**MITSUBISHI HEAVY INDUSTRIES, LTD.**
**16-5, KONAN 2-CHOME, MINATO-KU**
**TOKYO, JAPAN**

July 31, 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-08135

**Subject: MHI's Responses to US-APWR DCD RAI No.26**

**References:** 1) "Request for Additional Information No. 26 Revision 0, SRP Section: 06.04, Application Section: 6.4," dated July 1, 2008.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No.26 Revision 0."

Enclosed are the responses to two RAIs 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.26 Revision 0

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

Contact Information

C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

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Enclosure 1

UAP-HF-08135
Docket Number 52-021

# Responses to Request for Additional Information No.26 Revision 0

July, 2008

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/31/2008

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

| | |
|---|---|
| **RAI NO.:** | **NO.26 REVISION 0** |
| **SRP SECTION:** | **06.04 – CONTROL ROOM HABITABILITY SYSTEM** |
| **APPLICATION SECTION:** | **06.04 HABITABILITY SYSTEMS** |
| **DATE OF RAI ISSUE:** | **7/01/2008** |

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**QUESTION NO. : 06.04-1**

DISCUSS THE RADIOLOGICAL CONSEQUENCES ANALYSES FOR ALL BASIS ACCIDENTS (DBAS), AND PROVIDE THE RESULTING DOSES IN THE CONTROL ROOM FOR EACH DBA.

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## ANSWER:

Main control room (MCR) doses of each event are shown below.

The loss of coolant accident (LOCA) MCR dose is dominated by the inflow (inleak and intake) while direct shine doses are less important. Other DBAs have a similar relationship, i.e. inflow dominates the dose. Therefore in the table below only the doses determined from inflow are shown for the non-LOCA events. For the LOCA event, dose includes direct shine.

| Event | Control Room TEDE* dose | Comments |
|---|---|---|
| Steam system piping failure | 3.4 rem | Pre-transient iodine spike |
| | 4.3 rem | Transient-initiated iodine spike |
| Reactor coolant pump rotor seizure | 1.0 rem | |
| Rod ejection accident | 4.3 rem | |
| Failure of small lines carrying primary coolant outside containment | 0.56 rem | |
| Steam generator tube rupture | 3.5 rem | Pre-transient iodine spike |
| | 0.60 rem | Transient-initiated iodine spike |
| Loss of coolant accident | 4.5 rem | Includes direct shine = 0.018 rem |
| Fuel handling accident | 0.68 rem | Occurred in fuel handling area |
| | 3.4 rem | Occurred in containment |

*TEDE: total effective dose equivalent

Dose calculations have been made based upon the following assumptions.

- **Steam System Piping Failure (DCD 15.1.5.5)**

A hypothetical event where the main steam line breaks and the secondary coolant steam containing radioactivity is discharged to the environment. After occurrence of the steam system piping failure, emergency feedwater in the broken secondary side is isolated and the steam generator in the loop dries out. Transition of radioactivity in the primary coolant to the secondary coolant system due to primary-to-secondary leakage is assumed. At that time, an iodine spike in the primary system is assumed. The radioactivity leaked to the broken secondary side is assumed to be discharged directly to the environment. Radioactivity in the secondary coolant of the intact loop is discharged to the environment with steam in accordance with partition coefficient and moisture carryover. Release from the broken steam line, the main steam relief valve and the safety valve is assumed (See DCD Table 15A-18.).

- **Reactor Coolant Pump Rotor Seizure (DCD 15.3.3.5)**

A hypothetical event where the reactor coolant pump rotor seizes, the fuel in the core is broken and radioactive material is discharged. The radioactivity released from the broken fuel is assumed to be dispersed into the primary coolant both instantly and homogeneously. Due to the primary-to-secondary leakage, it is also assumed that radioactivity in the primary coolant makes transition to the secondary cooling system. Radioactivity in the secondary coolant is discharged to the environment with steam in accordance with partition coefficient and moisture carryover. Release from the main steam relief valve and the safety valve is assumed (See DCD Table 15A-19.).

- **Rod Ejection Accident (DCD 15.4.8.5)**

A hypothetical event where a control rod is ejected causing the fuel in the core to be broken and release radioactivity to the environment. Radioactivity released from the broken fuel makes the transition to the open volumes in the containment. The radioactivity in the containment is reduced due to the actions of the containment spray and natural deposition. Radioactivity is discharged directly to the environment by containment leakage. In addition, radioactivity from the containment may leak into the penetration area and be discharged through the ventilation stack via filters. After manual activation of the containment spray system radioactivity will be mixed in the refueling water storage pit and released to the environment by ESF system leakage.

