layout. The section states that "Final verification against HFE guidelines such as those in NUREG-0700 occurs at the site with the COL Holder." HFE design verification of workplace layout can be performed during the design stage, with detailed drawings and/or mockups. At such time, changes in the design to improve its human factors engineering are more likely to be made. Waiting until the control room is built on

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18.11-13 (cont.)			site hearkens back to the 1980s NUREG-0700 evaluations of the as built control rooms where the opportunity for improvements were limited. Please, explain the rationale for waiting until such a late date, to conduct this evaluation. Please clarify precisely what methodology and criteria will be used for HFE Design Verification.
18.11-14	Bongarra J	Identify the issue entry criteria for the HFE design verification	NEDO-33276, Section 4.3.3.9 discusses the documentation of HFE design verification results. This section indicates that HED's will be logged into the HFEITS if it matches at least one of the HFE issue entry criteria. The section does not indicate what those criteria are, or specifically what information will be logged into the system. Please identify the HFE issue entry criteria and specifically what information will be logged into the system.
18.11-15	Bongarra J	Provide details of validation and training	NEDO-33276, p. 8 indicates that "the validation supports training program development." Please provide more detail on how this will be done.
18.11-16	Bongarra J	Simulator availability time frame	Please indicate when the various simulator capabilities (GETS, BS, and the FSS) will be available relative to the overall schedule of the HFE activities.
18.11-17	Bongarra J	Clarify FSS conformance with ANSI/ANS-3.5	Please indicate whether the FSS will be ANSI/ANS-3.5 compatible.

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18.11-18	Bongarra J	Clarify the role of ESBWR procedures in the integrated system validation test program.	NEDO-33276, Section 4.3.4.4.1 states that "Validation is a progressive, cumulative activity. Applicable ESBWR specific procedures, if available, are used as necessary when simulating validation scenarios. Non-ESBWR specific procedures and/or the experience of test subjects and participants can also be used. Some Integrated System Validation can be conducted without operating procedures. For example, validation of display navigation and validation of HSI component layouts on consoles are not dependent on operating procedures and scenario simulations." For the purposes of integrated system validation. The staff considers it necessary to have ESBWR procedures. The main purpose of these tests is to show that acceptable performance is achieved when all important influences on human performance are integrated together. Procedures are an important aspect of the integrated system. While we do agree that validation in general is a progressive cumulative activity, the aspect of validation being addressed in this review is of an essentially completed design. Within the framework of the staff's evaluation, a validation of display navigation for HSI component layouts in the absence of procedures or the full integrated system are also important but considered HSI subsystem evaluations as part of the HSI design process. The notion that one can evaluate operational safety and task performance in a nuclear power plant environment without operating and emergency procedures is not consistent with the type of evaluation being addressed as part of integrated system validation. Please clarify the role of ESBWR procedures in the integrated system validation test program.
18.11-19	Bongarra J	Clarify which actions outside the control room should be included in validation scenarios	NEDO-33276, NEDO-33276 does not address how important actions at complex HSIs remote from the main control room will be addressed in validation. Specific operational conditions and scenarios to be used in validation have not yet been identified, it is not possible to know what important actions remote from the control room should be represented. Please provide information as to how it will be determined which actions outside the control room should be included in validation scenarios and how these actions will be modeled.

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18.11-20	Bongarra J	Explain how testbeds will be verified before validation tests	Please provide information as to how testbeds will be verified before validation tests are conducted.
18.11-21	Bongarra J	What types of personnel will participate in validation tests and how they will be sampled	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.
18.11-22	Bongarra J	Provide information on the scenarios to be used in validation	While NEDO-33276, Section 4.3.4.5 lists generic considerations for scenario development, NEDO-33276 does not address the specific scenarios to be used in validation or how they will be defined. Please provide information on the specific scenarios to be used in validation and how they will be defined.
18.11-23	Bongarra J	Provide descriptions on measurement characteristics	NEDO-33276 does not discuss the measurement characteristics, such as reliability and validity. For measures that are new or unique to the ESBWR V&V, please provide information on measurement characteristics that are relevant to that type of measure.

