

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

July 6, 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- 09364

**Subject: MHI's Response to US-APWR DCD RAI No. 383-3002 REVISION 1**

**Reference: 1)** "Request for Additional Information No.383-3002 Revision 1, SRP  
Section: 10.04.06 – Condensate Cleanup System, Application Section:  
10.4.6" dates June 8, 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. 383-3002 Revision 1."

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. 383-3002 Revision 1

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

*DOB  
NRW*

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Docket No. 52-021  
MHI Ref: UAP-HF- 09364

Enclosure 1

UAP-HF- 09364  
Docket Number 52-021

Response to Request for Additional Information  
No. 383-3002 Revision 1

July 2009

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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07/06/2009

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

**RAI NO.:** NO. 383-3002  
**SRP SECTION:** 10.04.06 - CONDENSATE CLEANUP SYSTEM  
**APPLICATION SECTION:** 10.4.6  
**DATE OF RAI ISSUE:** 06/08/2009

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**QUESTION NO.: 10.04.06-6**  
**Background**

RAI 10.04.06-1 (Reference 1) requested that the applicant provide clarification and/or verification of headings and entries in Table 10.3.5-3. The applicant's response(Reference 2) did not address our question about the table heading, but did supply the basic reasoning behind the limits for bulk impurity concentrations in the table. The applicant refers to Fig. 2-11 from the EPRI Guidelines (Reference 3) to obtain bulk pH limits for the tube material 690TT. The applicant's reply then states the concentration limits for sodium, chloride, and sulfate as being derived so as to maintain this limit, assuming a concentration factor (CF) of 105. (The local crevice concentration is given by multiplying CF by the bulk concentration.)

The details of applicant's derivations were not given, however it is possible to obtain values from the information in Figs. 3-4 through 3-7 of the EPRI Guidelines. These figures plot the change in pH with change in CF. If we assume element limits are derived from worst-case possibilities for each element, then approximate element limits can be derived from the figures in the EPRI Guidelines as follows:

**Sodium.** Fig. 3-4 indicates  $\text{pH} \geq 10$  when  $\text{CF} \geq 107$  (using the bulk concentration of 1 ppb from Table 3-1). Hence, for  $\text{CF} = 105$  as claimed by applicant, the analogous bulk concentration would be 100 ppb, which is less stringent than applicant's value of 50 ppb for a limit.

**Chloride.** Fig. 3-6 indicates  $\text{pH} \leq 5$  when  $\text{CF} \geq 2.5 \times 10^5$  (using the bulk concentration of 4.6 ppb from Table 3-1). Hence, for  $\text{CF} = 105$  as claimed by applicant, the analogous bulk concentration would be 10 ppb, which is much more stringent than applicant's value of 100 ppb for a limit.

**Sulfate.** Fig. 3-7 indicates  $\text{pH} \leq 5$  when  $\text{CF} \geq 106$  (using the bulk concentration of  $3[\text{Na}] = 3$  ppb from Table 3-1). Hence, for  $\text{CF} = 105$  as claimed by applicant, the analogous bulk concentration would be 30 ppb, which is more stringent than applicant's value of 100 ppb for a limit.

Only for the case of sodium, is the applicant's limit more stringent than these calculations using the EPRI Guidelines. In addition, the values calculated above are remarkably similar to the suggested EPRI limits (see Table 5-3), and both are considerably lower than the applicant's limiting values for DCD Table 10.3.5-3.

### **Requested Information**

1. Clarify the sub-heading under "Control Value" in DCD Table 10.3.5-3. It currently reads "Value Prior to Power Escalation Under 30%". This phrase is ambiguous since "escalation" implies increase, but "Under 30%" implies an upper limit. Also, it is remarkably similar to the analogous Table 5-3 in the EPRI Guidelines, where the heading reads "Value Prior to Power Escalation > 30%." 2. Provide more detail in the calculation of limits for chloride and sulfate to justify the values that are considerably higher than those in the EPRI Guidelines.

