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March 15, 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-10072

Subject: MHI's Response to US-APWR DCD RAI No. 523-4246 Revision 2

Reference: 1) "Request for Additional Information 523-4246 Revision 2, SRP Section: 11.02 - Liquid Waste Management System, Application Section: 11.2," dated January 26, 2010.

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. 523-4246 Revision 2."

Enclosed is the response to the RAI 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. 523-4246 Revision 2

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-10072
Docket Number 52-021

Response to Request for Additional Information No. 523-4246 Revision 2

March 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/15/2010

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

RAI NO.:	**NO. 523-4246 REVISION 2**
SRP SECTION:	**11.02 – Liquid Waste Management System**
APPLICATION SECTION:	**11.2**
DATE OF RAI ISSUE:	**01/26/2010**

QUESTION NO. : 11.02-28

Staff review of DCD Tier 2, Revision 2, and the RATAF code input/output files for the failed tank evaluation (10 liquid containing tanks) in Sections 11.2.3 and 2.4.13 (RAI 403-3027, Question 11.02-20, item 4, dated July 15, 2009) found that information on liquid containing tanks for compliance with 10 CFR 50.34a, 10 CFR 20.1301 and 20.1302, and Appendix B, Table 2 of 10 CFR 20, and Appendix I to 10 CFR 50 was not fully described. The staff requests the applicant to address the following:

1. Please provide details on the design features such as structure, capacity, etc. (or pointers to DCD sections and/or tables) on the boric acid evaporator (1,770 gal BA Evap) and primary water makeup tank (140,000 gal PMT) evaluated using the RATAF code.

2. The RWSAT volume is inconsistent with the input volume used in the RATAF code, the volume in DCD Tier 2, Revision 2, Section 6.3.2.2.3, and the volume calculated from the tank radius and length in DCD Tier 2, Revision 2, Table 12.1-1. Please clarify the RWSAT volume.

3. Describe the design features used to minimize facility and environment contamination for liquid containing tanks given the guidance of RG 4.21 and acceptance criteria of SRP Section 11.2 and BTP 11-6.

4. The RATAF code referenced in NUREG-0133 in BTP 11-6 calculates liquid tank and receptor concentrations based on 1% failed fuel. Further reducing RATAF liquid tank concentrations to 0.12% for an evaluation of the respective radionuclide ECLs at the critical receptor does not ensure that the "highest potential radioactive material inventory is selected among the expected types of liquid and wet waste streams processed by the LWMS," and neither results in the "highest concentrations of radioactive materials at the nearest potable water supply located in an unrestricted area" in accordance with BTP 11-6. Independent staff calculations on evaporator tank concentrations using the USAPWR design basis source term corrected for a fuel defect of 0.12%, information from applicant responses, and guidance in SRP Sections 11.2 and 2.4.13, BTP 11-6, NUREG-0133 and NUREG-0017 result in higher tank inventories and ECL fractions. For the US-APWR design and site-specific applications, the staff requests that the applicant add in Table 11.2-17 the failed tank concentrations calculated by the RATAF code based on 1% failed fuel for the HT, WHT, and BAT, identify the corresponding RATAF calculated ECL fractions at the critical receptor, and discuss these results in Sections 11.2.3.2 and 2.4.13 for the failed liquid tank evaluation.

Please revise the DCD to include this information and provide a markup.

ANSWER:

1. The Boric Acid Evaporator is located inside the Auxiliary Building at grade level in a shielded cubicle. This design insures that the dose limits for individual members of the public are in compliance with 10 CFR 20.1301 and 10 CFR 20.1302, and Appendix B, Table 2 of 10 CFR 20, and Appendix I to 10 CFR 50. The location of the evaporator at grade level facilitates drainage of the evaporator contents to the equipment at lower floors during maintenance and cleaning. The cubicle floor and walls are coated with non-porous epoxy material to facilitate easy decontamination. The cubicle is also equipped with a leak detection system. In the event that the boric acid evaporator leaks, the leak detection system will initiate an alarm signal to the Radwaste Control Room and the Main Control Room for operator action, including terminating evaporator operation and draining the content of the boric acid evaporator to the boric acid tank and the LWMS for processing, depending on the stage of evaporator operation. This design keeps levels of radioactive contamination and releases to unrestricted area to a minimum.

   For the Primary Water Makeup Tanks (PWMTs) please refer to part 3 of this response.

