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MFN 08-907

Docket No. 52-010

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U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Document Control Desk
Rockville, MD 20852

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 251 Related to ESBWR Design Certification Application - Chapter 18 - Human Factors Engineering - RAI Number 18.7-7 S04**

The purpose of this letter is to submit a response to Nuclear Regulatory Commission (NRC) Request Additional Information (RAI) 18.7-7 S04 as requested by Reference 1.

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI originally transmitted via the Reference 1. The response to RAI 18.8-47 S03 was provided in Reference 2 as requested by NRC in Reference 3. The response to RAI 18.8-47 S02 was provided in Reference 4 as requested by NRC in Reference 5. The response to RAI 18.8-47 S01 was provided in Reference 6 as requested by NRC in Reference 7. The original response to RAI 18.8-47 was provided via Reference 8 in response to NRC request in Reference 9.

Please contact me with any questions concerning this submittal.

Sincerely,

Lee F. Dougherty for

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

References:

1. MFN 08-687 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 251 Related To ESBWR Design Certification Application*, dated September 4, 2008
2. MFN 08-481 - *Response to Portion of NRC Request for Additional Information Letter No. 178 Related to ESBWR Design Certification Application – Human Factors Engineering - RAI Numbers 18.7-7 S03, 18.7-8 S03, 18.8-2 S02, 18.11-21 S02, 18.11-25 S02, 18.11-32 S02, and 18.12-4 S03*, dated July 8, 2008
3. MFN 08-460 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 178 Related To ESBWR Design Certification Application*, dated May 6, 2008
4. MFN 08-154 - Response to Portion of NRC Request for Additional Information Letter Nos. 125 and 135, Related to ESBWR Design Certification Application – Human Factors Engineering - RAI Numbers 18.2-19, 18.2-20, 18.4-16 S02, 18.4-21 S01, 18.4-25 S01, 18.7-7 S02, 18.11-32 S01, 18.12-2 S01, 18.12-3 S01
5. MFN 07-702 - Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 125 Related To ESBWR Design Certification Application*, dated December 14, 2007
6. MFN 07-334 - Submittal of *"ESBWR DCD Chapter 18, Human Factors Engineering - RAI to DCD Roadmap Document"*, dated June 27, 2007
7. Email from AE Cubbage to DL Lewis, *List of Chapter 18 RAIs for Roadmap Request*, dated May 18, 2007
8. MFN 06-403, *Response to Portion of NRC Request for Additional Information Letter No. 64 – Human Factors Engineering – RAI Numbers 18.7-1 through 18.7-15*, dated October 27, 2006
9. 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 08-907 – Submittal of Response to NRC Request Related to ESBWR Design Certification Application Chapter 18 - Human Factors Engineering - RAI Number 18.7-7 S04

cc:

AE Cubbage	USNRC (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
eDRF	0000-0094-5275

Enclosure 1

MFN 08-907

Submittal of Response to NRC Request Related to ESBWR Design Certification Application Chapter 18 Human Factors Engineering RAI Number 18.7-7 S04

For historical purposes, the original text of RAI 18.7-7 and any previous supplemental text and GE/GEH responses are included preceding each supplemental response. Any original attachments or DCD mark-ups are not included to prevent confusion.

RAI Number 18.7-7

NEDO-33267 and DCD Tier 2, Chapter 18.7 state in several places that the PRA/HRA will provide a listing of potentially risk-important human interactions for use in several portions of the HFE program. The initial PRA/HRA for ESBWR has been completed and submitted to NRC along with Chapter 19 of the DCD. Therefore, sufficient information is available to develop the initial list of risk important actions using the methods discussed in this report. The PRA and DCD Chapter 19 provide very informative lists of risk important structures, systems and components (SSCs), however they note in several places that human actions are not included. It is not clear why human actions were excluded from these importance listings and are not in NEDO-33267. Please provide the initial list of risk important human actions.

