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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 113 Related to ESBWR Design Certification Application – Human Factors Engineering - RAI Numbers 18.5-5 S02, 18.5-19 S01, 18.5-26 S01, 18.5-27 S02, and 18.5-30 S02**

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) dated October 16, 2007, Reference 1.

Responses to RAIs 18.5-5 S02, 18.5-27 S02, and 18.5-30 S02 were previously provided via Reference 2 in response to Reference 3. The original RAI responses were submitted to the NRC via Reference 4 in response to NRC Letter No. 64, Reference 5.

Responses to RAIs 18.5-19 S01 and 18.5-26 S01 were originally provided via Reference 4 in response to NRC Letter No. 64, Reference 5.

GEH's responses to RAIs 18.5-5 S02, 18.5-19 S01, 18.5-26 S01, 18.5-27 S02, and 18.5-30 S02 are addressed in Enclosure 1.

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

Sincerely,

Joseph Savage

for James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-557 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 113 Related To ESBWR Design Certification Application*, dated October 16, 2007
2. MFN 07-334 - Submittal of *"ESBWR DCD Chapter 18, Human Factors Engineering - RAI to DCD Roadmap Document"* dated June 27, 2007
3. Email from AE Cubbage to DL Lewis, *List of Chapter 18 RAIs for Roadmap Request*, dated 5/18/07
4. MFN 06-401, *Response to Portion of NRC Request for Additional Information Letter No. 64 – Human Factors Engineering – RAI Numbers 18.5-1 through 18.5-32*, dated October 28, 2006
5. MFN 06-352, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 64 Related to ESBWR Design Certification Application*, dated September 25, 2006

Enclosure:

1. MFN 07-624 - Response to Portion of NRC Request for Additional Information Letter No. 113 Related to ESBWR Design Certification Application ESBWR Human Factors Engineering - RAI Numbers 18.5-5 S02, 18.5-19 S01, 18.5-26 S01, 18.5-27 S02, and 18.5-30 S02

Attachment

1. MFN 07-624 - Markup Attachments for RAI Responses 18.5-19 S01, 18.5-27 S02

cc:	AE Cubbage	USNRC (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	eDRF	0000-0077-8845

Enclosure 1

MFN 07-624

Response to NRC Request for Additional Information Letter No. 113 Related to ESBWR Design Certification Application
Human Factors Engineering
RAI Numbers
18.5-5 S02, 18.5-19 S01, 18.5-26 S01, 18.5-27 S02, and 18.5-30 S02

For historical purposes, the original text of RAIs 18.5-5, 18.5-19, 18.5-26, 18.5-27, and 18.5-30 and any previous supplemental text and GEH responses are included preceding each supplemental response. Any original attachments or DCD mark-ups are not included to prevent confusion.

NRC RAI Number 18.5-5

The methodology generally conforms to the basic elements of the review criterion:

- *operational sequence diagrams are used as a linking technique*
- *the methodology provides for the development of high-level task descriptions and more detailed task decompositions*
- *the detailed task description should address the input, process, and output needed by and of personnel and the topics identified in the criterion.*

While these basic elements are generally described, some clarification of the details is needed as is identified in the questions below.

(A) Section 1.3. Methodology Background, states that "[t]his Task Analysis Implementation Plan recommends (emphasis added) methodology for performing task analysis during the design stage for human actions associated with the [main control room] MCR, [remote shutdown display] RSD, and other applicable [man machine interface systems] MMISs." Section 3.3 states that "[t]he actual human factor techniques and forms for data collection will be selected by the analysts." (p. 19).

Many other such statements exist in the document that qualify the methodology as a recommended practice rather than a commitment. The purpose of an Implementation Plan review is to certify the methodology that will be used, rather than what might be used. Please clarify why the methodology described is a recommendation only and not the actual plan that will be used to conduct that analyses.

(B) Figure 2, Task Analysis Implementation Process (p 86) needs clarification. Specific questions are:

- *Section 3.4.1, Task Analysis Methods, list the use of four approaches to task analysis. However, Figure 2 (p 86) providing an integrated overview of the methods does not include all of the methods listed, specifically Narrative Task Descriptions and operating sequence diagrams (OSDs) are included, but Mission Scenarios and functional flow diagrams (FFDs) are not.*

- *Why is task analysis (TA) evaluation not shown?*
- *Why do the reports listed not match those described in Section 3.9, Task Analysis Report?*

- *What is the meaning of dashed vs. solid lines?*
- *What is the meaning of the lines connecting the evaluation techniques at the bottom of the figure and the last three steps of the High-level task analysis?*
- *Explain why these particular steps (boxes) are connected?*

(C) An implementation plan should provide step-by-step, specific guidance on how to perform task analysis. The current document contains much background and tutorial information, and little in the way of step-by-step procedures. Absence of these type of specific procedural steps will make this document difficult for users and the intended methodology may be incorrectly and inconsistently applied.

