REQUEST FOR ADDITIONAL INFORMATION 354-2585 REVISION 0

5/7/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 06.02.02 - Containment Heat Removal Systems
Application Section: 6.2.2 & 6.3

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)

06.02.02-19

MHI discusses Break Selection in MUAP 08001-NP Section 3.1. NEI GR discusses break selection as a two step process involving selection of the size of the break and the location. The NRC staff requests that MHI specify the break size selected for primary and secondary line breaks (example, DEGB) and the basis for the break size selected.

06.02.02-20

MUAP 08001-NP (R2), US-APWR Sump Strainer Performance Report Table 3-1 provides break locations considered but does not provide type and quantity of debris. The NRC staff requests that MHI provide quantitative results that demonstrate a break in the main coolant piping is the limiting break location (worst case) in terms of debris generation, transport, and head loss. Results summary should allow comparison between break locations and include quantity of each debris type generated from each debris location evaluated. Include secondary line breaks (MS/MF) as they require recirculation (sump operation) per MUAP 08001-NP page 10. If more than four break locations evaluated provide data only for the four most limiting locations.

06.02.02-21

The NRC staff requests that MHI provide the following information regarding debris characteristics. MUAP-08001 Section 3.3 considers all generated debris to be “small”. Define the size classification term “small” and provide the reference for this classification.

06.02.02-22

For PWR analyses, it is important to distinguish between suspended and non-suspended debris. What does APWR imply when it states debris is “small” in regards to suspended or non-suspended debris? Does “small” indicate that all the material is in suspension? Provide technical basis and justify why this is conservative with respect to transport and head loss.

06.02.02-23

MUAP 08001-NP (R2) discusses how LOCA generated debris is transported to the sump. LOCA generated debris is initially distributed over the floor of the four steam generator compartments (inside secondary shield). Then, debris laden water overflows a 2 inch high slope located at four labyrinth access openings to exit the steam generator compartments and enter the containment floor area (outside the secondary shield). On the containment floor, the debris is routed to the RWSP at five (5) locations via pairs of drain pipes. The debris is assumed to be equivalently allocated (20%) to each of the five drain pipe locations. Justify assumption of equivalent allocation (20%) of debris to the 5 drain pipe locations? Demonstrate how the 20% debris allocation pattern is conservative given the worst case break location occurring in A-Loop? In addition, MUAP 08001 assumes 100% transport to the RWSP and 100% transport to the *two* (50% capacity) operable strainers. The maximum debris allocation to any one strainer is assumed to be 70%. Justify how a 70% debris allocation assumption is conservative with respect to head loss and resultant impact on NPSH.

06.02.02-24

MUAP 08001-NP (R2) Section 3.7.1 states, "In the refueling cavity, there are two 8 inches drain pipes which are communicated to bottom portion of the containment…and it is quite unlikely that a large amount of fibrous debris will blow down on the cavity, and block the drain path." The NRC staff requests that MHI provide the following information regarding upstream effects associated with these two 8 inch drain pipes:

1) Please describe what "communicated to bottom portion of containment" means? Do they go directly to RWSP? Are these drains depicted in the DCD (for example, DCD Figure 6.2.1-9)?

2) If the drain pipes were to fully block flow, how much water holdup would occur and what would the impact be on cooling the core and cooling containment?

3) What amount of water holdup (expressed in gallons or cubic meters and height in refueling cavity as well as height in RWSP) would result in challenging head loss across strainer (submergence etc) and/or NPSHa?

4) Operating plants with similar drain configurations have installed debris interceptors to ensure the drains remain functional during an accident. What is the APWR justification for not establishing debris interceptors?

06.02.02-25

DCD Table 6.2.2-2 provides MHI's response to regulatory positions established by RG 1.82. Regulatory position 1.1.1.5 states that drains and other narrow pathways that connect compartments with potential break locations to the ECC sump should be designed to ensure that they would not become blocked by the debris; this is to ensure that water needed for adequate NPSH margin could not be held up or diverted from the sump. Besides the transfer pipes, and refueling cavity drains, provide a list other drains and narrow pathways (if any) and discuss how they are designed to ensure they are not blocked by debris.

06.02.02-26

MUAP 08001-NP (R2) states that an adequate water level exists to submerge the strainer in case of a LBLOCA. The report further states, “The strainers are installed so as to submerge the top of the layer disk 3.67” under the minimum water level.” The NRC staff requests that MHI provide the minimum submergence under small break loss-of-coolant accident conditions. Explain the difference between the small and large break strainer submergence level (if any) or the basis for no difference.

06.02.02-27

DCD Table 6.2.2-2 compares APWR design to the requirements of RG1.82 position 1.1.1.13 and states RWSP suction strainers are submerged under a minimum of approximately 4 ft. of water during a LOCA. MUAP 08001-NP (R2) states the strainers are installed so as to submerge the top of the layer disk 3.67” under the minimum water level (page 3). Please explain the difference in levels of submergence.