GE Response

Risk important operator actions developed from the PRA rev. 1 are listed in Tier 2 Chapter 19 Rev 1, September 2006, in Table 19.2-3 on Risk Insights and Assumptions.
The use of the PRA/HRA in human factor engineering (HFE) is an iterative process, and this initial listing will be enhanced with additional actions as the design matures. For example, system level actions that are included within system level reliability models of the design level PRA do not specifically separate the automatic versus manual actions. This use of generic failure rate estimates for the structures, systems and components is adequate for estimating the overall risk in terms of the top down level 1 and 2 PRA. However, an enhanced listing of human actions requires the allocation of manual versus automated actions in each system and modeling within the PRA to expand the initial risk importance listing.

The HRA plan indicates that a process will be established to enhance this listing as an iterative tool to pass between the HFE/HRA assessments and the PRA/HRA risk evaluation. The list will be dynamic as HSI design features are established, and will be upgraded as the design details are established and modeled in the PRA. Listings of risk important actions in Table 19.2-3 will be further enhanced through implementation of the HFE HRA plan.

Reference to Table 19.2-3 in Tier 2 Chapter 19 Rev 1, September 2006 will be provided in the next revision to section 5.2 second paragraph of NEDO-33267.

"The initial baseline ESBWR PRA study which is described in the ESBWR DCD Chapter 19 will be used as the starting point for defining risk important human actions (e.g., Table 19.2-3 in Tier 2 Chapter 19 Rev. 1, September 2006)." Also the reference for chapter 19 will be updated.

DCD/LTR Impact

LTR NEDO-33267, Rev 0 will be revised as described above.

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

RAI Number 18.7-7 Supplement 1

The response refers to the updated Chap. 19, Rev. 1 and specifically Table 19.2-3. The initial list of R-I HAs, that was requested in the RAI, was not provided. The updated Chap. 19 and PRA/HRA still appear to have in HA modeling that may limit the ability to correctly identify the R-I HAs. This should be improved, as necessary, so that the R-I HAs can be identified and so that the design process can appropriately address R-I HAs. We did note that Table 18-2 of the PRA includes HAs and contains both RAW and F-V importance values. Examples of issues: 1. From the RAI response "..system level actions that are included within system level reliability models of the design level PRA do not specifically separate the automatic versus manual actions..., an enhanced listing of human actions requires the allocation of manual versus automated actions in each system and modeling within the PRA to expand the initial risk importance listing." Without such separation, how can R-I manual actions (such as manual actuation upon automation failure) be identified. 2. Table 19.1-3, Importance Analysis Results, is not discussed or explained in the text of Ch. 19. Col. 2 of the Table gives the basis for inclusion of items in the Table as RAW, FV, CCF but does not list values or selection criteria.3. Operator actions are not clearly identified in Table 19.1-3, for example N21, condensate and feedwater valves are listed, but it is not clear if they are auto or manually operated.4. In justifying the less than complete status of the PRA, Section 19.2.1 states that "..many aspects of assessing human actions cannot be analyzed in absence of a physical, operating plant and operation staff." This is true but other shortcomings, as in example #1 above, do not require an operating staff to model. Section 19 overall discusses the use of PRA insights for design decisions. However, this could be compromised by the limited nature of HA modeling. For example insights related to functional allocation between operators and automation may be lost.5. In the discussion of Significant CD sequences in Section 19.2.3.1.1, it is not always clear whether actions are automatic or performed by operators (e. g., injection with CRD pumps).6. The RAI response referred to Table 19.2-3 for important operator actions, but that Table includes all risk insights and assumptions. Thus, it is not clear which items are the risk-important operator actions. And the dispositions for HAs in the Table would not seem to include all activities for these actions that would be called out by the implementation plan.7. Table 19.2-3 appeared to be incomplete. For example, operator actions noted in Section 19.2.3.1.2 (Significant Large Release Sequences) related to LERF for minimizing water accumulation in lower drywell with core in vessel are not listed in Table 19.2-3. The dominant operator actions for internal shutdown fires from Sec. 18.4.3 of the ESBWR PRA are not included in the Table.8. The row for Human Actions in Table 19.2-1states that "No operator actions are required for safety function success in the ESBWR for the first 72 hours of an event." This is a deterministic statement. What does the PRA analysis show? Are the important HAs, as identified in the PRA, from the pre-72 hour regime?9. For Item 2b in Table 19.2-3 was an error of commission modeled in the PRA?

