REQUEST FOR ADDITIONAL INFORMATION 564-4399 REVISION 2

3/29/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

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

QUESTIONS for PRA Licensing, Operations Support and Maintenance Branch 1 (AP1000/EPR Projects) (SPLA)

19-423

Dominant sequence #4 (19LOOP_A-0004) with a CDF of about 9.0E-8/yr and 8.7 percent contribution, is initiated by a loss of offsite power (LOOP) event followed by the failure of all CCW pumps to restart (even though emergency power is available) and by the failure of alternate component cooling of the charging pumps (using water from either the fire suppression system or the non-essential chilled water system). This leads to loss of cooling of the RCP seals and, thus, a RCP seal LOCA. Since no systems which can mitigate the seal LOCA are available due to the total loss of CCW, the core is uncovered and core damage occurs. Risk important failures appearing in the minimal cutsets of this sequence are listed below:

- CCF of emergency service water (ESW) pumps to restart following loss of offsite power
- CCF of CCW pumps to restart following loss of offsite power
- Operator failure to connect the fire suppression pumps to the CCW system and provide alternate cooling to the charging pumps
- Operator failure to connect the non-essential chilled water system (cooling tower) pump to the CCW system for alternate cooling of the charging pumps
- CCF to open of three of four incomer 6.9kV ac bus circuit breakers from the unit auxiliary transformer (52/UATA,C,D)
- CCF to open of the incomer 6.9kV ac bus circuit breakers from the reserve auxiliary transformer (52/RATA,C,D)
- CCF of the Class 1E GTGs to start and run
- Unavailability of ESW pump B due to test or maintenance.

These failures imply that the accident sequence includes failures of emergency ac power, which contradicts the description of the sequence provided in both the DCD Rev 2 and PRA Rev 2. Please clarify the description of the accident sequence by referring to the LOOP event tree (Figure 3.2.14-1 of the PRA Rev. 2) and explain why all the dominant cutsets reported in Table 10.5-10 of the PRA Rev. 2 belong to this sequence.

In addition please explain/clarify the following:

(a) Define the sequence designator 19LOOP_A-0004 in the report,

(b) Define the terms LOOP_A, LOOP_B, and LOOP_C, appearing in the LOOP event tree,

(c) The reason the CCF to open of all 4 incoming 6.9kV CBs does not appear the cutsets,

(d) Was credit taken for manually opening the incoming CBs to buses A and B?

(e) The reason that only the unavailability of ESW pump B appears in the cutsets.

19-424

The following statement is made in Chapter 19 of the Revision 2 of the DCD (page 19.1-2):

"At the design phase, the PRA results have been used as information providing input to technical specifications…" Please provide a brief discussion in the DCD of the specific PRA information that has been used as input to technical specifications (TS), including the reasons/objectives for using PRA information as input to TS and how such information impacted the standard TS.

19-425

The following statement is made in Chapter 19 of the Revision 2 of the DCD (page 19.1-2 and 19.1-144-145):

"At the design stage…..PRA insights are utilized to develop risk-managed technical specifications (RMTS) and surveillance frequency control program (SFCP) in accordance with Reference 19.1-11 and 19.1-44, respectively."

It is not clear to the staff how PRA insights "are utilized at the design stage" to develop RMTS and SFCP. Please explain and revise the DCD, as necessary.

19-426

Several statements are made in Chapter 19 of Rev. 2 of the US-APWR DCD concerning the quality, technical adequacy, and level of detail of the PRA, such as the following (pages 19.1-4, 5 and 6):

"The quality of the PRA is sufficient to provide confidence in the results, such as that the PRA may be used in regulatory decision-making and to support risk-informed applications."

"The level of detail of the PRA is sufficient to provide confidence in the results such that the PRA may be used in regulatory decision-making to support risk-informed applications."

"The PRA has been developed in accordance with industry consensus standards ……and has subjected to a peer review process as defined in ASME-RA-S-2002 and associated addenda ….and as outlined in the Nuclear Energy Institute (NEI) peer review guide…."

"Upgrades of the PRA will receive a peer review in accordance with the requirements detailed in Section 6 of ASME RA-S-2002 and associated addenda, but will be limited to aspects of the PRA that have been upgraded."

Based on its review, the staff believes that these statements are not completely supported by the provided information, especially regarding the technical adequacy of the design certification PRA to support certain risk-informed applications, such as risk-managed technical specifications (RMTS):

- The staff has identified and communicated to MHI through the RAI process several areas of the design certification (DC) PRA model that need further investigation to determine whether specific PRA model improvements are needed to support certain risk-informed applications. MHI has indicated in RAI responses its agreement to consider future PRA model improvements in certain areas. Please discuss.
- Since a peer review was conducted, please provide the peer review findings and observations (F & O) and how they were dispositioned. Also, it is not clear from the provided information whether the scope of the peer review included only internal events at power operation or it also included internal fires and floods and external events for which standards have been issued (e.g., ASME/ANS RA-Sa-2009, February 2009) and guidance is available (e.g., RG 1.200 Rev 2, March 2009). Please provide this information.
- The above statements imply that MHI has concluded that no upgrades of the DC PRA model will be necessary to support certain risk-informed applications, such as RMTS, other than those required by plant-specific considerations or design and operational modifications. The staff believes that this conclusion should not be included in the DCD because (1) it is not needed for the design certification, and (2) it is not supported by the provided information and the staff's review. Please discuss.

The staff requests that a COL action item be included in Chapter 19 of the DCD to require COL holders referencing the US-APWR design to perform an integrated peer review on the entire plant-specific PRA model before it can be used to support certain risk-informed applications, such as RMTS. This peer review may take into consideration the findings and observations, as well as their disposition, from any previous peer reviews. Please discuss.

19-427

Four dominant accident sequences (each contributing more than 5% to the total CDF from internal events at power) are described in Revision 2 of the DCD (pages 19.1-36 and 37). These four sequences combined contribute about 67% to the total CDF from internal events at power. However, there are additional sequences with significant contribution to CDF which provide important information about the risk profile of the US-APWR design. Please describe in the DCD the top 14 sequences contributing at least 1% to the total CDF from internal events at power. Also, for each of the 14 sequences, list in the DCD (with a brief description) risk important failures appearing in the dominant minimal cutsets of the accident sequence.

19-428

The top five most significant basic events, based on FV and RAW risk importance measures, are described in revision 2 of the DCD (page 19.1-37 and 38). However, there are many more highly risk significant common cause failure (CCF) events. Although such additional basic events are reported in Tables 19.1-30 and 31 of the DCD, their description in these tables is very short and in many cases unclear. Please include a brief and clear description of additional basic events (beyond the top five) in the DCD. For example, the FV list can include basic events with FV value 2% or higher and the RAW list can include basic events with RAW value 100 or higher (after excluding external leak of piping events and listing only one CCF instead of all combinations for a certain set of components).

Please provide clear descriptions of some basic events, such as “CCF of basic software,” “CCF of safety related I&C hardware,” and “Group 2 application software” in the DCD.

Also, please clarify the description of basic events EPSSCF4CBSC52UAT-ALL and EPSSCF4CBSC52RAT-ALL. These events are defined as “CCF due to spuriously opening” in the description. However, it appears that “CCF due to spuriously closing” is a failure but not “CCF due to spuriously opening.”