### **References**

1. "Request for Additional Information No. 235-2134 Revision 1, SRP Section: 10.04.06 – Condenser Cleanup System, Application Section: DCD Tier 2, Section 10.4.6" dated February 26, 2009. (ADAMS Accession No. ML090610300)

2. Letter from Yoshiki Ogata, MHI, to NRC dated March 25, 2009; Docket No. 52-021 MHI Ref: UAP-HF-09106; Subject: MHI's Response to US-APWR DCD RAI No. 235-2134 (ADAMS Accession No. ML090890519)

3. *Pressurized Water Reactor Secondary Water Chemistry Guidelines*, Rev. 6, Electric Power Research Institute (December 2004).

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### **ANSWER:**

Item 1) The titles in DCD Table 10.3.5-3 mean the same things as in Table 5-3 in EPRI Guidelines. So, the description "Under 30%" is inappropriate, and will be revised to ">30%."

Item 2) 3.2.2 of EPRI Guidelines describes the concentration in Flow-Occluded Regions of RSGs, and states "In order to research crevice chemistries, investigators used two heated crevice systems. Both systems were of similar configuration, but one system was fed faulted bulk water chemistry in a laboratory while another was set up in Ohi Unit 1." Fig. 3-8 shows a heated crevice device. This laboratory conducts joint researches with MHI, and MHI installed dummy crevices by our design at the laboratory and Ohi No. 1 Unit (Reference 1).

Fig. 1 shows the outline of the crevice concentration evaluation codes owned by us, where the invasion of impurities and water into crevice and the discharge of impurities from crevice (steam, mist drift) are integrated in each unit time, and the concentrations of impurities in the crevice a specified time later are calculated, then pH of the crevice concentrated liquid is calculated by carrying out a high-temperature gas-liquid equilibrium calculation from the composition of impurities (Reference 1).

Fig. 2 compares the results of pH calculations by these calculation codes using Ohi No. 1 Unit SG blowdown water bulk water quality as an input condition, with the pH values of the compositions of concentrated liquids when Ohi No. 1 Unit SG blowdown water is introduced into the dummy crevice (Reference 1). Both pH evaluation results are correlated appropriately, and the crevice concentration evaluation codes owned by us are determined to be capable of evaluating the actual SG crevice environment.

Standard values of Na, Cl and SO<sub>4</sub> were determined by using the above evaluation codes. The preconditions for calculations and the results are described below.

(1) Division of control values by power 30%

Fig. 3 shows the concentration rate vs heat flux in SG crevices (Reference 2). In this drawing, the horizontal axis stands for the heat flux, and the ranges of heat flux in 30 and 100% powers are shown by arrows. At 30% power, here, an area shows a heat flux similar to the cold side at 100% power. At 30% load or more, therefore, concentration environment could be similar to the rated operation. So, in the heat flux corresponding to plant load 30% or less, the concentration rates are small at the part, and

in the heat flux corresponding to 30% or more, the concentration rates similar to rated operation can be realized. Consequently, the operation modes in water control were divided by plant load 30%.

(2) Concentration rate set to  $10^5$

In the low-load operation of plant load less than 30%, concentration rates in SG secondary crevice are determined small as described above. In this discussion, however, the crevice environment was evaluated under the condition of concentration rate of  $10^5$  (corresponding to the round-hole tube support plate in rated operation) for a conservative evaluation.

(3) Other preconditions

As shown in Fig. 2-11 of EPRI Guidelines referred to later, the damage occurrence sensitive regions of SG heat transfer tubes are seen in the strong alkali and strong acidity sides. In the case of TT690 as the material of SG heat transfer tube in US-APWR, the strong alkali side exists in the low-potential area, while the strong acidity area does exist in areas of fairly high potentials. In consideration of the facts that copper materials are excluded in US-APWR and that bring-in of strong acidity agents to SG has been alleviated to a large degree, it seems necessary to mainly monitor the formulation of alkali environment. In the discussions of standard values, therefore, it was evaluated how single increases of Na as a possible factor to formulate strong alkali environment could affect the SG crevice environment. Concerning  $SO_4$  and Cl as the factors to formulate acidity-side environment, on the other hand, possible effects were evaluated in case Na of upper-limit concentration co-exists, as evaluated above. At US-APWRs, TT690 is used for SG heat transfer tube. So, by using the conservative data of TT600, pH was set to 5 ~ 10 so that SCC/IGA might not occur.