GEH Response

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
18.7-7	7	7	N	LTR NEDO-33267	From GE response	33267	4.2	Para change per RAI
18.7-7	7	7.0	Y	Risk-important (R-I) Human Actions (HAs)	From GE response	33267	3.2.1 4.2	The initial list of human actions with a potential for risk contribution will be in the phase 0 HRA summary report. The criteria and approach for determining risk important human actions are provided in section 3.2.1 and the process for identifying additional actions through interaction with the HFE tasks is addressed in the third paragraph of section 4.2.
	7	7.1	Y	Issue 1-manual v. auto actions	From GE response	33267	3.1, 4.2	The allocation of functions activity in the operations analysis will establish the manual actions. In the case of the ESBWR the passive features and automation of the safety-related systems virtually eliminate the need for the safety-related human actions required for design basis events (e.g., manually start a safety system). These design features reduce the CDF to a mean value much lower than the plants used as the basis for the NRC risk regions in RG 1.174. As a result the risk boundaries associated with the risk regions in RG 1.174 are far above the ESBWR baseline risk. Hence, the ESBWR basic events representing HIs do not become important contributors to plant

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
								risk on an absolute basis.
	7	7.2	Y	Issue 2-Table 19.1-3 is not discussed and does not list values or criteria	From GE response	33267	3.2	These will be provided in the HRA initial results summary report for rev 1 of the PRA. Summary: To evaluate the risk impact of the HIs for the beyond design basis events a relative risk approach is used. First, risk sensitive actions that support ESBWR safety for beyond design basis events are identified in both the PRA and through the top down HFE operational analysis. Sensitivity analyses using the FV, RAW and RRW described above on the to basic events related to HIs human action tasks in are used to create a listing of the top risk contributors on a relative basis. This listing is generated in the PRA and is compared with the top down operational analysis to identify gaps and support requantification for the PRA. On a relative scale the HIs with a FV greater than 0.1 and RAW of 2.0 for CDF and LERF are subjected to the greatest detail in the HFE tasks, even though the absolute risk values are far below regions I and II described in NUREG-1764 (NRC, 2004).

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
	7	7.3	Y	Issue 3-operator actions not clearly identified in Table 19.1-3	From GE response	33267	3.2 4.2	The operating assumption is that these will be automated actions with the operator in a monitoring role with manual backup in the case of automation failure. The allocation of function will complete the determination of manual actions. The approach described in issue 2 is followed for these actions
	7	7.4	Y	Issue 4-with justifying incomplete PRA status, insights related to functional allocation may be lost	From GE response	33267	Figure 3 4.2.2 4.2.3 4.2.4	The functional allocation and detailed task information from the operation analysis are key inputs to the refinement of both the HRA and the PRA. After the initial listing of risk-important human actions from the PRA (labeled PRA/HRA probabilistic importance evaluation in Fig 3), the allocation and task details are used to expand the risk important actions (HRA qualitative evaluation for HFE tasks in Fig 3). This re-analysis is used to update the HRA and PRA (iteration loop).
	7	7.5	Y	It is not clear if actions are manual or automatic in CD sequences in 19.2.3.1.1	From GE response	33267	3.2 4.2	See answer to issues 1, 3, and 4.

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
	7	7.6	Y	It is not clear from Table 19.2-3 which items are risk-important Human Actions and it seems not to include all activities called for in the HRA implementation plan	From GE response	33267	4.2	The Risk Important actions modeled in the PRA are listed and screened in the HRA initial results summary report. From the ESBWR PRA model as described in DCD Tier 2 Chapter 19 Rev 1, September 2006, Tables 19.1-3, 19.2-1 and 19.2-3 list important components, systems functions, tasks and event initiators considered in the ESBWR PRA model and PRA models of previous BWR designs. Table 19.1-3 lists hardware elements that are important. The human interactions for these hardware elements including manual operation (if assigned in the allocation of functions), maintenance, repair, and backup to automatic functions are defined during the operational analysis by the HFE team. These results are then employed as described in item 18.7-7(4).
	7	7.7	Y	Table 19.2-3 incomplete	From GE response	33267	4.2	The human actions in these events will be identified in the operations analysis. See response to 18.7-7(4).

