REQUEST FOR ADDITIONAL INFORMATION 595-4519 REVISION 0

6/8/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 18 - Human Factors Engineering
Application Section: 18.7 Human Reliability Analysis

QUESTIONS for Operating Licensing and Human Performance Branch (AP1000/EPR Projects) (COLP)

18-85

Criterion: In accordance with NUREG-0711, Section 1.2.1, an applicant in expected to provide implementation plan level details as well as results summary details, and the applicant may choose to submit them as two reports or one. For more complex elements, additional reports may be submitted to address all criteria. When additional information is need it is identified in this section of each element.

Question:

The MHI Human Reliability Analysis Implementation Plan is described in multiple documents, primarily MUAP DC-0018, Rev. 2, 'Chapter 18 Human Factors Engineering,' and MUAP 07007-P, Rev. 3, 'HSI System Description and HFE Process.' The staff also reviewed the following additional MHI US APWR documents for the analysis of implementation plan level details and results summary details:

- MUAP 09019 P, Rev 0, 'US-APWR HSI Design';
- MUAP 08014 P, Rev. 0, Part 1 of 2 – Phase 1a (ML0900903852) and MUAP 08014 P, Part 2 of 2 – Phase 1a (ML0900903852)

Staff is unclear of the relationship(s) among the above documents as they relate to the NUREG-0711 Section 1.2.1 guidance. The applicant is requested to explain the hierarchy and the relationships among these documents. Please include how these documents provide the implementation plan level details and results summary details.

18-86

In accordance with NUREG-0711, 7.4 (1), 'Risk-important human actions should be identified from the PRA/HRA and used as input to the HFE design effort. These actions should be developed from the Level 1 (core damage) PRA and Level 2 (release from containment) PRA including both internal and external events. They should be developed using selected (more than one) importance measures and HRA sensitivity analyses to provide reasonable assurance that an important action is not overlooked

because of the selection of the measure or the use of a particular assumption in the analysis.'

Question:

MUAP 09019 states that HRA sensitivity analysis utilizing Fussell-Vessely (FV) and Risk Achievement Worth (RAW) is used to identify risk important HAs when complete data on the design is not available.

In Section 2.4.2.1 of MUAP 09019 P, the applicant states, "Risk importance measures, such as Risk Achievement Worth (RAW) and Fussell-Vesely (FV)… were used to measure risk importance of HAs."

Staff requests the applicant provide clarification on the use of the term 'such as'. For example, were other measures of risk importance used to determine the importance of HAs in place of, or in addition to, FV and RAW? Also clarify whether other measures will be used in the future in place of FV and RAW. If other measures were or will be used, indicate what measures.

18-87

Criterion: In accordance with NUREG-0711, 7.4 (1), Risk-important human actions should be identified from the PRA/HRA and used as input to the HFE design effort. These actions should be developed from the Level 1 (core damage) PRA and Level 2 (release from containment) PRA including both internal and external events. They should be developed using selected (more than one) importance measures and HRA sensitivity analyses to provide reasonable assurance that an important action is not overlooked because of the selection of the measure or the use of a particular assumption in the analysis.

Question:

As an example of the sensitivity analysis, in section 2.4.2.1 of MUAP 09019, as well as Appendix 2.10.1, the Applicant states that risk important HAs for LPSD are identified based on the following criteria:

- Risk important HAs during mid-loop state
  - Human actions that meet the importance criteria shown below are risk important: FV ≥ 0.005 or RAW ≥2.
- Risk important human action during POSs other than mid-loop state
  - HAs that are risk important during mid-loop are also risk important during other POSs.
  - HAs that are not credited in the PRA for the mid-loop state are all risk important. [Emphasis added.]

The staff currently interprets this last bullet to commit that all actions for plant operational state (POS) in mid-loop state will be considered risk important; this would include actions that are not typically relevant to the PRA. The staff requests the applicant to clarify whether this statement is correct as written and that all actions for plant operational state (POS) in mid-loop state will be considered risk important, including actions that are not typically relevant to the PRA. Staff are aware that this could lead to a large number of

HAs to be 'specially addressed'. If the statement is correct as written, staff requests the applicant provide information on how they will ensure that ALL the HAs that would be derived from the mid-loop PRA will be specially addressed.

18-88

Criterion: In accordance with NUREG-0711, 7.4 (2) 'Risk-important HAs and their associated tasks and scenarios should be specifically addressed during function allocation analyses, task analyses, HSI design, procedure development, and training. This will help verify that these tasks are well supported by the design and within acceptable human performance capabilities (e.g. within time and workload requirements).

Question:

Previously, staff asked RAI 18.0-40, (ML0918303502) which asked MHI to provide discussion of how risk-important human actions will be will be used as input to the HFE design. MHI responded that risk-important HAs and their tasks and scenarios are specifically addressed during Task Analysis, Function Allocation Analysis, HSI design, procedure development and training development. V&V activities are designed to 'specifically address' human performance for risk-important HAs, and validation scenarios all human actions shown by the HRA to be risk significant. Response to RAI 18-42 indicated that the Task Analysis Report and the Functional Analysis Report would provide the detail on how HAs were specifically addressed in these design elements.

Staff reviewed the Task Analysis Report and the Functional Allocation Report and were unable to identify the information which would detail how risk important HAs are specifically addressed in these elements. The commitment that risk important HAs are specifically address is a repetition of the guidance provided in NUREG-0711, which staff uses for reviews. Staff cannot determine a reasonable assurance of safety when the information provided is the guidance for the review.

Staff request information to explain how risk-important HAs will be specifically addressed in the HF elements included in the criteria.