06.02.02-28

MUAP 08001-NP (R2) Appendix A states the PCI strainer design discourages and prevents vortex formation and air ingestion. The NRC staff requests MHI justify that the APWR application of the PCI strainer design prevents vortex formation and air ingestion. Provide a summary of the methodology and assumptions of the vortexing evaluation and any bases for key assumptions. Describe significant margins and conservatisms used in the vortexing calculations.

06.02.02-29

In MUAP 08001-NP (R2) Section 3.1, Break Selection, page 9, states, “For the US-APWR, PCI SFS has been selected. PCI has never observed any evidence of the thin bed effect in vendor’s large flume testing facilities in the past, because of its three-dimensional geometry and very low approach velocities. The TBE may occur only under such very controlled conditions where the fibrous debris is very carefully prepared as individual fibers that are slowly added to a closed vertical pipe loop test apparatus. This configuration is not applicable for the US-APWR strainer design and configuration in the RWSP of the post-LOCA conditions.” This statement appears to be in conflict with recent operating plant testing experience during which high head loss (>20 feet) was achieved – indicative of a thin-bed effect - using a similarly designed PCI strainer. Therefore, the NRC staff requests MHI to address the ability of the screen to resist the formation of a thin bed or to accommodate partial thin bed formation.

06.02.02-30

DCD Table 6.3-5 (sheet 3 of 3) lists the RWSP peak temperature at approximately 250°F.
DCD Figure 3.8.1-11 lists the RWSP peak temperature at 270°F. The NRC staff

requests MHI explain why two peak temperatures are listed and provide a summary of the methodology, assumptions, and results used to determine if flashing would occur across the strainer surface. State the basis for peak temperature used in the flashing analysis. State whether containment accident pressure was credited and the methodology used to determine available containment pressure.

06.02.02-31

Consistent with guidance listed in RG 1.82 and GL 2004-02, provide a description of how permanent and temporary modifications to structures, systems, and components inside containment are programmatically controlled so changes to the analytical inputs and assumptions of the licensee analyses ensures ECCS remains in compliance with 10 CFR 50.46 and related regulatory requirements.

06.02.02-32

Regarding programmatic controls taken to limit debris sources in containment, provide a description of how maintenance activities including associated temporary changes are assessed and managed in accordance with the Maintenance Rule, 10 CFR 50.65.

06.02.02-33

Regarding programmatic controls taken to limit debris sources in containment provide a summary of the foreign material exclusion programmatic controls in place to control the introduction of foreign material into the containment.

06.02.02-34

Regarding programmatic controls taken to limit debris sources in containment provide a summary of the protective coating programmatic controls in place to control the introduction and use of coating material in containment and address coating deficiencies.

06.02.02-35

On page 6.2-49 of the DCD (Revision 1), the applicant discusses how preparation of a cleanliness program is the responsibility of the COL applicant and that this program addresses debris sources such as latent debris inside containment.   What specific latent debris limits or controls does the DCD establish to enable the COL applicant to remain within the containment cleanliness design basis limit? Explain why this design basis limit is not contained within the COL item?

06.02.02-36

The standard design for US-APWR does not define the specific type of materials for miscellaneous debris, such as tapes, tags or stickers, because these are controlled by the foreign material control program established by the plant owner. To deal with this uncertainty, a 200 ft2 penalty of sacrificial strainer surface area per sump is applied as a margin for future detail design and installation of the US-APWR (page 10, MUAP 08001). What specific miscellaneous debris limits or controls does the DCD establish to enable the COL applicant to remain within the foreign material 'uncertainty' (200 ft2) design basis limit or performance criteria? Explain why this design basis limit is not contained within the COL item?

06.02.02-37

DCD Tier 1, Section 2.4.4 (Emergency Core Cooling System) in the sub-section titled Design Description provides Figure 2.4.4-1 to show the functional arrangement of the ECCS. The functional arrangement depicts components that are further described in the section (un-numbered) titled "Key Design Features" and section 2.4.4.2 "ITAAC". The sump strainer is depicted in Figure 2.4.4-1and strainer ITAAC is prescribed (Table 2.4.4-5). However, there is no discussion or description of the strainer as a Key Design Feature. In contrast, DCD Tier 1, Section 2.11.3 (Containment Spray System) in the sub-section titled Design Description identifies the sump strainer as a Key Design Feature. The strainer is not identified in the functional arrangement figure (Figure 2.11.3-1) or tables discussing equipment or ITAAC (Table 2.11.3-5).
The strainer is a dual function component, serving both ECCS and CSS. Tier 1 should accurately communicate this dual functionality and provide sufficient information in ECCS and CSS sections. One section may refer to the other section to avoid duplication of effort. For example, the staff recognizes that strainer ITAAC is currently provided in Section 2.4.4 (ECCS) and does not see value in duplicating this ITAAC in CSS. Rather, the CSS could refer to the strainer ITAAC provided in the ECCS section. Therefore, the NRC staff requests MHI to clarify Tier 1 information in relation to the sump strainer or provide the basis for not including a description of the sump strainer (ECCS key design feature) within DCD Section 2.4.4 (ECCS) and the basis for not including the sump strainer in the functional arrangement and ITAAC for the CSS (2.11.3).