Chapter 18 Roadmap Document								
RAI NO	SEC	#	NRC Supplemental	DocName/Question	Resolved	Plan	Section	Resolution Description
	7	7.8	Y	No operator actions for first 72 hrs - Is this from PRA? Are human actions in PRA from the pre-72 hrs	From GE response	33267	4.2	The initial baseline ESBWR PRA study is used as the starting point for defining risk-important HA tasks. The ESBWR design objective is to avoid the need for operator actions for the first 72 hours following an initiating event for the design basis events. The types of human actions from the initial PRA are actions such as misposition valve (either latent Type A, or commission type C). These are addressed in initial HRA and are described in the HRA results summary report. The operations analysis will identify and analyze human actions supporting these events. See response for 18.7-7(4).
	7	7.9	Y	Was error of commission modeled in PRA?	From GE response	33267	3.2.3	Errors of commission are addressed as follows: The Risk Important actions modeled in the PRA, are compared with other PRA studies and with important OER events. Data from the OER provide error modes, including potential examples of errors of commission (EOC). The results are listed and screened In the HRA and documented in the HRA results summary report. Errors of commission from the initial results include premature depressurization.

RAI Number 18.7-7 Supplement 2

The staff asked for additional information in RAI 18.7-7 regarding the PRA/HRA which was addressed; however, the following parts of the original RAI are still open:

2. Table 19.1-3, Importance Analysis Results, is not discussed or explained in the text of Ch. 19. Col. 2 of the Table gives the basis for inclusion of items in the Table as RAW, FV, and CCF, but does not list values or selection criteria. Rev. 2 of Plan gives acceptance criteria as FV greater than 0.1 and RAW of 2.0 for both CDF and LERF. However, these criteria are not specifically linked to the RI HAs. This should be clarified.

8. The row for Human Actions in Table 19.2-1 states that "No operator actions are required for safety function success in the ESBWR for the first 72 hours of an event." This is a deterministic statement. What does the PRA analysis show? Are the important HAs, as identified in the PRA, from the pre-72 hour regime? This RAI was not satisfactorily answered. Please provide a response.

9. For Item 2b in Table 19.2-3 (spurious actuation of GDCS deluge to containment) was an error of commission modeled in the PRA? The Roadmap answer provided a discussion of the EOC method used for the HRA but didn't answer the specific question related to Item 2b.

GEH Response

Table 19.1-3 was removed from the DCD in revision 4 with the pertinent information restructured in Tables 19.2-2 and 19.2-3.

Also, the PRA referenced in Chapter 19 DCD revision 4 demonstrated that no accidents generated early health effects as considered for a large early release frequency (LERF), thus the PRA team uses the term large release frequency (LRF) to address accident sequences that result in containment releases. For this reason the calculation for LRF is used for measuring the importance of human action instead of the calculation for LERF. The PRA/HRA models will continue to search for LERF sequences.

Comment 2 Discussion

Both quantitative and qualitative tools are used by GEH to develop risk insights for the ESBWR. The risk insights are based on the use of the importance measures Risk Achievement Worth (RAW) and Fussell Vesely (FV) to measure the risk importance of basic events and common cause failures that contribute to the CDF for level 1 and LRF for level 2, internal and external events, and other special PRA models. The risk summary information and insights in DCD Chapter