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18.11-24	Bongarra J	Clarify selection of performance measures	NEDO-33276, Section 4.3 .4 .4 does describe in varying levels of detail, the types of performance measures that will be used. These measures include some of the types of measures identified in the criterion. However, it is not clear that a full range of measures will be included. Please provide additional information on the performance measures to be used in validation. Specific questions are identified below: A. Plant/system level measures - measures of plant and system performance were not addressed. Please, justify. B. Operator task measures - NEDO-33276, p. 14 lists the performance measures used to determine the validity of the MCR, RSS, and LCS designs. Operator task performance is not included in the list, yet it is included in list of measures on page 45. However, while the term "task performance" is included in the title of Section 4.3.4.1, it does not address what measures will be taken and how they will be determined. Section 4.3.4.7.1 identifies a list of task related measures; however, the tasks for which these measures will be taken are not identified. Please identify the tasks that will be evaluated during integrated system validation. C. Situation awareness - Section 4.3.4.4.3 describes the evaluation of situation awareness. The section indicates that the Situation Awareness Control Room Inventory (SACRI) method will be used. However, in Section 4.3.4.7.3, the measurement of situation awareness is discussed. This section indicates that situation awareness is subjectively evaluated on the basis of correctness to test subject responses to questions asked during the test scenarios. Is this statement referring to SACRI method identified in the earlier section? The latter section also describes many other indications of situation awareness. How will all these methods be combined to assess overall situation awareness? If the SACRI method is used, additional details about its implementation should be provided. Please indicate how questions will be developed for each scenario

RAI Number	Reviewer	Question Summary	Full Text
18.11-24 (cont.)			used in the evaluation and what criteria will be used to judge whether or not, the level of situational awareness is acceptable? D. Operator workload - Section 4.3.4.4.4 discusses the assessment of operator workload. This section provides a cross reference to the task analysis implementation plan for a discussion of workload assessment methods. In Section 4.3.4.7.4 performance measures for workload are discussed. It indicates that workload will be assessed using a rating scale method and actual operator performance during test scenarios. The rating scale method identified is the NASA TLX. In addition, a list of activities to evaluate is provided. The list includes evaluating navigation, evaluating information gathering, evaluating plant conditions, alarm interaction, analyzing information needed to assess plant situation, and analyzing the memory demands to perform operational tasks. How will each of these be evaluated? And how will they be integrated, along with rating scale evaluations, to determine the acceptability of workload? E. Crew communication and coordination - Section 4.3.4.4.5 indicates that crew, communication and coordination will be subjectively evaluated on the basis of the crew's demonstrated performance during training exercises. Please explain why training exercises are being used for this evaluation and not integrated system validation trials? In Section 4.3.4.7.5, it states that crew communication and coordination are subjectively evaluated on the basis of how well crews exhibited a number of characteristics related to teamwork, such as effective leadership, well defined roles and responsibilities, teamwork, open dialogue, etc. Please indicate how the nine items listed in this section will be measured and how they will be evaluated?

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18.11-25	Bongarra J	provide additional information regarding NEDO-33276	Three additional areas of evaluation are discussed and performance measures are identified: automation, procedures, and displays. It is not clear that these represent three areas of performance measurement or three aspects of the design that will be evaluated. In either event, the following additional information is requested. A. Automation - NEDO-33276, Section 4.3.4.7.7 provides a list of performance measures for automation, such as operator cognition. Please indicate how these items will actually be measured. B. Procedures - NEDO-33276, Section 4.3.4.4.8 discusses the validation of operating procedures. The section indicates that the validation is completed during operator training phases. What training phases are being referred to in this statement? Section 4.3.4.7.8 on performance measures for operating procedures, states "refer to operate a performance measures regarding situation awareness." Please explain this statement. Based on the earlier discussion of situation awareness, the questions asked of operators appear to relate to awareness of plant status. How then can they be used to validate procedures? C. Displays - NEDO-33276, Section 4.3.4.7.9 states that there are no performance measures for graphical displays. Please explain.
18.11-26	Bongarra J	Provide specific criteria for the proposed measures discussed in Section 4.3.4.6.	Acceptance criteria for performance measures are discussed in NEDO-33276, Section 4.3.4.6. However, the statements contained in this section for each of the performance measures, do not provide actual criteria for acceptability. For example, Section 4.3.4.6.1 provides the following acceptance criteria for operational safety and task performance: "Acceptable human performance is based, in part, on success with the measures for operational safety and task performance." Such a statement would not provide clear criteria for determining the acceptability of observed task performance. And without clear performance criteria, how will HEDs be identified. Please provide specific criteria for the proposed measures and indicate which are to be used in deciding that the design is validated.

