REQUEST FOR ADDITIONAL INFORMATION 924-6352 REVISION 3

4/24/2012

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

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

QUESTIONS for PRA and Severe Accidents Branch (SPRA)

19-568

The PRA states on page 20A.7-1, "In the case of automatic isolation failure of low pressure letdown line isolation valves, operator action to isolate the CVCS from the RHRs is required. When one out of two low-pressure letdown line isolation valves fails to close due to components failure, letdown heat exchanger inlet valves CVS-HCV-012 located at downstream of the low –pressure letdown line isolation valves is assumed to be closed manually."
As documented in chapter 5.4 of the DCD , "The RCS water level should be maintained higher than 0.33 feet above the loop center and the RHR flow of 1,550 to 2,650 gpm should be supplied". The staff understands that the automatic isolation of letdown occurs at .47 feet above loop center. The available time for the operator to isolate the RCS drain path after automatic isolation failure seems very short. The staff understands that air entrainment of the RHR pumps is not planned to occur at or greater than 0.33 inches above hotleg mid-pipe assuming an RHR flow rate of 2650 gpm. Auto-isolation of letdown is planned to actuate at 0.47 inches above hotleg mid-pipe. The difference between 0.47 inches and 0.33 inches above hotleg mid-pipe seems very tight given an approximate drain rate of 100 gpm from operating PWRs.
This margin of time does not seem to be consistent with a 3E-3 failure estimate as reported in Chapter 19 of the US-APWR DCD (page 19.1-135). During SG tube draining, the RCS must be lowered below the top of the MCP to allow the communication between the SG and the RV. During this operation, the water level will be below "Below Normal Level", so the alarm will be actuated and there will be no additional alarms to alert the operator that RCS level is approaching 0.33 feet above loop center.
The staff has the following questions related to this low pressure letdown line isolation interlock and RCS drain down operations which are needed to understand the human reliability estimate of 3E-3. The staff requests that this information be documented in the DCD in Chapters, 5, 7, and 19 as appropriate

A. Describe RCS hot leg level indication. The staff believes the following questions affect indication reliability but the response should include any additional pertinent information.

1. How is RCS hot leg level measured?
2. Are there two hotleg level indicators as recommended by Generic Letter 88-17?
3. Where are the level taps for the hot leg level instrumentation that actuates the interlock (e.g. bottom of hot leg and the other tap on the top of the hot leg)?

B. Describe SG tube draining operations

1. What is the planned hot leg level at which MHI plans to drain the SG tubes?
2. What is the maximum anticipated RCS drain rate once level in the RCS is below the top of the MCP for SG tube draining or for RCS hot leg and cold leg maintenance such as maintenance on an RCP?
3. After automatic isolation failure, at what hot leg level must the operators isolate letdown manually to prevent vortexing, assuming a RHR flow rate of 2650 gpm?
4. What is the time required to isolate letdown after automatic isolation failure given the maximum drain rate and the planned hot leg level for draining the SG tubes?
5. Describe the administrative controls that support operator manual isolation of letdown (e.g. mass balances, etc.)

C. Describe the indication that is available to the operator that would communicate the need to manually isolate letdown. The staff believes the following questions are relevant but the response should include any additional pertinent information.

1. Is the hot leg level instrumentation part of the Safety Related Protection and Safety Monitoring System (PMS) or the non-safety related Plant Control and Monitoring System (PCMS)?
2. Is the hot leg level instrumentation part of the Safety Parameter Display System?
3. Is the following information on RHR system part of the Safety Parameter Display System, if not where is the information displayed:
    a. RHR Inlet/Outlet Heat Exchanger Temperature.
    b. RHR Flow rate with Low and High Alarms.
    c. RHR Pump motor amperage.

4. What is the impact of draining the RCS with only a pressurizer spray vent valve (3/4 in diameter) on the RCS level indication – complications from a partial vacuum in the RCS?

19-569

Based on MHI's responses to RAI Number 06.02.05-46, it appears that for full power severe accident scenarios, hydrogen has the potential to accumulate in the RWSP to detonable levels. In response to staff RAIs, MHI has proposed a design change for the hydrogen igniters in which each train will be powered by dedicated batteries having a capacity of at least 24 hours following the onset of a complete SBO. The staff has two requests regarding a severe accident during shutdown conditions.

1. Please update Chapter 19 of the DCD to include whether the hydrogen igniters need to be operable for the containment to remain intact and provide an effective barrier against the postulated release of fission products following a severe accident at shutdown. Please provide the justification for your response (e.g, results of analyses, etc.).

2. Please update Chapter 19 of the DCD to include other severe accident design features that need to be operable for the containment to remain intact and provide an

effective barrier against the postulated release of fission products given a severe accident at shutdown (e.g, results of analyses, etc.).

19-570

The staff has reviewed MHI's response to RAI 19-550. In particular, the staff reviewed MHI's new table on Key Sources of Uncertainty and Key Assumptions (LPSD Operation) (Table 19.1-181) to be added to the next version of the DCD. The staff agreed with the table, but has two questions regarding the Summary of Results of Qualitative Assessment.

(1) Based on PWR operating experience, the staff has observed that outage types (e.g. outages with a drained RCS with high decay heat) and the specific RCS configurations have a large impact on risk and represent a key source of uncertainty. The MHI design is unique from many PWRs such that the MHI design is drained to reduced inventory operations maintaining the RCS closed with exception of the RCS low pressure letdown line and a RCS pressurizer spray vent valve with an approximate diameter of 3/4 inches. MHI has stated in Table 19.1-119 that nitrogen will not be injected into the RCS to speed draining of the SG tubes. The staff understands that vacuum conditions may develop in the RCS using this method of draining and prolong SG tube draining. Thus, the staff is requesting MHI to perform a sensitivity study assuming draining of the RCS is performed consistent with many operating PWRs using a large RCS vent such as an open pressurizer manway, before RCS draining is initiated. This sensitivity study would assume (for POS 4-1) that the SGs would not be available for decay heat removal. Please include the results of this sensitivity study in Chapter 19 of the DCD in Table 19.1-181.

(2) Based on PWR operating experience, the staff has observed that equipment outages (particularly the availability of injection pumps and containment closure) have a large impact on risk. Based on MHI's response to RAI 19-442, MHI reported that the USAPWR shutdown CDF removing all equipment not required by TS to be 2.1E-5 per year. Since it is assumed that CDF equals LRF, this result means that the LRF from removing all equipment not required by TS would be 2.1E-5 per reactor year which exceeds the Commission's goals for new reactors. Therefore, the staff concludes that voluntary initiatives must be implemented by the COL applicant for the USAPWR design to meet the Commission's goals. Thus, the staff concludes that voluntary initiatives are needed to obtain MHI's reported low shutdown core damage frequencies and a key source of uncertainty which should be included in Table 19.1-181. Please address this source of uncertainty by sensitivity studies, evaluating the numbers of safety injection trains combined with evaluating the probability of successful containment closure against the baseline CDF and LRF.