19 rev 2 were significantly revised with additional information added based on results from Rev. 2 of NEDO-33201 PRA Model which accounted for greater understanding of the design features and operator interface design. The ESBWR PRA defines potentially risk-significant structure, system or component (SSC) and HI events and information using conservative thresholds such as FV greater than 0.01, and a RAW greater than 5.0 for individual basic events and a RAW greater than 50.0 for common cause failures. The resulting listings of SSCs and HIs in NEDO-33201 Rev 2 section 18 are used to generate the risk insights that are qualitatively provided in Table 19.2-3. Some of the insights from the predecessor PRA models have been addressed through design changes and no longer appear, because the risk values are well below the quantitative PRA risk importance identification values. The HFE design examines all human interactions (HIs) required for each system and mode of operation during the operational assessment, task analysis and HRA. Many of these actions are addressed implicitly in the PRA at a functional level until specifically identified as an automatic system or operator control action as determined in the operational assessment. Once incorporated in the PRA models, any potentially risk important human actions are examined and are kept below the threshold risk measures for FV of 0.1 and for RAW of 2.0 through verification that the design clearly provides the means to identify, plan, and carry out the action within the required timing.

In summary:

The ESBWR PRA defines potentially risk-significant SSC and HI events and information that contribute to CDF and LRF using conservative thresholds such as FV greater than 0.01, and a RAW greater than 5.0 for individual basic events and a RAW greater than 50.0 for common cause failure events. The goal of the HRA and HFE operational analysis in DCD Chapter 18 is to verify that the means are provided in the plant design to keep the quantitative risk importance of all potentially risk important human interactions modeled in the PRA below a FV value of 0.1 and RAW of 2.0. The goals are met by ensuring that information for identifying, planning and implementing the needed action within the time permitted is provided in the design or by providing automated support to carry out the needed action. For example, the operator can identify the need for manual actions through the HSI plan through procedures and training and implement with tools as needed.

The revised approach is added to NEDO-33267, section 3.2.1 as provided in the attached markup. The quantitative thresholds for evaluating the risk importance of human actions are added to DCD Tier 2, Section 19.2.2.1 as noted in the attached markup.

Comment 8 Discussion

The deterministic statement in DCD Revision 4, September 2007, Tier 2, "No operator actions are required for safety function success in the ESBWR for the first 72 hours of an event," relates to the design goal of providing passive cooling and automatic systems for responding to the DCD Chapter 15 design basis events. These design basis events provide the means for sizing the systems to respond to an initiating event and a single failure except for special initiators such as fire, which go beyond single failures.

The role of the licensed operators in the ESBWR is to be in control of the plant via monitoring with the potential to override the automatic responses to obtain a better path to shutdown, restart, plant operating points and protection of safety barriers than provided by the automatic system; or as backup to automated system failures that might occur as a result of multiple and common cause failures. Thus, in considering multiple failures in many sequences that go beyond the design basis events, the PRA treats many operator actions combined with failures of the automatic control and protection systems as a basic event. If the sequence becomes important, then the details of the operator interaction during the sequence is explicitly defined and is further evaluated by human factors engineering if identified as risk important. Such specific operator actions occur near the recognition of additional failures and are clearly within the 72-hour regime.

Therefore, by design, operator actions are not required for any safety function success in the ESBWR for the first 72 hours of an event as long as the plant is operated within its design basis. Many important actions can be actuated or inhibited either manually or automatically. Example manual actions in predecessor plants that have automatic initiation in the ESBWR include reactor vessel depressurization, ADS inhibit, actuation of standby liquid control, and equipment alignments for reactor core and suppression pool cooling.

The PRA also addresses cases where the plant is outside the design basis due to hypothetical event sequences that involve multiple failures. In cases where the automatic systems fail, the operators can switch from their normal monitoring functions, to actively control systems that are needed for safe operation of the plant at any time. For rare events in the ESBWR, such as automatic control failures, the operators provide the back up to selected automatic functions. In this way the operator actions can provide another path to shutdown, cooldown, managing the operating point or providing barrier protection than would normally be achieved with reliance only on the automated systems. This use of operators (i.e. manual recovery actions) provides an additional reduction in the frequency of the hypothetical core damage sequences.

The human action section right hand column in Table 19.2-1 will be revised as noted in the attached markup.