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18.11-27	Bongarra J	Provide descriptions of the methodology used for test design	NEDO-33276 does not provide detailed information on test design. Please provide descriptions of the methodology used for the following aspect of test design: • presentation of scenarios to crews • test procedures • training of test conductors • training of test participants • pilot studies.
18.11-28	Bongarra J	Clarify duplication of scenarios in Section 4.3.4 .4.1	NEDO-33276, Section 4.3.4 .4.1 states that "Operator crews are subjected to a set of test scenarios run on the simulator. The test scenarios have predefined initial conditions, applicable symptoms, and expected system responses and plant behavior. Each crew is subjected to a given scenario at least twice. Each crew is also subjected to the same set of scenarios for purposes of comparing crew performance under similar uses, and conditions, of the HSI." If a crew is subject to the same scenario twice, what will prevent it from simply being recognized. Once recognized, any data collected for the rest of the scenario may not be valid. Please, clarify.
18.11-29	Bongarra J	Describe detailed information on data analysis and interpretation	NEDO-33276 provides little detailed information on data analysis and interpretation. Please describe: • what methods will be used to analyze data and to assess performance criteria • how HEDs will be identified • how consistency across different measures will be evaluated • how data analysis will be verified for correctness

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18.11-30	Bongarra J	Describe the documentation of validation conclusions including the bases	NEDO-33276, Section 4.3.4.9 addresses documentation and integration of results. However this section does not address the evaluation of conclusions from integrated system validation. Please describe the documentation of validation conclusions including the bases for determining that the performance of the integrated system is acceptable and how potential limitations to the validation will be assessed.
18.11-31	Bongarra J	Clarify scope of issue resolution verification	NEDO-33276, Sections 4.2.5 and 4.3.5 discuss human factors issue resolution verification. However, this type of verification was identified in earlier versions of NUREG 0711 and referred to verifying that issues identified in the tracking system were resolved. While Section 4.2.5 seems to clearly indicate that this verification pertains to the HEDs identified throughout the V&V process, Section 4.3.5.1 identifies the scope as "The verification applies principally to significant issues in the HFEITS requiring resolution (i.e., those with potential for risk-significant human error and adverse impact on plant safety or performance)." The latter seems to be a broader scope that HED resolution. Please clarify the intended scope. An additional suggestion is to change the name of this activity to HED resolution in order to avoid any potential for confusion for COLs who may be familiar with the original issue resolution, verification process.
18.11-32	Bongarra J	Clarify HED resolution methodology	A methodology for the evaluation and resolution of HEDs identified as part of the V&V process is not fully described. NEDO-33276 states "Significance Category is a temporary field for potentially future HED compilation, ranking and screening purposes. It is a methodology to rank or prioritize new and unresolved issues in terms of their significance and potential impact on plant safety and performance. The intent is to facilitate evaluation and resolution of HEDs in a manner consistent with the guidelines of NUREG-0700 and NUREG 0711. The Significance Category methodology is depicted in Figure 3." Figure 3 provides an outline of a categorization methodology, but it does not stand alone. A. While the staff agrees on the importance of ranking and prioritizing HEDs, the method by which this valuation will take place should be described in order for