(4) Result of standard value evaluation

a. Na

Fig. 4 shows the Na concentrations when Na alone increases under the condition of concentration rate of  $10^5$  vs the crevice pHt (evaluation code calculation result). The crevice pHt thereby would be 10 or more at Na concentration of 50 ppb or more. Therefore, the value of 50 ppb is set as the control upper-limit value for Na concentration in the operation mode of less than plant load 30%.

b.  $SO_4$

Fig. 5 shows the behavior of crevice pHt (evaluation code calculation result) when  $SO_4$  concentration is increased while 50 ppb of Na co-exists under the condition of concentration rate of  $10^5$ . If  $SO_4$  concentration becomes 100 ppb or more, thereby, crevice pHt drops rapidly to 5 or less. Consequently, 100 ppb is set as the control upper-limit value for  $SO_4$  concentration in the operation mode of less than plant load 30%.

c. Cl

Fig. 6 shows the behavior of crevice pHt (evaluation code calculation result) when Cl concentration is increased while 50 ppb of Na co-exists under the condition of concentration rate of  $10^5$ . If Cl concentration becomes 100 ppb or more, thereby, crevice pHt drops rapidly to 5 or less. Cl, on the other hand, affects the drop of crevice pHt, and Cl itself provides causes of pitting in its co-existence with oxidizing agents. Concentration, in which Cl does not affect the materials of SG heat transfer tube soundly, is 100 ppb as shown in Fig. 7 (Reference 3). From the viewpoint of preventing the occurrence of these damages, 100 ppb is set as the control upper-limit value for Cl concentration in the operation mode of less than plant load 30%, by reflecting both conditions.

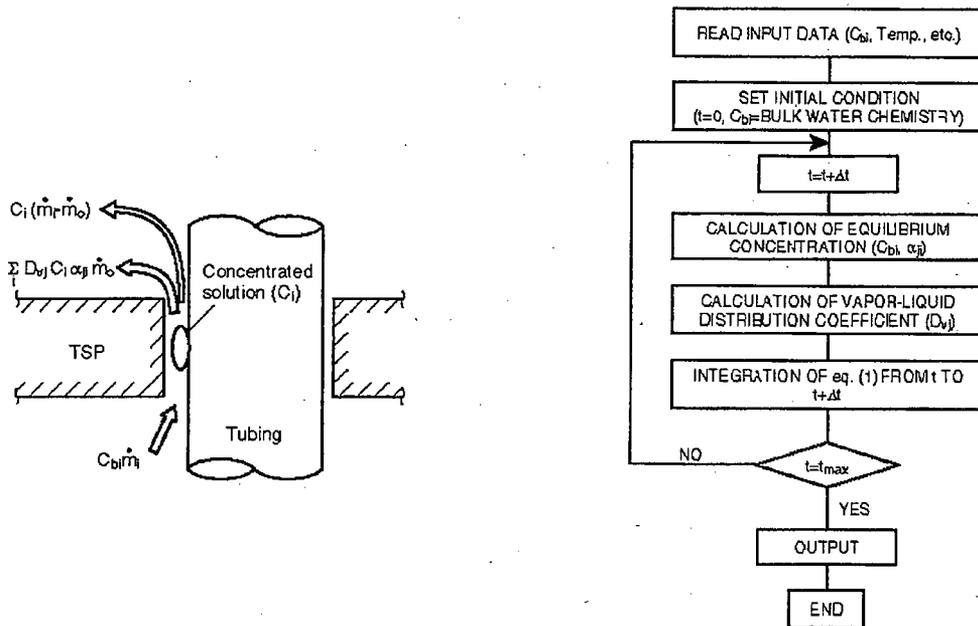


Fig. 1 Outline of crevice concentration calculation codes

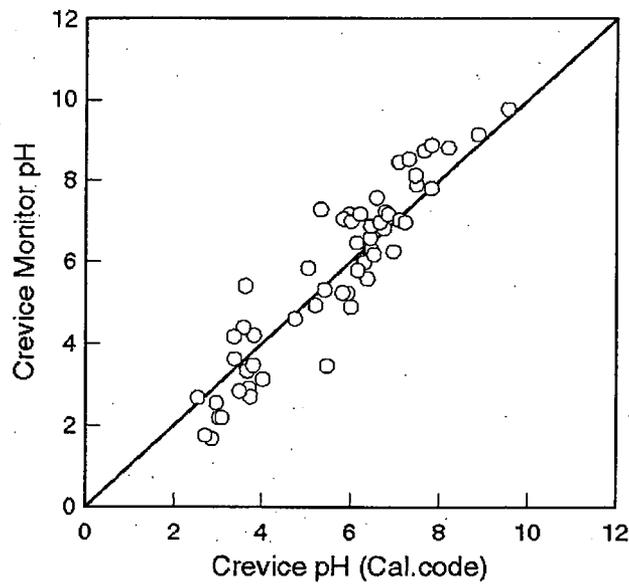


Fig. 2 Comparison of concentration calculation codes with crevice monitor concentrated liquid pH

