

US-APWRRRAIsPEm Resource

From: Ciocco, Jeff
Sent: Monday, March 04, 2013 9:05 AM
To: us-apwr-rai@mhi.co.jp; US-APWRRRAIsPEm Resource
Cc: Green, Brian; Junge, Michael; Ward, William; Hamzehee, Hossein
Subject: US-APWR Design Certification Application RAI 999-6982 (18)
Attachments: US-APWR DC RAI 999 COLP 6982.pdf

MHI,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, MHI is currently working to provide the NRC with a schedule of ongoing HFE work. The schedule will include dates for the submission of this RAI response. We will adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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Application Title: US-APWR Design Certification - Docket Number 52-021

Operating Company: Mitsubishi Heavy Industries

Docket No. 52-021

Review Section: 18 - Human Factors Engineering
Application Section:

QUESTIONS

18-189

10 CFR 52.47, "Contents of applications; technical information" states:

"The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted.

In addition, SECY-92-53 states "The DAC are a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in a limited number of technical areas, in making a final safety determination to support a design certification. The DAC are to be objective (measurable, testable, or subject to analysis using pre-approved methods), and must be verified as part of the ITAAC performed to demonstrate that the as-built facility conforms to the certified design."

Section 3.1, "Background", (page 2-154) of MUAP-09019 does state "The Phase 2b TA addresses the HAs that were not identified as risk important in Phase 2a. The Phase 2b TA also reassesses the RIHAs to confirm the results of Phase 2a, based on additional plant system design detail, as it becomes available."

MUAP-09019 does not contain sufficient detail to determine which specific actions will receive the 2a task analysis treatment and which will receive the 2b task analysis treatment. The detail is not sufficient to support an ITAAC inspection as stated in SEC-92-053.

RAI 5886, Question 18-131 has previously addressed this concern. The response to this question has provided additional information however it does not clearly indicate which human actions will receive the 2a TA and which will receive the 2a and 2b TA.

Please provide sufficient detail describing how the task analysis will be performed to support use of the task analysis implementation plan as a source for ITAAC acceptance criteria.

18-190

Internal consistency issues within MUAP-09019 make it unclear how the plan will be implemented. It is unclear how the methodology addresses the acceptance criteria described in NUREG-0711 section 5.4.

- Section 3.6.1 "Methodology of MUAP-09019 (page 2-156) states "A preliminary

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evaluation will be conducted for each task against the following screening criteria..." This preliminary evaluation will be used to determine if either a Basic or Detailed TA should be performed. This suggests that either a basic **or** detailed TA will be completed. The summary of the same section implies that this decision is made as the third step of the Basic TA process. This suggests that some tasks will have BOTH a basic and detailed TA. Please clarify the method to be used and revise all inconsistent phrases.

- Section 3.9.5 "Methodology" (p2-167) makes reference to a "TA Results table." It is unclear to which table the reader should refer. Please use a reference to a specific table.

- Is table 3.6-1(p2-157) meant to be identical to Table 3.9-1(p2-168)? These tables have the same title and have nearly the same wording. What are the differences between these tables? In the table of tables (in the table of contents) these tables have different titles. Please clarify references in the text, table of tables, and on the tables themselves as necessary so that the tables can be easily distinguished.

- MUAP-09019 Section 3.6.12 "Allocation of control" (page2-162) states "Additional tasks that are not addressed in the FRA/FA have the allocation of control defined in the TA." There is no reference to the process used to determine allocations at this stage. Please describe the process to be used or provide a reference to an appropriate reference.

- MUAP-09019 Section 3.6.9 "Situational and performance shaping factors" (page 2-162) includes consideration of "situational and PSF." However, elsewhere in section 3.9.7 these factors are explicitly excluded. The last line on p2-199 states "The 'Time Required to complete actions' in examples 1 and 2 above are merely a summation of the times required to perform each OSD as specified in Table 3.9-5 because the sub-steps for these RIHAs are not influenced by any other qualitative factors, such as Task Support Requirements, Situational and PSF, or Workplace Factors & Hazards." Please clarify how situational and PSF will be addressed.

Please clarify the description of the processes to be used and update all references and titles to clearly represent the desired processes.

18-191

10 CFR 52.47 "Contents of applications; technical information" states:

"The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted..."

