US-APWRRAIsPEm Resource

From: Ciocco, Jeff
Sent: Monday, March 04, 2013 10:02 AM
To: us-apwr-rai@mhi.co.jp; US-APWRRAIsPEm Resource
Cc: Bongarra, James; Junge, Michael; Ward, William; Hamzehee, Hossein
Subject: US-APWR Design Certification Application RAI 1002-6994 (18)
Attachments: US-APWR DC RAI 1002 COLP 6994.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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United States Nuclear Regulatory Commission
Protecting People and the Environment

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REQUEST FOR ADDITIONAL INFORMATION 1002-6994

Issue Date: 3/4/2013

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

18-221

MUAP-09019, R-2, page 2-1, section 1.1, Purpose, states: “The goal of the US-APWR HFE FRA/FA is to identify the plants Critical Functions that must be maintained to meet plant safety and power production goals, and to ensure that the Success Paths that are used to control those Critical Functions are assigned properly as either HAs or to automated systems.” Please explain why the term “Critical Functions” is used. Are all functions that are necessary to accomplish plant safety and power production goals “Critical?” Are there functions that must be performed to accomplish plant goals that are not “Critical” but, nonetheless considered necessary achieve and maintain plant goals? Also, please identify where is the term “Critical Function” used in IEC 60964 (or IEC 61839)? The term does appear in IEC 964 (1989). Also, please explain why Success Paths are only assigned to either HAs or automation and not a combination as well. See also similar/disimilar statements later in page 2-1, section 1.1 and pages 2-9 & 2-10.

18-222

MUAP-09019, R-2, page 2-1, section 1.1, Purpose, states: “The FA allocates control of actions, identified in the FRA, which are categorized as either Machine (automatic), Human (manual) or Shared based on HFE principles.”

What actions are identified from the FRA? Provide an example(s). Also, this statement indicates that FA actions can be allocated as shared as well as manual or automatic, which is different than the initial statement in the Purpose section. Please reconcile this discrepancy.

18-223

MUAP-09019, R-2, page 2-1, section. 1.2, Scope and General Description: The material reads more like a laundry list rather than a discussion of the scope and general description of FRA/FA. Please restructure this information to clearly delineate information that is “scope” of the FRA/FA and material that is “general description.”

18-224

MUAP-09019, R-2, page 2-1, section. 1.2, Scope and General Description states: “(2) The FRA/FA relies on the joint knowledge and experience of SMEs and reviewers. To control the bias of past experiences in conventional MCRs and staffing levels that may be introduced into

the FRA/FA, the SMEs are specifically instructed to not consider current operating reactor practices (allocations) in their final US-APWR allocations[emphasis added]. These final allocations get reviewed by the designers and any differences are identified as HEDs. The FRA/FA is revisited as the design matures."

This approach seems like it would discourage using important operating experience that only SMEs would have rather than biasing judgment. Also, this statement seems contrary to statements made later in the process description that seem to emphasize SME experience. For example, page 2-26, discussing the load evaluation process states, "The load associated with the concurrent Critical Functions is evaluated based on SME experience." Please explain why these instructions are not inappropriate and the apparent discrepancy in instructions.

18-225

MUAP-09019, R-2, page 2-2, section. 1.2, Scope and General Description states: "(6) The FRA/FA is first performed by three SMEs having integrated nuclear plant operational experience on conventional 4-loop Westinghouse PWRs. The FRA/FA then undergoes subsequent review by other SMEs possessing HFE and control engineering experience. The FRA/FA review organization consists of team members from Mitsubishi Heavy Industries (MHI) and Mitsubishi Nuclear Energy Systems (MNES), consultants to MHI/MNES, subcontractors to MHI/MNES, and operations experts from US-APWR COLA applicants."

Please explain how this process was performed. Specifically, explain how this "2-step" FRA/FA process was performed as it related to Appendix 1.8-5 Team Members.

18-226

MUAP-09019, R-2, page 2-2, section. 1.2, Scope and General Description states, "(9) The following events and HAs are reviewed, against the plant goals to ensure that applicable Success Paths exist:

• DCD Chapter 15, Table 15.0-1 PA and AOO

• DCD Credited HAs contained in DCD Table 7.5-5 *List of Accidents and Credited Manual Actions*."

Have PRA-identified events that include HAs also been included? If yes, where are these identified? If not, why not?

18-227

MUAP-09019, R-2, page 2-3, item (13) states: "The only allocation changes identified in the plant system designs from the conventional PWR plant's functions are:

• Addition of automatic isolation of Emergency Feedwater for a faulted steam generator.
• Elimination of manual or automatic Emergency Core Cooling System (ECCS) sump switching. Refueling Water Storage Pit (RWSP) is located inside containment and replaces the containment sump."

DCD proposed R-4 (redline/strikeout version provided after the September 6 public meeting) page 18.3-6, states: "Automatic establishment of recirculation for ECCS." The description of this change to the US APWR from the Japanese PWR is inconsistent with the change

described in MUAP-07007 (R5), section 5.3, page 109 ("elimination of of recirculation of ECCS"). The proposed DCD revision indicates that the ECCS function was automated; the HFE Topical Report (MUAP-07007) description states that the ECCS function was eliminated; MUAP-09019 (R2) states yet a different change. What change is correct? Please reconcile the discrepancies and any others that may exist in other licensing documents.

