# MITSUBISHI HEAVY INDUSTRIES, LTD.

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TOKYO, JAPAN

December 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-08297

**Subject: MHI's Response to US-APWR DCD RAI No. 114-787 Revision 0**

**Reference:** 1) "Request for Additional Information No. 114-787 Revision 0, SRP Section: 06.02.01.04, Application Section: 6.2.1.4" dated December 3, 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. 114-787 Revision 0."

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,

Y. Ogata

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

Enclosure:

1. Response to Request for Additional Information No. 114-787 Revision 0

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


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Enclosure 1

UAP-HF-08297
Docket Number 52-021

Response to Request for Additional Information
No. 114-787 Revision 0

December 2008

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

**12/22/2008**

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No.52-021**

| | |
|---|---|
| **RAI NO.:** | **NO.114-787 REVISION 0** |
| **SRP SECTION:** | **06.02.01.04 – Mass and Energy Release Analysis for Postulated Secondary System Pipe Ruptures** |
| **APPLICATION SECTION:** | **6.2.1.4** |
| **DATE OF RAI ISSUE:** | **12/03/2008** |

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**QUESTION NO. : 06.02.01.04-3**

6.2.1.4: Justify and/or clarify that the chosen single failure is the one that maximizes the calculated containment pressure and temperature.

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## ANSWER:

Section 6.2.1.4 of the DCD discusses the assumptions that are made in the mass and energy release analysis. Table 6.2.1-25 in the DCD also indicates which assumptions are used in each of the 9 cases that were analyzed for maximum containment pressure and temperature.

In order to demonstrate that each of the 9 analyzed cases bounds any single failure, a Failure Modes and Effects Analysis (FMEA) of the mitigation systems and components which are considered in the mass and energy release for a secondary system pipe break is shown in Table 06.02.01.04-3.1. As can be seen from the table, the 9 cases that were directly analyzed bound the worst case single failure. Although passive components such as main steam check valves are not assumed as part of a single active failure, MHI assumes this failure as part of the conservatism in the analysis. It should be noted that the feedwater isolation valve has redundant closure mechanisms such that a single failure of either closure mechanism will not cause a failure of the valve to close. As shown in the FMEA below, the main feedwater isolation valve (MFIV) is conservatively assumed to fail even though a single active failure could not cause an MFIV isolation failure. Therefore, it is clear that the assumptions used in the analysis lead to the maximum mass and energy release.

In addition to the mass and energy release, the calculated maximum containment pressure and temperature is also affected by assumptions for the containment response analysis. For the containment response analysis, a single failure of one train of the containment spray system with another train of the spray system out due to on-line maintenance is assumed to minimize the heat removal of the containment atmosphere. Thus the unavailable engineered safety features are two of the four containment spray systems.

In the mass and energy release analysis and the containment response analysis for the secondary system pipe break, both a single failure and on-line maintenance of one of the remaining redundant systems are assumed for each analysis in order to maximize the calculated containment pressure and temperature.

**Table 06.02.01.04-3.1: Failure Modes and Effects Analysis for Mass and Energy Release for Secondary System Break**

| System/Component | Failure Mode | Consequence of Single Failure | Applicability to 6.2.1.4 Analysis |
|---|---|---|---|
| Main Steam Isolation Valve (affected SG) | Fails to close | No effect. Uni-directional valve allows reverse flow from all intact SGs. | N/A |
| Main Steam Isolation Valve (intact SG) | Fails to close | No effect. The check valve in the affected steam line is credited for this case, terminating backflow from the intact steam generators. | N/A |
| Main Steam Check Valve (affected SG) | Fails to close | Allows all intact SGs to blow down through break until main steam isolation of intact SGs. | Check valves in affected steam line not credited in analysis for all 9 cases prior to steam line isolation. |
| Main Steam Check Valve (intact SG) | Fails to close | No effect. Reverse flow does not occur in intact SG. | N/A |
| Main Feedwater Isolation Valve (affected SG) | Fails to close | Main feedwater regulation valve provides redundancy for isolation, but allows additional feedwater from unisolated portion to flash. | Additional feedwater line volume flashing already assumed in all 9 cases. |
| Main Feedwater Isolation Valve (intact SG) | Fails to close | No effect. Main feedwater regulation valve provides redundancy for isolation. | N/A |
| Main Feedwater Regulation Valve (affected SG) | Fails to close | No effect. Main feedwater isolation valve provides redundancy for isolation. | N/A |
| Main Feedwater Regulation Valve (intact SG) | Fails to close | No effect. Main feedwater isolation valve provides redundancy for isolation. | N/A |
| Emergency Feedwater Control or Isolation Valve (affected SG) | Fails to close | No effect. EFW control valve and EFW isolation valve in series provide redundancy for isolation (DCD Table 10.4.9-4). | NA |
| Emergency Feedwater Control or Isolation Valve (intact SG) | Fails to close | No effect. EFW control valve and EFW isolation valve in series provide redundancy for isolation (DCD Table 10.4.9-4). | N/A |
| Reactor Trip System | 1 train fails to operate | No effect. Reactor is tripped by remaining redundant trains. | N/A |
| Engineered Safety Features Actuation System* | 1 train fails to operate | No effect. Actuation occurs by remaining redundant trains. | N/A |
| Emergency Feedwater System | 1 train fails to operate | No effect. Assuming all EFWS trains operate is worse than assuming a failure. | EFWS train is assumed to operate for the loop with the affected SG in all 9 cases. |
| Active Safety Injection System | 1 train fails to operate | Decreased boron delivery and increased core power during shutdown (more energy is transferred to secondary and released). | Failure of 1 SI train with 1 train out for on-line maintenance already assumed in all 9 cases. |

**Includes actuation signals for safety injection, main steam line isolation, main feedwater isolation, emergency feedwater, and reactor coolant pump trip*

**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.

This completes MHI's response to the NRC's question.