(D) The document contains a detailed methodology with many steps and considerations. Provide a worked out example to illustrate the application of the methodology as it will be performed for ESBWR reflecting a slice of the methodology from top to bottom. Such an example does not need to reflect a complete analysis at any step.

GEH Response

(A) The scope section defines the commitments and the methodology section defines a group of methods and approaches that can be applied to meet the objectives. Section 3 gives examples to explain the factors and elements considered in the task analysis process.

Section 3.4.1 shows a variety of Task Analysis methods and ways of displaying the information that have been used in the past. These methods are redundant and only one needs to be picked as shown in Figure 2, which is a sketch of the task implementation process.

(B) A revised Figure 2 will be provided in the next revision to NEDO-33221. It will reflect an iterative top down approach and will address items such as TA evaluation and the TA documentation reports with more clarity and detail. In the current Figure 2 the dashed and solid lines represent feed forward and feedback paths. The solid lines represent the first functional TA feed forward path. The dashed lines represent first, second, and third level feedback paths that lead to changes in the TA evaluation. The dotted lines from boxes 2) is the first feedback and from 3) is the second feedback. The 1), 2), and 3) boxes are combined because they represent evaluation of the TA using different methods that are applied as the design progresses. The revised Figure 2 will further clarify the lines for each pathway. For example, a single solid line going from Workload Assessment to Outputs to Allocation of Functions to HSID to In-Plant Installation will represent the feed forward path, long dashed lines represent the first evaluation feedback going to the paper step evaluation and then to the Convert Functions to Tasks medium dashed lines represent the second evaluation feedback going to the mock-up or part task simulator evaluation step and then to

the Convert Functions to Tasks, and short dashed lines represent the third evaluation feedback going to the full scope simulator evaluation step and then to the Convert Functions to Tasks box. Each result at a level of analysis (e.g., a paper evaluation, a mock-up or part task simulator evaluation, and a full scope simulator evaluation) provides input to any of the boxes in the High Level Task Analysis Desk.

(C) This document needs to be simplified and focused on a clear step by step process. This will be done in the next revision to NEDO-33221 by linking the TA to the top level requirements in the SFRA Implementation Plan. See NEDO-33219r0 page 63 figure 4 for an example the top-level step by step process that is applied to safety related goals.

(D) We will provide an example of the application of the Detailed Task Analysis for the ESBWR RWCU system in the report identified in section 3.9 of NEDO-33221.

DCD/LTR Impact

LTR NEDO-33221, Rev 0 will be revised as described above.
No DCD changes will be made in response to this RAI.

NRC RAI Number 18.5-5 Supplement 1

(Refer to Subquestion A)
The response does not provide the clarification requested and it does not appear that any modifications to the NEDO are planned. Why is the document written as a recommended practice. The response indicates that there are many methods to choose from. If so, how is the selection to be made?

(Refer to Subquestion B)
While some clarification of the figure is provided relative to figure elements (e.g., meaning of solid and dashed lines) the response is primarily an indication that a revised Figure will be included in the next revision of the NEDO. There is not sufficient information in the response to indicate whether the revision will address the original questions (specifically the first three bullets of the subquestion).

(Refer to Subquestion C)
While some clarification is provided, the response is primarily an indication that a revised the next revision of the NEDO will provide a simplified and focused step-by-step process. There is not sufficient information in the response to indicate whether the revision will accomplish this objective.

GEH Response

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
18.5-5	5	5	Y	Clarification of Methodology Selection (Subquestion A)	From GE response	33221	3.1.4 4.1.3	Operational sequence diagrams are not a chief product of the revised analysis. The primary use of these diagrams was to analyze the sequential elements of the tasks. This will be accomplished by providing time and workload estimates to the tasks and examining the serial tasks assigned to a particular operator for a specific event. In this way the task database can be used to analyze any event by serially linking the tasks associated with the mitigation response and the staffing assignments from the S&Q and AOF activities. To complete the event analysis, the informational tasks (decisions which will link the combinations of functions), and their time and workload assessment will be defined in the task analysis. The results are then analyzed to ensure that there is sufficient time and capacity (physical and cognitive workload) for the operator to complete assignments.
18.5-5	5	5	Y	Clarification of Figure 2 of NEDO 33221 (Subquestion B)	From GE response	33221	Figure 2, 3	Figure was removed and replaced with figures describing the step-by-step analysis.
18.5-5	5	5	Y	Provision of a step-by-step process (Subquestion C)	From GE response	33221	3.1.4, 3.2.4 4.1, 4.2	Revised approach provides the step-by-step process that was presented and discussed in the NRC audit.

