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TOKYO, JAPAN

July 17, 2009

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-09389

Subject: MHI's Response to US-APWR DCD RAI No. 397-3060 REVISION 0

Reference: 1) "Request for Additional Information No.397-3060 Revision 0, SRP Section: 10.03.06 – Steam and Feedwater System Materials, Application Section: 10.3.6" dates June 18, 2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 397-3060 Revision 0."

Enclosed are the responses to 2 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.

Enclosure:

1. Response to Request for Additional Information No. 397-3060 Revision 0

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

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NRO

Contact Information

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Enclosure 1

UAP-HF-09389
Docket Number 52-021

Response to Request for Additional Information
No. 397-3060 Revision 0

July 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

07/17/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 397-3060**
SRP SECTION:	**10.03.06 – STEAM AND FEEDWATER SYSTEM MATERIALS**
APPLICATION SECTION:	**10.3.6**
DATE OF RAI ISSUE:	**06/18/2009**

QUESTION NO.: 10.03.06-8

In response to RAI 10.03.06-1, the applicant provided a proposed revision to FSAR Table 10.3.2-3, "Main Steam and Feedwater Piping Design Data" and the applicant added Table 10.3.2-5 "ASME Materials Specifications with Filler Metal Specifications and Classification." In order for the staff to complete its review, the staff requests the following.

1. Proposed Table 10.3.2-5 lists AWS welding specifications. ASME Code Section III, NC/ND-2121 states, in part, that welding and brazing materials used in manufacture of items shall comply with an SFA specification in Section II, Part C. Therefore, the staff requests that the applicant remove references to AWS specifications and replace them with the appropriate SFA specifications.

2. Proposed Table 10.3.2-5 contains filler materials classifications containing an "X" in the classification number. For weld filler metal used on ASME Code Class 2 and 3 piping and components, modify Table 10.3.2-5 to include the complete classification. If "G" classification filler metals will be used, provide a technical justification for why standard available non "G" classifications are not used and provide your ordering requirements for these filler materials.

3. Note 1 of Table 10.3.2-5 states that filler metal classifications were given for GTAW and SMAW only because these are the most likely welding processes. In addition, Note 1 states that filler metal information can be provided for other welding processes if required. The staff requests that the applicant provide, in the FSAR, a complete list of welding filler metal specifications and classifications for the welding of ASME Class 2 and 3 piping and components.

ANSWER:

Answer to question 1:

References to AWS welding specifications have been removed and the appropriate SFA specifications are provided in revised table 10.3.2-5 below.

Answer to question 2:

Complete classifications of weld filler material is provided in revised table 10.3.2-5 below.

Answer to question 3:

A complete list of welding filler material specifications and classifications is provided revised table 10.3.2-5 below.

Impact on DCD

Table 10.3.2-5 will be revised as shown below:

Table 10.3.2-5 ASME Material Specifications with Filler Metal Specifications and Classifications for each Welding Process

ASME Material Specification	P#	Gr#	Tensile Strength (ksi)	Filler Metal (Note 7)							
				GTAW/GMAW (Note 1)		SMAW (Note 2)		FCAW (Note 3)		SAW (Note 4)	
				ASME Specification	Classification	ASME Specification	Classification	ASME Specification	Classification (Note 8)	ASME Specification	Classification (Note 9)
SA-333 Grade 6	1	1	60	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-672 Grade B60	1	1	60	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-335 Grade P22	5A	1	60	SFA-5.28	ER90S-B3	SFA-5.5	E9018-B3	SFA-5.29	E91T1-B3M	SFA-5.23	F9A2-EB3-B3
SA-182 F22	5A	1	Note 5	SFA-5.28	ER90S-B3	SFA-5.5	E9018-B3	SFA-5.29	E91T1-B3M	SFA-5.23	F9A2-EB3-B3
SA-217 Grade WC9	5A	1	70	SFA-5.28	ER90S-B3	SFA-5.5	E9018-B3	SFA-5.29	E91T1-B3M	SFA-5.23	F9A2-EB3-B3
SA-508 Grade 1	1	2	70	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-352 Grade LCB	1	1	65	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-106 Grade B	1	1	60	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-106 Grade A	1	1	48	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-387 Grade 22	5A	1	Note 6	SFA-5.28	ER90S-B3	SFA-5.5	E9018-B3	SFA-5.29	E91T1-B3M	SFA-5.23	F9A2-EB3-B3
SA-672 Grade C60	1	1	60	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-105	1	2	70	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-216 Grade WCB	1	2	70	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K
SA-266 Grade 2	1	2	70	SFA-5.18	ER70S-2	SFA-5.1	E7018	SFA-5.20	E71T-1	SFA-5.17	F7A2-EM12K