2. Figure 6.2.2-7 indicates the correct capacity for the Refueling Water Storage Auxiliary Tank (RWSAT) of 29,410 ft^3. The RWSAT capacity of 47,680 ft^3 as described in section 6.3.2.2.3 should be corrected to 29,410 ft^3 (220,000 gal). DCD Tier 2 Section 6.3.2.2.3 will be revised to include the correct capacity of 29,410 ft^3 for the RWSAT. Additionally, the RWSAT dimensions, activity and source strength in DCD Tier 2, Table 12.2-1 and Table 12.2-50 should be reflected the capacity of 29,410 ft^3 (220,000 gal).

3. The RWSAT, together with two smaller Primary Water Makeup Tanks (PWMTs) are located inside a tank house adjacent to the plant north wall of the Auxiliary Building. The bottom of the tank house consists of a concrete foundation and short concrete retaining walls around the tanks. The tanks are protected by full height walls and roof to prevent infiltration of rain and other precipitation, to minimize cross-contamination. The tank house is also equipped with a pit for leak detection capabilities and to facilitate collection of leakage to avoid release of contamination to the environment. The concrete foundation, the short walls, and the pit are coated with epoxy to facilitate easy decontamination in the event that contaminated water leaks. Regular epoxy coating inspection and maintenance are to be included in the plant epoxy coating inspection and maintenance program. These design features satisfy the applicable guidance provided in RG 4.21.

4. As described in DCD Tier 2, Revision 2, Subsection 11.2.3.2, the RATAF code is used for the liquid containing tank failure analysis. The RATAF code is used to calculate the radionuclide inventory in failed components as described in NUREG-0133, in accordance with BTP 11-6. The RATAF primary coolant concentration calculation is based on a 1% fuel defect level, except for tritium, as described in NUREG-0133. DCD Table 11.2-17 provides the calculation results for effluent concentrations due to liquid containing tank failures for the holdup tank, waste holdup tank, and boric acid tank. As indicated by the reviewer, the table did not include the concentrations in the failed tanks as calculated by RATAF under the 1% fuel defect level assumption. DCD Table 11.2-7, as well as the corresponding description in Subsection 11.2.3.2, will be revised as shown in the "Impact on DCD" section below to include a column for the concentration in each of the three tanks.

   The RATAF calculation of the concentration in the failed tanks is based on a 1% fuel defect level, in accordance with NUREG-0133, as described above. This 1% fuel failure is based on the original PWR-GALE code as described in NUREG-0017 Revision 0. However, the methodology described in BTP 11-6 allows for the radioactive source term used to calculate the concentration at the critical receptor location to be based on an expected fuel defect level of 0.12% of the core thermal power. In order to more clearly distinguish between the methodology used for the two calculations, a footnote will be added to the critical receptor concentrations in Table 11.2-7 to state that the critical receptor values are based on the 0.12% fuel defect level, as shown in the "Impact on DCD" section below.

Impact on DCD

1. There are no impacts on the DCD.

2. DCD Tier 2 Section 6.3.2.2.3, 1st paragraph will be revised as follows to include the correct capacity of 29,410 ft^3 for the RWSAT.

   The RWSP is designed to have a sufficient inventory of boric acid water for refueling and long-term core cooling during a LOCA. A minimum of 81,230 ft3 of available water is required in the RWSP. Sufficient submerged water level is maintained to secure the minimum NPSH for the SI pumps. The RWSP capacity includes an allowance for instrument uncertainty and the amount of holdup volume loss within the containment. The capacity of the RWSP is optimized for a LOCA in order to prevent an extraordinarily large containment. Therefore, a refueling water storage auxiliary tank containing **29,410 ft^3** ~~47,680 ft3~~ is provided separately outside the containment to ensure that the required volume for refueling operations is met. Table 6.3-5 presents the relevant RWSP data. Detail description of structure and capacity of RWSP is provided in Subsection 6.2.2.2.

