REQUEST FOR ADDITIONAL INFORMATION 689-4976 REVISION 2

02/03/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.04.01 - Control Room Area Ventilation System
Application Section: DCD Section 9.4.1

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

09.04.01-25

Follow-up RAI
This is a follow-up RAI to RAI No. 582-4456, Question No. 09.04.01-18. Technical Rational 1 and 2 of SRP 9.3.3 provides the bases for this follow-up RAI. The regulatory basis for this request for additional information is from 10CFR50 Appendix A which reads, in part:

***"Criterion 4--Environmental and dynamic effects design bases*. Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit. However, dynamic effects associated with postulated pipe ruptures in nuclear power units may be excluded from the design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping."**

The staff notes that DCD Table 3.6-1 "High and Moderate Energy Fluid Systems" defines the Chilled Water System (VCWS) as a moderate energy fluid system. The staff also notes that DCD 3.6.1.1 "Design Basis" for "Plant Design for Protection against Postulated Piping Failure in Fluid Systems Inside and Outside Containment" reads:

"Essential systems are evaluated for conformance to the following design bases and susceptibility to pipe failure effects. …

> **… N. The environmental effects of a postulated piping failure do not preclude habitability of the MCR or access to surrounding areas important to the safe control of reactor operations needed to cope with the consequences of the piping failure.**
> **The capability of all essential components to perform their intended safety functions is maintained."**

The staff also notes that the DCD Section 9.3.3.1.1 "Safety Design Bases" for the "Equipment and Floor Drainage Systems" reads, in part:

- **The equipment and flood drainage systems function to prevent flooding and water accumulation for volume being drained. …**
- **The equipment and floor drainage systems are designed to prevent damage to safety-related systems, structures, and equipment.**
- **Equipment and floor drainage system failures will not prevent the proper function of any safety-related equipment.**

In follow-up RAI No. 582-4456, Question No. 09.04.05-18 the staff noted for cooling coils of the MCR HVAC ventilation system AHUs, FMEA Table 9.4.1- 2 does not address a failure mode of concern. With the applicant's response FMEA Table 9.4.1-2 was not amended to include this mode of failure. The staff requests that the applicant amend the DCD FMEA Table with this failure mode. The staff finds that a failure in the AHU should not create an unacceptable condition in the control room and that the control room should be protected from such a failure. Please designate a design basis leakage from the failure in the AHU.

What design features within the AHU will prevent the failure of a essential chilled water cooling coil leak inside the AHUs from adversely impacting the safety related components contained in the control room below? The applicant referenced DCD subsection 3.4.1.5.2.2 in its response. Just referencing the equipment drain system is not adequate to address the concern. Please specify how design basis leakage from the potential failure of a cooling coil (i.e. 45 gpm per DCD Table 9.2.7-2) will be directed to the drain system. Specify in the DCD this is part of the design basis of the drain system and explain how the bypass of the drain system is precluded.

09.04.01-26

This is a follow-up question to RAI No. 582-4456, Question No. 09.04.01-23 SRP 6.5.1, Revision 3, states that the "component design criteria, qualification requirements, and qualification testing of heaters, demisters, prefilters, and high-efficiency particulate air (HEPA) filters, design requirements of the filter and adsorber mounting frames, system filter and adsorber housings, and water drains, the adsorbent used for removal of gaseous iodides (in the preliminary safety analysis report (PSAR)), the physical properties of the adsorbent, and the design of the adsorber section of the filter trains (in the final safety analysis report (FSAR))" are to be reviewed.

The staff notes that Revision 1 of the DCD and Revision 0 of the RCOLA FSAR contained COL Item 6.4(4) read "*The COL Applicant is responsible to determine the charcoal adsorber weight, type and distribution."* This COL Item has been deleted from Revision 2 of the DCD. DCD Revision 2 Table 6.4-1 contains insufficient information to determine if Regulatory Guide 1.52 is met with respect to carbon filters of the MCR emergency filtration units.

Please provide the design information for the control room filters in sufficient detail to demonstrate RG 1.52 is met.

1. **The design average atmosphere residence time should be 0.25 seconds per 2 inches in thickness of adsorbent bed.**

   The staff requests that the applicant provide a value for the design average atmosphere residence time based on bed dept and adsorber weight.

2. **The maximum charcoal loading for the adsorbent train should be below 2.5 mg/gm (≤ 2.5 mg of total iodine per gram of charcoal).**

   Revision 2 Table 6.4-2 Item No. 4.11c reads "*Applicable to US-APWR design, including ASME AG 1-2003. The COL Applicant is responsible to determine the charcoal adsorber weight, type and distribution*"

   The staff requests that the applicant amend Item 4.11c of Table to remove the carryover error from Revision 1 of the DCD. The staff requests that the applicant provide a value for the maximum iodine loading of the charcoal beds of the MCR emergency filtration units based on adsorber weight.