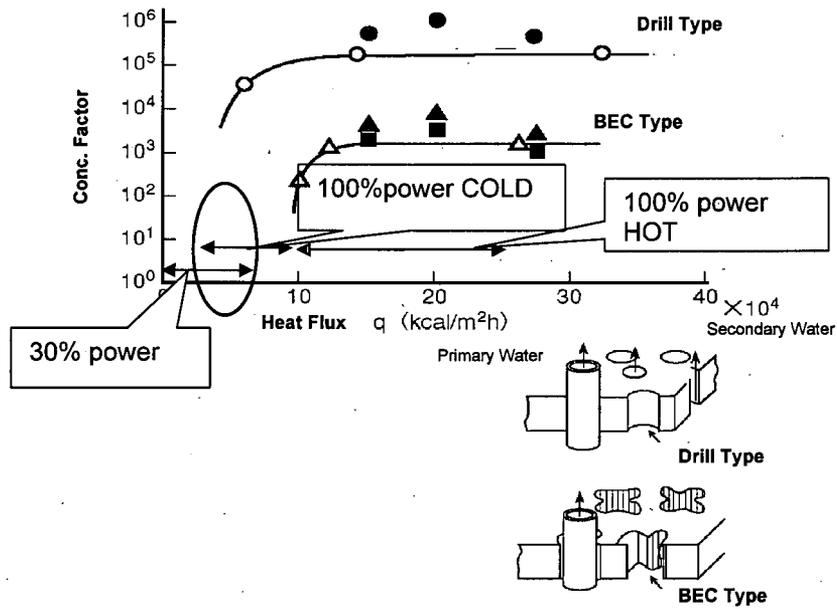


Fig. 3 Concentration rate vs heat flux

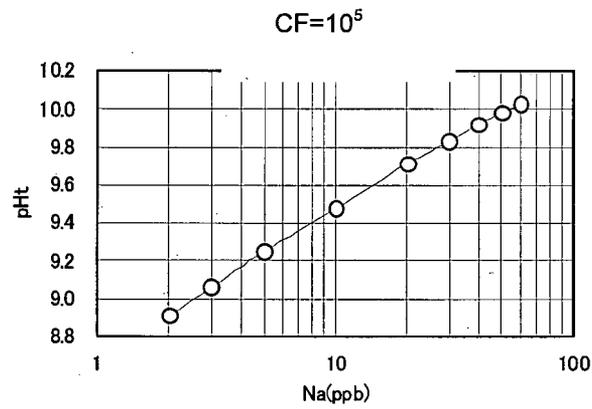


Fig. 4 Na concentration vs crevice pHt when Na alone increases  
(Concentration rate = 10<sup>5</sup>)

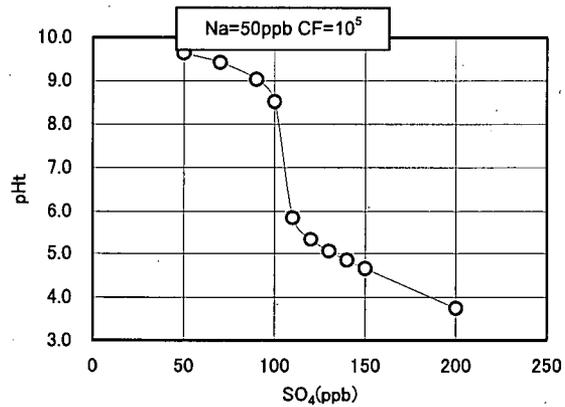


Fig. 5 SO<sub>4</sub> concentration vs crevice pH when Na co-exists (Concentration rate = 10<sup>5</sup>)