06.02.02-38

The APWR Design ensures that during a design basis event, the RWSP is replenished with water which has been released to the containment from the RCS sufficient to maintain adequate net positive suction head to the SI and containment spray/ residual heat removal (CS/RHR) pumps throughout the event. A key design feature that directly impacts the ability of the ECCS/CSS systems to perform this replenishment function is the system of transfer pipes and drain pipes, and their associated debris interceptors, that direct water back to the RWSP. For example, there are ten, 18 inch drain pipes with associated debris interceptors on the containment floor that return spray and break water to the RWSP. It does not appear that there is any design description of these key components in Tier 1. DCD Table 2.4.4-3 lists Emergency Core Cooling System Piping characteristics. Included in this table is NaTB solution transfer piping; essentially drain piping. The NRC staff requests MHI to address the basis for not including a discussion of the transfer/drain piping and their associated debris interceptors (as applicable) within DCD Tier 1 and any associated inspection and acceptance criteria; given that their replenishment functions are necessary for the ECCS to perform its safety function.

06.02.02-39

During a LBLOCA, water from the RWSP is pumped into containment and a portion of this water eventually collects on the containment floor. It is important to return this water back to the RWSP to maintain sufficient NPSH available to the CSS and ECCS pumps. For APWR there are gravity drains that allow water to flow from the containment floor to the RWSP. These gravity drains consist of ten 18” drain pipes that are dispersed around the containment floor at five (5) locations. No documentation was provided that demonstrates how the number and size of the openings was determined. Therefore, the NRC requests MHI discuss the technical basis for the number and size of the drain connections that serve to return water to the RWSP (not limited to containment floor; should include other credited drains such as refueling cavity). Describe methodology, key assumptions and justify how this is conservative with respect to NPSH available.

06.02.02-40

DCD Table 6.3-5 presents relevant ECC/CS Strainer data. Many strainer design values were provided such as design flow, surface area, and hole size. No design value for strainer head loss was provided. Please provide the basis for not including the strainer design value for head loss in DCD Table 6.3-5.

06.02.02-41

DCD Figure 6.2.1-9, “Outline of Paths that Solutions from the ECCS and CSS would follow in the Containment to the RWSP” depicts potential holdup areas within the Containment (see also Section 6.2.2.2.5 “Refueling Water Storage Pit”). On Figure 6.2.1-9, there is a cross–hatched region, indicative of holdup inventory that is not labeled. It is situated between two holdup areas labeled as C/V reactor coolant drain pump room and Containment recirculation air distribution chamber. Please describe and label this holdup area.

06.02.02-42

MUAP 08001-NP (R2), US-APWR Sump Strainer Performance Report, at the bottom of page 7 and continuing to page 8, states: “Particulate insulations are not used inside the containment. Therefore, only the RMI debris and fibrous debris are considered as the potential insulation debris for the US-APWR.” However, section 6.1.1.2.1 on page 6.1-4 of US-APWR DCD (R1), states “Min-K based pipe insulation is prohibited in containment, unless encased in stainless steel cans.” Explain the apparent conflict between the Sump Strainer Performance Report and the DCD in addressing particulate pipe insulation such as Min-K?

06.02.02-43

RG 1.82 regulatory positions 1.1.1.6 and 1.1.1.8 discuss that trash racks or debris interceptors should be designed to withstand loads posed by expanding jets, missiles, and earthquakes. Each RWSP transfer pipe opening into the containment is protected from large debris and missiles by vertical debris interceptor bars that are capped by a ceiling plate. DCD Figure 6.2.2-12 depicts a transfer pipe debris interceptor. The NRC Staff requests that MHI describe the design basis for this debris interceptor. What design loads were assumed? What is the seismic classification? Provide basis for methodology and assumptions used to analyze this protective device.

06.02.02-44

As part of its review of the US-APWR design aspects that address GSI-191, the staff reviewed the applicant's sump strainer performance to the applicable regulatory criteria 10CFR52.47 "Contents of Applications; technical information" using the guidance of RG 1.206 Combined License Applications for Nuclear Power Plants. RG 1.206 outlines information to be submitted with design certification applications that will facilitate review by the NRC staff. The following information items, outlined in Section C.I.6.2.2 Containment Heat Removal Systems, as it relates to sumps, were not provided in the US-APWR DC application and form the basis for this request for additional information:

1) Discuss [in the DCD FSAR] the types of insulation used inside the containment and identify where and in what quantities each type is used. As part of the DCD FSAR discussion, identify the design basis debris source term used for the strainer performance analysis to include LOCA generated and Latent debris types and quantities.

2) Describe the methods used to attach the insulation to piping and components.