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Sent: Thursday, July 24, 2008 8:55 AM
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Subject: US-APWR Design Certification Application RAI No.35
Attachments: US-APWR DC RAI 35 SPLA 746.pdf

MHI,

Attached please find the subject request for additional information (RAI). This RAI was sent to you in draft form. The schedule we are establishing for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. Please submit your RAI response to the NRC Document Control Desk.

Thanks,

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REQUEST FOR ADDITIONAL INFORMATION NO. 35 REVISION 0

7/24/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation

Application Section: RG 1.206

SPLA Branch

QUESTIONS

19-79

At the introduction of Chapter 3 of the PRA report (page 3-1) it is stated that "The success criteria for event headings are defined in Table 3.2.1.3-1 to Table 3.2.17.3-1." These tables appear to include information that is confusing since there is no explicit association of the top event headings with their associated success criteria and no explanation. Please explain how the success criteria listed in these tables are related to the event tree top events. Examples of confusing information provided in Tables 3.2.1.3-1 to 3.2.17.3-1 are:

- Table 3.2.3.3-1 (SLOCA) shows 2 out of 4 and 3 out of 4 success criteria for "secondary cooling system." If these success criteria are associated with top event EFA (emergency feedwater system), it is not clear why two sets of criteria are used for same top event. In addition, no criteria for turbine bypass, main steam relief or main steam safety valves are listed.
- Note (5) in Table 3.2.3.3-1 (SLOCA) reads: "Alternate CV cooling is ¼ are undecided." Please clarify.
- Table 3.2.2.3-1 (MLOCA) does not include any success criteria for top event SRA "secondary side cooling."
- Table 3.2.2.3-1 (MLOCA) shows 1 out of 4 and 1 out of 3 success criteria for "CS/RHR (heat removal)." If these success criteria are associated with top event CXC, it is not clear why two sets of criteria are used for same top event.
- Table 3.2.4.3-1 (VSLOCA) shows some success criteria in parentheses without any explanation.

19-80

At the introduction of Chapter 3 of the PRA report (page 3-1) it is stated that "The description of each event heading and branch of event trees is shown in Table 3.2.1.2-1 to Table 3.2.17.2-1." These tables appear to include undefined events and other terms as well as confusing information since in many instances there is more than one fault tree associated with a top event heading without any explanation. Please explain how the information provided in the last two columns, labeled "input event" and "bc set," is

related to the first column, labeled "event heading name." Examples of confusing information provided in Tables 3.2.1.2-1 to 3.2.17.2-1 are:

- Events ZZ0 and RSS-RHR-LL in Table 3.2.1.2-1 are not defined.
- Event CXC in Table 3.2.2.2-1 has two input events (fault trees): RSS-CSS-HR and RSS-RHR-HRML. However, Table 6A.3-2 shows top event CXC associated with fault tree RSS-RHR-HRML and top event CXA associated with fault tree RSS-CSS-HR.
- Event CXB in Table 3.2.3.2-1 has two input events (fault trees): RSS-CSS-HR and RSS-RHR-HRSL. However, Table 6A.3-2 shows top event CXB associated with fault tree RSS-RHR-HRSL and top event CXA associated with fault tree RSS-CSS-HR.
- Event FNA8 in Table 3.2.5.2-1 has three input events (fault trees): NCC, NCC-SG-DP2, and NCC-SG-DP3. However, fault trees NCC-SG-DP2 and NCC-SG-DP3 are not defined.

19-81

The information on system functions/success criteria for the CS/RHR system, provided in Table 6A.3-2 and Tables 6A.3-3 to 6A.3-10 of the PRA report, includes several conflicting and confusing statements that need clarification. Examples are:

- It appears to be conflicting information between Tables 6A.3-2 and 6A.3-7 and event trees for several initiating events. Tables 6A.3-2 and 6A.3-7 indicate that top event CXA "pump RWST water by CS/RHR, with cooling through the heat exchangers, to containment spray hearers" applies to initiating events, such as LLOCA, MLOCA, SLOCA and SGTR, which is not in agreement with the event trees. Please clarify and revise, as necessary.
- Table 6A.3-2 indicates that top event CRC applies to LLOCA, MLOCA and ELDV initiating events. However, the MLOCA event tree uses top event CRD which is not defined in Table 6A.3-2 or anywhere else. Event tree ELDV is not defined or discussed in the PRA. Please clarify and revise, as necessary.
- The top events CRB1 and CXB1 are used in the VSLOCA event tree, which are not defined. Please explain how are these events different from events CRB and CXB defined in Tables 6A.3-2, 6A.3-4 and 6A.3-8.
- Table 6A.3-2 indicates that both top events CXA and CXD are applicable to SGTR sequences only. However, the SGTR event tree shows only top event CXD for which no description is provided in Section 3.2.8.2 (a description of top event CXA is provided in Section 3.2.8.2). Please clarify and revise, as necessary.
- Top events CRA and CXD apply to SGTR accident sequences according to the information provided in Tables 6A.3-2, 6A.3-6 and 6A.3-10. However, there is no discussion how these two events are different and under what conditions each of them apply. Please explain.
- Top events CXB (described in Section 3.2.3.2 for SLOCA) and CXC (described in Section 3.2.1.2 for LLOCA and in Section 3.2.2.2 for MLOCA) are described as "....heat removal from the containment vessel atmosphere and cooling of the RWSP water....using spray lines and CS/RHR pumps." However, these events are associated in Table 6A.3-2 with success criteria for injecting water to cold legs and to fault tree identifiers RSS-RHR-HRSL and RSS-RHR-HRLM,

respectively. These fault tree identifiers are described in Tables 6A.3-8 and 6A.3-9, respectively, as "Intake RWSP water by CS/RHR pump and inject water by CS/RHR Heat Exchanger to Cold Legs Pipe." Please clarify and revise, as necessary.

19-82

In Section 3.2.6.2 of the PRA report (page 3-25) it is stated that "The Reactor Vessel Rupture Event Tree is shown in Figure 3.2.6-1. A description of each event heading and branch of Reactor Vessel Rupture Event is shown in Table 3.2.6.2-1." However, Figures 3.2.6-1 and 3.2.6.2-1 are not included in the PRA report. Please clarify and revise, as necessary.

19-83

Several sequences in many event trees indicate that both containment spray (top event CSA) and alternate core injection by CS/RHR through the cold legs (e.g., top events CRB and CRB1) can be successful in same sequence (e.g., LLOCA sequence #18 and VSLOCA sequence #3). Since event CRB requires closing the containment spray header isolation valves (Table 6A.3-4), it appears that containment spray ceases its operation when alternate core injection is activated by the operator. Please state the key assumptions that were made and explain the basis of the assumed mission time for the containment spray function and the time window for successful switching to alternate core injection.

19-84

The medium LOCA (MLOCA) event tree model is discussed in Section 3.2.2 of the PRA report. On page 3-6 it is stated: "In the medium LOCA, RCS pressure is higher than CS/RHR pumps zero-flow pressure, so the additional time to decrease the RCS pressure with secondary side cooling is required." On page 3-8, where the top event SRA is defined, it is stated: "When CS/RHR (Spray injection) System is not available, this measure depresses RCS pressure and enables to actuate CS/RHR (alternate injection) System and CS/RHR (heat removal) System." However, the staff notices that the top event SRA "Secondary side cooling to depressurize the RCS" is credited towards the end of the event tree and there are several MLOCA sequences (e.g., MLOCA sequences # 5 and #7), as well as sequences in the SLOCA and VSLOCA event trees, where CS/RHR injection and heat removal is credited without secondary side cooling. Please explain.

19-85

Two top events, related to secondary side cooling/depressurization, are used in the small LOCA (SLOCA) event tree. These two events, which are described in Section 3.2.3.2 of the PRA report, are (1) top event EFA "Emergency Feedwater System," and (2) top event SRA "Secondary side cooling to depressurize the RCS." Event EFA is defined as "...a combined operation of SG feed water by emergency feedwater system, and the actuation of either the main steam relief valves, the main steam safety valves or

turbine bypass valves." Event SRA is defined as "....secondary side cooling to decrease RCS pressure and temperature by opening the main steam relief valves and supplying water with emergency feedwater system." Please discuss the differences between these two top events and state their success criteria in terms of minimum equipment needed for success, operator actions needed, and preferred means (if any) for performing the associated accident mitigation functions (e.g., turbine bypass valves versus main steam relief valves and main steam safety valves).