NRC RAI 18.5-5 S02

NEDO-33221, Rev 1, is an extensive revision of Rev 0. However, the methodology is presented in outline form with little explanation of how the task analysis is actually performed. Most of the implementation sections are limited to bullet lists (see Section 4). This does not provide sufficient information to evaluate the methodology to be used. Also NEDO-33221, Rev 1 does not appear to describe the actual methodology being used that was demonstrated during the July 2007 Design Process Audit. The methodology discussed by GEH in the July 2007 Audit included many considerations that cannot be found in the implementation plan, such as the evaluation of critical steps. Many of the terms used to describe the methodology and the example shown cannot be found in the plan. While this apparent difference may in part be due to differences in level of detail, it does provide an example of the staff's concern that an engineer using the plan would not clearly produce the type of results shown during the audit. Clarification is needed of (1) the relationship between the plan and the actual task analysis, and (2) how an engineer makes the transition from the plan to the actual conduct of the analysis.

GEH Response

NEDO-33221 ESBWR HFE TASK ANALYSIS IMPLEMENTATION PLAN presents an overview of the process to be used, inputs, outputs, and scope. NEDO-33221 commits to compliance with the applicable regulations and provides insight into the process flow but does not describe discrete process steps, tools, or methodologies. The Task Analysis detailed work document or work instruction and associated software tools define and govern execution of the task analysis process and document the resulting data. The draft work instruction, pilot software tool, and the results of one completed analyzed task were presented during the July 2007 Design Process Audit. This process and the governing draft detailed work instruction have continued the pilot process and GEH started production task analysis in November 2007. The draft Task Analysis detailed work instruction will be entered in GEH's controlled document repository (E-Matrix) and issued for use after lessons learned from pilot implementation are incorporated.
Once issued for use, the Task Analysis detailed work instruction provides a detailed, step-by-step description of the methodology and process steps required to consistently perform task analysis as demonstrated in the July 2007 Design Process Audit. GEH policies and procedures require that work be performed in accordance with an approved work document. The work instructions are available for audit by the NRC. Engineers seeking to implement NEDO-33221 ESBWR HFE TASK ANALYSIS IMPLEMENTATION PLAN do so through compliance with the Task Analysis detailed work instruction.

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 Number 18.5-19

Section 3.7, Methods for Identification of Critical Tasks - NUREG-0711, Task Analysis Criterion 1, 3rd bullet states "[human actions] that have been found to affect plant risk by means of PRA importance and sensitivity analyses should also be considered risk important.
Internal and external initiating events and actions affecting the PRA Level I and II analyses should be considered when identifying risk-important actions." Section 3.7 defines critical tasks and references Section 19.4 of the PRA. However, neither the scope or section 3.7 address all aspects of this criterion. Section 19.3 of PRA is titled Determination of Important structures systems and components (SSCs) for Level I and 19.4 is Determination of Important SSCs for Level II. Section 19.3 did sorts by Fussell-Vesely (FV) and risk achievement worth (RAW) and developed Tables 19.1 and 19.2. This section noted that there were several human error contributions, but they are not listed anywhere and they were apparently eliminated from these tables. Section 19.4 relates to the PRA level II analysis and discusses ADS and containment venting as important but actually only addresses the systems and components and does not clearly conclude that any HAs are risk- important or critical. There does not appear to be a list of risk important operator actions anywhere in the PRA. Please address the risk aspects of this criterion.

GEH Response

Use of the term PRA in the TA implies that PRA Level I and II with internal and external initiating events are included. It is also important to note that a design level PRA has less detail and uses broader definitions of basic events than for a completed plant specific PRA. Thus, the top down TA (Enclosure 2, Addendum to RAIs 18.5) provides input to and gets information from the PRA/HRA to identify risk-important actions. The list of important human actions is an on going development and is subject to significant change during the design process; thus, the list is not fully developed until later in the design process. The listing of these actions will be communicated between the HFE and the PRA and will be available for NRC review when developed. There are over 150 human action basic events and about 30 of those are in the importance ranking. Furthermore, the listing of system and component basic events includes both human and hardware failure modes. The determination of whether human or automatic functions will be accomplished will not be set until after the Allocation of Function step of HFE is complete. Thus, it is premature to present the listing of important human actions until the initial iterations between the TA and PRA/HRA have been completed.

DCD/LTR Impact

LTR NEDO-33221, Rev 0 will be revised as described above.
No DCD changes will be made in response to this RAI.

NRC RAI 18.5-19 S01

NEDO-33221, Rev 1, on page 3 makes the commitment to perform task analysis for "task identified as risk-important as determined by the HRA/PRA" NEDO-33267, the PRA/HRA Integration Plan, should be referenced since that is where the criteria for risk-important actions are identified.

GEH Response

NEDO-33221, Rev 1, ESBWR HFE TASK ANALYSIS IMPLEMENTATION PLAN, page 3, will be revised to reference NEDO-33267.
Section 1.2, Task Analysis paragraph, main bulleted item number 3 will be changed to read:

- "Evaluates tasks that the HRA/PRA has determined to be risk-important using the process described in NEDO-33267, ESBWR HFE HUMAN RELIABILITY ANALYSIS IMPLEMENTATION PLAN."