18-228

MUAP-09019, R-2, page 2-4, section. 1.3, Definitions: NRC staff suggests placing this section before the scope and general description as some of the terminology in the definition section is used in text prior to the section.

18-229

MUAP-09019, R-2, page 2-4, section. 1.3, Definitions, states: "Function – A process or activity that is required to achieve a desired goal. For the purpose of this analysis, functions are divided into two categories, Critical Functions which are composed of Sub-functions." Please explain what are the two "categories" being referred to; there doesn't seem to be a second category provided in the definition.

18-230

MUAP-09019, R-2, page 2-7, section. 1.4.2, Functional Requirements Analysis, item (3) defines plant modes and describes their use in FRA/FA.

How did MHI determine that these modes were the only plant modes requiring analysis? For example, does MHI's shutdown mode definition include shutdown conditions as defined by technical specifications? Also, please explain why refueling is not identified and analyzed as a mode, as there are risk important human actions associated with that mode.

18-231

MUAP-09019, R-2, page 2-8, section. 1.4.2, Functional Requirements Analysis, item (4) identifies and defines plant conditions.

Why has MHI limited their definition of abnormal conditions? This definition seems limited to very extreme circumstances and not sufficiently sensitive to cover beyond design basis/severe accidents.

18-232

MUAP-09019, R-2, page 2-10, section. 1.4.3, Function Allocation, first paragraph, makes a statement regarding how the allocation is performed and references IEC-60694.

IEC 60964 (specifically, IEC-61839), states that "the designer shall consider, at a minimum…" seven characteristics. MHI used less than seven. Please explain why MHI did not include at least seven characteristics.

18-233

MUAP-09019, R-2, page 2-11, section. 1.4.4, Comparison, second sentence, mentions the possibilities of allocations that are different than that of the US-APWR system designs.

Where are the US-APWR system designs being referred to in this section? As the NRC is in the process of completing a design certification review for the US-APWR, to what US-APWR design is this FA being compared?

18-234

MUAP-09019, R-2, page 2-11, section 1.4.6, Consensus Process Description, last bullet, discusses how consensus is reached.

Please explain how the COL participated in evaluating the results of the FRA/FA. For example, how many representatives from the COL participated in the evaluation? What were their technical backgrounds? What criteria did the COL use to evaluate the FRA/FA results? What criteria were used to arrive at consensus?

18-235

MUAP-09019, R-2, under 1.8 Appendices, page 2-15, Appendices section 1.0, Instructions for Functional Requirements Analysis, FRA, sub-section 1.2 (1), lists Critical Functions based on guidance from IEC-60694 and industry experience.

Please identify where in IEC 60964 the listed Critical Safety Functions are specified or the method and basis MHI used to determine these functions.

Also, please confirm that the Section 1.4.2 mentioned in Appendices section 1.0 refers to the earlier section 1.4.2 of MUAP-09019. If this is correct, clearly state this in the sentence. If not, please revise the sentence to clearly state the document being referenced.

18-236

MUAP-09019, R-2, Appendix 1.8-3, page 2-26, sections 1.1.1 and 1.1.2 discuss the potential for skewing the aggregate average Load value if certain numeric values were used in the calculations for both Power Production and Safety goals (see tables 1.8-3a and 1.8-3b). In order for the statements made in these sections to be true, MHI made some unidentified assumptions. Please provide and explain any assumptions made which support the decisions made in these paragraphs.

18-237

MUAP-09019, R-2, Appendix 1.8-3, page 2-31, section, 1.2.3, states: “Initial Assignment – The initial assignment is the designer’s allocation to Human, Machine, or Shared that is documented in and/or determined from current US-APWR system design documents.”

Please explain the meaning of this statement. For example, who are the “designers” and, specifically, where in US-APWR system design documents have the designers specified the allocation of control and monitoring functions to humans or machines?

18-238

MUAP-09019, R-2, page 2-72, Appendix 1.8-5 FRA/FA Team Member Qualifications and Experience, states: “The FRA/FA team as a whole contains HFE experts, I&C experts, and nuclear plant process, systems, and operations experts with educational backgrounds

supporting their expert credentials."

Please identify and explain where the HFE and I/C areas of expertise are contained within the team. Also, expertise and input from PRA is not evident from the experience descriptions. Please explain how this discipline is represented by the team.

18-239

MUAP-09019 (R1) vs MUAP-09019 (R2): Why was figure 1.4-2 eliminated from R2? Where else in MHI's FRA description is the functional requirements hierarchy displayed and described? A hierarchy diagram provides needed analytic detail and should be retained and integrated into the FRA/FA method description. As well, the hierarchy diagram should be US-APWR-specific, not merely representative of a previous FRA for a conventional PWR. The diagram's value is that it depicts the results of MHI's analysis of the US-APWR functional decomposition; a diagram for a previous conventional PWR does not demonstrate that MHI analyzed the function requirements of the US-APWR.


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