Previously, RAI 5886, Question 18-132 was asked regarding the level of detail provided in MUAP-07007 (R3). The response to Question 18-132 included a commitment to providing a detailed and step-by-step methodology in a revision of MUAP-09019. Additional detail has been added to MUAP-09019, however, there are still areas where additional detail or clarification is needed:

- The last line of section 3.9.7 "Results" states "The 'Time Required to complete actions' in Examples 1 and 2 above are merely a summation of the times required to perform each OSD as specified in Table 3.9-5 because the sub-steps for these RIHAs are not influenced by any other qualitative factors, such as Task Support Requirements, Situational and PSF, or Workplace Factors & Hazards." Please explain the assumptions used to come to the conclusion that these factors are not influenced by these factors.

- Section 3.2 "Purpose" (p2-154) of MUAP-09019 states "Where the TA identifies an excessive task burden for the design basis staff, the staff will generate HED." The wording of this sentence is unclear. The term "excessive task burden" is also used in section 3.6.1

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“Methodology” (p2-156). The definition of “excessive task burden” is unclear. Please clarify what is meant by “excessive task burden.”

- MUAP-09109, Section 3.6.10 “Identify workplace factors and hazards” (page 2-162) states “Under normal main control room conditions, workplace factors and hazards are not present and are not applicable to tasks performed in the control room.” Is there any consideration of tasks for off-normal or emergency situations when task completion is likely to be challenged by the event? Criterion 2 of NUREG-0711 table 5.1 explicitly states “typical and *extreme environmental conditions*.” Please clarify how this implementation plan addresses extreme environmental conditions.

- Section 3.9.5, “Methodology” (p2-167) states “Both actions are represented with shape codes that consist of geometric configurations.” It is unclear what is meant by “geometric configurations.” It is unclear if this is a redundant phrase (all shapes are “geometrically configured”) or if some additional meaning is meant to be conveyed by this phrase. Please clarify what is meant by this phrase or revise.

- Section 3.9.6 “Task Linking and Cognitive Workload Analysis” (p2-170) states “task frequency and load become obvious.” This phrase is not specific enough to support measurable ITAAC acceptance criteria. Please specifically state how task frequency and load are determined and will be documented.

- Section 3.9.6 “Task Linking and Cognitive Workload Analysis” (p2-187) states “That is based upon an information processing framework that assumes a number of different states of types of memory with separate perceptual, motor, and cognitive processing.” The sentence is vague. It is unclear to what the pronoun “that” is referring. Please revise this sentence or clarify the pronoun reference.

Please revise to include the enough detail to provide measurable ITAAC acceptance criteria.

18-192

Section 5.4 of NUREG-0711, criterion 2 states: “The analysis should define the nature of the input, process, and output needed by and of personnel.” Several specific questions are listed below regarding the appropriateness of using GOMS as a workload estimate. GOMS is not typically used as workload measurement method and it is unclear how the method described will produce the desired output as stated in the criterion.

Several questions regarding the use of GOMS had previously been asked in RAI 5886 Question 18-134. The response to the question states that “GOMS is used as an optional detailed task analysis methodology,” however elements of NUREG-0711 Section 5.4 criterion 2 and 4 are not clearly addressed if GOMS is not considered. Moreover it is not clear from MUAP-09019 and the response to Question 18-134 how the use of GOMS provides valid workload estimates as this is not the purpose of GOMS.

[Please explain what validation has been done to use GOMS as workload measurement/estimation tool. In addition, please address the specific questions below.](#)

1. MUAP-09019 Section 3.2 “Purpose”(Page 2-155) states “The TAs provides {sic} one of the bases for making design decisions, verifies human-performance requirements do not exceed human capabilities...”

It is unclear how the plan addresses physical workload considerations such as: collocated actions such as simultaneous key turns, the time it takes to walk from one part of the control room to another, or other concurrent tasks such as reporting for drug testing that might influence the operator’s ability to complete a task.

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Please clarify how the methodology described addresses aspects commonly associated with physical workload, especially those that are functions of distances between two points. How does MUAP-09019 address these high level considerations which are likely to have a greater impact on human performance than the low level considerations shown by a GOMS analysis?

2. MUAP-09019 Section 3.6.6 “Time Constraints” (page 2-161) discusses the “time required” to complete tasks. It is not clear how the “time required” is different from the measurement of what is referred to as Workload in the final column of Table 3.9-4 “Time Required to Perform OSD Pattern Tasks”? This measurement is reported in units of msec which would be consistent with Time Required.

