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September 22, 2008

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-08198

Subject: MHI's Responses to US-APWR DCD RAI No.48-840

References: 1) "Request for Additional Information No. 48-840 Revision 0, SRP Section: 05.04.12, Application Section: 5.4.12," dated August 11, 2008.

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.48-840 Revision 0."

Enclosed are the responses 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,

Y. Ogata

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

Enclosures

1. Responses to Request for Additional Information No.48-840 Revision 0

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-08198
Docket Number 52-021

Responses to Request for Additional Information No.48-840 Revision 0

September, 2008

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/22/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO.48-840 REVISION 0**
SRP SECTION:	**05.04.12- REACTOR COOLANT SYSTEM HIGH POINT VENTS**
APPLICATION SECTION:	**5.4.12**
DATE OF RAI ISSUE:	**8/11/2008**

QUESTION NO. : 5.4.12-1

Section 5.4.12.2 of DCD indicated that the reactor vessel head vent system consists of a flow path that diverges into two parallel paths each with two redundant motor operated remote manual valves in series. Also, each valve connected in series is powered by the independent Class 1E power supply. Please provide detailed discussion for the Class 1E power supplies to each of the four valves in the redundant vent flow path and demonstrate that at least one of the redundant vent flow path will open on demand and be able to isolate after the flow path is opened with the capability of preventing inadvertent or irreversible actuation of a vent path following a single failure of an active component, mechanically or electrically.

(These regulatory criteria are consistent with the information provided on page 5.4.12-5 of the SRP Section 5.4.12, Revision 1, March 2007.)

ANSWER:

The Class 1E power supplies to each of the four valves in the reactor vessel head vent line are as follows.

RCS-MOV-002A and 002B are respectively powered from trains B and C of the Class 1E dc power supply system.
RCS-MOV-003A and 003B are respectively powered from Class 1E 480V motor control centers A1 and D1. And Class 1E 480V motor control centers A1 and D1 are respectively connected to Class 1E 480V load centers A1 and D1. The Class 1E 480V load center A1 is normally connected to train A of Class 1E ac power supply system. During on line maintenance of train A of the Class 1E gas turbine generator, Class 1E 480V load center A1 is manually connected to train B of Class 1E ac power supply system. Similarly, Class 1E 480V load center D1 is normally connected to train D of the Class 1E ac power supply system. During on line maintenance of train D Class 1E gas turbine generator, Class 1E 480V load center D1 is manually connected to the train C of Class 1E ac power supply system.
Electric power system is discussed in detail in Chapter 8.

As shown in Table 1 below, the above mentioned arrangements of power supplies provide that at least one vent flow path can be opened and that the vent flow path can be isolated following a single failure of an active component. Moreover, this arrangement precludes the possibility of inadvertent opening of the vent flow path.

Table 1 Failure Mode and Effect Analysis for Reactor Vessel Head Vent

Component	Failure Mode	Effect on System Operation	Remark
1. RCS-MOV-002A. (RCS-MOV-002B analogous)	Failure to open on demand with on line maintenance of a Class 1E power supply	None At least one vent flow path can be opened by opening RCS-MOV-002B and RCS-MOV-003B.	RCS-MOV-002B and RCS-MOV-003B are on Class 1E electrical trains different from the failed valve. RCS-MOV-002B is on Class 1E dc power electrical train, and on line maintenance of dc power electrical train is prohibited. RCS-MOV-003B can be on electrical train C or D which is not in on line maintenance.
	Failure to close on demand with on line maintenance of a Class 1E power supply	None The vent flow path can be isolated by closing RCS-MOV-003A	RCS-MOV-003A is on Class 1E electrical train different from RCS-MOV-002A. RCS-MOV-003A can be on electrical train A or B which is not in on line maintenance.
2. RCS-MOV-003A. (RCS-MOV-003B analogous)	Failure to open on demand with on line maintenance of a Class 1E power supply	None At least one vent flow path can be opened by opening RCS-MOV-002B and RCS-MOV-003B.	Same as item 1.
	Failure to close on demand with on line maintenance of a Class 1E power supply	None The vent flow path can be isolated by closing RCS-MOV-002A	RCS-MOV-002A is on Class 1E electrical train different from RCS-MOV-003A. RCS-MOV-002B is on Class 1E dc power electrical train, and on line maintenance of dc power electrical train is prohibited.

Impact on DCD
There is no impact on the DCD.

Impact on COLA
There is no impact on the COLA.

Impact on PRA
There is no impact on the PRA.

QUESTION NO. : 5.4.12-2

Provide discussions regarding power supplies to motor operated valves in the reactor coolant system high point vent system on pressurizer using safety depressurization valve and depressurization valve to demonstrate that the vent system will perform its design safety function and capable of preventing inadvertent or irreversible actuation of a vent path following a single failure of an active component, mechanically or electrically.

(These regulatory criteria are consistent with the information provided on page 5.4.12-5 of the SRP Section 5.4.12, Revision 1, March 2007.)

ANSWER:

Class 1E power supplies to safety depressurization valves and block valves are as follows.

RCS-MOV-116A and 116B, block valves, are respectively powered from train B and C of Class 1E dc power supply system.
RCS-MOV-117A and 117B, safety depressurization valves, are respectively powered from Class 1E 480V motor control center A1 and D1.

The arrangements of power supplies are same as for reactor vessel vent valves. As discussed in the answer to RAI 5.4.12-1, at least one flow path can be opened and the flow path can be isolated following a single failure of an active component.

In addition, as an administrative control, the safety depressurization valves can be selected to be in the "Pull Lock" mode to reduce the chance of inadvertent actuation by an operator error.