Notes:

1. GTAW – Gas Tungsten Arc Welding process /GMAW – Gas Metal Arc Welding process
2. SMAW – Shielded Metal Arc Welding process

3. FCAW – Flux Cored Arc Welding process
4. SAW – Submerged Arc Welding process
5. Class 1 has a tensile strength of 60 ksi and Class 3 has a tensile strength of 75 ksi.
6. Class 1 has a tensile strength of 60 ksi and Class 2 has a tensile strength of 75 ksi.
7. The filler metal specifications and classifications shown assume the base metal is being joined to itself.
8. The letter "M" after B3 may also be a "C" depending on which shielding gas is specified on the WPS.
9. Depending on the thickness of base material being welded, the "A" in the filler metal classification may also be a "P".

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

07/17/2009

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

RAI NO.:	**NO. 397-3060**
SRP SECTION:	**10.03.06 – STEAM AND FEEDWATER SYSTEM MATERIALS**
APPLICATION SECTION:	**10.3.6**
DATE OF RAI ISSUE:	**06/18/2009**

QUESTION NO.: 10.03.06-9
In response to RAI 10.03.06-7, the applicant stated, in part, that a computer program like CHECWORKS or equivalent utilized to design systems in order to minimize the effect of FAC depends on the COL applicant. Because the design of the plant is provided by the DCD applicant, the US-APWR FSAR should include a description of the design methods and design attributes used to mitigate the affects of FAC in all ASME Code Class 2 and 3 piping and components as well as non-safety related high energy piping and 2 components potentially susceptible to FAC. Therefore, the staff requests that the applicant modify the FSAR to include the following:

1. Describe the process used to determine which systems or parts of systems are potentially susceptible to FAC and provide the basis for the materials that you have selected for these systems. In addition, identify all systems that are potentially susceptible to FAC and are included in your analysis

2. Describe the corrosion allowance specified and discuss how the corrosion allowance covers the design life of the plant for all high energy systems (ASME Code Class 1, 2 and 3 and non-safety related systems) potentially susceptible to FAC.

3. Describe how the design and layout of piping minimizes the effects of FAC taking into consideration system piping and component configuration and geometry, water chemistry, piping and component material, fluid temperature (including flash points), and fluid velocity.

ANSWER:

Answer to question 1:

Flow accelerated corrosion (FAC) is generally experienced in carbon steel piping systems with single-phase and two-phase fluid conditions, for both safety and non-safety related systems. The following portions have the potential for FAC from past experiences in operating power plants and are included in FAC monitoring program. These systems are basically based on NUREG-1344 attached to GL 89-08. Generally, most of these systems are entirely made of carbon steel, however, materials for the portions extremely susceptible to FAC are FAC-resistant alloy taking into consideration past experiences.

Single-Phase Line

- Main feedwater lines
  The piping from steam generator up to and excluding main feedwater equalization piping in the upstream of feedwater flow meter is made of high content of chrome-moly materials as shown in table 10.3.2-3. This portion is resistant to FAC.
- Main feedwater recirculation to condenser
  This portion is made of carbon steel.
- Feedwater pump suction line
  This portion is made of carbon steel.
- Feedwater pump discharge line
  This portion is made of carbon steel.
- Condensate pump recirculation to condenser line
  This portion is made of carbon steel.

Two-Phase Line

- Main steam line
  This portion is made of carbon steel. There is no portion which is susceptible to FAC because of the low moisture which is approximately 0.1 %.
- Cross-under pipe
  This portion is made of FAC-resistant alloy as shown in table 10.3.2-4. This portion is immune to FAC.
- Extraction steam line
  This portion is made of FAC-resistant alloy. This portion is immune to FAC.
- Feedwater heater drain piping
  Most of this entire portion is made of carbon steel, however, material of extremely susceptible to FAC portion such as downstream of control valves are made of FAC-resistant alloy.
- Steam generator blowdown line
  Most of this portion is entirely made of carbon steel, however, material for the portion extremely susceptible to FAC such as downstream of angle valve are stainless steel or chrome-moly materials.