3. **The design percent of the impregnant carbon should be no more than 5% of the total carbon.**

   Item 4.11.d for the US-APWR Design reads "*Applicable to US-APWR design, including ASME AG 1-2003*."

   In its review of ASME AG-1-2003, the staff could not locate this limitation on charcoal impregnant. The staff requests that this limit be incorporated into DCD Table 6.4-1.

4. **The staff notes that ASME N509-2002 section 4 "Functional Design" 4.10 reads: " *Where heat of radioactive decay or heat of oxidation or both may be significant, means shall be provided to remove this heat from the adsorbent beds to limit temperatures to values below 300°F (149°C) to prevent significant iodine desorption."***

   The maximum component temperature in the adsorber section with normal flow conditions is not specified. The iodine loading post-accident radioactivity-induced heat in the adsorbent should not exceed that design temperature.

   The staff requests that the applicant provide calculated values for the maximum component temperatures: (a) in the adsorber section with normal flow conditions <u>and</u> (b) with the unit shutdown & the charcoal adsorbent unit isolated (i.e. post LOCA condition).

   The staff requests additional information about what design features of the adsorbent beds will prevent the bed temperatures from approaching 300ºF thereby permitting iodine desorption from taking place.

5. **Under conditions of a failed fan post-LOCA, the charcoal temperature rise resulting from radioactivity-induced heat in the adsorbent should be below the 626 °F (330ºC – Ref. AG-1-2003, pg 435) charcoal ignition temperature. Will water deluge from the fire protection sprinkler utilized to control this?**

6. SRP 6.5.1 section III. "Review Procedures" 3.G lists demisters (a.k.a. moisture separators) as a component that may be required in ESF atmospheric cleanup systems. The MCR emergency filter trains of the US-APWR do not contain demisters as a component. The staff could not find criteria within AG-1-2003 that established when demisters are to be employed in the design of the ESF filter trains. ASME N509-2002 section 4 "Functional Design" 4.1 (d) reads*: "Moisture separators (demisters) are required when entrained water droplet concentration may be greater than 1 lb (0.45 kg) of water per 1,000 cfm (1,700 m^3/hr) of airflow."*

What criteria did the applicant use to conclude that all future US-APWR plants (i.e. regardless of the plant's location within the United States) will not need demisters to remove entrained moisture from the outside air stream for the filter trains to fulfill their safety function?

7. In addition, there is insufficient information to determine if the following Regulatory Guide 1.52 parameter is met with respect to HEPA filters. For the US-APWR, the applicant specifies that the design filter efficiency for removal efficiency of particulates by the HEPA filter is 99% minimum (as credited in accident dose evaluations). There is insufficient information to determine if the HEPA filters have sufficient design margin to accommodate fission product loading without restricting flow rate. Provide the additional information necessary to support and meet the requirements listed above.

8. Regulatory Guide 1.52 Section 6.4 ("In-place Testing Criteria") reads *"…The test should be performed in accordance with Section 11 of ASME N510-1989 (Ref. 8). The leak test should confirm a combined penetration and leakage (or bypass)[9] of the adsorber section of 0.05% or less of the challenge gas at rated flow ±10%."*

The staff notes that this 0.05% or less leakage corresponds to an adsorbent bed efficiency of ≥ 99.95%.

DCD Table 6.4-1 permits a minimum "Charcoal Iodine Removal Efficiency" of 95% for the adsorber beds of the ESF MCR filter trains.

The staff requests additional information about this apparent mismatch of regulatory guidance with what is represented as acceptable in the DCD.

09.04.01-27

<u>Follow-up RAI</u>

This is a follow-up RAI question to RAI No. 582-4456, Question No. 09.04.01-19 The staff recognizes that relative humidity varies from site to site and that all nuclear power plants may not require control room humidifiers. However, some sites will require humidity control in the control room to protect safety-related equipment. Extremely dry air can impact safety-related electrical equipment if the equipment is not qualified for the dry conditions. In the nuclear industry, static charges have caused actuations and reactor trips and other undesired occurrences. In the design certification process, a design basis needs to be established for the control room ventilation system. Options include but are not

limited to establishing a minimum credible humidity for the site conditions permitted in the DC with no humidity control to use for the qualification of control room electrical equipment or the use of safety-related humidifiers.

- **Please state the minimum humidity used for qualification of electrical equipment in the control room and explain how the ventilation system will accomplish this without humidifiers.**