REQUEST FOR ADDITIONAL INFORMATION NO. 73-943 REVISION 0

9/24/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 06.05.01 - ESF Atmosphere Cleanup Systems

Application Section: FSAR Sections 6.4, 9.4.5 and 9.4.6

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

06.05.01-1

RAI 6.5.1-1 The second to last paragraph of Tier 2 FSAR Section 6.2.1.7 "Instrumentation Requirements" reads "*Four area radiation monitors are positioned inside the containment. The containment area radiation monitors detect airborne particulate radioactivity in the containment circulating air. High radiation in the containment isolates the containment ventilation and alarms in the MCR*."

Tier 2 FSAR Section 9.4.6 does not identify this important system interlock and interface with the Radiation Monitor System. It follows that Tier 2 FSAR Section 14.2.12.1.69 "Containment Fan Cooler System Preoperational Test" will not test this interlock given the as written acceptance criteria of the preoperational test (i.e. "*The containment fan cooler system operates as described in Subsection 9.4.6."*). What is meant by "…*isolates the containment ventilation*"? By this statement, it appears that containment isolation valves will close. Are containment ventilation fans shut down through this interlock? If so, which ones? The staff requests more information about this interlock.

The staff requests that the DC applicant amend the both Tier 2 Sections 9.4.6 and 14.2.12.1.69 to ensure the testing of this system interlock and system interface during the preoperational test.

RAI 6.5.1-2 10CFR50 Appendix A General Design Criterion 42 reads *"**Inspection of containment atmosphere cleanup systems.** The containment atmosphere cleanup systems shall be designed to permit appropriate periodic inspection of important components, such as filter frames, ducts, and piping to assure the integrity and capability of the systems*."

General Design Criterion 43 reads *"**Testing of containment atmosphere cleanup systems.** The containment atmosphere cleanup systems shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the systems such as fans, filters, dampers, pumps, and*

valves and (3) the operability of the systems as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of associated systems."

Tier 2 DCD Section 9.4.6 contains no discussion of how the exhaust filtration units of the Containment Low Volume Purge System and the Containment High Volume Purge System satisfy these criteria.

The staff requests that the DC applicant include a discussion in Section 9.4.6 of how these filtration units satisfy the requirements of GDC 42 and 43.

RAI 6.5.1-3 10CFR50 Appendix A General Design Criterion 61 reads "***Fuel storage and handling and radioactivity control.*** *The fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety, (2) with suitable shielding for radiation protection, (3) with appropriate containment, confinement, and filtering systems, (4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, and (5) to prevent significant reduction in fuel storage coolant inventory under accident conditions."*

The first three design attributes [i.e. (1), (2) and (3)] of GDC 61 applies to the filtration units of the Containment Low Volume Purge System and the Containment High Volume Purge System.

Tier 2 DCD Section 9.4.6 contains no discussion of how the exhaust filtration units of the Containment Low Volume Purge System and the Containment High Volume Purge System satisfy these three attributes during normal power operations or during a refueling operations (e.g. with respect to a Fuel Handling accident within containment.)

The staff requests that the DC applicant include a discussion in Section 9.4.6 of how these filtration units satisfy the requirements of GDC 61.

RAI 6.5.1-4 10CFR50 Appendix A General Design Criterion 64 reads *"Monitoring* ***radioactivity releases.*** *Means shall be provided for monitoring the reactor containment atmosphere, spaces containing components for recirculation of loss-of-coolant accident fluids, effluent discharge paths, and the plant environs for radioactivity that may be released from normal operations, including anticipated operational occurrences, and from postulated accidents."*

Tier 2 DCD Section 9.4.6 contains no reference to GDC 64. In addition, Section 9.4.6 contains little discussion about the monitoring of the effluents from the filtration units of the Containment Low Volume Purge System and the Containment High Volume Purge System for radiation during normal operations, including anticipated operational occurrences, and from postulated accidents. For example, what interlocks exist between the radiation monitoring instrumentation and the components of the Containment Ventilation System (i.e. any interlocks other than the CIS with Containment Isolation Valves)?

The staff requests that the DC applicant include more discussion in Section 9.4.6 about the system interface between the Radiation Monitoring System and the Containment Ventilation System.

