REQUEST FOR ADDITIONAL INFORMATION 899-6281 REVISION 2

1/31/2012

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)

19-565

The staff has reviewed MHI's response to RAI question 19-548. The RAI response reported that (1) the CDF from drain down events during POSs 5,6,and 7 (refueling cavity flooded) combined was higher than a hot midoop (POS 4-3) and (2) the CDF from these drain down events equals the reported CDF from internal shutdown risk. These risk contributors appear to be significant contributions to the internal shutdown risk. Please justify why these risks should not be included and provide the details for this justification in the DCD or update the DCD to include them. When updating the DCD to include this risk from drain down events, please address:

1. The refueling cavity level instrumentation and alarms available to the operators to detect a draindown event when the refueling cavity and the spent fuel pool are not connected. Staff's review of Chapters 5, 7, 9, and 19 failed to find any reference to refueling cavity instrumentation other than for midloop operation. Please update Chapters 5, 7, 9, and 19 of the DCD to include this instrumentation.
2. How the availability/operability of this instrumentation will be controlled during POSs 5, 6, and 7 (e.g. Technical Specifications, etc.).
3 The largest possible drain down path from the refueling cavity. Please include all drain paths even those that have two or more closed valves in series, since operator errors have created inadvertent drain paths in operating PWRs. Please consider that pumps could be running to increase the flow rate from these postulated drain paths.
4. The pumps anticipated to mitigate the largest possible drain down path and their source of water and power given that they may not be required by Technical Specifications to be operable if fuel is not in the core but is in the temporary fuel racks. .
5. For inadvertent drain down paths leading outside of containment such as the CCW surge tank and the RWSAT, please document the instruments and alarms that would notify the operators of the abnormal condition.
6. The use of two temporary fuel racks that are capable of temporarily storing a total of six fuel bundles in the refueling cavity. Please update Chapters 5, 9 and 19 of the DCD to discuss the risk and consequences of uncovery of these fuel bundles during a refueling cavity drain down event. In your response, please address:

    (a) containment equipment hatch closure and personnel hatch closure,
    (b) isolation of refueling cavity drain paths including those that require manual closure,

(c) the potential for criticality, assuming the maximum reactive fuel in all six locations.

7. Since a seismic margins analysis was used to address shutdown seismic risk, please update the LPSD seismic margins analysis to include the fragility (HCLPF) of: the PCS (permanent cavity seal) and the SG nozzle dams. Failure of the these components could lead to a large, rapid, loss of inventory at the same time as a potential inability to close the personnel hatch and the equipment hatch during the loss of inventory event. In addition, please include the fragility (HCLPF) of the temporary fuel storage racks.

19-566

According to the DCD Figure 3.81-1, the equipment hatch is 27’11” in diameter and sits at the 76’ elevation (4th floor in containment which is on the refueling deck). The personnel airlocks are located at the 76’ elevation and at the 25’ elevation. In section 19.2.5 of the DCD, MHI states that, “However, the ability to close the containment and to recover heat removal without ac power is minimal and may not be possible……. It may also be preferable to limit undertaking the maintenance activities which require opening the equipment hatch during the inventory is low in the reactor.” Not having a containment closure capability during reduced inventory operation is inconsistent with US industry guidance, NUMARC 91-06, and staff guidance Generic Letter 88-17.

NUMARC 91-06, states, "3) Containment hatches (equipment and personnel) and other penetrations that communicate with the containment atmosphere (primary or secondary, as appropriate) should either be closed or capable of being closed prior to core boiling following a loss of DHR and should be addressed in procedures."
Generic Letter 88-17 (the attachment) states, " The following expeditious actions should be implemented prior to operating in a reduced inventory condition....., (2) Implement procedures and administration controls that reasonably assure that containment closure will be achieved prior to the time at which a core uncovery could result from a loss of DHR coupled with an inability to initiate alternate cooling or addition of water to the RCS inventory. Containment closure procedures should include consideration of potential steam and radioactive material release from the RCS should closure activities extend into the time boiling takes place within the RCS. These procedures and administrative controls should be active and in use." GL 88-17 also states, "Reasonable assurance of containment closure should include consideration of activities which must be conducted in a harsh environment. For example, once boiling initiates in the RCS, a large volume of steam may be entering containment, potentially leading to high containment temperature and increased pressure. The 200 F temperature identified above provides assurance that containment is closed prior to the existence of such conditions."

Based on this operating experience:
(a) Please update Chapter 19 of the DCD to include all SSCs that are needed to close the containment equipment hatch (e.g. polar crane) and the containment personnel hatches. Please include the sources of power needed to close the containment equipment hatch and the containment personnel hatches.

(b) Please provide details on how containment closure will be achieved before boiling to meet the intent of GL 88-17 and NUMARC 91-06. Please discuss when the abnormal

procedures would direct the operators to close containment (e.g. immediately after loss of all trains of RHR, etc.).

(c) Since there is staff and industry operating experience that recommend containment closure prior to boiling, under Criterion 4 of 10CFR50.36(c)(ii)(D), it appears that there is sufficient basis to add containment closure prior to RCS boiling in Technical Specifications. Please consider adding containment closure in Technical Specifications, or please provide a justification as to why it does not need to be included.

19-567

The staff has reviewed MHI's response to RAI question 19-406 regarding automated safety injection to evaluate MHI's response, the staff has reviewed operating experience and the risk results from operating and new plant low power shutdown (LPSD) PRAs. Operating experience and LPSD PRAs show the operator error, particularly the failure of the operator to initiate standby RCS injection given a loss of the DHR function, is significant to shutdown risk. Many, if not all of the new passive designs and the evolutionary BWR and PWR designs have an automated RCS injection path.
In response to RAI question 19-406, MHI stated that automated SI, when successfully initiated upon correct detection of low water level (such as bottom of the hotleg) is a concern for the workers inside containment. If there is RCS boiling with the RCS open, steam ejecting from RCS penetrations within containment will threaten worker safety well before level reaches the bottom of the hotleg. Staff guidance from GL 88-17 a PWR recommends that a PWR licensee have the ability to close containment and evacuate personnel before RCS temperatures reach 200F. If these actions are taken, automated SI on a low water level (such as bottom of the hotleg) would not pose a threat to worker safety and would improve shutdown risk.
In response to RAI question 19-406, MHI stated that if spurious operation of SI occurs, there would be no barriers to protect the workers from high pressure water and such a situation should not be created. Please consider the following:

1. Automated fire suppression systems such as Halon and carbon dioxide are a potential threats to workers in fire areas. However, the risk of not having automated fire suppression is considered to be greater than the risk to workers. The instrumentation logic of an automated SI system can be designed to limit spurious actuation..

2. Automated injection flow can be limited to reduce the potential hazard to workers.

3. Workers are protected against RCS contamination when they work inside the RCS installing SG nozzle dams.

4. On the job pre-briefings and mock-ups can be used to limit the time needed for SG nozzle dam installation.

5. An injection signal after a time delay upon a false detection of low level could be used to allow workers to evacuate containment.

Based on the above information, please consider adding auto-initiated RCS injection signal or justify why it should not be included. Further, based on Criterion 4 of 10CFR50.36(c)(ii)(D) in the context of operating experience and PRA insights, the staff is requesting MHI to consider adding this signal capability in TS for Modes 5 and 6 until the refueling cavity is flooded.