

  
**MITSUBISHI HEAVY INDUSTRIES, LTD.**  
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TOKYO, JAPAN

March 9, 2011

Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021  
MHI Ref: UAP-HF-11061

**Subject: MHI's Response to US-APWR DCD RAI No.691-5410 Revision 2 (SRP 06.04)**

**References:** 1) "Request for Additional Information No. 691-5410 Revision 2, SRP Section: 06.04 – Control Room Habitability System Application Section: 6.4" dated February 7, 2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No.691-5410 Revision 2".

Enclosed is the response to one RAI contained within Reference 1.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,



Yoshiaki Ogata,  
General Manager- APWR Promoting Department  
Mitsubishi Heavy Industries, LTD.

Enclosure:

1. Response to Request for Additional Information No. 691-5410, Revision 2

CC: J. A. Ciocco  
C. K. Paulson

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MPC

Docket No. 52-021  
MHI Ref: UAP-HF-11061

Enclosure 1

UAP-HF-11061  
Docket Number 52-021

Response to Request for Additional Information  
No. 691-5410, Revision 2

March, 2011

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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3/9/2011

**US-APWR Design Certification  
Mitsubishi Heavy Industries  
Docket No. 52-021**

**RAI NO.:** NO.691-5410 REVISION 2  
**SRP SECTION:** 06.04 - CONTROL ROOM HABITABILITY SYSTEM  
**APPLICATION SECTION:** DCD Tier 2 Sections 6.4  
**DATE OF RAI ISSUE:** 02/07/2011

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**QUESTION NO. : 06.04-14**

This is a follow-up RAI to the DCD (MHI) RAI series RAI No. 49-895 Question No. 06.04-19 and RAI 338-2325, Question No. 06.04-6 ([ML091700682](#)); RAI No. 559-4387; Question No. 06.04-13 ([ML101450224](#)) (NRC ID 4387, Q#16732).

This is also a follow-up RAI to the R-COLA (Luminant) RAI series: RAI No. 3968, Question No. 06.04-7 ([ML100550345](#)); RAI No. 4678, Question No. 06.04-11 ([ML102810224](#))

Due to the expected plant design impact of the resolution of the issues associated with this RAI, it is being issued simultaneously to both DCD applicant, MHI and the R-COL applicant, Luminant.

In response to Question No.: 06.04-13, **OPEN ITEM** - Follow-up RAI (NRC ID 4387, Q#16732), dated May 20, 2010, the FSAR was revised in a confusing and potentially ambiguous manner. Specifically, the FSAR commits to design the enclosure and chillers in accordance with ANSI/ASHRAE Standard 15-2007. The staff can accept essential and non-essential chillers located in proximity of other important equipment if they are designed in accordance with a robust consensus standard like ANSI/ASHRAE Standard 15. Unfortunately, compliance with the standard was made ambiguous with the recent revision to the FSAR. The specific or detailed design of the chillers has not been finalized and it is not possible at this time to demonstrate compliance with STD 15. It is also not possible to conclude whether a dedicated ventilation for each machinery room is necessary to comply with STD 15. The recent FSAR revision has precluded the use of dedicated ventilation and instead indicated that the auxiliary building ventilation would be used. STD 15 clearly requires dedicated ventilation under certain conditions. Specifically, Section 8.11.4 reads, "*Air and supply and exhaust ducts to the machinery room shall serve no other area.*"

Please justify why a dedicated ventilation and the other requirements of STD 15 Sections 8.11 and 8.12 are not necessary for compliance with STD 15 for all possible chiller configurations permitted by the FSAR. If additional design commitments for the chillers (size, refrigerant type, refrigerant volume, refrigerant amount ...) are necessary to justify this assertion please include these design commitments in the FSAR.

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**ANSWER:**

As stated in the response to RAI 559-4387, Question 06.04-13, the Essential Chilled Water System (ECWS) chillers and non-Essential Chilled Water System (non-ECWS) chillers will be located in

equipment rooms designed in compliance with ANSI/ASHRAE Standard 15-2007, *Safety Standard for Refrigeration Systems*. Overall compliance with ANSI/ASHRAE Standard 15 is demonstrated in the following discussion. Specifically, compliance with Requirement 8.11.4 does not preclude use of the auxiliary building HVAC system, as discussed in detail below. DCD Sections 9.2.7.1 and 9.2.7.2 will be revised to clarify the ambiguity.