DCD/LTR Impact

No DCD changes will be made in response to this RAI.
LTR NEDO-33221, Rev 1 will be revised as noted in the attached markup.

NRC RAI Number 18.5-26

If the ESBWR task analysis focuses only on a selected subset of tasks (as discussed above in Criterion 1), e.g., those that are new or significantly changed, then how is the integration of all tasks into a specific job assessed?

GEH Response

The approach for addressing task interactions during the task analysis will use a top down approach as shown in Enclosure 2, Addendum to RAIs 18-5. NEDO-33221 will be revised to include the top down approach which naturally defines task interactions.

DCD/LTR Impact

LTR NEDO-33221, Rev 0 will be revised as described above.
No DCD changes will be made in response to this RAI.

NRC RAI 18.5-26 S01

NEDO-33221, Rev 1 Sections 4.1.3.6 and 4.2.3.6 provide information regarding workload assessments that list workload, crewmember skills, and work allocation; however no information about how such considerations are made is provided. Please clarify how these considerations are addressed.

GEH Response

The ESBWR project human factors engineering (HFE) team realizes the significance of evaluating workload and cognitive demands in order to mitigate or eliminate human errors. In a design that features plants that are passive and automated, it is recognized that the complexion of workload has changed. It is also well known that cognitive activities cannot be measured directly.

In keeping with this knowledge, the ESBWR project had adopted a graded approach to assess workload including cognitive demands. The strategy is phased to coordinate with the HFE project schedule and tailored to the tasks associated with an ESBWR plant. The stages proposed to assess workload begin with an initial screening. This high-level screening, administered by an analyst, uses a questionnaire type of instrument to identify tasks that may have high workload levels, questionable cognitive demands, or may in some way stress the operator – either physically or psychologically. At this level, tasks are identified that require further in-depth analysis.

Stage two of the workload analysis, invokes several additional tools that screen the remaining tasks to allow analyst and subject matter experts to differentiate between workload and stress inducing elements and identify those tasks that require further analysis. The tasks analyzed in stage two will use known ranking systems such as the NASA –TLX that have both validity and reliability.

In stage two, workload and stress are analyzed independently, and the analysis drills down to an elemental level. Tasks with elements that approach or exceed predetermined boundaries of demand are subject to further analysis.

Later stages of analysis identify those tasks with elements that due to the high task demands or stress loading require human factors intervention. An intervention may include but is not limited to engineering controls (such as element redesign), alteration of function (machine versus human, administrative controls (for example, training and procedures), or the possibility of job performance aids or personnel assignment. These tasks will be tracked, monitored, and subsequently re-entered into the analysis process to confirm a reduction of workload or stress to an acceptable level.

Routine tasks, task scheduling, assignment, and other variables pertinent to operations then are reviewed against typical daily demands and the impact of a task or multiple tasks that are superimposed as a result of an anomaly in processes (for example, equipment

malfunction, component failure, catastrophic natural events). In other words, tasks are analyzed, brought in line with acceptable workload, and then, viewed in concert with other tasks that are both routine and unpredicted.

The detailed methods for assessing workload and stress are described in a workload assessment detailed work document or work instruction currently under development. The HFE work instructions are available for audit by the NRC. The workload assessment work instruction fulfills guidance as set forth by NUREG-0711, best practices, and accepted human factors guidelines, methods, and principles and is available for NRC audit and inspection. A formalized method of tracking and disposition is used to ensure all tasks are within accepted workload parameters and do not have a negative impact during the course of multiple tasking scenarios. The utility of this approach fortifies the operational analysis, particularly task analysis, and paves the way for enhanced procedures, training, staffing, and resource allocation.

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 Number 18.5-27

The topic of minimum inventory is not adequately addressed in NEDO-33221. In Section 1.2, Scope, a commitment to define a minimum inventory is made; however, it is not addressed in the detailed methodology. Additional information is needed as to how the minimum inventory will be identified and what criteria will be used in the selection process.

GEH Response

In the case of safety parameters the top down HLFA, AOF and TA as described in the Addendum to RAIs 18.5 will identify the minimum inventory of information and cues needed to accomplish start up, operation and shutdown and trigger entry into the plant emergency procedures. This pattern for functional and task analyses is followed for the non-safety operational functions (detailed analyses), and then for the conditions for taking equipment out of service for surveillance, maintenance, testing, and repair (preoperational analyses). The output provided by each iteration lists a minimum set of alarms, displays and controls necessary for the crews to perform required functions to meet the requirements of the human tasks in performing system operations as well as developing strategies for adjusting plant states and configurations.

DCD/LTR Impact

LTR NEDO-33221, Rev 0 will be revised as described above.
No DCD changes will be made in response to this RAI.

