RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

08/30/13

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 490-3732 REVISION 0**
SRP SECTION:	**03.08.01 – Concrete Containment**
APPLICATION SECTION:	**3.8.1**
DATE OF RAI ISSUE:	**11/15/2009**

QUESTION NO. 03.08.01-02:

NOTE: This question and all other questions in this Request for Additional Information (RAI) were based on Revision 1 of the Design Control Document (DCD). These questions were written prior to the receipt of DCD Revision 2 on 10/28/2009. If the response to a question can be found in Revision 2, the applicant needs to identify where and how the response is provided.

In its response to Question 3.8.1-1 (of RAI 223-1996 hereinafter unless indicated otherwise, dated 4/14/2009, MHI Ref: UAP-HF-09161, ML091060749), Mitsubishi Heavy Industries (MHI) points out that it is similar to Question 06.02.05-19 of RAI 62 dated 10/01/2008. MHI's position is that the structural integrity of the prestressed concrete pressure vessel (PCCV) should be evaluated with different criteria than that contained in RG 1.136 for severe accident cases. {It should be noted that this position is counter to the intent of RG 1.136 in which loadings to be considered include all types of accidental loads [specifically loss of coolant accident {LOCA), hydrogen burn, etc.]}. Previously, in its evaluation of MHI's response to Question 06.02.05-19, the NRC staff's conclusion was that the response was unacceptable. The staff finds that the same conclusion applies in this current review of MHI's response to Question 3.8.1-1, namely, MHI's position as stated in the response is not acceptable because Regulatory Position 5 in RG 1.136 makes it clear that the applicant is to evaluate the containment structure for several severe accident loads, including loads associated with LOCA accidents and the effects of a hydrogen burn following a 100% fuel clad metal-water reaction. The staff subsequently issued follow-up Question 06.02.05-34 of RAI 270-1898. The following is the open Item for this issue:

> "Open Item 6.2.5-13: The staff requested, in RAI 6.2.5-19 (RAI 62) that the applicant clarify whether the load associated with dead load plus 45 psig, would result in higher containment loadings than would result from the loads associated with the releases of hydrogen generated from 100% metal-water reaction of the fuel cladding and accompanied by uncontrolled hydrogen burning.

The applicant provided the following response:

> "MHI agrees that the NRC's concern is true, that the load associated with the release of hydrogen generated from 100% cladding-water reaction exceeds the one associated with dead load plus 45 psig. As for the MHI's understanding, it is necessary

to separately consider the design-basis accident and severe accident for this issue. The discussion provided in Section 3.8.1.3.2.2 of the DCD is based on the design-basis accident, thus 100% cladding reaction is not taken into account. The postulated condition with 100% cladding reaction is obviously significantly beyond the design-basis. The conclusion in Section 3.8.1.3.2.2 is therefore good only for the evaluation on the design-basis accidents. The USAPWR PCCV is designed based on a [Design Basis Accident] DBA pressure Pa of 68 psig and a corresponding design test pressure of 1.15 x Pa, hence the minimum design condition of D+45 psig is satisfied under the postulated conditions of DBA. On the other hand, Section 19.2 of the DCD describes the severe accident analyses, including the pressure load associated with the hydrogen released from 100% cladding-water reaction. Please refer to the technical report "US-APWR Probabilistic Risk Assessment" (MUAP-07030) Chapter 15 Separate Effect Analysis, in which detailed discussions on severe accident evaluations are provided. Section 15.3 of this report describes the discussion on the hydrogen generation and control, and the evaluations of the containment integrity under the hydrogen burning condition, including local burn and global burn, are described. Chapter 16 of this technical report describes the discussion on the containment ultimate pressure capability, in which the ultimate containment capability is evaluated as 216 psia. It is concluded from these evaluations that the containment integrity is sufficiently maintained against the challenge from hydrogen burn associated with 100% cladding-water reactions."

The staff has reviewed this response and has identified that the following needs to be addressed by the applicant:

> “The staff does not agree with MHI’s position that the structural integrity of the PCCV should be evaluated with different criteria than that specified in RG 1.136 for the severe accident case. RG 1.136 section C(5) clearly states that severe accident loads, such as the pressure resulting from an accident that releases hydrogen generated from 100% fuel clad-metal-water reaction plus the pressure resulting from uncontrolled hydrogen burning be considered in the Factored Load Category when evaluating allowable limits from stresses and strains, when using ASME Article CC-3720.
>
> Please provide an American Society of Mechanical Engineers (ASME) Code, Section III, Division 2, Subarticle CC-3720 analysis that demonstrates that containment structural integrity will be maintained in such an event, or please provide an alternate methodology, and clarify the DCD.
>
> The staff has identified this as open item 6.2.5-13.”

In their response to this current Question 3.8.1-1, MHI states that they will investigate this problem and incorporate the necessary modifications associated with this Question 3.8.1-1 in the DCD, Revision 2. MHI further states that Chapters 19 and 3 will be revised as necessary to: (1) provide values of Pg1 and Pg2 (in the RG 1.136.equations); and (2) further clarify the discussion.

For this Question 3.8.1-1, the applicant is requested to demonstrate that the PCCV steel liner does not develop any cracks or tears that could jeopardize the leaktightness function of the liner when the PCCV is subjected to the pressure loads associated with the 100% metal-water reaction and uncontrolled hydrogen burn. The guidance in RG 1.136 should be considered in determining the factored loads used in any calculations made to provide this demonstration.

ANSWER:

This answer revises and replaces the previous MHI response that was transmitted by letter UAP-HF-11394 (ML100430768).

Technical Report MUAP-10018, Rev.1, provides an American Society of Mechanical Engineers (ASME) Code, Section III, Division 2, Subarticle CC-3720, analysis that demonstrates that containment structural integrity will be maintained. Technical Report MUAP-10018, Rev.1, Appendix A, demonstrates that the prestressed concrete containment vessel (PCCV) steel liner does not develop cracks or tears that could jeopardize PCCV liner leak-tightness due to beyond design basis pressure loads created by post-loss-of-coolant accident (LOCA) 100% Zirconium-water reaction and uncontrolled hydrogen burn.

US-APWR PCCV factored design loading conforms to Regulatory Guide (RG) 1.136 guidance. Technical Report MUAP-10018, Rev. 1, Appendix A, discusses PCCV liner pressure integrity under hydrogen-burn generated pressure loads and includes sufficient details related to hydrogen burn pressure loading conditions.

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on the Technical/Topical Report.

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