As stated in the Purpose, the intent of ANSI/ASHRAE Standard 15 is to specify the safe design, construction, installation, and operation of refrigeration systems. With respect to refrigeration equipment located within machinery rooms, ANSI/ASHRAE Standard 15 provides requirements intended to prevent the escape of refrigerant to occupied spaces in the event of a leak that could endanger the life of occupants. The Standard provides classifications for occupancy type, refrigerating system, and refrigerants in order to apply the restrictions and requirements for the refrigeration equipment installation.

The US-APWR plant is classified as *industrial occupancy* in accordance with ANSI/ASHRAE Standard 15, Section 4 since access to the plant is limited to authorized persons and not open to the public.

The ECWS and non-ECWS chillers are *indirect closed systems* based on the definition in ANSI/ASHRAE Standard 15, Section 5.1.2.3. The ECWS and non-ECWS systems utilize a secondary coolant (chilled water) in a closed circuit such that the refrigerant cannot come in direct contact with the air to be cooled in the areas served by the chilled water systems. This type of refrigeration system is classified as a *low-probability system* in ANSI/ASHRAE Standard 15, Section 5.2, meaning that leakage from a failed connection, seal, or component in the refrigerant system cannot enter the occupied space being cooled by the chilled water systems.

Section 6 of Standard 15 provides requirements for refrigerant safety classification. Refrigerants are classified into safety groups based on flammability and toxicity levels. The refrigerant type used in ECWS and non-ECWS chillers will be of lower flammability and toxicity level included in Safety Group A1.

The chillers are located in machinery (equipment) rooms, consistent with Section 7.4 of Standard 15. In addition, Safety Group A1 refrigerants are used such that the requirements for machinery room construction and maintenance in Section 8.11 are applicable in accordance with Section 7.4.2. Since Safety Group A2, B2, A3, or B3 refrigerants are not used, the requirements in Section 8.12 are not applicable.

The applicable additional restrictions of Section 7.5 are operational requirements, but are consistent with normal plant practice.

ANSI/ASHRAE Standard 15, Section 8 provides refrigeration equipment installation restrictions and requirements. The requirements of Subsections 8.1 through 8.5 and 8.9 are met with typical plant installation practices. Subsections 8.6 through 8.8 and 8.10 are not applicable to a chilled water system installation with no refrigerant piping routed outside of the equipment rooms.

Section 8.11 provides the general requirements for machinery room design and construction. The provisions of this section are summarized below along with a description of how each is met.

**8.11.1** *The machinery room shall provide access to installed equipment with space for service, maintenance and operation.*

The installation of the ECWS and non-ECWS chillers will provide sufficient access space for service, maintenance and operation consistent with normal installation practice for plant equipment.

**8.11.2** *Each machinery room shall have tight fitting doors opening outward and self-closing; adequate in number to allow personnel escape in an emergency. There shall be no other openings that will permit passage of escaping refrigerant to other parts of the building.*

As described in the response to RAI No. 559-4387 Question 06.04-13, the chiller equipment rooms include tight-fitting doors. The door is adequate to allow personnel escape in an emergency. The only unsealed openings in the equipment room are the supply and exhaust air penetrations. Refrigerant will not pass through these openings to other parts of the building since the exhaust airflow will ensure flow into the room through the supply air opening and out through the exhaust duct.

- 8.11.2.1 *Each machinery room shall contain a detector, located where refrigerant will concentrate and with a setpoint corresponding to the threshold limit value time weighted average (TLV-TWA), that actuates an alarm and mechanical ventilation. The alarm shall annunciate visual and audible alarms inside and outside the room.*

As described in the response to RAI No. 559-4387 Question 06.04-13, each equipment room contains a refrigerant leak detector that actuates an alarm in the main control room. The equipment rooms exhaust ventilation is provided by the auxiliary building HVAC system and is continuously in service such that actuation of a separate mechanical ventilation system by the detector is not required. The installation location and setpoint of the detector will be in compliance with ANSI/ASHRAE Standard 15. Visual and audible alarms are annunciated inside and outside of the room consistent with the requirements of ANSI/ASHRAE Standard 15.

