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TOKYO, JAPAN

March 30, 2010

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-10085

Subject: Amended MHI's Responses to US-APWR DCD RAI No. 379-2756 Rev 0

Reference: [1] "Request for Additional Information 379-2756 Revision 0, SRP Section: 06.01.01 –Engineered Safety Features Materials Application Section: 6.1.1, Questions for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects)" dated May 29, 2009.
[2] "MHI's Responses to US-APWR DCD RAI No.379-2756 Revision 0", UAP-HF-09370, dated July 10, 2009

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

Enclosed is the response to the Question No. 06.01.01-9 that is contained within Reference [1].

This response amend the previously transmitted answers submitted under Reference [2] in order to correct description of carbon content of stainless steels used in ESF materials.

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.

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NRO

Enclosure:

1. Amended Response to Request for Additional Information No. 379-2756 Revision 0

CC: J. A. Ciocco
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Docket No. 52-021
MHI Ref: UAP-HF-10085

Enclosure 1

UAP-HF-10085
Docket No. 52-021

Amended Response to Request for Additional Information
No. 379-2756 Revision 0

March 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/30/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.:	NO. 379-2756 REVISION 0
SRP SECTION:	06.01.01 – ENGINEERED SAFETY FEATURES MATERIALS
APPLICATION SECTION:	6.1.1
DATE OF RAI ISSUE:	5/29/2009

QUESTION NO.: 06.01.0-9

Table 6.1-1 indicates that non-low carbon austenitic stainless steels will be used to fabricate some ESF components. Given that the use of stainless steels, in LWRs, with a maximum carbon content of 0.03% has been shown to be highly resistant to stress corrosion cracking, the staff requests that the applicant modify FSAR Section 6.1.1 and Table 6.1-1 to limit the carbon content of austenitic stainless steel to 0.03% maximum or provide a technical basis for why this is not necessary.

ANSWER:

As most of ESF systems such as ECCS and CSS are standby condition and isolated from the RCS, these systems are in low temperature condition. Therefore, the possibility of stress corrosion cracking (SCC) is very low. However, the conditions for some portions which are connected to the RCS are similar to the RCS. These portions should be treated as same as the RCS components against SCC.

As for these portions which are connected to the RCS, MHI understands that low-carbon austenitic stainless steel is a better choice of material because of its high resistance to stress corrosion cracking (IGSCC) and sensitization even in the PWR environment.

Therefore, when MHI uses the standard grades of stainless steel (called MHI's SS), the maximum carbon content will be limited as follows;

Carbon content: Maximum 0.05% (heat analysis) / 0.06% (product analysis)

The requirements of RG 1.44 and the EPRI Utility Requirement Document (URD-5.3.1.8 "Prevention of IGSCC of austenitic stainless steel") are summarized in table 1.

According to RG 1.44, subparagraph C.4(a), stainless steel material that is subjected to sensitizing temperatures, subsequent to solution heat treating, is not required to have a carbon content less than or equal to 0.03% if it is in a PWR environment where the dissolved oxygen is less than 0.10 ppm. The US-APWR reactor coolant standard dissolved oxygen content is 0.005ppm and during component manufacture, MHI does not expose SS to sensitizing heat

treatments such as post weld heat treatment (PWHT). Therefore, MHI's SS satisfies the RG 1.44 requirements if applied in the US-APWR (PWR plant).

MHI's SS also satisfies the EPRI URD requirements because it has been proven to be resistant to sensitization by both testing and actual operating experience. MHI's SS has been used for pressure boundary components, piping, and reactor internal structures in Japanese domestic PWR plants. The absence of IGSCC in these applications confirms the acceptability of this material for PWR applications, including US-APWR.

Figure 1 shows the SCC potential of stainless steel as a function of dissolved oxygen and chlorides (Reference: 1st U.S. - Japan Joint Symposium on Light Water Reactors, Fuji, Japan (1978), presented by M. O. Speidel). This figure shows that SCC does not occur in the zone where dissolved oxygen and chlorides are low, even if the SS is sensitized. The US-APWR reactor coolant chemistry is well within the no-SCC area below the curve. This means that the standard grades of SS will not experience IGSCC in the US-APWR environment.

The above explanation shows that MHI's SS is acceptable for application in the PWR environment and meets the requirements of R.G 1.44 and EPRI URD-5.3.1.8.

