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

ORIGINAL

August 23, 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-11270

Subject: **MHI's Second Responses to US-APWR DCD RAI No. 752-5614 Revision 0 (SRP 19)**

References:
1) "Request for Additional Information No. 752-5614 Revision 0, SRP Section: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation, Application Section: SRP Chapter 19," dated May 3, 2011.
2) Letter MHI Ref: UAP-HF-11168 from Y. Ogata (MHI) to the U.S. NRC, "MHI's Responses to US-APWR DCD RAI No. 752-5614 Revision 0 (SRP19)" dated June 3, 2011.
3) Letter MHI Ref: UAP-HF-11213 from Y. Ogata (MHI) to the U.S. NRC, "MHI's Second Responses to US-APWR DCD RAI No. 752-5614 Revision 0 (SRP19)" dated July 12, 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 are the third responses to the RAIs contained within Reference 1, in which one response to question #19-522 is included.

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.

D081
NRO

Enclosures:

1. Third Response to Request for Additional Information No. 752-5614 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

Docket No. 52-021
MHI Ref: UAP-HF-11270

Enclosure 1

UAP-HF-11270
Docket Number 52-021

Third Response to Request for Additional Information
No. 752-5614 Revision 0

August, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/23/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.: NO. 752-5614 REVISION 0

SRP SECTION: 19 – Probabilistic Risk Assessment and Severe Accident Evaluation

APPLICATION SECTION: SRP Chapter 19

DATE OF RAI ISSUE: 5/3/2011

QUESTION NO.: 19-522

Follow-up to Question 19-449:
The MHI analyses show results that are qualitatively consistent with the MELCOR analyses of ERI/NRC 10-205 regarding the build-up of potentially detonable mixtures in the Refueling Water Storage Pit (RWSP). The MHI response states "It is assumed in this study that occurrence of a detonation will cause the containment structure to fail, and the potential of detonation is probabilistically treated."

In the MHI approach (as part of sensitivity calculation), a containment failure fraction for hydrogen combustion of 0.10 is assumed if hydrogen concentration is greater than 13% (Case 1). Furthermore, as part of a "bounding" analysis (Case 2), this failure fraction is set to 1.0.

MHI has not provided any basis for the assumed containment failure fraction of 0.10; therefore, the argument that this value takes into account the uncertainties is not strong. (The uncertainties that are associated with potentially higher hydrogen concentrations when containment cooling is not available and the RWSP water is not utilized for ECCS and/or CSS.).

MHI dismisses consideration of placement of hydrogen igniters inside the RWSP because of potential complications for maintenance. No other mitigative or design improvements have been considered.

The results of MHI sensitivity calculations show, irrespective of the assumed failure fraction, the Large Release Frequency (LRF) is approximately 10^{-6} per reactor year (ranges from 8.5×10^{-7} to 1.1×10^{-6}). Furthermore, the Conditional Containment Failure Probability is in the range of 0.102 to 0.165.

Given the potential for build-up of large hydrogen concentration inside RWSP, please examine potential changes in the design, operation, and/or implementation of accident management strategies to circumvent the potential for build-up of high combustible gas concentrations inside the RWSP compartment. Please use the Level-2 PRA to demonstrate compliance with NRC's deterministic and probabilistic guidelines as applicable to combustible gas control. Please discuss any potential accident management procedures that are considered for detection and

mitigation of hydrogen build-up inside the RWSP.

ANSWER:

In the answer to Question 19-449, MHI assumed that the probability of hydrogen detonation in the RWSP and the consequential containment failure was 0.1 for the sensitivity case and 1.0 for the bounding case because of several uncertainties involved in this physical phenomenon such as ignition timing, ignition source, detonation impulse, etc.

The PRA evaluation results provided in the answer to Question 19-449 were based on the DCD Rev. 2 and the bounding analysis result exceeded the NRC's probabilistic target of 10^{-6}/ry. For the DCD Rev. 3, the PRA evaluation results have improved especially for fire and flood because several unreasonably conservative assumptions are reconsidered to more realistic assumptions. Table 19-522-1 summarizes the differences between DCD Rev. 2 and Rev. 3 results with addressing RWSP hydrogen burn scenario. As shown in the table, the LRF for the DCD Rev. 3 satisfies the NRC's probabilistic target of LRF less than 10^{-6}/ry regardless of the assumed failure fraction.

Table 19-522-1 Comparison between DCD Rev. 2 and Rev. 3

	LRF (/RY)				
	DCD Rev. 2			DCD Rev. 3	
	Base case	Sensitivity analysis (Case 1) (HB203 = 0.1)	Bounding analysis (Case 2) (HB203 = 1.0)	Base case (*1)	Bounding analysis (HB203 = 1.0)
Internal events at power	9.9E-08	1.1E-07	1.7E-07	1.07E-07	1.71E-07
Internal fire	2.3E-07	2.4E-07	4.2E-07	1.87E-07	2.45E-07
Internal flood	2.8E-07	2.8E-07	2.8E-07	1.56E-07	1.56E-07
LPSD	2.2E-07	2.2E-07	2.2E-07	1.80E-07	1.80E-07
Total	8.3E-07	8.5E-07	1.1E-06	6.29E-07	7.52E-07

(*1) DCD Rev. 3 base case model addresses the possibility of containment failure due to hydrogen burn in the RWSP, which is equivalent to the DCD Rev. 2 sensitivity analysis (case 1) model.

Regarding the design option to prevent RWSP hydrogen build-up, the NRC staff has issued a follow-up question in RAI #803-5891 for Chapter 6 combustible gas control system design. Hence, responses to consideration of design options will be answered to the RAI #803-5891.

Impact on DCD

DCD Section 6.2.5 and Section 19.2.3.3.2 will be revised in conjunction with the response to RAI #803-5891, which will be answered by 9th September 2011. The modification proposal in the response to RAI #803-5891 will be based on the response to RAI #751-5709, in which first modification from DCD revision 3 was proposed.

Impact on R-COLA

There is no impact on the R-COLA

Impact on S-COLA

There is no impact on the S-COLA

Impact on PRA

There is no impact on the PRA