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

March 7, 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-11059

**Subject: MHI's Responses to US-APWR DCD RAI No. 696-5543 Revision 2 (06.02.05)**

**Reference:** 1) "Request for Additional Information No. 696-5543 Revision 2, SRP Section: 06.02.05 – Combustible Gas Control in Containment, Application Section: 6.2.5," dated February 23, 2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document as listed in Enclosures.

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.

Enclosures:

1. Responses to Request for Additional Information No. 696-5543 Revision 2

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

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Docket No. 52-021
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Enclosure 1

UAP-HF-11059
Docket Number 52-021

Responses to Request for Additional Information
No. 696-5543 Revision 2

March 2011

## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

**3/7/2011**

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No.52-021**

**RAI NO.:** NO. 696-5433 REVISION 2
**SRP SECTION:** 06.02.05 – Combustible Gas Control in Containment
**APPLICATION SECTION:** 6.2.5
**DATE OF RAI ISSUE:** 2/23/2011

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**QUESTION NO.: 6.2.5-41**

Clarify how the US-APWR RWSP design complies with 10 CFR 50.44(c)(1) and (c)(2). Section 19.2.3.3.2 of the DCD application provides the result of the analysis that shows that the hydrogen concentration in all sub compartments are either inerted by steam or less than 10% volume hydrogen. In your November 1, 2010 response to RAI 19-449, you describe several additional analyses on the RWSP subcompartment, where you observe a higher concentration in the RWSP than 10% hydrogen by volume.

In order to evaluate whether the US-APWR combustible gas control system design meets the requirements of 10 CFR Part 50, § 50.44, 50.34(f)(2)(ix), and GDC41, to control the concentration of H2 in the containment atmosphere and of GDC 41 to provide systems as necessary to ensure that containment integrity is maintained, additional information is needed.

Provide a discussion on design features to address potential hydrogen accumulation within the RWSP. Alternatively, clarify how the US-APWR design complies with requirements for ensuring a mixed atmosphere in10 CFR 50.44(c)(1) and requirements to limit the concentration of hydrogen below 10% by volume in 10 CFR 50.44(c)(2) without such design features.

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**ANSWER:**

In the answer to RAI 19-449, it was recognized through the detailed GOTHIC analysis that the hydrogen concentration in the RWSP could become higher than 10% by volume long after the initiation of an accident, especially when the RWSP water was not utilized for decay heat removal.

In order to preclude such hydrogen accumulation in the RWSP, it was proposed in the answer to RAI 19-449 that "For the sequences in which containment cooling is available and RWSP water is not utilized, the operator action to inject firewater into the reactor cavity is performed. The RWSP will be filled with the injected water, and accordingly this operation will inherently prevent high hydrogen concentration in the RWSP."

In the RAI 19-449 answer, the necessary case to consider was limited to a very rare scenario, in which containment cooling is available although RWSP water is not utilized. It was because the scope of that RAI addressed how to deal with such hydrogen accumulation scenarios in the PRA. In addition to the scenario considered in the RAI, the operator action to fill the RWSP with firewater is considered effective for other cases when RWSP water is not utilized in order to prevent high hydrogen concentration in the RWSP.

Therefore, the operator action to fill the RWSP with firewater will be more broadly addressed in the DCD Revision 3, as follows.

### 19.2.3.3.2 Hydrogen Generation and Control

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Analysis result

Accident progression analyses for hydrogen generation and control utilizing the hydrogen ignition system have been performed using GOTHIC code. In the developed GOTHIC model, hydrogen igniters are located at 20 locations in the containment and are modeled to initiate hydrogen burning when hydrogen concentration becomes greater than 8% by volume except under ~~steam inert condition~~ the condition inerted by steam.

Hydrogen concentration in each compartment is either lower than 10% or the compartment is inerted by steam. The pressure in the containment vessel is kept below 68 psia, and this pressure is much lower than the containment ultimate pressure 216 psia as described in DCD Section ~~Subsection~~ 19.2.4. For several sequences especially when RWSP water is not utilized for decay heat removal, the hydrogen concentration in the RWSP may increase to greater than 10% long after the initiation of an accident. Under such a situation, operator action to inject firewater into the containment is initiated. As a result, the RWSP is filled with water, thus preventing high hydrogen in the RWSP air volume. Therefore, ~~the~~ containment integrity is maintained against hydrogen combustion events, and the requirements of 10 CFR 50.44(c)(1), 10 CFR 50.34(f)(2)(ix), 10 CFR 50.44(c)(2), 10 CFR 50.34(f)(3)(v) (A)(1), and 10 CFR 50.44(c)(5) are ~~therefore~~ met.

The maximum pressure in the containment vessel under the adiabatic isochoric complete combustion condition is127 psia. This pressure is lower than the containment ultimate pressure of 216 psia ~~and~~ thus the requirement of 10 CFR 50.44(c)(5) is met.

...

### 19.2.5 Accident Management

...

(3) To maintain containment integrity as long as possible

(During operations at power)

...

- Firewater can be utilized to fill the RWSP in the case when no decay heat removal function is available. This will eliminate the possibility of high hydrogen concentration in the RWSP.

(During LPSD operations)

...

**Impact on DCD**

The DCD will be revised as described above.

**Impact on R-COLA**

None

**Impact on S-COLA**

None

**Impact on PRA**

None