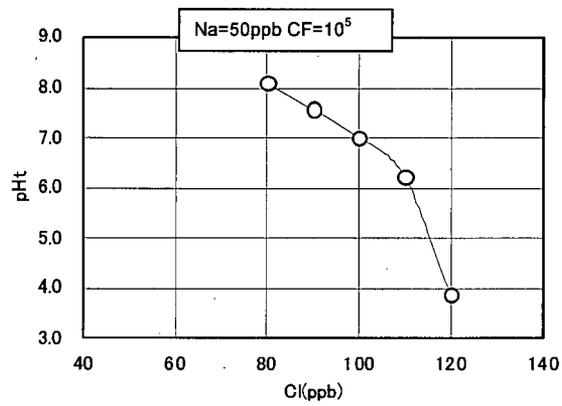


Fig. 6 Cl concentration vs crevice pH when Na co-exists (Concentration rate = 10<sup>5</sup>)

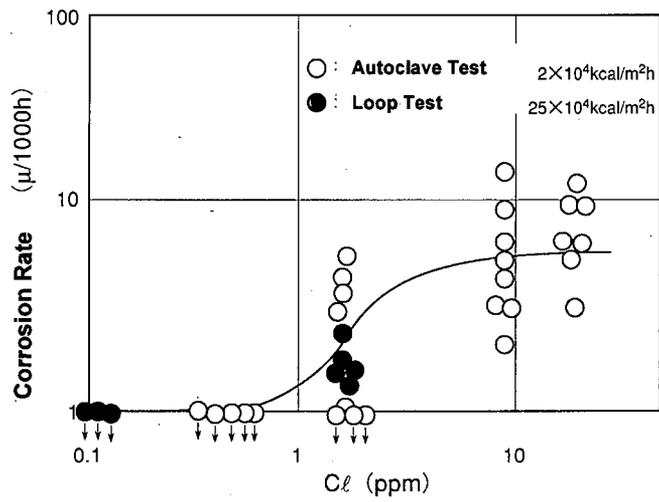


Fig. 7 Chloride ion's effects on the corrosion of inconel 600 material

<References>

1. Y.Shoda, E.Kadokami and T.Hattori,"Examination of New Bulk Water Molar Ratio Index for Crevice Environment Estimation", Proceeding of International Conference on Water Chemistry of Nuclear Reactor System 7, BENS, p608(1996)
  2. I.Ohsaki, K.Ohnishi, Y.Ohkubo,T.Hattori, S.Tokunaga, Proceeding of International Steam Generator and Heat Exchanger Conference., Tronto, p893(1994)
  3. M.Do, K.Onimura, K Arioka, T.Hattori, "Secondary Water Chemistry of PWR Nuclear Power Plant",The Journal "The Thermal and Nuclear Power"p32, vol.30, March, 1979
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**Impact on DCD**

There is no impact on DCD

**Impact on COLA**

There is no impact on COLA.

**Impact on PRA**

There is no impact on PRA.

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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07/06/2009

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

**RAI NO.:** NO. 383-3002  
**SRP SECTION:** 10.04.06 - CONDENSATE CLEANUP SYSTEM  
**APPLICATION SECTION:** 10.4.6  
**DATE OF RAI ISSUE:** 06/08/2009

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**QUESTION NO.: 10.04.06-7**  
**Background**

RAI 10.04.06-2 (Reference 1) requested that the applicant provide clarification regarding the limiting values and frequencies for sampling secondary system water. Specifically, the applicant was requested to:

1. Recommend COL information items for issues that should be addressed by the COL applicant.
2. Discuss limiting values and corrective actions, specifically as to how they relate to Action Levels 1, 2, and 3 of the EPRI PWR Secondary Water Chemistry Guidelines.
3. Discuss the recommended sampling schedule (frequency) for parameters from DCD Tier 2 Tables 10.3.5-1, 10.3.5-2, and 10.3.5-3.

In addition, RAI 10.04.06-3 (Reference 1) requested additional clarification and discussion of limiting values for control parameters with respect to the Action Levels 1-3.

