

# REQUEST FOR ADDITIONAL INFORMATION 543-4368 REVISION 1

3/2/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 10.04.06 - Condensate Cleanup System

Application Section: 10.4.6

QUESTIONS for USAPWR Projects Branch (NMIP)

10.04.06-11

## Background

### **[Open Item 10.04.06-1]**

The EPRI PWR Secondary Water Chemistry Guidelines (Reference 1) define concentration limits during power operation for three Action Levels. If the Action Level 1 limit is violated, power operation can continue while corrective action is taken; if violation lasts longer than one week, this becomes an Action Level 2 violation. An Action Level 2 violation requires immediate power reduction and correction within 100 h; otherwise an Action Level 3 violation occurs. Action Level 3 requires immediate shutdown until the violation is corrected.

In response to RAI 235-2134, Question 10.04.06-2 (Reference 2), the applicant also mentions Action Levels 1-3, but lacks the any consequences and time limits for correction. In response to RAI 235-2134, Question 10.04.06-3 (Reference 2), the applicant defended the lack of limits for Action Levels 2 and 3, since these values would require input from the plant operator. However, they neglected to issue COL information items to provide guidance to COL holders. In response to RAI 441-3461, Question 10.04.06-9 (Reference 3), the applicant again mentions Action Levels 1-3. However, the applicant's definitions of the action levels do not match those of the EPRI Guidelines, and are in fact devoid of any mention of consequences for prolonged limit violation.

For review of secondary water chemistry control, the guidance of the Standard Review Plan (SRP) NUREG-0800 Section 10.4.6 is used. SRP Section 10.4.6 refers to SRP Section 5.4.2.1, "Steam Generator Materials," for acceptance criteria for secondary water chemistry. SRP Section 5.4.2.1 in turn references Branch Technical Position, BTP 5-1, "Monitoring of Secondary Side Water Chemistry in PWR Steam Generator."

With respect to secondary water chemistry, BTP 5-1 states, in part, that "The applicant should address how its program meets industry guidelines (e.g., EPRI's secondary water chemistry guidelines and Nuclear Energy Institute (NEI) 97-06)."

While the staff does not review or accept the EPRI water chemistry guidelines through a safety evaluation, these guidelines are recognized as representing the industry consensus on best practices in water chemistry control and have been proven to be effective via many years of successful operating experience. As such, the staff finds the

## REQUEST FOR ADDITIONAL INFORMATION 543-4368 REVISION 1

application of the guidance of the EPRI PWR Secondary Water Chemistry Guidelines, and a programmatic commitment to use these guidelines, to be an acceptable method for the applicant to ensure compliance with GDC 14. Because the standard review plan is a guidance document rather than a regulation, alternatives to the EPRI guidelines may be used, provide adequate justification is provided for deviating from the SRP guidance.

### Requested Information

Justify any differences in the Action Level 1, 2, and 3 descriptions in Reference 3 from those in the EPRI Guidelines, with respect to consequences for plant operation and the time limit allowed for corrective action. Applicant must thoroughly justify any deviation from requirements of the EPRI Guidelines for any violation of concentration limits. The justification should include detailed test data, operating experience, or a combination of both, demonstrating that the operation with impurities exceeding the various action levels for a longer time period than recommended by the EPRI guidelines, will not increase the likelihood of corrosion-induced failure of the steam generator tubing.

### References

1. Pressurized Water Reactor Secondary Water Chemistry Guidelines, Rev. 6, Electric Power Research Institute (December 2004).
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. Letter from Yoshiki Ogata, MHI, to NRC dated September 16, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09451; Subject: MHI's Response to US-APWR DCD RAI No. 441-3461 (ADAMS Accession No. ML092610532).
4. Letter from Yoshiki Ogata, MHI, to NRC dated July 6, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09364; Subject: MHI's Response to US-APWR DCD RAI No. 383-3002 (ADAMS Accession No. ML091910255).