RAI 6.5.1-5 Tier 2 DCD Section 9.4.6.4 reads "*Air handling units are factory tested in accordance with the Air Movement and Control Association Standards. Air filters are tested in accordance with the American Society of Heating, Refrigerating and Air-Conditioning Engineers Standards. Cooling coils are hydrostatically tested in accordance with ASME, Section VIII and their performance is rated in accordance with the Air Conditioning and Refrigeration Institute Standard*."

The staff requests that the DC applicant provide specific standards for this testing and include these specific references in the Reference section 9.4.8.

RAI 6.5.1-6 10CFR50 Appendix A General Design Criterion 2 reads "***Design bases for protection against natural phenomena.*** *Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The design bases for these structures, systems, and components shall reflect: (1) Appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and (3) the importance* of the safety functions to be performed."

Tier 2 DCD Section 9.4.6.1 reads "*The containment ventilation system is classified as a non-safety related, non-seismic Category I system. However, ductwork is supported, as required, to prevent adverse interaction with safety-related systems during a seismic event."*

DCD Sections 9.4.6.3.1, 9.4.6.3.2 and 9.4.6.3.3 contain words that indicate that all ductwork of the relevant system is supported in accordance with seismic Category I requirements so as to remain in place during the SSE and to preclude damage to any safety related SSCs. This description appears to fit the definition of Seismic Category II of DCD

Section 3.2.1.1.2. DCD Table 3.2-2 (sheets 37 through 39) lists all components of the for the Containment Purge System; Containment Fan Cooler System, the CRDM Cooling System and the Reactor Cavity Cooling System with the exception of containment isolation valves as "NS" (i.e. Non Seismic per DCD Section 3.2.1.1.3). This is conflicting information.

The staff requests that the DC applicant revise the DCD to remove this conflict. The staff also requests that the DC applicant include a detailed discussion in Section 9.4.6 of how the design of the Containment Ventilation System satisfies the guidance of Regulatory Guide 1.29 and GDC 2. In addition, Tier 1 Section 2.7.5.3 "Containment Ventilation System (CVVS)" indicates for each CVVS subsystem under the attribute of "Seismic and ASME Code Classifications" that each subsystem is "…non seismic category …". These attributes may need to be changed to read "seismic category II" based on the staff's finding above.

RAI 6.5.1-7 Tier 2 DCD Figure 9.4.6-1 Containment Ventilation System Flow Diagram (2 of 2) displays an arrow from another drawing labeled as "VAS" providing flow to the A/B Containment Low Volume Purge Exhaust Filtration Units. DCD Section 9.4.6 does not provide an explanation for this system interface.

The staff requests that the DC applicant provided additional information in the DCD about this system interface and amend the DCD to reflect this information.

RAI 6.5.1-8 GDC 60 requires provisions to be included in the design to ensure suitable controls on the release of radioactive materials in gaseous effluents during normal reactor operation, including anticipated operational occurrences. Three methodologies of satisfying this criterion include:

- Keep dose levels due to the airborne radioactivity below the allowable values set by 10 CFR 20 by supplying and exhausting sufficient airflow.
- Controls exhaust fan airflow continuously and automatically at a predetermined value to maintain a slightly negative pressure in the controlled areas relative to the outside atmosphere and minimize exfiltration from the radiological controlled areas during normal plant operation.
- Maintain airflow from areas of low radioactivity to areas of potentially higher radioactivity.

Upon review of the Control Rod Drive Mechanism Cooling System in Tier 2 DCD section 9.4.6, it appears that the first two methodologies are effectively employed. However, the design of the system appears to do just the opposite of the third methodology as displayed on Figure 9.4.6-1 (sheet 1 of 2). More specifically, it directs air from an area of potentially higher radioactivity to an area of lower radioactivity. The area around the control rod drive mechanisms on top of the reactor vessel would appear

to be an area that is potentially highly contaminated and could receive high dose rates during power operations.

The staff requests that the DC applicant provide additional information about the design of this ventilation system around the CRDMs with respect to the issue preventing the spread of radioactive contamination throughout containment.