   DCD Tier 2, Table 12.2-1 (Sheet 4 of 6) will be updated as follows to reflect the correct RWSAT dimensions:

Components	Assumed Shielding Sources						
	Source Approximate Geometry as Cylinder Volume		Source Characteristics				Qualit y
	Radius (in.)	Length (in.)	Type	Material	Density (lb/ft3)	Equipment Self-Shielding (in.)	
Refueling water storage auxiliary tank							
Plant Yard Area (Outside the Power Block)	**196.9** ~~236.2~~	**446.3** ~~536.6~~	Homoge neous	Water	62.4	Ignored	1

DCD Tier 2, Table 12.2-50 will be updated as follows to reflect the correct RWSAT dimensions:

Refueling Water Storage Auxiliary Tank activity	
Nuclide	Activity ($\mu Ci/cm^3$)
Co-60	**2.0E-04** ~~1.8E-04~~

Refueling Water Storage Auxiliary Tank source strength	
Gamma Ray Energy (MeV)	Source Strength ($MeV/cm^3/sec$)
0.015	**1.2E-05** ~~1.1E-05~~
0.3	**1.7E-04** ~~1.6E-04~~
0.8	**4.5E-04** ~~4.2E-04~~
1.0	**7.5E+00** ~~6.8E+00~~
1.5	**1.1E+01** ~~1.0E+01~~
2.0	**1.6E-04** ~~1.5E-04~~
3.0	**8.1E-07** ~~7.4E-07~~

3. There are no impacts on the DCD.

4. DCD Tier 2, Revision 2, Subsection 11.2.3.2 will be revised as shown below. Note that the response to question 11.02-30 of this RAI also revises this subsection of the DCD. For simplicity, changes due to both RAIs are shown together here.

In the evaluation, the holdup tank, the waste holdup tank and boric acid tank are selected because they contain a large amount of radioactivity. The calculation model ~~wa~~is based on ~~the entire tank content directly released~~ an unmitigated release of the entire content of the tank to the groundwater system~~, the~~ with subsequent mixing and ~~moving~~ migration within the groundwater system. It is assumed that the released liquid is diluted with 4.4E+10 gallons of water ~~until~~before it reaches ~~to~~ the location of the potable water supply. This parameter is based on the conditions of actual sites. The model assumes~~d~~ the tank content is diluted with only this body of water in the vicinity of the ponds surrounding the site. No other water (such as other discharges and groundwater) is credited as dilution water, and no credit is taken for retardation or suspension of radionuclides in the subsurface media. Hence the conservative assumption that the radionuclides are not filtered (or reduced) by the soil is used. In addition, groundwater transport and soil properties are site-specific parameters. Therefore, COL Applicant is responsible for assessment of this model [COLA Item#11.2(3)] using the site specific parameters to evaluate the conservativeness of this analysis. In addition, the traveling time is assumed to be 365 days in order to cover the transfer rate of several radionuclides. Table 11.2-16 shows the evaluation conditions applied to each tank. ~~The fuel defect level is set to 0.12% of the core thermal power, which is based on Branch Technical Position (BTP) 11-6 (Ref 11.2-17).~~

Table 11.2-17 shows summarizes the evaluation results of radioactivity concentration at the location of the potable water supply. Branch Technical Position (BTP) 11-6 (Ref 11.2-17) Subsection B.2, endorses Appendix A of NUREG-0133, which describes the RATAF code for PWR plants. Accordingly, the RATAF code is utilized in this evaluation. The liquid radioactivity concentration in the tank is calculated by RATAF assuming a primary coolant concentration based on 1% fuel failure. However, for the determination of the critical receptor concentration BTP 11-6 allows the use of a source term based on the expected failed fuel fraction, which is set to 0.12% of the core thermal power. The evaluation result obtained from the case of the failure of the boric acid tank, which has the largest value of 2.2E-01, indicates that the ratio of concentration is still less than the allowable value of 1.0, in accordance with 10CFR 20 Appendix B (Ref 11.2-8). Satisfying the concentration limits of 10 CFR 20 Appendix B (Ref 11.2-8) results in a dose of less than 50 mrem/yr that is required in 10 CFR 20.1301 and 10 CFR 20.1302 (Ref.11.2-1). BTP 11-6 Subsection B.2, endorses Appendix A of NUREG-0133, which describes the RATAF code for PWR plants. Accordingly, the RATAF code is utilized.

In addition to the 1% failed fuel assumption described above, the RATAF code uses several built-in parameters, including a plant capacity factor of 80%, which is less than most current operating power plants. However, as demonstrated in Table 11.2-17 the resultant effluent concentrations calculated by the RATAF analysis have sufficient margin to the acceptance criteria to cover any possible US-APWR capacity factor between 80% and 100%. As a result of the of the various built-in RATAF assumptionsFor the dominant nuclides Cs-134 and Cs-137, the reactor coolant activities for the dominant nuclides (Cs-134 and Cs-137) calculated by the RATAF code are higher than the realistic source terms as described in Table 11.1-9 (ie.,1.4E-02 μCi/ml vs. 2.1E-05 μCi/g in Table 11.1-9 and 1.0E-02 μCi/ml vs. 3.0E-05 μCi/g in Table 11.1-9 for Cs-134 and Cs-137 respectively, with the conversion of 1g=1ml) and equal for tritium (H-3).