10.04.06-12

### Background

#### **[Open Item 10.04.06-2]**

During power operation, the DCD is consistent with EPRI Guidelines (Reference 1) with regard to Action Level 1 limits for condensate O<sub>2</sub> and feedwater dissolved oxygen (O<sub>2</sub>), Fe, and Cu. The limits for hydrazine are approximately the same, although calculated somewhat differently. However, the applicant's response to RAI 441-3461, Question 10.04.06-9 (Reference 3) indicated that the Standard Value and Action Level 1 values for Condensate O<sub>2</sub> are different than the DCD, the EPRI Guidelines, and a previous RAI

## REQUEST FOR ADDITIONAL INFORMATION 543-4368 REVISION 1

response (Reference 4, Question 7). Whereas the applicant's former value (10 ppb) was consistent with the EPRI Guidelines, it is now higher (15 ppb). In addition, the applicant has not declared any change in the DCD to reflect this new value; hence, there is considerable uncertainty in the appropriate Action Level 1 value.

### Requested Information

Reconcile the discrepancies in condensate O<sub>2</sub> Standard Value and Action Level 1 value. If the value in Reference 3 is to be used, justify its difference with the EPRI Guidelines and describe how the DCD should be revised to incorporate this new value.

### References

1. Pressurized Water Reactor Secondary Water Chemistry Guidelines, Rev. 6, Electric Power Research Institute (December 2004).
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. Letter from Yoshiki Ogata, MHI, to NRC dated September 16, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09451; Subject: MHI's Response to US-APWR DCD RAI No. 441-3461 (ADAMS Accession No. ML092610532).
4. Letter from Yoshiki Ogata, MHI, to NRC dated July 6, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09364; Subject: MHI's Response to US-APWR DCD RAI No. 383-3002 (ADAMS Accession No. ML091910255).

10.04.06-13

### Background

#### **[Open Item 10.04.06-3]**

A substantial difference between the DCD and the EPRI Guidelines (Reference 1) is that the DCD lacks Action Level 2 and 3 limits for control parameters O<sub>2</sub> (in condensate and feedwater) and Na, Cl, and SO<sub>4</sub> (blowdown). In response to RAI 441-3461, Question 10.04.06-9 (Reference 3), the applicant states in the first sentence of the reply that they will supply all the missing limits. However, the table that follows does not contain all of this information, lacking Action Level 3 values for Na, SO<sub>4</sub>, and feedwater O<sub>2</sub>, and Action Level 2 values for condensate O<sub>2</sub>. Also in this table (Reference 3), the applicant gives Action Level 2 limits for Cl and SO<sub>4</sub> which exceed EPRI Guidelines, and has supplied a detailed justification for these values (see RAI 10.04.06-14). However, the Action Level 3 limit for Cl is nearly an order-of-magnitude higher than the corresponding value in the EPRI Guidelines. The applicant has not supplied any explanation or justification for this discrepancy. Combined with the definition of Action Level 3 proposed by the applicant (see RAI 10.04.06-11), this would allow operation with greater than 2000 ppb Cl for up to 24 hours. Further, a US-APWR plant could also operate for up to 1 week with chloride

## REQUEST FOR ADDITIONAL INFORMATION 543-4368 REVISION 1

between 100-2000 ppm given the definition of Action Level 2 and the proposed CI action levels.

For review of secondary water chemistry control, the guidance of the Standard Review Plan (SRP) NUREG-0800 Section 10.4.6 is used. SRP Section 10.4.6 refers to SRP Section 5.4.2.1, "Steam Generator Materials," for acceptance criteria for secondary water chemistry. SRP Section 5.4.2.1 in turn references Branch Technical Position, BTP 5-1, "Monitoring of Secondary Side Water Chemistry in PWR Steam Generator."

With respect to secondary water chemistry, BTP 5-1 states, in part, that "The applicant should address how its program meets industry guidelines (e.g., EPRI's secondary water chemistry guidelines and Nuclear Energy Institute (NEI) 97-06)."

While the staff does not review or accept the EPRI water chemistry guidelines through a safety evaluation, these guidelines are recognized as representing the industry consensus on best practices in water chemistry control and have been proven to be effective via many years of successful operating experience. As such, the staff finds the application of the guidance of the EPRI PWR Secondary Water Chemistry Guidelines, and a programmatic commitment to use these guidelines, to be an acceptable method for the applicant to ensure compliance with GDC 14. Because the standard review plan is a guidance document rather than a regulation, alternatives to the EPRI guidelines may be used, provide adequate justification is provided for deviating from the SRP guidance.