In response (Reference 2), the applicant discussed issues that would need to be addressed by a COL applicant or plant operator, but did not identify a COL information item. Also, the applicant discussed Action Levels 1, 2, and 3, but its descriptions of the Action Levels do not match those of the EPRI Guidelines. For example, for Action Level 1 as defined by the EPRI Guidelines, Action Level 2 must be entered if Action Level 1 is exceeded for more than one week. The EPRI Guidelines also require a reduction in power if Action Level 2 is exceeded for 8 hours, and immediate shutdown or reduction in power to less than 5% power if Action Level 3 is exceeded. Finally, the applicant provided a table with recommended sampling frequencies. However, ambiguity still remains with regard to sampling frequency and consistency with the EPRI Guidelines.

The applicant stated that Action Levels 2 and 3 will not be presented at the DCD or COL stage, because these require actions that limit plant operation, and such procedures should only be developed in concert with the eventual plant licensee (owner). However, it is the position of the staff that the DCD applicant should make recommendations to the COL applicant regarding the limits to be followed to ensure materials integrity. If the applicant does not recommend that the COL holder conform to the latest industry (i.e. EPRI) water chemistry guidelines, then the applicant should make alternate recommendations for water chemistry parameter limits to

preserve materials integrity. Any differences from the Action Levels from the EPRI Guidelines should be justified.

The design and construction must be undertaken with certain chemistry standards in mind, and it is unclear to the staff what those standards are. In the Tier 2 DCD, Chapter 5 (p. 5.4-13, paragraph 2), it is stated, "The primary and secondary water chemistry is controlled in accordance with industry guidelines." This implies consistency with the EPRI Guidelines. Further, Tier 2 DCD Section 10.3.5.5 states:

Appropriate responses to abnormal chemistry conditions provide for the longterm integrity of the secondary cycle components. Remedial actions are taken when chemistry parameters are outside normal operating ranges.

Secondary side water chemistry guidelines are provided in Table 10.3.5-1.

Thus, MHI has declared some guidelines (namely, those in Table 10.3.5-1), and has stated that appropriate actions should be taken if they are violated. If the DCD Table were consistent with EPRI Guidelines, then it would be appropriate to assume that the responses and actions were those specified in the EPRI Guidelines. However, the DCD table(s) are not consistent with the EPRI Guidelines, which include Action Levels 1-3. Hence, "appropriate responses" and "remedial actions" are not well defined.

With regard to the sampling frequencies supplied in the table provided in the response to RAI 10.04.06-2, several are ambiguous and may not match the EPRI Guidelines. The frequency label 'D' is used to denote daily grab sampling, but may also imply continuous monitoring. The DCD Tier 2 Section 9.3.2.2.4 mentions continuous monitoring in reference to Table 9.3.2-4, but the measurement description suggests that grab samples are intended. Table 9.3.2-4 itself mentions continuous monitoring only in describing when and where it does not occur. It is not clear to the staff whether the US-APWR design includes the equipment to permit continuous monitoring of secondary water chemistry parameters, but these parameters are only required to be recorded once per day. Thus, the monitoring frequency for many of the control variables is still unclear to the staff.

### **Requested Information**

1. Identify what recommendations can be made for COL applicants and licensees regarding sampling limits and frequencies, in order to assure consistency with the EPRI Guidelines or other industry standard. If the recommended limits or frequencies differ from those recommended in the EPRI guidelines, provide a technical justification for each difference
2. Justify any inconsistencies of the control values in DCD Tier 2 Tables 10.3.5-1, 10.3.5-2, and 10.3.5-3 with the Action Level 1, 2, and 3 values recommended by the EPRI Guidelines.
3. Clarify the recommended monitoring frequency for the various secondary water chemistry parameters:
  - a) Clearly identify all secondary water chemistry parameters that are continuously monitored.
  - b) Clarify which parameters in DCD Tier 2 Table 9.3.2-4 are continuously monitored.
  - c) Indicate if there are parameters for which continuous monitoring equipment is included in US-APWR design, but the parameter value will only be recorded once per day.
  - d) Justify any variation from the recommendations in the EPRI Guidelines.

### **References**

1. "Request for Additional Information No. 235-2134 Revision 1, SRP Section:

10.04.06 – Condenser Cleanup System, Application Section: DCD Tier 2, Section 10.4.6" dated February 26, 2009. (ADAMS Accession No. ML090610300)

2. Letter from Yoshiki Ogata, MHI, to NRC dated March 25, 2009; Docket No. 52-021 MHI Ref: UAP-HF-09106; Subject: MHI's Response to US-APWR DCD RAI No. 235-2134 (ADAMS Accession No. ML090890519)

3. *Pressurized Water Reactor Secondary Water Chemistry Guidelines*, Rev. 6, Electric Power Research Institute (December 2004).