Furthermore, the radioactivity released from the broken fuel is dissolved in the primary coolant and, due to primary-to-secondary leakage, the radioactivity dissolved in the primary coolant is assumed to make transition to the secondary cooling system. Radioactivity in the secondary coolant is discharged to the environment with steam in accordance with partition coefficient and moisture carryover. Release from the plant vent, the containment, the main steam relief valve and the safety valve is assumed (See DCD Table 15A-20.).

- **Failure of Small Lines Carrying Primary Coolant Outside Containment (DCD 15.6.2.5)**

A hypothetical event where it is assumed that the RCS sample line that carries the primary coolant outside the containment breaks and the primary coolant is discharged outside of the containment. In the RCS sample line that is broken, the primary coolant flowing from the broken opening is assumed to be of the maximum RCS pressure at normal operating conditions. Of the flow from the breakage, the proportion of flash is assumed to be 47% and iodine included in the flashed primary coolant makes transition to the vapor phase part of the building. The flow moved to the vapor phase part of the building is assumed to be discharged directly to the environment and the discharge is assumed to continue until the said broken line is isolated. Release from the broken RCS sample line is assumed (See DCD Table 15A-21.).

- **Steam Generator Tube Rupture ( DCD 15.6.3.5)**

A hypothetical event where it is assumed that one of the steam generator tubes breaks and the primary coolant is discharged outside of the containment via the secondary cooling system. After occurrence of the SGTR, the primary coolant flows into the broken SG as a breakage flow. Due to primary-to-secondary leakage, it is also assumed that radioactivity in the primary coolant makes transition to the secondary cooling system. At that time, an iodine spike in the primary system is assumed. Part of the radioactivity leaked to the broken secondary side is assumed to be discharged directly to the environment by flashing of the breakage flow. Radioactivity in the secondary coolant is discharged to the environment with steam in accordance with partition coefficient and moisture carryover. Release from the main steam relief valve and the safety valve is assumed (See DCD Table 15A-21.).

- **Loss of Coolant Accident (DCD 15.6.5.5)**

This is a hypothetical event where the reactor coolant system has a significant rupture causing the fuel in the core to be broken and release radioactivity to the environment. Radioactivity released from the broken fuel makes the transition to the open volumes in the containment. The radioactivity in the containment is reduced due to the actions of the containment spray and natural deposition. Radioactivity is discharged directly to the environment by containment leakage. In addition, radioactivity from the containment may leak into the penetration area and be discharged through the ventilation stack via filters. After activation of the containment spray system radioactivity will be mixed in the refueling water storage pit and released to the environment by ESF system leakage. Release from the plant vent and the containment is assumed (See DCD Table 15A-22.).

- **Fuel Handling Accident (DCD 15.7.4)**

A hypothetical event where it is assumed that a spent fuel assembly drops and is broken during replacement of fuel in a reactor and radioactivity is discharged to the environment. The event is assumed to occur in the fuel handling area or in the containment. The broken fuel assembly is assumed to have high activity. Radioactivity in a gap of the broken fuel is discharged to the environment through the pool water above the broken fuel. Release from the fuel handling area and the air lock of the containment is assumed (See DCD Table 15A-23.).

**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

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

7/31/2008

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

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| **RAI NO.:** | **NO.26 REVISION 0** |
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| **APPLICATION SECTION:** | **06.04 HABITABILITY SYSTEMS** |
| **DATE OF RAI ISSUE:** | **7/01/2008** |

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**QUESTION NO. : 06.04-2**

DISCUSS HOW THE MAIN CONTROL ROOM HEATING AND VENTILATION SYSTEM AND EMERGENCY VENTILATION SYSTEM RESPOND TO EACH OF THE DBAS OTHER THAN THE LOSS-OF-COOLANT ACCIDENT (LOCA).

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**ANSWER:**

The main control room (MCR) HVAC system is changed to the pressurization mode by the MCR isolation signal following radiological accidents. The MCR isolation signal is initiated by the ECCS actuation signal or high MCR outside air intake radiation. The initiation signal of each DBA is shown in the followings.

- Steam System Piping Failures : ECCS actuation signal
- Reactor Coolant Pump Rotor Seizure : High MCR outside air intake radiation
- Rod Ejection Accidents : High MCR outside air intake radiation
- Failure of Small Lines Carrying Primary Coolant Outside Containment : High MCR outside air intake radiation
- Steam Generator Tube Rapture : High MCR outside air intake radiation
- Fuel Handling Accident : High MCR outside air intake radiation

**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 responses to the NRC's questions.