RAI 6.5.1-9 Tier 2 DCD Section 9.4.6.1.2.3 provides design bases for the Reactor Cavity Cooling System. Two of the design bases from this section reads *"…Provide local cooling for the reactor vessel support base plates to limit the interface temperature between the plates and the concrete to 200° F or lower to prevent concrete dehydration.*" and "*Provide adequate cooling so that the temperature of the primary shield wall is maintained at or below the 150° F maximum to prevent dehydration of the concrete."*

DCD Section 9.4.6.5.3 indicates that there will be instrumentation for recording concrete temperature.

The staff requests additional information about this recorder. Will it record both the concrete temperature of the shield wall and the temperature of the interface temperature between the reactor vessel support plates and the concrete?

Will the COL applicant be required to track the time durations of temperature excursions above the *200° F and 150° F to ensure the structural integrity of the concrete for the licensed forty year plant life? In terms of plant life extension, will the tracking of these temperatures limitations be considered as a Time Limited Aging Analysis requirement?*

The staff requests that the DC applicant provide information in response to the above questions and amend the DCD as applicable with the relevant information. An additional COL item may be warranted.

RAI 6.5.1-10 "Review Procedures" of SRP 6.5.1 section 3.I.ii reads "*If a radioiodine decontamination factor of 10 or less is needed for the calculated dose to be below 10 CFR 100.11 or 10 CFR 100.21, as applicable, an atmosphere cleanup system that meets the design, testing, and maintenance guidelines for HEPA filters and charcoal adsorbers as specified in Regulatory Guide 1.140 are acceptable*. …" and section 3.I.iii reads "*If a radioiodine decontamination factor of greater than 10 is needed for the calculated dose to be below 10 CFR 100.11 or 10 CFR 100.21, as applicable, the ESF atmosphere cleanup system meeting all of the above acceptance criteria, with the exception of Items 2b and 2c of Part C of Regulatory Guide 1.52, Rev. 2 or Regulatory Positions 3.2 and 3.4 of Regulatory Guide 1.52, Rev. 3, is acceptable*."

The last paragraph of Tier 2 FSAR section 9.4.6.2.4.1 reads "*The capacity of the containment low volume purge system is sized to maintain acceptably low levels of radioactivity, including noble gases, during normal plant operation.*" and section 9.4.6.2.4.2 reads "*The capacity of*

the containment high volume purge system is sized to maintain acceptably low levels of radioactivity, including noble gases, during refueling operations."

DCD sections 9.4.6.4.4.1 and 9.4.6.4.4.2 indicate that the filtration units of the containment low volume purge system and the containment high volume purge system will be periodically inspected and tested in accordance with RG 1.140, ASME N510, and ASME AG-1.

The staff requests that the DC applicant provide additional information about the sizing of these exhaust filtration units. Additional information is to include calculation procedures and methods, including assumptions and margins. In particular, the staff needs the essential information that the applicant considered in the determination that the exhaust filtration unit of the containment high volume purge system need not satisfy the regulatory guidance of Regulatory Guide 1.52. DCD section 9.4.6 lacks detail with respect to this determination.

RAI 6.5.1-11 10CFR50 Appendix A General Design Criterion 2 requires that SSCs important to safety be designed to withstand the effects of a design basis earthquake. SRP 9.4.3 section III.2.A indicates that the P&IDs should clearly indicate the physical divisions between essential and nonessential portions and indicate design classification changes. The flow diagrams shown in Figure 9.4.6-1 do not show the boundaries between seismic Category I safety-related components and nonessential components. Provide additional information and clarify if the seismic classification boundaries for the Containment Ventilation System safety related containment isolation valves should be shown in the Figure.

The four subsystems that comprise the Containment Ventilation System either contain Seismic Category I components or have components (e.g. AO valves, ducting etc) in areas where safety-related Seismic Category I components are located. This system attribute is important to plant safety. None of the five preoperational tests (i.e. DCD sections 14.2.12.1-65 through 14.2.12.1-69) for these four subsystems require verification as a Prerequisite that seismic II/I construction is complete and that design certification walk down is complete before executing the preoperational test. The staff requests the DC applicant add this requirement as a test "Prerequisite." In addition, given the importance to plant safety, the staff requests that a line item be added to ITACC Table 2.7.5.3-1 Containment Ventilation System Inspections, Tests, Analyses, and Acceptance Criteria that seismic II/I construction is complete and that design certification II/I walk down is complete.