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**ANSWER:**

Item 1) Our water chemistry control requirements and sampling schedule for the steam generator blowdown system (SGBDS) are shown as below.

First of all, we clarify the differences between our above requirements and the EPRI secondary water chemistry guidelines for SGBD shown as Table.1.

Table.1 The difference between MHI sampling requirements and EPRI guidelines for SGBDS

Sampling item	MHI Requirements	EPRI guidelines	Remarks
(1)p H	Not required to monitor continuously	required to monitor continuously	
(2)Cation conductivity	Not required to monitor continuously	required to monitor continuously	
(3) Hydrazine	Not required	Required	During only Heat up/Hot standby and startup
(4) Silica	Not required	Required	

As for pH, cation electric conductivity and hydrazine (see above table.1 items (1) through (3)), no control value is set.

We understand it is not necessary to monitor the values of item (1) through (3) with SGBDS sampling at the same time while monitoring the above values with main feedwater sampling mainly.

That's because it is difficult for us to understand a phenomenon that main feedwater shows normal values and on the other hand, SGBD water shows abnormal values.

Accordingly, we understand it is not necessary to monitor continuously and/or monitor intermittently the values of item (1) through (3) with SGBDS sampling according to our requirements in table.1.

Control value is not set for silica, because few troubles caused by silica would be generated considering on the fact that no silica's carry-over to steam side is found in the secondary system of PWR due to not using superheated steam.

Silica is brought in from make-up water, generally. Therefore, silica concentration should be controlled at make-up water individually per plant within the value which is decided according to the experimental concentration based on actual concentration at the outlet of make-up water treatment facility.

Therefore, we understand it is not necessary to monitor silica concentration with SGBDS sampling according to our requirements in table.1.

Furthermore, in SG blowdown water, control value of Na, Cl and SO<sub>4</sub> are set in order to maintain pH in SG crevice within the range of not generating IGA/SCC, because there is a possibility of becoming a different environment from SG bulk water after being concentrated at the crevice.

According to our above concept, the analysis item and the sampling schedule of the SG blow down sampling that we plan are shown as shown in Table 2.

Table.2 Sampling schedule for SG blowdown water during heat up and power operation

Item	Monitored system	Condensate	Main Feedwater	SG Blowdown water
p H			C	
Cation conductivity			C	
Hydrazine			C	
Dissolved oxygen		C	C	
Sodium				C
Chloride				D
Sulfate				D
Crevice p H t				W
Total Iron			W	
Total copper			F	

Frequency: C: Continuously monitored  
D: Once/Day (manual analysis or monitoring instruments)  
W: Once/Week  
F: As required

Once/week shall be applied for sampling SG blowdown water during cold shutdown and wet lay-up.

Item2)

Comparison between the US-APWR specifications and EPRI GL is shown Table.3 The US-APWR specifications are almost consistent with the EPRI GL.

Table. 3 Comparison between the US-APWR spec. and EPRI GL

System	parameter	US-APWR		EPRI			Diagnostic Value
		Control value	Diagnostic Value	Action Level			
				1	2	3	
Condensate water	pH	-	-	*1	-	-	-
	cation conductivity (mS/m)	-	-	-	-	-	-
	sodium (ppb)	-	-	-	-	-	-
	dissolved oxygen (ppb)	<10	-	>10	>30	-	-
Feed water	pH	-	>9.2*2	-	-	-	-
	Hydrazine (ppm)	>0.05	-	<8xCPD[O <sub>2</sub> ] or <20ppb	-	-	-
	Dissolved oxygen (ppb)	5	-	5	>10	>20	-
	Cation conductivity (mS/m)	5	*3	5	-	-	-
	Total iron (ppb)	5	-	5	-	-	-
	Total copper (ppb)	25	-	5	-	-	-
	Total nickel (ppb)	25	-	1	-	-	-
	Electrical potential CP transport to SG Lead	-	*4 *5 *5	- - -	- - -	- - -	- - -
SG blowdown water	cation conductivity (mS/m)	-	-	-	>0.1	>0.4	-
	sodium (ppb)	5	-	5	>50	>250	-
	chloride (ppb)	<10	-	>10	>50	>250	-
	sulfate (ppb)	<10	-	>10	>50	>250	-
	Crevice pHt	-	5-11*6	-	-	-	-