DCD Tier 2, Revision 2, Table 11.2-17 will be revised as follows:

Table 11.2-17 Calculation Results of Effluent Concentrations due to Liquid Containing Tank Failures

1 : Holdup Tank

Isotope(1)	Concentration in the tank (μCi/ml)(3)	Critical Receptor Concentration (μCi/ml)(4)	Effluent Concentration Limit (μCi/ml)(2)	Fraction of Concentration Limit
H-3	7.8E-01	1.6E-06	1.0E-03	1.6E-03
Cs-134	4.7E-02	8.8E-09	9.0E-07	9.7E-03
Cs-137	3.4E-02	8.8E-09	1.0E-06	8.8E-03
TOTAL				**2.0E-02**

Note:

1. Nuclides less than 1.0E-3 in fraction of concentration limit are excluded.
2. 10CFR20 Appendix B Table 2
3. RATAF output based on 1% fuel defect level (except for tritium)
4. Adjusted values based on 0.12% fuel defect level (except for tritium)

2 : Waste Holdup Tank

Isotope[(1)]	Concentration in the tank (µCi/ml)[(3)]	Critical Receptor Concentration (µCi/ml)[(4)]	Effluent Concentration Limit (µCi/ml)[(2)]	Fraction of Concentration Limit
Cs-134	2.1E-02	9.8E-10	9.0E-07	1.1E-03
Cs-137	1.5E-02	9.8E-10	1.0E-06	1.0E-03
TOTAL				**2.1E-03**

Note:
1. Nuclides less than 1.0E-3 in fraction of concentration limit are excluded.
2. 10CFR20 Appendix B Table 2
3. RATAF output based on 1% fuel defect level
4. Adjusted values based on 0.12% fuel defect level

3 : Boric Acid Tank

Isotope[(1)]	Concentration in the tank (µCi/ml)[(3)]	Critical Receptor Concentration (µCi/ml)[(4)]	Effluent Concentration Limit (µCi/ml)[(2)]	Fraction of Concentration Limit
Cs-134	1.2E+00	9.0E-08	9.0E-07	1.0E-01
Cs-137	8.6E-01	1.2E-07	1.0E-06	1.2E-01
TOTAL				**2.2E-01**

Note:
1. Nuclides less than 1.0E-3 in fraction of concentration limit are excluded.
2. 10CFR20 Appendix B Table 2
3. RATAF output based on 1% fuel defect level
4. Adjusted values based on 0.12% fuel defect level

Impact on COLA

There are no impacts on the COLA.

Impact on PRA

There is no impact on the PRA

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

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/15/2010

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

RAI NO.:	**NO. 523-4246 REVISION 2**
SRP SECTION:	**11.02 – Liquid Waste Management System**
APPLICATION SECTION:	**11.2**
DATE OF RAI ISSUE:	**01/26/2010**

QUESTION NO. : 11.02-29

Staff review of DCD Tier 2, Revision 2, Sections 11.4.6 and responses to the staff's questions (RAI 401-3031, Revision 0, Question 11.04-18, dated July 15, 2009; RAI 403- 3027, Revision 0, Questions 11.02-18 and 11.02-19, dated July 15, 2009) found that information on the concrete epoxy coating systems used to line equipment and tank cubicles in the LWMS (Section 11.2), and tank cubicles and SRST rooms in the SWMS (Section 11.4) for compliance with 10 CFR 50.34a and 10 CFR 20.1406 was not fully described. In the responses, it states that the DCD will be revised to establish upper tier maintenance and inspection criteria for Service Level II coatings used in the LWMS cubicles and SWMS rooms consistent with RG 1.54, Revision 1. The staff requests the applicant to address the following:

1. The responses provide design information on typical Service Level concrete coating systems such as coating types, dry film coating thicknesses, and specific permeabilities, etc. that will be considered, but this information was not included in the proposed revisions of DCD Tier 2, Revision 2, Sections 11.2 and 11.4. Please include this design information on the coating systems.