### Requested Information

1. Supply Action Level 3 limits during normal operation that would be recommended to COL applicants for blowdown concentrations of Na and SO<sub>4</sub>, and feedwater dissolved O<sub>2</sub>. Supply Action Level 2 limits for condensate dissolved O<sub>2</sub>. Thoroughly justify any deviation from concentration limits specified by the EPRI Guidelines. The justification should include detailed test data, operating experience, or a combination of both, demonstrating that the operation with impurities exceeding the various action levels for a longer time period than recommended by the EPRI guidelines, will not increase the likelihood of corrosion-induced failure of the steam generator tubing
2. Supply a description of the recommended consequences to plant operation (e.g., reduced power or shutdown) and corrective action requirements to be taken by plant personnel for violations of these limits.

### References

1. *Pressurized Water Reactor Secondary Water Chemistry Guidelines*, Rev. 6, Electric Power Research Institute (December 2004).
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. Letter from Yoshiki Ogata, MHI, to NRC dated September 16, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09451; Subject: MHI's Response to US-APWR DCD RAI No. 441-3461 (ADAMS Accession No. ML092610532).

## REQUEST FOR ADDITIONAL INFORMATION 543-4368 REVISION 1

4. Letter from Yoshiki Ogata, MHI, to NRC dated July 6, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09364; Subject: MHI's Response to US-APWR DCD RAI No. 383-3002 (ADAMS Accession No. ML091910255).

10.04.06-14

### Background

#### **[Open Item 10.04.06-4]**

The applicant has specified limits for several control parameters (Na, Cl, and SO<sub>4</sub>) which are greater than the values in the EPRI Guidelines. In response to RAI No. 383-3002 Question No. 10.04.06-6 (Reference 4), the applicant has defended these limits with a thorough analysis, including references and calculations with computer models. Part of the analysis involves computation of the pH that can occur in crevices and other locations isolated from the main (bulk) flow. These crevice pH values must be bounded away from values that would facilitate tube corrosion, by limiting the bulk concentrations of the control parameters. To obtain limits for Cl and SO<sub>4</sub>, MHI fixes the Na concentration at its maximum value of 50 ppb. However, this is not conservative, since the EPRI Guidelines (Reference 1, Figs. 3-3 and 3-7) indicate that crevice pH increases as the ratios Na/Cl and Na/SO<sub>4</sub> increase. Thus, for fixed values of Cl or SO<sub>4</sub>, raising Na to its maximum value will increase the crevice pH. However, limits for Cl and SO<sub>4</sub> will be determined by violation of the lower limit for crevice pH; hence, a lower value of Na should be used.

### Requested Information

Revise the justification for limiting values of Cl and SO<sub>4</sub>, so as to not depend on a non-conservative assumption for the Na concentration.

### References

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

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. Letter from Yoshiki Ogata, MHI, to NRC dated September 16, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09451; Subject: MHI's Response to US-APWR DCD RAI No. 441-3461 (ADAMS Accession No. ML092610532).

4. Letter from Yoshiki Ogata, MHI, to NRC dated July 6, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09364; Subject: MHI's Response to US-APWR DCD RAI No. 383-3002 (ADAMS Accession No. ML091910255).

## REQUEST FOR ADDITIONAL INFORMATION 543-4368 REVISION 1

10.04.06-15

### Background

#### **[Open Item 10.04.06-5]**

In Table 2 of their response to RAI No. 383-3002 Question No. 10.04.06-7 (Reference 4), the applicant has defended the lack of continuous monitoring of cation conductivity in the blowdown water. However, in Table 4 of the same response the applicant declares that they will indeed measure cation conductivity continuously in the blowdown sample (along with Na). Thus, the applicant has provided conflicting responses which must be resolved.

### Requested Information

Provide clarity on the plans to measure (or not to measure) cation conductivity in blowdown water.

### References

1. *Pressurized Water Reactor Secondary Water Chemistry Guidelines*, Rev. 6, Electric Power Research Institute (December 2004).
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. Letter from Yoshiki Ogata, MHI, to NRC dated September 16, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09451; Subject: MHI's Response to US-APWR DCD RAI No. 441-3461 (ADAMS Accession No. ML092610532).
4. Letter from Yoshiki Ogata, MHI, to NRC dated July 6, 2009; Docket No. 52-021, MHI Ref: UAP-HF-09364; Subject: MHI's Response to US-APWR DCD RAI No. 383-3002 (ADAMS Accession No. ML091910255).