NRC RAI Number 18.5-27 Supplement 1

The GE responses to RAIs 18.8 13, 18.8 23 and 18.5 27 all address minimum inventory. While they are not all the same, GE clearly indicate that the minimum inventory will be developed and is not done yet. The response to 18.5 27 sounds very broad and seems to include all the task requirements identified through task analyses in the minimum inventory. This may be excessive. The most complete discussion of the minimum inventory guidance is in the SERs for the new reactors that have undergone design certification; for example Section 18.14, Minimum Inventory, of the AP1000 SER contains the following lead in discussion:"As part of the general resolution of the issue pertaining to lack of control room detail, the staff requested that applicants for design certification identify the minimum group of fixed position CDAs that are required for transient and accident mitigation. ... It should be noted that the inventory is described as a 'minimum' inventory to indicate that an applicant can add to it but cannot delete from it [without an exemption]", {note: The SER said 'without rulemaking', but a COL applicant or licensee would follow the change process in section VIII of the appropriate appendix to 10CFR52. Generic changes, i.e. vendor proposed, changes to Tier 1 require rulemaking, but applicant requested changes to Tier 1 do not} NUREG 0800, the NRC SRP, Chap. 14.3.9 (Apr. 1996 is the latest available, but it's being updated now) provides review criteria for the minimum inventory, which explains how to determine the minimum inventory. These criteria include: GTGs, PRA, task analyses, RG 1.97 Cat. I items, and important controls and displays for transient mitigation. SRP Section 14.3.9 also includes a minimum inventory for the remote shutdown system (RSS), but the AP 1000 SER accepted non fixed position (computer based) displays for the RSS. Further 14.3.9 specifies that the minimum list should be included in the DCD Tier 1. GE has not committed yet to add the minimum inventory list to Tier 1. The topic of minimum inventory as addressed in these three RAI responses needs further discussion and clarification.

GEH Response

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
	5	27	N	LTR NEDO-33221	From GE response		3.2.4	Minimum inventory is not defined, but information and control needs will be established in the operations analysis for the actions necessary to perform crew tasks
18.5-27	5	27	Y	Identification of Minimum Inventory	From GE response		Tier 1 Table 3.3-1, item 6d	Given the uncertainty about the term "minimum inventory", GE has committed to adding the "list of instruments that complies with RG 1.97" in ITAAC, with the intent that this satisfies "minimum inventory" . GE will abide by the definitions currently under NRC and industry discussions. The GE minimum inventory will be established by task analysis output.

NRC RAI 18.5-27 Supplement 2

In the original RAI, staff requested additional information as to how the minimum inventory will be identified and what criteria will be used in the selection process. The GEH response to RAIs 18.8-13, 18.8-23 and 18.5-27 all address minimum inventory. While they are not all the same, GEH clearly indicates that the minimum inventory will be developed and is not done yet. The response to 18.5-27 sounds very broad and seems to include all the task requirements identified through task analyses in the minimum inventory. This response needs further explanation.

GEH's tasks analysis methodology in NEDO-33221, Rev. 1 also does not fully address minimum inventory. Provide a discussion and clarification on how minimum inventory is identified consistent with DI&C-ISG-05, "Digital Instrumentation and Controls Interim Staff Guidance on Highly-Integrated Control Rooms - Human Factors Issues (HICR-HF)," dated September 28, 2007.

GEH Response

GEH's original response to the RAI required additional clarification. The response to this supplement request is consistent with DI&C-ISG-05 and will replace the original response.

NEDO-33221 Revision 1 will be revised to define the Minimum Inventory Human System Interface (HSIs) and provide the process for identifying, implementing, and documenting the Minimum Inventory HSIs associated with the Main Control Room and Remote Shutdown Station (see attached markup).

Minimum Inventory HSIs: The Minimum Inventory HSIs are those that are needed beyond the selectable HSIs provided on the nonsafety related, computer-based workstations normally used by the operators to monitor and control the plant as defined by the Minimum Inventory HSI determination process.

A top down approach will be conducted to determine the Minimum Inventory HSIs needed to implement the plant's Emergency Operating Procedures (EOPs), bring the plant to a safe condition, and to carry out operator actions shown to be risk important by the ESBWR PRA. Design bases and requirements for this minimum inventory will be identified.

DCD/LTR Impact

No DCD changes will be made in response to this RAI.
LTR NEDO-33221 Rev 1 will be revised as noted in the attached markup as described above.

NRC RAI Number 18.5-30

Identify what changes will be made to DCD Tier 2, Section 18.5, Task Analysis, in response to the Task Analysis Implementation Plan and any revisions made on the basis of the RAIs.

GEH Response

The DCD tier 2 will be updated, if needed, to reflect changes in the HFE implementation plans when the revisions in NEDO-33221 are complete.

DCD/LTR Impact

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

NRC RAI Number 18.5-30 Supplement 1

The response indicates the DCD will be updated "if necessary." The impact statement states the No DCD changes will be made. It is the staff's opinion the DCD changes will be needed to address the top-down approach identified in the Addendum and the role of prior analyses in the task analysis.