2. The responses state that an Initial Test Program (ITP) will be utilized for the coating systems using normal construction testing practices with qualified coating inspections in guidance with ASTM D4537-04a, but this information was not included in the proposed revision of DCD Tier 2, Revision 2, Chapter 14. Please clarify the statement in utilizing an ITP on the coating systems in DCD Tier 2, Chapter 14.

3. Please describe in DCD Tier 2 Sections 11.2 and 11.4 how the technical procurement and the construction and inspection activities for coating systems, and the operational maintenance and assessment program (i.e., in-service coatings monitoring program) will be addressed by the COL applicant using guidance in ASTM D5144-08, ASTM D3843-00 (Reapproved 2008), ASTM D4537-04a, ASTM D5163-03 (Reapproved 2008), ASTM D1653-08, ASTM D5163-03 (Reapproved 2008), RG 1.54, and EPRI Report TR-109937.

4. DCD Tier 2, Revision 2, Section 11.4.6 (with pointer in Section 11.4.1.3) describes testing and inspection requirements for the SWMS such as preoperational tests, initial testing, and epoxy coating requirements such as QA, selection, qualification, testing, maintenance and inspection, conformance to guidance documents, etc., but a similar section which describes testing and inspection requirements is absent for the LWMS. Please include a Testing and Inspection Requirements section in Section 11.2.

Please revise the DCD to include this information and provide a markup.

ANSWER:

1. New Tables 11.2-20 and 11.4-7 with typical service level II concrete systems such as coating types, dry film coating thicknesses, and specific permeabilities of epoxy coatings will be included in DCD Tier 2, as indicated in response to DCD RAI 403-3027, Revision 0, Questions 11.02-18. Tables 11.2-20 and 11.4-7 provides typical Service level II concrete epoxy coatings, but approved equivalent Service level II concrete epoxy coatings can be utilized as a liner. Also, sections 11.2.1.4 and 11.4.1.4 will be updated with the text to reference these new tables.

2. DCD Revision 2 Subsection 11.2.2.2.2, "Tanks" and Subsection 11.4.6, "Testing and Inspection Requirements," refer to post-construction initial inspections to be performed by personnel qualified using ASTM D 4537 using the inspection plan guidance of ASTM D 5163. These inspections are addressed in the Construction Test phase of the Initial Test Program (ITP) (i.e., they are not preoperational or startup tests per RG 1.68 and DCD Section 14.2). As stated in DCD Subsection 14.2.1.2.1, "Construction Tests," test abstracts for construction tests are not included in DCD Section 14.2. A matrix is developed to list the required construction tests for each system.

3. As stated in the DCD Table 1.9.1-1 position on RG 1.54 conformance, the programmatic, operational and site-specific aspects of the coatings program are not applicable to the US-APWR design certification. Therefore, COL items have been added to DCD Sections 11.2 and 11.4 to address the COL applicant's responsibilities with respect to these coatings. These COL items, combined with the DCD descriptions of LWMS and SWMS coatings, assure the adequacy of a coatings program commensurate with NRC regulatory guidance, recognizing that a COL applicant may appropriately reference standards that have superseded those endorsed by RG 1.54 Revision 1.

4. A new section 11.2.4 on Testing and Inspection Requirements will be added to DCD Tier 2. Refer to "Impact on DCD" section of this RAI for the DCD Tier 2 mark-up.

Impact on DCD

1. Add the following sentence in between the 5th and 6th sentences to DCD Tier 2, Section 11.2.1.4, 5th paragraph;

   "Table 11.2-20 contains typical service level II concrete systems such as coating types, dry film thicknesses (DFT), and specific permeabilities for the three typical epoxy coatings. This table provides typical Service level II concrete epoxy coatings, but approved equivalent Service level II concrete epoxy coatings can be utilized as a liner."

Add the following new Table 11.2-20 to DCD Tier 2, after Table 11.2-19:

Table 11.2-20 Typical Service Level II Concrete Systems Epoxy Coatings

Coatings	DFT	Specific Permeability	
		$g/m^2/mil/24hrs$	$g/m^2/mil/24hrs$
No. 5500 Kolor-poxy self leveling floor coating	40 mils	0.6	2.2
No. 3500 Kolor-poxy self- priming surf. Enamel	16 mils	2.7	10.5
No. 3200 Kolor-poxy white primer	9 mils	2.2	8.7
N-series Neothane Enamel	7 mils	18.0	70.9

Add the following sentence in between the 2nd and 3rd sentences to DCD Tier 2, Section 11.4.1.4, 6th bullet for SWMS processes both wet and dry solid wastes:

"Table 11.4-7 contains typical service level II concrete systems such as coating types, dry film thicknesses (DFT), and specific permeabilities for the three typical epoxy coatings. This table provides typical Service level II concrete epoxy coatings, but approved equivalent Service level II concrete epoxy coatings can be utilized as a liner."