- 8.11.3 *Machinery rooms shall be vented to the outdoors utilizing mechanical ventilation.*

The chiller equipment rooms are vented to the plant vent stack by the auxiliary building HVAC system.

- 8.11.4 *Mechanical ventilation shall be by power-driven fans capable of exhausting an adequate amount of air from the room. Provision shall be made for inlet air to replace exhausted air. Inlet air openings shall be placed to avoid recirculation. Air supply and exhaust ducts shall serve no other area. The discharge of air to the outdoors shall not cause a nuisance or danger.*

Equipment room ventilation is provided by the auxiliary building HVAC system, which includes power-driven exhaust fans. The auxiliary building HVAC system provides once-through ventilation for the chiller equipment room at an exhaust flowrate adequate to purge the room of leaked refrigerant. There is a provision in each of the equipment rooms for supply air to replace exhausted air. Inlet air openings are not located adjacent to exhaust ducts in order to preclude recirculation. The air supply inlet consists of an opening in a room wall that is adjacent to an open space, such as a corridor, or a supply branch duct that is routed directly from the auxiliary building HVAC supply trunk and serves no other area. Equipment room exhaust is provided by ducted exhaust from the auxiliary building HVAC system. Each room exhaust branch duct is routed directly from the room to the auxiliary building HVAC system exhaust duct so that the air exhausted from the equipment rooms does not communicate with any other area served by the ventilation system. The auxiliary building HVAC system exhaust is routed to the plant vent stack such that any exhausted refrigerant cannot cause a nuisance or danger to any occupied space.

- 8.11.5 *Mechanical ventilation exhaust airflow requirement is based on mass of refrigerant in chiller. Ventilation shall be operating when occupied.*

Although the ECWS and non-ECWS chiller refrigerant charge is not currently available, the auxiliary building HVAC system flowrate is expected to be adequate to purge the equipment room of leaked refrigerant. The exhaust ventilation is continuously in service whether or not the room is occupied.

- 8.11.6 *No open flames using combustion air from the machinery room shall be installed.*

There is no open flame combustion equipment installed in the chiller equipment rooms.

- 8.11.7 *There shall be no airflow to or from an occupied space through a machinery room unless the air is ducted and sealed in such a manner as to prevent any refrigerant leakage from entering the airstream.*

As stated in the compliance to section 8.11.4, there is no ventilation to occupied spaces from the chiller equipment rooms since the equipment room exhaust is provided by ducted exhaust from the auxiliary building HVAC system. Supply ventilation airflow does not cascade from equipment rooms to occupied spaces, and there is a provision in each of the equipment rooms for supply air to replace exhausted air.

8.11.8 *Access to the machinery room shall be restricted. Doors shall be clearly marked.*

Chiller equipment room access is by authorized personnel only. Equipment room doors are labeled in accordance with normal plant practice.

Based on the evaluation above, the design and construction of the ECWS and non-ECWS chiller equipment rooms is consistent with ANSI/ASHRAE Standard 15.

#### **Impact on DCD**

DCD Revision 2 Subsection 9.2.7.2.1 and 9.2.7.2.2 will be revised as follows, which supplements the DCD changes previously described in response RAI 559-4387, Question 06.04-13:

“The chillers are protected by a pressure-relief devices to safely relieve **overpressure, which are and are vented** piped to **the** outside of the building in accordance with ANSI/ASHRAE Standard 15 **to prevent the discharge from entering any building.** And the **The** chiller mechanical equipment rooms meet ANSI/ASHRAE Standard 15 requirements for refrigerating machinery rooms including being equipped with refrigerant leak detectors that can actuate an alarm **inside the equipment room and in the MCR** and tight-fitting doors. **No occupied spaces are ventilated from the chiller equipment rooms.** The pressure-relief device for each chiller is designated to prevent the discharge from entering any building.”

#### **Impact on COLA**

There is no impact on the COLA.

#### **Impact on PRA**

There is no impact on the PRA.