RAI 6.5.1-12 The rotating piece parts of the fans of the Containment Ventilation System potentially all represent internally generated missile hazards to nearby safety related components. Tier 2 DCD Section 9.4.6 fails to address this threat to safety related components.

The staff requests that the DC applicant provide additional information of how this threat to plant safety is negated for each of the fans that

comprise the Containment Ventilation System. The applicant should also amend Section 9.4.6 to reflect this information.

RAI 6.5.1-13 SRP 9.4.3 sections III.1, III.3 and III.4 make reference to use of a failure modes and effects analysis, as appropriate, to confirm that the essential safety-related portions of the system are capable of functioning in spite of the failure of any active component, in the event of an earthquake, during loss of offsite power, or a concurrent single active failure. DCD section 9.4.6 does not contain any references to or COL items for a failure modes and effects analysis for the Containment Ventilation System. Provide additional information and clarify if a failure modes and effects analysis is necessary for the Containment Ventilation System.

RAI 6.5.1-14 The last two paragraphs of Tier 2 DCD Section 9.4.6.2.1, reads

"*During the LOOP condition, containment fan cooler system is powered from the alternate AC power source and maintains the average containment air temperature below 150° F.*

In addition, the containment fan cooler units provide the cooling to mitigate the consequence of accident by natural circulation under the severe accident condition. Since the chilled water cannot be supplied under the severe accident condition, the cooling water system is switched form the non-essential chilled water system to CCW system to supply the cooling water to the containment fan cooler units"

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For this excerpt to be meaningful to the staff and the COL applicants, additional information needs to be added to the DCD. For a LOOP, will nonessential chilled water be available to provide cooling water to any of the containment fan coolers? Or will the AAC power source provide power only to support the mixing of the containment atmosphere and to prevent localized "hot pockets" within containment?

The second paragraph indicates that there is a system interface with the Seismic I safety related component cooling water system. Tier 1 Section 2.7.5.3.1.2 "Interface Requirements" reads "*There are no safety-related interfaces with systems outside the certified design*"

The staff request that the DC applicant provide additional information that provides clarity about the operation containment fan coolers during a LOOP and under a severe accident condition. The applicant is requested to update the relevant sections of the Tier 1 and Tier 2 section to reflect this additional information.

RAI 6.5.1-15 The last paragraph of Tier 2 DCD section 9.4.6.2.3 reads "*During the LOOP condition, <u>CRDM</u> cooling system is powered from the alternate ACC power source."*

Should this paragraph read?

"During the LOOP condition, Reactor Cavity cooling system is powered from the alternate ACC power source."

RAI 6.5.1-16 Acceptance Criteria 5 of SRP 9.4.1 reads: "*Control of Releases of Radioactive Material to the Environment. Information that addresses the requirements of GDC 60 regarding the suitable control of the release of gaseous radioactive effluents to the environment will be considered acceptable if the guidance of RGs 1.52 and 1.140 as related to design, inspection, testing, and maintenance criteria for post-accident and normal atmosphere cleanup systems, ventilation exhaust systems, air filtration, and adsorption units of light-water-cooled nuclear power plants are appropriately addressed. For RG 1.52 rev 2, the applicable regulatory position is C.2. For RG 1.52 rev 3, the applicable regulatory position is C.3. …*"

The staff could find no reference to the replacement of filters used during plant/system construction in Tier 2 DCD Section 9.4.6. Regulatory Guide 1.52 "Design, Inspection, And Testing Criteria For Air Filtration And Adsorption Units Of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems In Light-Water-Cooled Nuclear Power Plants" position C 5.2 reads "*The cleanup components (i.e., HEPA filters, prefilters, and adsorbers) that are used during construction of the ventilation systems should be replaced before the system is declared operable*."