Class 1E power supplies to depressurization valves are as follows.

RCS-MOV-118 and 119 are respectively powered from Class 1E 480V motor control centers A1 and D1. These arrangements of power supplies allow for the vent flow path to be isolated following a single failure of an active component. Moreover, the valve arrangement precludes the possibility of inadvertent opening of the vent flow path.

On the other hand, the flow path can not be opened if a single failure of an active component is assumed. See the answer to RAI 5.4.12-6 for the justification.

Impact on DCD
There is no impact on the DCD.

Impact on COLA
There is no impact on the COLA.

Impact on PRA
There is no impact on the PRA.

QUESTION NO. : 5.4.12-3

Provide discussions regarding high points in the reactor coolant system (RCS) other than the reactor vessel head and pressurizer that could accumulate non-condensable gases and the need of providing vent system at these high points to assure adequate core cooling during natural circulation cooldown following an accident.

(These regulatory criteria are consistent with the information provided on page 5.4.12-1 of the SRP Section 5.4.12, Revision 1, March 2007.)

ANSWER:

As shown in Figure 4.4-1 of the DCD Chapter 4, Isometric View of the Reactor Coolant System, the only high points in the reactor coolant system that could accumulate non-condensable gases are the reactor vessel head and pressurizer except for the U-tubes of the steam generators. Therefore, there is not the other high point vent path.

Impact on DCD
There is no impact on the DCD.

Impact on COLA
There is no impact on the COLA.

Impact on PRA
There is no impact on the PRA.

QUESTION NO. : 5.4.12-4

Provide discussion regarding provision of flow restriction in the RCS high point vent flow path to assure that the size of the vent is smaller than the size corresponding to the definition of a LOCA to avoid unnecessary challenges to the ECCS.

(These regulatory criteria are consistent with the information provided on page 5.4.12-5 of the SRP Section 5.4.12, Revision 1, March 2007.)

ANSWER:

Flow restrictors such as orifices are not provided in reactor vessel head vent system. However, valve arrangement precludes the possibility of inadvertently opening of the vent flow path, as discussed in the answer to question No.5.4.12-1. In addition, the reactor vessel head vent line break is bounded by the LOCA analyzed in Subsection 15.6.5.

Impact on DCD
There is no impact on the DCD.

Impact on COLA
There is no impact on the COLA.

Impact on PRA
There is no impact on the PRA.

QUESTION NO. : 5.4.12-5

Provide discussion regarding operating procedures including instrumentation required by operators and the bases for these procedures for the RCS system high point vents.

(These regulatory criteria are consistent with the information provided on page 5.4.12-2. The acceptance criteria of SRP Section 5.4.12 specify that procedures should be developed to use the vent paths to remove gases that may inhibit core cooling from the U-tubes of the SGs. In addition, the procedures to operate the vent system should consider when venting is needed and when it is not needed, taking into account a variety of initial conditions, operator actions, and necessary instrumentation.)

ANSWER:

The RCS high point vents of non-condensable gases are implemented when in-vessel retention (IVR) is achieved for transient sequences in severe accidents. Although loss of core cooling leads to core damage, IVR prevents the reactor vessel (RV) failure by cooling molten core due to early recovery of coolant injection into the reactor coolant system (RCS). This accident scenario is the same as in the TMI-2 accident. The specific operating procedures are summarized below.

- Even when severe accident occurs, operators try to recover the coolant injection into the RCS for accident mitigation if possible, see subsection 19.2.5 of the DCD.

- Valves for high point vents are opened when IVR is achieved in transient sequences and when non-condensable gas exists in the RV upper head. Whether IVR is achieved or not will be determined from containment dose rate, core exit temperature, and RV water level. These valves are opened if the RV water level stands at below the top of the RV, judging that non-condensable gas exists in the RV upper head.

- These valves are closed if the RV water level recovers to around the top of the RV, judging that non-condensable gas is removed from the RV upper head.

- Then reactor coolant pumps (RCPs) are started and decay heat is removed through SGs.

- Non-condensable gas may accumulate again in the RV upper head after RCPs are started if it has remained in U-tubes of SGs. In such case, the RCPs are stopped and these valves are opened and closed for gas venting.

- The above operating procedures are repeated if the RV water level is lowered due to non-condensable gas accumulation in the RV upper head.

Impact on DCD
There is no impact on DCD from this RAI as the response contains only additional information.

Impact on COLA
There is no impact on COLA from this RAI as the response contains only additional information.

Impact on PRA
There is no impact on PRA from this RAI and the response as this additional information does not cause any changes to the PRA.

QUESTION NO. : 5.4.12-6

DCD Section 5.4.12.2 indicates that the depressurization valves (DVs) only consist of a single flow path. Explain how this flow path could open to perform its designed safety function following a single failure in the system.

ANSWER:

In SECY-90-016 III. F., there is a statement that features provided only for severe-accident protection need not be subject to the 10 CFR 50.49 environmental qualification requirements, 10 CFR Part 50, Appendix B quality assurance requirements, and 10 CFR Part 50, Appendix A redundancy/diversity requirements. Because the DVs are used only in operator actions relating to severe accident mitigation, redundancy requirements are not applied to their design in accordance with the statement in SECY-90-016. Therefore, the DVs are not expected to operate following a single failure in the system.

Impact on DCD
There is no impact on DCD from this RAI as the response contains only additional information.

Impact on COLA
There is no impact on COLA from this RAI as the response contains only additional information.

Impact on PRA
There is no impact on PRA from this RAI and the response as this additional information does not cause any changes to the PRA.

This completes MHI's responses to the NRC's questions.