Comment 9 Discussion

Table 19.2-3 was revised with additional information added based on results from Rev. 2 of NEDO-33201 PRA Model. The question of explicitly modeling errors of commission (EOC) in the PRA has been replaced with an identification of possible situations, making an assumption for the PRA with regard to the impact and providing the information to human factors engineering for operational assessment including detailed task analysis and identification of HSI features, procedures and training to minimize the potential for an EOC. The results of these HFE/HRA evaluations are returned to the PRA for adjustment of the assumptions. There is no need to adjust format for Table 19.2-3, but the content is updated as the HFE results are completed and human interface systems are developed and tested.

There are no document revisions as a result of this comment response.

DCD Impact

DCD Tier 2, Subsection 19.2.2.1 will be revised as noted in the attached markup (see Attachment).

DCD Tier 2, Table 19.2-1 will be revised as noted in the attached markup (see Attachment).

NEDO-33267 Section 3.2.1.1 will be revised as noted in the attached markup (see Attachment).

RAI Number 18.7-7 Supplement 3

The RAI response includes markups to NEDO-33267 that provide additional detail on the probabilistic risk assessment/human reliability analysis (PRA/HRA). There are some aspects of the RAI response that need additional clarification.

- *The question regarding Table 19.1-3 was answered by deleting the Table and moving information into Tables 19.2-2 and -3. But the same problems remain. The tables are not adequately explained in the text. It is not clear how the items were selected for the tables. What are the criteria and thresholds? Are the human interactions (HIs) in the table risk-important? Are they the only risk-important HIs?*

- *In the RAI response to Comment 2 on p. 20, explain what was meant by "the quantitative PRA risk importance identification values."*

- *In the RAI response to Comment 9 on p. 21, sentence 2 is not clear. The staff was not able to find the information in Table 19.2-3 as described.*

GEH Response

Responses to these questions resulted in changes to NEDO-33267 and DCD-18.7 as provided in attachments.

Bullet 1

How were items selected for the tables in Chapter 19?

For the Tables in DCD Chapter 19 risk significance is defined in terms of risk increase (RAW) and risk contribution (FV). Also, an increase in CDF risk of greater than or equal to 1 E-7/year is considered risk significant for the design certification ESBWR PRA. For the Tables in Chapter 19 and in NEDO-33201R2, the risk important items are developed using an expert panel based on a review of the risk importance measures for each PRA input. The tables in Chapter 19 no longer contain the details of risk importance analysis, they are in NEDO-33201R2 chapter 17.

What are the criteria and thresholds?

The criteria and thresholds used in developing the list of HIs for HFE review are described in Chapter 19.2.

Are the human interactions (HIs) in the table risk-important?

The Tables in Chapter 19 address insights drawn from review of the risk results and do not contain quantitative links to the risk measures. One insight is that there are no risk significant human actions identified in the PRA. These high level HI descriptions of potentially risk important actions in predecessor BWR PRAs are related to specific components in the ESBWR. The risk important

human interactions from analysis of the ESBWR PRA results are provided in NEDO-33201R2 in Table 17.1-3 and additionally in Table 17.2-5. These HIs are considered to be risk important human actions for evaluation in the HFE task analysis. The potentially risk important HIs used in the HFE evaluation of risk important human actions are also provided in the HRA results summary report.

The human interactions that are used as inputs to the PRA are provided in Table 6.3-3 in NEDO-33201R2 and provide additional potentially risk important HIs.

Are they the only risk-important HIs?

No, additional potentially risk important actions are identified during the TA process, the OER process and observations of simulated scenarios. These actions will be evaluated using automation and HSI improvement to minimize potential errors. Additional PRA modeling is used to assess the quantitative importance.

The Tables in Chapter 19 provide qualitative summaries of risk insights based on the evaluation of importance measures. They do not include the quantitative risk importance measure results. Chapter 17 of NEDO-33201R2 provides risk importance information on human interactions in Tables 17.1-3 and 17.2-5. The human interactions listed in Table 17.1-3 are based on the human error risk thresholds. HIs from the PRA are classified as risk important HAs when their FV measure of importance exceeds a threshold of 0.1 or when their RAW exceeds a threshold of 2.0 when generated from the PRA models as listed in the HRA summary report.