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18.11-32 (cont.)			the staff to determine whether or not, the methodology is consistent with the review criteria in NUREG 0711. B. Regarding Figure 3, what is the significance of an HED being classified into the different category levels, that is, what are the design implications of the various categories?
18.11-33	Bongarra J	Clarify statement on Section 18.11.1, item f	Please clarify the following statement (DCD Tier 2, Revision 1, Section 18.11.1, item f): "COL Holder's final plant HFE/HIS Design Verification completion is performed and documented as a basis to human performance monitoring."
14.3-87	Bongarra J	Update DCD Tier 1, ITAAC for HSI Design	The Tier 1 inspections, tests, analysis, and acceptance criteria (ITAAC) for V&V is in DCD Tier 1, Revision 1, Table 3.3-1, Item 12.a relates to developing a V&V plan, which has already been completed and is being reviewed as part of design certification of the ESBWR. Therefore, 12.a does not belong in the ITAAC. Item 12.b relates to the implementation of the V&V itself. This should be modified to be the implementation of the V&V Plan and should be constructed following the guidance on the Standard Review Plan (SRP) Section 14.3.
18.12-1	Bongarra J	Clarify aspects of the design not evaluated as part of validation	Use of plant specific training and procedures is identified as an HFE aspect that may not be evaluated in a simulated environment. Please explain why these aspects of the design will not be evaluated during V&V. This RAI is related to an RAI addressing procedures in the V&V section (RAI 18.11-18)
18.12-2	Bongarra J	What criteria will be used to determine that the as-built design is acceptable?	NEDO-33278, Section 4.3.2 provides acceptance criteria. These criteria address acceptance that the verification has been completed. What criteria will be used to determine that the as-built design is acceptable?

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18.12-3	Bongarra J	Clarify methodology for HSI as-build verification	The methodology to perform this verification is identified in NEDO-33278, Section 3.1 and 4.1. It is noted that following HFE V&V, the standard plant HSI Report is revised and becomes the basis for the requirements and acceptance criteria for the as-built design verification. The methodology described primarily addresses the review of procurement and construction documents, including engineering change documentation. An HED is written if that documentation is not consistent with the HSI report. While a document review is an important step to ensuring that the design will reflect the HSI report description, the focus of this verification is on the as built- design. Therefore, it is expected that the design itself would be verified, not just its documentation. Please provide clarification for how the as-built design can be verified based on a review of documentation alone.
18.12-4	Bongarra J	Clarify roles of the COL applicant and GE in the as-built design verification	NEDO-33278, Section 1.3 identifies the COL as the lead and manager of this effort. However, in Section 4.1.3, it appears that GE may be conducting these evaluations. Please clarify the roles of the COL and GE in this process.
18.12-5	Bongarra J	Clarify the relationship between the training program and the ESBWR Writer's Guide.	NEDO-33278, Section 3 .2 states that "The standard plant procedures and training documentation are established in development activities using the guidance in the ESBWR Writers Guide." Please clarify the relationship between the training program and the ESBWR Writer's Guide.

RAI Number	Reviewer	Question Summary	Full Text
18.12-6	Bongarra J	Update the Design Implementation Description in NEDO-33217 and applicable DCD sections to correct inconsistencies	Several requests for clarifications of NEDO-33217, Section 4.12 are made below: • The table of contents for Section 4 .12 does not agree with the section. • The description of issue resolution verification in Section 4.12.1 (this section title is missing from page 113 in NEDO-33217) is not consistent with NEDO-33278 and should be updated to reflect the implementation plan and any revisions may as a result of the review process. • The description of Final Plant HFE/HSI design verification in Section 4.12.2 is not consistent with NEDO-33278 and should be updated to reflect the implementation plan and any revisions may be needed as a result of the review process. These changes may be part of the overall NEDO-33217 and DCD update process to achieve better consistency between it and the more detailed implementation plans.
14.3-88	Bongarra J	Update DCD Tier 1, ITAAC for Design Implementation	The Tier 1 inspections, tests, analysis, and acceptance criteria (ITAAC) for Design Implementation as is in DCD Tier 1, Revision 1, Table 3.3-1, Item 13.a, relates to developing an implementation plan, which has already been completed and is being reviewed as part of design certification of the ESBWR. Therefore, 13.a does not belong in the ITAAC. Item 13.b relates to the implementation of the V&V itself. This should be modified to be the implementation of the V&V Plan and should be constructed following the guidance on the Standard Review Plan (SRP) Section 14.3.
18.13-1	Bongarra J	Clarify certain aspects of NEDO-33277 the Human Performance Monitoring (HPM) Plan	A. NEDO-33277, Section 3.1.1 discusses converting “single incidents into measures.” Are these incidents to be collected from the fleet of ESBWRs or just from one single plant? B. NEDO-33277, Section 3.1.2 mentions “precursor analysis.” When is this analysis method used?