Add the following new Table 11.4-7 to DCD Tier 2, after Table 11.4-6:

Table 11.4-7 Typical Service Level II Concrete Systems Epoxy Coatings

Coatings	DFT	Specific Permeability	
		$g/m^2/mil/24hrs$	$g/m^2/mil/24hrs$
No. 5500 Kolor-poxy self leveling floor coating	40 mils	0.6	2.2
No. 3500 Kolor-poxy self- priming surf. Enamel	16 mils	2.7	10.5
No. 3200 Kolor-poxy white primer	9 mils	2.2	8.7
N-series Neothane Enamel	7 mils	18.0	70.9

2. There is no impact on the DCD resulting from part 2 of this response.

3. Add the following to DCD Tier 2 Table 1.8-2 and Subsection 11.2.4:

   "COL 11.2(7) The COL Applicant is responsible for identifying the implementation milestones for the coatings program used in the LWMS. The coatings program addresses RG 1.54 Revision 1, recognizing that more recent standards may be used if referenced in DCD Section 11.2."

Add the following to DCD Tier 2 Table 1.8-2 and Subsection 11.4.8:

"COL 11.4(9) The COL Applicant is responsible for identifying the implementation milestones for the coatings program used in the SWMS. The coatings program addresses RG 1.54 Revision 1, recognizing that more recent standards may be used if referenced in DCD Section 11.4."

4. Add the following new section 11.2.4 on "Testing and Inspection Requirements" after section 11.2.3.3 to DCD Tier 2;

"11.2.4 Testing and Inspection Requirements

Preoperational testing of the LWMS is performed to verify the proper operation of equipment and processes, and is discussed in Chapter 14, Section 14.2. Performance testing of the LWMS is conducted to demonstrate acceptable performance of the radioactive waste processing and storage subsystems under normal operational conditions and AOOs as discussed in Chapter 14, Section 14.2. Thereafter, portions of the systems are tested as needed.

During initial testing of the system, performance of the process and utility (such as nitrogen) supply and mobile systems are tested to demonstrate conformance with design flows and process capabilities. An integrity test is performed on the system upon completion of construction.

Provisions are made for periodic inspection of major components to verify the capability and integrity of the systems. Display devices are provided to indicate vital parameters required in routine testing and inspection.

Epoxy coatings in cubicles that contain significant quantities of radioactive material, are Service Level II coatings as defined in RG 1.54 Revision 1, and are subject to the limited QA provisions, selection, qualification, application, testing, maintenance and inspection provisions of RG 1.54 and standards referenced therein, as applicable to Service Level II coatings. Post-construction initial inspection is performed by personnel qualified using ASTM D 4537 (Reference 11.2-22) using the inspection plan guidance of ASTM D 5163 (Reference 11.2-23)."

Add the following reference to DCD Tier 2, "Reference" section 11.2.5;

11.2-24 Nuclear Regulatory Commission, Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants, Regulatory Guide 1.54, Rev. 1, July 2000.

Add the following reference to DCD Tier 2, "Reference" section 11.4.9;

11.4-34 Nuclear Regulatory Commission, Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants, Regulatory Guide 1.54, Rev. 1, July 2000.

Impact on COLA

The COLA shall be updated to address changes to the DCD for COL item 11.2(7) and 11.4(9).

Impact on PRA

There is no impact on the PRA

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

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/15/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 523-4246 REVISION 2**
SRP SECTION:	**11.02 – Liquid Waste Management System**
APPLICATION SECTION:	**11.2**
DATE OF RAI ISSUE:	**01/26/2010**

QUESTION NO. : 11.02-30

Staff review of DCD Tier 2, Revision 2, Sections 11.2.3 and 11.3.3, and Tables 11.2-9 and 11.3-4 found that the basis for applying the built-in plant capacity factor value of 0.8 (80%) in the PWR-GALE and RATAF computer codes for compliance with 10 CFR 50.34a, 10 CFR 20.1301 and 20.1302, and Appendix B to 10 CFR 20, and Appendix I to 10 CFR 50 was not fully described. Please discuss the impacts on the calculated annual radioactive effluent release rates and radionuclide concentrations, and the subsequent public doses from normal routine releases and AOOs from applying the built-in plant capacity factor of 80% in the PWR-GALE and RATAF codes. Similarly, please discuss these impacts on the failed liquid tank evaluation. The discussions should identify the expected plant capacity factor for the US-APWR design, acknowledge that the current fleet of operating reactors is operating at factors in excess of 90%, and address whether the calculated annual radioactive effluent release rates, radionuclide concentrations, and subsequent public doses need to be increased due to a higher plant capacity factor. Please revise the DCD to include this information and provide a markup.