Please explain how “time required” is different from workload as described in this methodology. If these are in fact treated as similar constructs please describe how this methodology provides a reasonable estimation of workload as it related to NUREG-0711 Section 5.4 Criteria 2&4. If these are not treated as similar constructs please clarify why the workload column on Table 3.9-4 (p2-190) is reported in msec.

3. MUAP-09019 Section 3.9.5 “Methodology” (page 2-167) states “The OSD is utilized to identify simplified operator action patterns and break down complicated or integrated operator actions into OSD patters in order to evaluate operator’s physical and cognitive workload.” It is unclear how these “simplified operator actions” provide a reasonable estimation of workload in an operational setting which is not simplified. Considering workload at this level omits realistic and probable concurrent operator actions which will increase workload such as answering telephones, fire brigade duties, etc.

Please describe how the methodology addresses concurrent tasks.

4. Section 3.9.6 “Task Linking and Cognitive Workload Analysis” (p2-187) states “In order to evaluate an operating crew member’s cognitive workload, human information processor model is used.” The Information Processing Model provides time estimates for perceptual, motor, and cognitive cycle times. It is not typically considered a workload measurement technique.

Please provide evidence supporting use of the Information Processing Model as a workload estimation technique that meets Criterion 2 of NUREG- 0711, Section 5.4.

5. Section: 3.9.6 “Task Linking and Cognitive Workload Analysis” (p2-187) states “The result of the evaluation is a set of quantitative metrics including workload and processing time for each scenario.” This suggests that there should be two separate values: one for workload, the other for processing time. It appears that the data are simply referring to process time as workload instead of providing an actual workload estimate. This is demonstrated on Table 3.9-4 (p2-190) where the Workload column is presented in units of msec.

Please clarify the treatment of workload vs. processing times as described in this methodology.

6. Section 3.9.6 “Task Linking and Cognitive Workload Analysis” (p2-187) has 3 bullets describing process times for tp, tc, and tm. The values used in MUAP-09019 are using mean process times which may be idealized for some users and under some conditions. Card, Moran, and Newell provide ranges for each of these figures which account for slower and faster than average human performance. These ranges were referenced in the response to RAI 5886 Question 18-134 but were not included in this revision MUAP-09019.

Please describe any considerations given for faster than average and slower than average

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cognitive, physical, and motor process times?

7. Table 3.9-3 (p2-189) shows the Extended Basic Actions. These are not part of the classic GOMS model. It is not clear from MUAP-09019 how these Extended Basic Actions were created, how they will be used, or how they have been validated to ensure that they will provide a useful output.

The response to RAI 5886 Question 18-134 provides some additional detail in a Table on page 18-15. However the entries are vague and use incomplete sentences. The items on the table in the RAI response have different names than those on Table 3.9-3.

Please provide clear descriptions of the Extended Basic Actions and example of how and when they will be used. For instance, what are some examples of “simple reaction without move” or “simple reaction without perception?” In addition, please establish consistent terminology that matches the definitions.

8. Section 3.9.7 “Results” (p2-198) states “This time is also specified in Table 3.9-6 “Response Time Criteria for Risk significant human actions” in the “Time Required” column, which is less than the time of one hour specified in the “Time Available” column, and concludes that there is sufficient margin between the Time Available (as defined in the safety analysis or PRA) and the Time required (as determined by the HFE TA).”

The methodology does not specifically state how much margin is necessary to make a determination if the Time Required is adequate. It is not clear what the difference between the time available and time required needed to be to be considered adequate margin. For instance, if the Time Required was estimated to be 59 minutes and the time Available was 60 minutes would this be considered adequate margin?

Please clarify the criteria used to determine the difference between adequate and inadequate safety margin.

9. Section 3.9.7 “Results” (2-199) states “The ‘Time Required to complete actions’ in Examples 1 and 2 above are merely a summation of the times required to perform each OSD as specified in Table 3.9-5 because the sub-steps of these RIHAs are not influenced by any other qualitative factors such as Task Support Requirements, Situational and PSF or Workplace Factors & Hazards.” The basis for this statement is unclear as written. For instance, low light conditions or smoke could affect the operator’s ability to see displays which could adversely influence perception times.

Please clarify the basis for the statement and provide evidence to support the statement or revise.