\*1 in case of copper release as pH exceeds 9.2, action is needed, \*2 from FAC management, value of >9.2 is set, \*3 semi-quantitative indicator of organic acid concentration, \*4 if ECP-meter installed, \*5 indicator periodically measured (plant specific), \*6 MHI recommends that the value is used as an indicator for SG crevice environment evaluation

included as appropriate, based on MHI experience and information available from the literature.

**Hydrazine**

The value of 8xCPD[O<sub>2</sub>] has a possibility to reach 40 ppb because the upper limit of O<sub>2</sub> is 5 ppb. Accordingly, 50 ppb was determined to be the standard value with some control margin taken into consideration.

**Crevice pHt**

Based on MHI experience, the crevice pHt was set as a diagnostic value to prevent IGA of the SG heat transfer tubing. MHI can evaluate this value from the bulk concentration of impurities using MHI's calculation code.

Item3)

- a) For the parameters that are continuously monitored, refer to the response to Table.2 of Item1.
- b) Continuously monitored parameters in DCD Tier 2 Table 9.3.2-4 are shown as follows
  1. Condenser A Hotwell Side A :CC
  2. Condenser A Hotwell Side B :CC
  3. Condenser B Hotwell Side A :CC
  4. Condenser B Hotwell Side B :CC
  5. Condenser Condensate Makeup: SC, SiO<sub>2</sub>
  6. Condenser C Hotwell Side A :CC
  7. Condenser C Hotwell Side B: CC
  8. Condenser Discharge:DO\*1,CC
  9. Filter/Demineralizer Vessel 1:SC
  10. Filter/Demineralizer Vessel 2:SC
  11. Filter/Demineralizer Vessel 3:SC
  12. Demineralizer Total Effluent:SC
  13. Point After Chemical Injection:SC
  14. Feedwater to SG:DO\*2,SC,pH,ECP,Hydrazine
  15. SGBDS Discharge:SC,CC, Na
  29. Deaerator Inlet:DO\*1
  30. Deaerator Outlet:DO\*2

\*1: It is used changing the same DO meter.  
\*2: It is used changing the same DO meter.
- c) There are no parameters.
- d) EPRI PWR Secondary Water Chemistry Guidelines(Rev.6),Table 7-1 recommends "Continuous instrumentation for Recirculating Steam Generators". Variation from the recommendations in the EPRI Guidelines are shown Table.4

Table. 4 Variation from the recommendations in the EPRI Guidelines

Analysis	Blowdown	Feedwater	Condensate Demineralizer Outlet	Condensate Pump Discharge	Individual Hotwells
Specific Conductivity				Y	
Cation Conductivity		Y	Y		
pH	Y			Y	
Dissolved Oxygen					
Sodium		Y	Y	Y	Y
Hydrazine					

Y:EPRI Guidelines recommends continuous instrument, but US-APWR does not plan to settle monitors.

1. For Our water chemistry control concept for the Blowdown and Feedwater, refer to Item1.
2. Specific Conductivity(Condensate Pump Discharge):  
It is judged that the necessity for installation is low only in the value corresponding to pH value of a secondary system coolant being displayed.
3. Cation Conductivity(Feedwater):  
US-APWR plan to settle Cation Conductivity meter at Blowdown
4. Cation Conductivity(Condensate Demineralizer Outlet):  
pH agent is captured by Condensate Demineralizer , so Cation is not needed.
5. pH(Blowdown and Condensate Pump Discharge):  
US-APWR plan to measure pH at Feedwater to SG.
6. Sodium(Feedwater, Condensate Demineralizer Outlet, Condensate Pump Discharge and Individual Hotwells):  
US-APWR plan to measure Sodium at Blowdown since sodium is important to keep the integrity of SG heat-transfer tube, and the necessity for continuous measurement is low in other sampling point.

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**Impact on DCD**

There is no impact on DCD

**Impact on COLA**

There is no impact on COLA.

**Impact on PRA**

There is no impact on PRA.