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18.13-1 (cont.)			C. NEDO-33277, Section 3.1.2 also mentions the use of risk importance measures. How are these to be used in this context? D. Please clarify how the third paragraph of NEDO-33277, Section 3.1.2 relates to HPM. E. NEDO-33277, Section 3.3 states that the "HFE design team assumes that the COL holder HPM process includes the following essentials." These essentials should be stated as required items for the COL holder in the Plan. F. The HPM Plan uses both "Full Scope Simulator (FSS)" and "Baseline Specific Simulator" (BSS)." The BSS is not defined. Is this the same as the BS described in Section 4.3.3.5.3 of the V&V Implementation Plan (NEDO-33278)? Also, Section 3.3.2, of NEDO-33277, Operating Phase Requirements, states that strategy elements are implemented through use of the BSS. Is the BSS still used during the operating phase? Wouldn't all operator training be done using the FSS? G. Section 4.2 of the HPM Plan states that the activities and results of the HPM Plan will be summarized in a result summary report. When will that report be issued? Is it a periodic report?
18.13-2	Bongarra J	Clarify scope of HPM program.	The first bullet of Criterion 1 for the HPM element in NUREG-0711 states the performance monitoring strategy should provide reasonable assurance that the design can be effectively used by personnel, including within the control room and between the control room and local control stations and support centers. DCD Tier 2, Revision 1, Section 18.13.2, and the HPM Plan, address this item for the V&V portion of the design phase. However, they do not address it for the operational phase of the HPM program. Also, the Plan does not address human performance between the control room and the support centers at all. Please clarify.

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18.13-3	Bongarra J	Clarify process for identifying risk important changes.	NEDO-33277 mentions risk screening of operational events for importance in Sections 1.2.2 and 3.3. Also, Section 3.1.2 mentions precursor analysis, importance measures, and advanced risk and reliability techniques. However, it is not clear just what the process will be for monitoring and screening for risk important changes in human performance. Please clarify.
18.13-4	Bongarra J	Clarify monitoring of important human actions.	NEDO-33277, Section 3.3.1 of the plan mentions monitoring HAs commensurate with their safety importance during the pre-operational phase. However, the operational phase does not address this aspect of the HPM program. Please clarify.
18.13-5	Bongarra J	Clarify timeliness of HPM Program actions.	The operational phase of the HPM program is tied to the plant's periodic training program and the corrective action program, therefore certain aspects will be recurrent and timely. However, the description does not specifically address the timing of analyses and feedback of information to ensure that deviations in performance are identified and corrected in a routine and timely fashion. Clarify if this is not known now and is a COL responsibility to define.
14.3-89	Bongarra J	Update DCD Tier 1, ITAAC for HPM Implementation Plan	The Tier 1 inspections, tests, analysis, and acceptance criteria (ITAAC) for **human performance monitoring** in DCD Tier 1, Revision 1, Table 3.3-1, Item 14.a relates to developing an implementation plan, which has already been completed and is being reviewed as part of design certification of the ESBWR. Therefore, 14.a does not belong in the ITAAC. Item 14.b relates to the implementation of the monitoring program itself, which is a COL responsibility subsequent to plant startup. This ITAAC should be modified to be the establishment of the human performance monitoring program by the COL licensee and should follow the guidance of the Standard Review Plan (SRP) Section 14.3.

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