Answer to question 2:

Corrosion allowance is the difference between the actual minimum wall thicknesses after any wall thinning that occurs during fabrication, and the required design wall thickness. The required design wall thickness is determined based on piping design pressure/ temperature and allowable stress in accordance with ASME Sec.III NX-3641 or ASME B31.1 paragraph. 104. The specified wall thickness (prior to fabrication) is a standardized wall thickness stipulated in ASME B36.10M and ASME B36.19M. It is specified to exceed the required design wall thickness by a large and appropriate amount to account for the expected wall thinning during fabrication. The fabrication thinning is controlled by establishing fabrication tolerances. The FAC monitoring program provided by COL applicant will include preservice thickness measurements of as-built piping considered susceptible to FAC. By performing this preservice measurement, the piping thickness margin that will be used as a wall thinning margin will be known, and then by combining the measurement with regular inspection the frequency of the pipe replacement will be predicted. Integrity and safety of a plant is assured by the COL applicant by conducting inspection and maintenance during over 60 years of service and replacing piping if necessary.

Answer to question 3:

The US APWR design and piping layout has considered several features for the various piping systems to minimize incidence of FAC in piping. These features include:

- elimination of high turbulence points wherever possible (example: adequate straight pipe length downstream of flow orifice or control valve, etc)
- use of long radius elbows
- smooth transition at shop or field welds
- selection of pipe diameter to have velocities within industry recommended values
- use of corrosion resistant materials
- use of austenite stainless steel and P11 or P22 chrome-moly materials

Impact on DCD

The following paragraphs will be added after 1st paragraph of 10.3.6.3 Flow-Accelerated Corrosion (FAC):

The following portions have the potential for FAC from past experiences in operating power plants and are included in FAC monitoring program. These systems are basically based on NUREG-1344 attached to GL 89-08. Generally, most of these systems are entirely made of carbon steel, however, materials for the portions extremely susceptible to FAC are FAC-resistant alloy taking into consideration past experiences.

Single-Phase Line

- Main feedwater lines
  The piping from steam generator up to and excluding main feedwater equalization piping in the upstream of feedwater flow meter is made of high content of chrome-moly materials as shown in table 10.3.2-3. This portion is resistant to FAC.
- Main feedwater recirculation to condenser
  This portion is made of carbon steel.
- Feedwater pump suction line
  This portion is made of carbon steel.
- Feedwater pump discharge line
  This portion is made of carbon steel.
- Condensate pump recirculation to condenser line
  This portion is made of carbon steel.

Two-Phase Line

- Main steam line
  This portion is made of carbon steel. There is no portion which is susceptible to FAC because of the low moisture which is approximately 0.1 %.
- Cross-under pipe
  This portion is made of FAC-resistant alloy as shown in table 10.3.2-4. This portion is immune to FAC.
- Extraction steam line
  This portion is made of FAC-resistant alloy. This portion is immune to FAC.
- Feedwater heater drain piping
  Most of this entire portion is made of carbon steel, however, material of extremely susceptible to FAC portion such as downstream of control valves are made of FAC-resistant alloy.
- Steam generator blowdown line
  Most of this portion is entirely made of carbon steel, however, material for the portion extremely susceptible to FAC such as downstream of angle valve are stainless steel or chrome-moly materials

The 2nd paragraph of DCD 10.3.6.3, "Flow-Accelerated Corrosion (FAC)" will be replaced as shown below:

Corrosion allowance is the difference between the actual minimum wall thicknesses after any wall thinning that occurs during fabrication, and the required design wall thickness. The required design wall thickness is determined based on piping design pressure/ temperature and allowable stress in accordance with ASME Sec.III NX-3641 or ASME B31.1 paragraph. 104. The specified wall thickness (prior to fabrication) is a standardized wall thickness stipulated in ASME B36.10M and ASME B36.19M. It is specified to exceed the required design wall thickness by a large and appropriate amount to account for the expected wall thinning during fabrication. The fabrication thinning is controlled by establishing fabrication tolerances. The FAC monitoring program provided by COL applicant will include preservice thickness measurements of as-built piping considered susceptible to FAC. By performing this preservice measurement, the piping thickness margin that will be used as a wall thinning margin will be known, and then by combining the measurement with regular inspection the frequency of the pipe replacement will be predicted. Integrity and safety of a plant is assured by the COL applicant by conducting inspection and maintenance during over 60 years of service and replacing piping if necessary.

The 3rd paragraph of DCD 10.3.6.3, "Flow-Accelerated Corrosion (FAC)" will be replaced as shown below:

The US APWR design and piping layout has considered several features for the various piping systems to minimize incidence of FAC in piping. These features include:

- elimination of high turbulence points wherever possible (example: adequate straight pipe length downstream of flow orifice or control valve, etc)
- use of long radius elbows
- smooth transition at shop or field welds
- selection of pipe diameter to have velocities within industry recommended values
- use of corrosion resistant materials
- use of austenite stainless steel and P11 or P22 chrome-moly materials

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.