18-89

Criterion: In accordance with NUREG-0711, 7.4 (2), Risk-important HAs and their associated tasks and scenarios should be specifically addressed during function allocation analyses, task analyses, HSI design, procedure development, and training. This will help verify that these tasks are well supported by the design and within acceptable human performance capabilities (e.g. within time and workload requirements).

Question:

The DCD states that the guidelines for incorporating the risk important HAs into the other design elements are contained in NUREG/CR-6689. Staff are aware that NUREG/CR-

6689, “Proposed Approach for Reviewing Changes to Risk-Important Human Actions,” was superseded by NUREG-1764. NUREG 1764 provides an approach for assessing the human performance aspects of changes to operator actions that are applicable primarily for plant modifications, but it is not clear how it provides guidance on incorporation of important HAs into HFE design elements of a new plant design. Staff request clarification of this reference, and identification of applicable guidance and methods for incorporation of risk important HAs into the HFE design elements of a new design.

18-90

Criterion: In accordance with NUREG-0711, 7.4 (1), the use of PRA/HRA results by the HFE design team should be specifically addressed; that is, how are risk-important HAs addressed (through HSI design, procedural development, and training) under the HFE program to minimize the likelihood of operator error and provide for error detection and recovery capability.

Question:

MUAP 09019P states that issues identified during the HRA/PRA integration evaluation are entered into the HFE tracking system. MUAP 09019 P, Section 2.5 states that HRA/PRA integration evaluation data is recorded in a summary (provided in Appendix 2.10.2. “US-APWR HRA/PRA Evaluation Table”). This form is used to identify HFE design issues to be addressed through the HFE design process, primarily in the Task Analysis and HSI design activities. Issues are addressed in the Human Engineering Deficiencies process.

It is not clear to staff how entering issues identified during HRA into the HED system will allow the HFE program to minimize the likelihood of operator error or provide error detection and recovery capability for these HAs. Staff request more detailed information to explain how HAs will be dealt with once they are entered into the HED system or to explain how HAs will be addressed to minimize the likelihood of operator error and provide error detection and recovery capability.

18-91

Criterion: In accordance with NUREG-0711, 7.4 (1), the use of PRA/HRA results by the HFE design team should be specifically addressed; that is, how are risk-important HAs addressed (through HSI design, procedural development, and training) under the HFE program to minimize the likelihood of operator error and provide for error detection and recovery capability.

Question:

In Section 18.6.2 of the DCD, the applicant states that it identifies PSFs using the guidance found in IEEE Std 1082-1997, Subsection 4.5.2; these guidelines are used to 'optimize the PSF, thereby enhancing the overall human success probability.'

Staff request information on what is meant by 'optimization of PSFs'. Staff request further information to clarify how optimization of PSFs will minimize the likelihood of operator error, provide error detection, and error recovery capability.

18-92

Criterion: In accordance with NUREG-0711, 7.4 (4), HRA assumptions such as decision making and diagnosis strategies for dominant sequences should be validated by walkthrough analyses with personnel with operational experience using a plant-specific control room mockup or simulator. Reviews should be conducted before the final quantification stage of the PRA.

Question:

MUAP 09019 P, Section 2.5 states that HFE design issues to be addresses are identified in the 'comment' section of Table 2.10.2. The Applicant states that identified issues are resolved via the HFE design process, in the Task Analysis and HSI Design elements. HRA assumptions are identified for evaluation in Table 2.10.2 in Section 2.5. Section 2.8 states "HSI basic design, operating procedure and operator training program including staffing assumption shall use those assumptions as their input information."

It is not clear that *all* HRA assumptions for dominant sequences will be identified and validated using the process described in MUAP-09019 P, Section 2.5. Staff request clarification that decision making and diagnosis strategies will be validated by walkthrough.

18-93

Criterion: In accordance with NUREG-0711, 7.4 (4), HRA assumptions such as decision making and diagnosis strategies for dominant sequences should be validated by walkthrough analyses with personnel with operational experience using a plant-specific control room mockup or simulator. Reviews should be conducted before the final quantification stage of the PRA.

Question:

MUAP 09019P discusses the use of HRA in the design of US-APWR. Appendices are provided which describe tasks analyzed. Appendix 2.10.1 states that for the low-power and shutdown (LPSD) PRA for the US-APWR DCD, detailed PRA has been carried out only for mid-loop operation state.

The Applicant states that HRA assumptions will be validated via walkthroughs before the final quantification stage of the PRA as part of the V&V process. DCD-0019 implies that the HRA quantification has been performed for the final design. It is not clear to staff when, relative to completion of the V&V process, these reviews will be conducted relative to the final quantification stage of the PRA. Staff request information to clarify when validation of assumptions will be conducted (e.g., during which cycle they will be performed). NUREG-0711, states that reviews of assumptions used in HRA should be conducted prior to the final PRA quantification.

Staff is therefore unclear whether the HRA sensitivity analyses (presented in the Appendix) were run for the JAPANESE standard HSI, for the US BASIC HSI, or for the US APWR HSI design, or for all three iteratively. Staff is further unclear whether identical methods and procedures will be used for later HRA and request clarification.

The applicant is requested to clarify whether the HRA sensitivity analyses (presented in the Appendix) were run for the Japanese standard HIS, for the US BASIC HIS, the US-APWR HSI design, or for all three iteratively.

The applicant is requested to clarify on which design and procedures that HRA analysis will be conducted. If the HRA analysis will be conducted on all three designs or more than one design, please clarify when each will be conducted.

The applicant is requested to provide clarification regarding when HRA assumptions specific to the US APWR design will be validated, as these designs differ in HSI configuration, as well as in type and use of procedures.