GEH Response

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
18.5-30	5	30	Y	Clarification of changes to the DCD Tier 2 material	From GE response	DCD	DCD Tier 2 18.5.1(2) b and c	DCD Tier 2 Rev 3 does address the top-down approach. At the time of the response, the DCD revision was complete including the revised task analysis approach.

NRC RAI 18.5-30 S02

The task analysis methodology presented in NEDO-33221, Rev. 1 is not consistent with the methodology summarized in DCD Section 18.5, Rev 3. For example, the implementation plan discusses two major levels of analysis, plant and system. This is not addressed in the DCD. Please revise DCD, Section 18.5 to ensure consistency with the NEDO-33221, Rev. 1 and any modifications made to address other 18.5 RAIs.

GEH Response

The DCD section 18.5 provides a high level description of the scope, range, and requirements contained in the Task Analysis (TA) Implementation plan. Additionally, it states that the plan will include the methods by which:

- data sources are used,
- the high level TA is performed,
- detailed task descriptions are developed,
- TA results are evaluated,
- Other TA analyses are conducted and documented.

DCD section 18.5, Rev 3 and Rev 4 do not describe the processes used to accomplish Task Analysis, rather, set forth the requirement that the Task Analysis Implementation Plan do so. DCD section 18.5.1(3) does make reference to the two major levels of analysis when it sets the following Results Summary Report requirement. The DCD refers to the plant level analysis (high-level Plant FRA) and system level analysis (Design FRA, Detailed FRA, and Economic FRA) as shown below:

> "A separate report is generated following each phase of the analysis, that is, high-level Plant FRA, Design FRA, Detailed FRA, and Economic FRA. The TA RSR may be combined with the RSR(s) from FRA and AOF."

DCD section 18.5, Rev 4 and NEDO-33221 ESBWR HFE TASK ANALYSIS IMPLEMENTATION PLAN present the same analysis process but do so in different levels of detail.

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.

MFN 07-624

Markup Attachments for RAI Responses

18.5-19 S01
18.5-27 S02

- TA responsiveness to HRA/PRA and deterministic evaluations
- Task sequencing for each identified function
- Overall system configuration design.

To accomplish these objectives, component-level, system-level, and plant-level functions are systematically analyzed. The relationships and interaction between human and machine tasks are examined through several iterations of analysis. TA considers all functions identified by the FRA and allocated to human, machine, or shared ownership.

Task analysis:

Applies to the full range of plant operating modes including:

- Startup
- Normal operations
- Abnormal and emergency operations
- Transient conditions
- Low power operation
- Shutdown conditions

- Identifies needed information, controls, and alarms
- Supports operations during periods of maintenance and tests of plant systems and equipment, including HSI equipment
- ~~Evaluates tasks that are risk-important as determined by the HRA/PRA~~ NRC RAI 18.5-1950 Insert (See Attachment
- Produces procedure outlines
- Produces automation logic

RAI 18.5-19 SO1

NEDO-33221, Rev 1 ESBWR HFE TASK ANALYSIS IMPLEMENTATION PLAN page 3, section 1.2, Task Analysis paragraph, main bulleted item number 3 will be changed to read:

"Evaluates tasks that the HRA/PRA has determined to be risk-important using the process described in NEDO-33267 ESBWR HFE HUMAN RELIABILITY ANALYSIS IMPLEMENTATION PLAN."

Table of Contents

4.3 ← NRC RAI 18.5-27 S02 INSERT SEE ATTACHMENT

- Operator workload and situational awareness (e.g., HRA/PRA)
- Capital cost, operating costs, and technical feasibility

1.1 Purpose

The purpose of this implementation plan is to prescribe and guide task analysis for the ESBWR plant design in accordance with the requirements of the ESBWR MMIS HFE Implementation Plan (NEDO-33217).

The TA Plan establishes methods to:

- Conduct the TA consistent with accepted HFE methods
- Promote the ESBWR mission, goals, and philosophy
- Identify prerequisites to performing a task or task sequence
- Identify the parameters required to coordinate tasks and task sequences
- Identify the termination criteria to abort a task or task sequence
- Identify the parameters that confirm successful completion of tasks or task sequences
- Sequence tasks to support normal operation
- Sequence tasks to support abnormal operation
- Sequence tasks to support surveillance functions
- Sequence tasks to support maintenance functions
- Provide analysis methods to assess the impact of design, staffing, training, procedure, and HSI changes on the sequence and coordination of tasks
- ← NRC RAI 18.5-27 S02 INSERT SEE ATTACHMENT

1.2 Scope

This plan establishes the following scope elements for the analysis:

- Objectives, performance requirements, and constraints
- Methods and criteria for conducting the TA in accordance with accepted human factors principles and practices,
- System and function requirements that define task sequencing and coordination restraints
- Resultant systems HSI requirements

- TA responsiveness to HRA/PRA and deterministic evaluations
- Task sequencing for each identified function
- Overall system configuration design.
- ⟵ NRC RAI 18.5-27 SO2 INSERT SEE ATTACHMENT

To accomplish these objectives, component-level, system-level, and plant-level functions are systematically analyzed. The relationships and interaction between human and machine tasks are examined through several iterations of analysis. TA considers all functions identified by the FRA and allocated to the plant operator (human and shared).