The staff requests that the DC applicant amend DCD Section 9.4.6 and the relevant Preoperational Tests (i.e. 14.2.12.1.65, 14.2.12.1.66, 14.2.12.1.67, 14.2.12.1.68, 14.2.12.1.69 and 14.2.12.1.79) to include a test prerequisite to reflect this requirement.

RAI 6.5.1-17 DCD Section 9.5.1.2.7 reads "*Ventilation system fire dampers close automatically against full airflow, if required, on high temperature to limit the spread of fire and combustion products. Fire dampers serving certain safety-related, smoke-sensitive areas are also closed in response to an initiation signal from the fire detection system. In selected areas, the fire alarm system will provide interface with the HVAC systems such as to shut down HVAC operation upon a fire alarm signal. Where continued HVAC system operation is deemed necessary for radiological control, the HVAC system incorporates design features to allow operation under fire conditions*."

Tier 2 DCD Section 9.4.6 contains no information about the specifics of how the Fire Protection System interfaces with the Containment Ventilation System.

The staff requests that the DC applicant provide additional information about what generic HVAC system attributes contained in the passage from DCD Section 9.5.1.2.7 above are applicable to the operation of four subsystems of the Containment Ventilation System. This information needs to be amended into Section 9.4.6.

RAI 6.5.1-18 Acceptance Criteria D.3 of Tier 2 Section 14.2.12.1.65 CRDM Cooling System Preoperational Test reads "*The CRDM cooling system performs in accordance with design specifications during hot functional testing*"

The only information that contains design specifications for this subsystem is displayed on Table 9.4.6-1 for the CRDM Cooling Unit (i.e. 4,000,000 btuh at 71,000 cfm) and the CRDM Cooling Fan (i.e. 71,000 cfm). The staff requests that the DC applicant provide additional information in Tier 2 DCD Section 9.4.6 and Table 9.4-1 that indicates the Normal and Abnormal (i.e. LOOP) conditions at the inlet and outlet of the CRDM Cooling Unit.
The test method from this Preoperational Test contains the following requirement:

"C. Test Method
1. Simulate start and interlock signals for each cooling fan and cooling unit and verify operation and annunciation.
2. Simulate high temperature signals and high vibration signals and verify alarm annunciation."

Section 9.4.6.5.2 indicates that there are alarms for high CRDM inlet and outlet temperatures; for low air flow and for "motor winding temperature". It does not list a high vibration signal alarm.

What will be the setpoints for these alarms? Are these local alarms?... or MCR alarms? … or both?

The staff requests that the DC applicant add this missing information to Section 9.4.6, Table 9.4-1 and add a listing of the vibration alarm (for the fans or motors or both) to Section 9.4.6.5.2.

In the light of the above finding, the staff further requests that the DC applicant review in detail Preoperational Tests 14.2.12.1.66, 14.2.12.1.67, 14.2.12.1.68, 14.2.12.1.69 and 14.2.12.1.79 to (1) ensure that all required information to complete the preoperational test is contained either in Section 9.4.6, Table 9.4-1 and/or Table 9.4.6-1 (2) remove any conflicting information that would impair preoperational test completion.

RAI 6.5.1-19 The third paragraph of Tier 2 DCD Section 9.4.6.4 reads "… *All HVAC system airflows are balanced in conformance with the design flow, path flow capacity, and proper air mixing throughout the containment."*

Section 9.4.6.4 does not contain any flow balance data that will allow the COL applicants to demonstrate and satisfy the above requirements.

The staff requests that the DC applicant add this information to DCD Section 9.4.6.4.

RAI 6.5.1-20 Provide additional details for the following section 9.4.6 containment ventilation system calculation procedures and methods, including

assumptions and margins. The staff requests this information to satisfy the procedural review requirements of SRP Section 9.4.3, Revision 3, March 2007:

- Containment Ventilation System calculations supporting the normal and abnormal condition min max temperatures shown in Table 9.4-1 sheet 1 of 3.
- Containment Purge System calculations supporting the normal condition min max temperatures shown in Table 9.4-1 sheet 1 of 3.
- Control Rod Drive Mechanism Cooling System calculations supporting the normal and abnormal condition min max inlet and outlet cooler temperatures (to be included in Table 9.4-1; refer to RAI 6.5.1-18)
- Reactor Cavity Cooling System