MHI will decide on the actual stainless steel grades to be used for the US-APWR (i.e. MHI's SS or other, low carbon material such as LN grades) at the time of procurement, based on material availability and other market conditions.

If, during the detailed design, MHI determines there are local areas where significant flow stagnation may be present (that could produce locally elevated dissolved oxygen levels), then other parameters, such as temperature will be considered to determine the potential for SCC. MHI determines that the SCC potential is sufficient, then stainless steel with carbon content less than or equal to 0.03% will be applied for portions around that area.

This policy is the same as the materials of RCPB components, which is described in the letter, UAP-HF-10058 (Ref. 2).

References

1. The 1st U.S. - Japan Joint Symposium on Light Water Reactors, Fuji, Japan (1978), presented by M. O. Speidel.
2. "Amended MHI's Response to US-APWR DCD RAI No.289", UAP-HF-10058, dated March 1, 2010

Table 1 Summary of the RG 1.44 and EPRI URD Requirements

Source	Requirement
RG 1.44	The following cases do not require stainless steel which carbon content less than or equal to 0.03%. (a) PWR environment (dissolved oxygen is less than 0.10ppm) (*1) (b) Small diameter piping (c) Non-sensitization of the material is verified using ASTM A262 after completion of all manufacturing operations (excluding welding) (d) Material which actual service experience and/or test data to demonstrate that it will not result in increased susceptibility to IGSCC (in case of receiving heat treatment without welding).
URD 5.3.1.8	Although the low carbon materials are recommended, the "proven" materials with IGSCC resistance are also available. Recommendation : (a) Low carbon wrought austenitic steel (304L, 316L, 304LN, 316LN, 304NG, and 316NG) (b) Modified 347 austenitic stainless steel (c) Other specific grades which have proven to be resistant to sensitization and IGSCC.

(*1)The standard value of the dissolved oxygen in US-APWR is 0.005ppm, as discussed in the DCD Table-5.2.3-2.

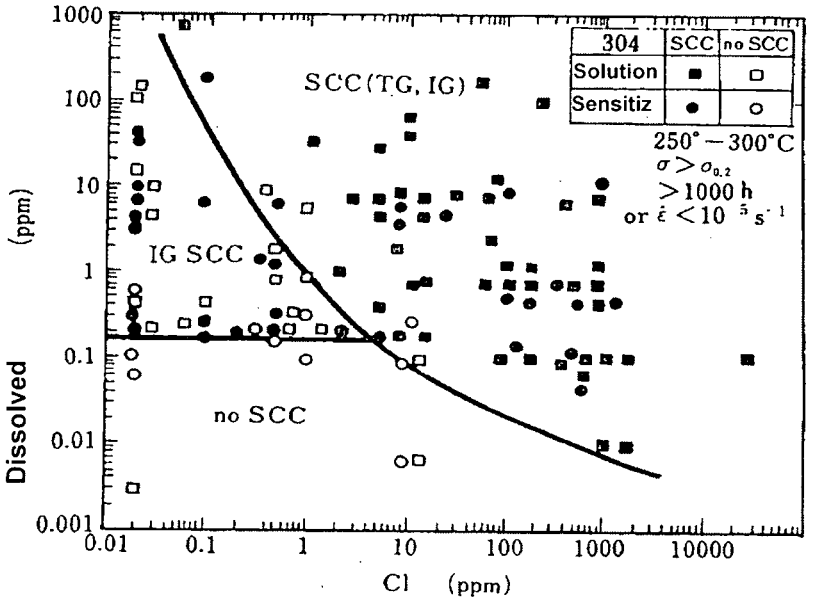

Figure 1 SCC resistance of stainless steel against dissolved oxygen

Impact on DCD

The last sentence of the 2nd paragraph in the DCD Subsection 6.1.1.1 will be deleted.

~~Austenitic stainless base metal used for the pressure retaining material of the ESF components has a limited carbon content not exceeding 0.03%.~~

The following sentence will be added in the last of 4th paragraph in the DCD Subsection 6.1.1.1:

Austenitic stainless steel base metal used for the pressure retaining materials, which conditions are similar to the RCS, has a limited carbon content not exceeding 0.05% (heat analysis) and 0.06% (product analysis) when the standard grade stainless steel is used.

Table 6.1-1 will be revised. Revised table will be shown in responses to the RAI No. 544-4267.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.