Task analysis:

- Applies to the full range of plant operating modes including:
  - Startup
  - Normal operations
  - Abnormal and emergency operations
  - Transient conditions
  - Low power operation
  - Shutdown conditions
- Identifies the need for information, controls, and alarms
- Supports operations during periods of maintenance and tests of plant systems and equipment, including HSI equipment
- Evaluates tasks that are risk-important as determined by the HRA/PRA

Workload: The physical and cognitive demands placed on plant personnel (NUREG-1764).

MINIMUM INVENTORY HSIs ← NRC RAI 18.5-27 S02
INSERT SEE ATTACHMENT

2.2 Codes and Standards

The following codes and standards are applicable to the HFE program to the extent specified herein.

1. ASME RA-S-2002, Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications

2.3 Regulatory Guidelines

1. NUREG-0700, Rev. 2, Human-System Interface Design Review Guidelines, 2002
2. NUREG-0711 Rev 2, Human Factors Engineering Program Review Model, 2004
3. NUREG-0737, Clarification of TMI Action Plan Requirements, 1980, and Supplement 1, Requirements for Emergency Response Capability, 1983
4. NUREG-0800: Standard Review Plan, Chapter 18, Rev 1, 2004
5. NUREG-1764, Rev 0, Guidance for Review of Changes to Human Actions, 2004
6. ← NRC RAI 18.5-27 SO2 INSERT SEE ATTACHMENT

2.4 DOD and DOE Documents

N/A

2.5 Industry and Other Documents

1. NUREG/CR-6634, Computer-Based Procedure Systems: Technical Basis and Human Factors, 2000

2. 3. } NRC RAI 18.5-27 SO2 INSERT SEE ATTACHMENT

contain more detailed information about the systems and further establish the roles of various personnel.

Task sequences provide IOP outlines and PAS logic. Procedures and machine logic generated by a common data structure minimize potential errors when transferring control from manual to automatic, as well as when human action is required.

Latent errors are detected during TA through the use of simulation. Thus, future consequences and costs of corrective actions are avoided. Active errors are reduced during workload assessment by:

- Providing feedback to AOF from workload assessment to reallocate functions
- Setting function hierarchy and priorities to allow the humans to concentrate on the most risk-important tasks

3.2.5 Application

Identify, prioritize, and organize plant and system tasks including:

- Sets priorities among system functions
- Directs user focus
- Sequence plant and system tasks
- Coordinates task initiation and interlocks
- Verifies successful task completion
- Responds to aborted tasks

3.3 ← NRC RAI 18.5-27 S02 INSERT SEE ATTACHMENT 1

4.2.4 Outputs

- Communications requirements
- HSI descriptors
- Availability and arrangement of indicators
- Display requirements
- Control requirements
- Alarm requirements
- Data processing requirements
- Access requirements
- Workplace and workstation design considerations
- Environmental considerations
- Equipment requirements
- Activities required for successful completion of tasks
- Sequences that serve as both procedure outlines and PAS logic

4.3 ← NRC RAI 18.5-27 S02 INSERT SEE ATTACHMENT

5 RESULTS

5.1 Results Summary Reports

The results summary report contains a rendering of common sequences, priorities, and logic employed by the procedures and automatic control systems. The rendered sequences are included as appendices in each System Design Specification.

The results summary report contains the following:

- The Task Analysis team members and backgrounds
- The scope of the Task Analysis
- High level task descriptions
- Detailed task descriptions
- The methodology and implementation of the Task Analysis concluding that the activity was performed in accordance with implementation plans.

← NRC RAI 18.5-27 S02 INSERT SEE ATTACHMENT

5.2 Periodic Reports

N/A

5.3 Technical Output Reports

N/A

NRC RAI 18.5-27 S02

Revise NEDO-33221 Revision 1 as follows:

In Table of Contents under Section 3 Methods add Section 3.3 as follows:

3.3 System and Plant-Level Task Analysis for identifying and implementing the Minimum Inventory Human System Interfaces

In Table of Contents under Section 4 Implementation add Section 4.3 as follows:

4.3 System and Plant-Level Task Analysis for identifying and implementing the Minimum Inventory Human System Interfaces

In Section 1.1 Purpose add the following bullet:

- Identify the Minimum Inventory Human System Interfaces (HSIs)

In Section 1.2 Scope add the following bullet:

- Methods for identifying the Minimum Inventory HSIs.

