

REQUEST FOR ADDITIONAL INFORMATION 793-5880 REVISION 3

7/27/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 18 - Human Factors Engineering

Application Section: 18.3

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

18-141

NUREG-0711, item 4.4 (3) states in part that a description of the functions and systems should be provided. Safety functions include functions needed to prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public.

MUAP-09019-P, Figure 1.4-2 provides the Functional Requirements Hierarchical Structure, which shows the Plant Goals of Availability and Safety. Below the Safety Goal on this figure are the high level functions, which are properly focused on the reactor fuel and reactor coolant system. However, it does not address at all the spent fuel in the spent fuel pool or in dry storage onsite. This should also be part of the FRA and FA. Please address.

18-142

DCD Tier 2, Section 18.3.3 states that one of the two changes in FA for the US-APWR is "automatic isolation of a failed steam generator (SG)." From further reading of both the DCD and the D3 Coping Analysis report this does not appear to be an accurate statement. More detail about the actual design is provided in MUAP-09019, part 2, Section 1.4.1; and MUAP-07014, Figure 5.6.3-1 on page 5-39, which lists the first SGTR specific manual action as "isolation of the affected SG." DCD Section 15.6.3.4.2 item (c) also describes that the major operator action on an SGTR is to isolate the ruptured SG with 5 minutes after the reactor trip. Please correct and update the DCD in this area.

18-143

In the applicant's response to RAI Question 18-82, the applicant stated that MUAP-09019 (R0), Part 2, Section 1 contains the Results Summary Report (RSR) for FRA/FA activities. An RSR is needed for completed elements so the staff can review the methodology, its implementation, and the produced results. The staff recognizes that the RSR is a summary, but it should contain the results pertinent to each aspect of the methodology reviewed by the staff. This does not appear to be the case with the results provided in MUAP-09019 (R0), Part 2, Section 1 or its appendices. For example, results illustrating how OER was used to identify modifications to function allocations (NUREG-0711, Section 4.4, Review Criterion 7) did not appear in an Appendix 1.8.5. Also, the analysis of personnel responsibilities to monitor automatic functions and to assume

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manual control in the event of an automatic system failure (Review Criterion 8) was only shown for a few functions. Summaries of how the methodology was used to produce results for the US-APWR should be provided or should be made available for staff audit. MHI is requested to provide this information or explain when and how it will be provided.

Reference: MHI's Responses to US-APWR DCD RAI No. 594 COLP-4429; MHI Ref: UAP-HF-10197; Dated July 9, 2010; ML101930501.

18-144

The DCD and the Compliance Roadmap (MUAP-09024) both reference MUAP-09019 and MUAP-07007 for detailed information concerning how FA is performed. The methods described are not completely the same. For example, in MUAP-09019, Revision 0, HSI Design, Part 2, Section 1.4.2, Function Allocation, the allocation is based on an assessment of five dimensions: Load, time margins, rate, complexity of action logic, and complexity of decision-making. In MUAP-07007, Revision 3, Section 5.3.2, Function Allocation, functions are allocated in accordance with a set of general rules (which overlap with the 09019 dimensions) and a set of additional considerations, such as "automation has to ensure that the plant can be operated by one RO in all plant situations without multiple failures/events" and "automation may be appropriate to standardize frequently used sequences of actions like normal/back-up switching of actuators." The additional considerations do not appear to be part of the MUAP-09019 methodology. Please clarify the relationship between the two and which method or combination of methods was used for the US-APWR.

18-145

In the DCD, Tier 2, Section 18.3.1.2, Function Allocation Analysis, and MUAP-07007, Revision 3, Section 5.3.2, Function Allocation, the applicant states that the methodology allocates functions to personnel (manual control), system elements (automatic control), and a combination of manual and automation (shared control). In MUAP-09019, Appendix 1.8.4, Function Allocation Determination, five allocation parameters are rated for each function analyzed and an overall assignment is made to human or automation. The method does not provide an opportunity for shared control. Please clarify how the methodology achieves its stated objective to allocate to manual, automatic, or shared control.

18-146

The function evaluation criteria are qualitative and depend to a great extent on subjective evaluations. MUAP-09019, Revision 0, HSI Design, Part 2, Section 1.6.1, FRA/FA Team Responsibilities, describes the FRA/FA team. Section 1.6.3, Additional Guidance, points to the DCD, Section 18.1 for additional information. However, the DCD does not mention the FRA/FA team. Who is the FRA/FA team, how does the team perform the evaluations (individually or as a group) and how does it differ from the HFE team?

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18-147

DCD Tier 2, Revision 3, Section 18.3.3, Results, states that the technical basis for each function allocation is documented in accordance with the staff's review criterion number 6 (NUREG-0711, section 4.4). The DCD references MUAP-07007, Revision 3, HSI System Description and HFE Process, Figure 5.3-1. This figure presents the hierarchical structure of safety functions. Please clarify the relevance of this figure to the technical basis for allocations. The DCD further references Section 5.3.2 of this document which provides a description of rules and considerations for allocating functions. Please identify where these considerations are used to provide a technical basis for function allocations.

18-148

The DCD and MUAP-09019 both indicate that the function analysis considers personnel responsibilities to monitor automation and assume backup in the event of failure. The information provided restates the staff's review criterion. The methodology used to perform this evaluation and documented results of such evaluations are not provided.

The staff identified this concern in Question 18-72, which the applicant responded to on July 9, 2010. The applicant indicated that the US-APWR control system uses manual and automatic control. Each is available to the operator, but manual is not considered a failure backup. This response does not clearly address the question of how the FRA/FA methodology addresses the DCD and MUAP-09019 commitment to consider the responsibilities of personnel with respect to monitoring automation and backing it up. Please provide this information.

Reference: MHI's Responses to US-APWR DCD RAI No. 594 COLP-4429; MHI Ref: UAP-HF-10197; dated July 9, 2010; ML101930501.

18-149

MUAP-09019, Revision 0, HSI Design, Section 1.4.3, Data Documentation, states that a description of the integrated personnel role across functions and systems is provided in terms of personnel responsibility and level of automation. The information provided restates the staff's review criterion. The document references Tables 1.8-4 and 1.8.5. Appendix 1.8.5 describes allocations for high-level functions on a function-by-function, not an integrated role across functions. Please clarify how the methodology addresses the integrated personnel role and where the results are documented.