The following text change is made to the LTR in 3.2.1.1 paragraphs 1 and 2.

The ESBWR PRA defines potentially risk-significant structures, systems, and components (SSC) and HI events and information that contribute to CDF and LRF using conservative thresholds, such as FV greater than 0.01, and a RAW greater than 5.0 for individual basic events and a RAW greater than 50.0 for common cause failure events (NEDO-33201R2 Chapter 17). These risk importance threshold values are established to meet PRA goals and support the identification of potentially risk important human interactions.

The risk important HIs from analysis of PRA results are provided in NEDO-33201R2 in Table 17.1-3 and additionally in Table 17.2-5 post-initiator actions. These are considered to be risk important human actions for evaluation in the HFE task analysis. Potentially risk important HIs that are used as inputs to the PRA are provided in Table 6.3-3 in NEDO-33201R2. The risk important HIs used in the HFE evaluation of risk important human actions are also provided in the HRA results summary report.

Bullet 2

The term "the quantitative PRA risk importance identification values." has been replaced with the "risk importance threshold (or cutoff)" to provide a quantitative measure for classifying HAs as risk important and taking action in the design to reduce the risk importance to as low as practical. An example change is: "The risk importance threshold values are established to meet PRA goals and support the identification of potentially risk important human interactions."

Bullet 3

The importance measures for the PRA and the HRA have different uses as explained in a revision to the description as follows in Section 3.2.1.1 Paragraph 3 as contrasted with paragraph 1.

The goal of the HRA and HFE operational analysis in DCD Chapter 18 is to verify that the means are provided in the plant design to keep the quantitative risk importance of all potentially risk important human interactions modeled in the PRA as low as practical. For the purpose of human reliability analysis and human factors engineering, HIs with a FV value greater than 0.1 or a RAW value greater than 2.0 are classified as important to risk.

DCD/LTR Impact

DCD Tier 2, Section 18.7.1 and 18.7.2 has been revised as noted above in Revision 5.

LTR NEDO-33267, Rev 2 has been revised as noted in the text boxes for revision 3.

RAI Number 18.7-7 S04

The response to Supplement 3 and NEDO 33267, Rev. 3, (the Human Factors Engineering (HFE) Human Reliability Analysis (HRA) Implementation Plan (IP)) now provides acceptable criteria for determining the risk-important (RI) human actions (HAs). The staff also reviewed the actual list of RI HAs/human interactions referenced in the RAI response and based on NEDO-33201, Rev. 3 (the ESBWR Certification Probabilistic Risk Assessment (PRA)). This list is not clearly or fully specified in the DCD, the IP, the PRA, or in NEDO-33411, "Risk Significance of Structures, Systems and Components for the Design Phase of the ESBWR," Revision 0.

Please provide (or reference) the current list of all HAs including their importance measures. Provide list(s) ordered by risk achievement worth (RAW) and Fussell Vesely (FV) values for each PRA analysis, namely internal and external events PRAs, and the shutdown PRA, using both core damage frequency (CDF) and large release frequency (LRF) importance. Also indicate which HA meet the criteria for risk importance. This should be based on the latest revision of the PRA. It is understood that the PRA will later be updated and that the RI HA list may change as the PRA and HRA evolve with the ESBWR design.

GEH Response

The current lists of PRA Human Actions, including their importance measures, will be included in Section 17 of NEDO-33201, Revision 4. The lists will be ordered by risk achievement worth and Fussell-Vesely values for the internal and external events PRA, and the shutdown PRA, using both core damage frequency and large release frequency importance values. The revised NEDO 33201 R4, Section 17 will also indicate which human actions meet the criteria for risk importance.

DCD/LTR Impact

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

NEDO-33201, Revision 4 is scheduled to be issued in December 2008, and will include the items requested in this RAI. Per telephone conversation between GEH (Lewis, Miller, et.al.) and NRC (Galvin, et. al.) on December 3, 2008, GEH stated that they will submit a supplement to this RAI in January 2009, which will contain the tables that are described in the GEH response.