In Section 1.3 Definitions and Acronyms add the following:

Minimum Inventory HSIs: The Minimum Inventory HSIs are those that are needed beyond the selectable HSIs provided on the nonsafety related, computer-based workstations normally used by the operators to monitor and control the plant as defined by the Minimum Inventory HSI determination process.

In Section 2.3 Regulatory Guidelines add the following:

6. Regulatory Guide 1.97, Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants Revision 4, June 2006.

In Section 2.5 under Industry and other documents add the following:

2. Digital Instrumentation and Controls DI&C-ISG-05 (Highly Integrated Control Rooms-Human Factors Issues), September 2007.
3. IEEE Std 497-2002 IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations, September 2002.

Add new Section 3.3

3.3 Systems and Plant-Level Task Analysis for identifying and implementing the Minimum Inventory Human System Interfaces (HSIs)

3.3.1 Background

This plan provides the methodology for identifying and implementing the Minimum Inventory HSIs for the Main Control Room and Remote Shutdown Station during the plant design process.

3.3.2 Goals

- Generate the list of minimum inventory HSIs that are needed beyond the selectable HSIs provided on the non-safety related, computer-based workstations normally used by the operators to monitor and control the plant as defined by the Minimum Inventory HSI determination process.

3.3.3 Basis and Requirements

The methods and criteria recommended for identifying and implementing Minimum Inventory HSIs are in accordance with a top down review as part of the overall control room design.

3.3.4 General Approach

A top down approach will be conducted to determine the Minimum Inventory HSIs needed to implement the plant's Emergency Operating Procedures (EOPs), bring the plant to a safe condition, and to carry out operator actions shown to be risk important by the ESBWR PRA. Design bases and requirements for this minimum inventory will be identified.

3.3.5 Application

The Systems and Plant-Level Task Analysis for identifying and implementing the Minimum Inventory HSIs will provide the minimum inventory and classification of equipment needed to implement the plant's EOPs, bring the plant to a safe condition, and to carry out operator actions shown to be risk important by the ESBWR PRA .

Add New Section 4.3:

4.3 Systems and Plant-Level Task Analysis for identifying and implementing the Minimum Inventory Human System Interfaces (HSIs)

4.3.1 Assumptions

- Task Analysis at the Plant and System level are completed to the level of identifying functions and parameters required for the Minimum Inventory HSIs.
- ESBWR EOPs are developed for input to the process.

4.3.2 Inputs

- Plant design basis
- Overall concept of operation for the plant
- Initial concepts for the overall I&C and information systems architecture.
- ESBWR EOP
- Plant Probabilistic Risk Assessment (PRA)
- Industry and regulatory standards and guides applicable to the plant design
- Diversity and Defense in Depth (D3) evaluation results
- Plant functions supporting the plant safety sub goals (including critical functions)

4.3.3 Process

- Identify applicable Regulatory Guides, Standards and other supporting documents necessary for identification and implementation of the Minimum Inventory HSIs. Supporting documents used in this process include:
    1. Digital Instrumentation and Controls DI&C-ISG-05 (Highly Integrated Control Rooms-Human Factors Issues), September 2007
    2. IEEE Std 497-2002 IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations, September 2002
    3. Regulatory Guide 1.97, Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants Revision 4, June 2006

- Identify the specific functions and tasks that need to be supported by the Minimum Inventory HSIs. Included in the functions and tasks to be evaluated are those that:
    1. Perform and confirm a reactor trip
    2. Perform and confirm a controlled shutdown of the reactor using the normal or preferred safety means
    3. Perform credited risk important manual actions identified by the PRA
    4. Monitor safety functions and back up automatic safety actions
    5. Carryout preferred manual safety success paths in the EOPs
    6. Carryout preferred manual non-safety success paths in the EOPs
    7. Perform additional post accident monitoring

8. Monitor safety system availability
9. Monitor plant safety parameters
10. Support continued operation under conditions of failed/degraded HSIs
11. Support mitigation of the licensing basis document anticipated operational occurrences.

- Identify specific minimum inventory HSI resources required to support the functions and tasks identified above. Examples of resources that may be required include:

    1. Indications and alarms used to detect the need to take the action. These can be alarms indicating a threat to a critical safety function.
    2. Controls used to perform the action and indications that provide immediate feedback confirming that the action has been taken.
    3. Indications and alarms used to monitor performance of the actuated component or system to confirm that the manual action has been achieved.

4.3.4 Outputs

The list of minimum inventory HSIs that are needed beyond the selectable HSIs provided on the non-safety related, computer-based workstations normally used by the operators to monitor and control the plant as defined by the Minimum Inventory HSI determination process.

Revise last bullet in Section 5.1 to include "System level Task Analysis", "Plant level Task Analysis" and " Minimum Inventory HSIs":

5.1 Results Summary Reports

- The methodology and implementation of the Task Analysis concluding that the activity was performed in accordance with implementation plans, including:
    - System level Task Analysis
    - Plant level Task Analysis
    - Minimum Inventory HSIs