ANSWER:

The US-APWR uses the PWR-GALE code to calculate the annual releases of radionuclides from the plant Liquid Waste Management System (LWMS) and Gaseous Waste Management System (GWMS) in accordance with RG 1.109 and NUREG-0017, as described in DCD Sections 11.2 and 11.3, respectively. The input parameters for these calculations are described in DCD Subsections 11.2.3.1 and 11.3.3.1 for the LWMS and GWMS, respectively, and identified in Table 11.2-9. The RATAF code, whose primary coolant activity calculation is based on the PWR-GALE code, is used for the liquid containing tank failure analysis, as described in DCD Subsection 11.2.3.2. As indicated by the reviewer, the plant capacity factor is not an input parameter, but is built-in to these codes.

The PWR-GALE and RATAF codes use a built-in capacity factor of 0.8 (80%). However, most current U.S. plants operate at a capacity of 90% or more. Since the capacity factor depends on a variety of factors that may be plant dependent, such as the cycle length, maintenance outages, etc.. Although the expected capacity factor for the US-APWR is greater than the built-in code assumption, the existing conservatisms in the effluent concentrations and dose estimates are adequate to cover increases associated with a larger capacity factor.

The annual release rates generated by the PWR-GALE code are based on operating plant primary coolant concentrations data that are over 30 years old. Decades of operating experience and improved technology have significantly reduced the occurrence and severity of fuel defects, so that the actual fission product concentration is much less than that predicted by PWR-GALE. A review of the PWR-GALE code shows that, except for tritium, the liquid release calculation methodology does not utilize the capacity factor. Therefore, the difference between the built-in and expected capacity factor has no effect on the liquid effluent releases calculated by PWR-GALE tabulated in DCD Tables 11.2-10 and 11.2-11, except for tritium. Additionally, the annual liquid effluent release discharge concentrations tabulated in DCD Tables 11.2-12 and 11.2-13 assume a dilution flow from the circulating water system that corresponds to 292 days of operation (80% capacity factor). If the capacity factor increases, this annual dilution flow will correspondingly increase for all radionuclides, essentially reducing the overall discharge concentration. Therefore, the use of the built-in capacity factor of 80% is conservative for the estimation of the liquid effluent release discharge concentration and corresponding LADTAP II dose calculation.

PWR-GALE assumes an annual liquid effluent release tritium release rate of 0.4 Ci/yr per MWt. This release rate is linearly proportional to the assumed capacity factor of 80%. However, as described above, the dilution flow used to determine the discharge concentration is also proportional to capacity factor. The increase in tritium release at a higher capacity factor would be canceled out by the increased dilution. Therefore, the above conclusion that the use of the built-in capacity factor is conservative for liquid effluent releases remains valid.

The results of the liquid containing tank failure analysis using RATAF, given in DCD Table 11.2-17, show that the limiting case is for the boric acid tank. However, RATAF also used the PWR-GALE model for calculating tank activity concentrations and thus the same argument applies as justification for the use of the built-in capacity factor for these dose estimates as well.

The situation is different for the PWR-GALE model used to calculate the gaseous effluent releases. In this case, the capacity factor is directly used in the calculation of release concentrations for all isotopes. But again, the results are approximately linearly proportional to the value of the capacity factor. The results of the gaseous effluent release discharge concentration and dose calculations show that there is sufficient margin to the regulatory limits to cover the expected difference in capacity factor. This can be demonstrated using a simple and conservative sensitivity study. Conservatively multiplying the DCD dose results by a sensitivity factor of 1.25 (100%/80%) will bound the effect of any capacity factor greater than 80%.

DCD Tables 11.3-6 and 11.3-7 show the offsite airborne concentrations compared to those of the 10 CFR 20 regulations for both the expected release and maximum release, respectively. The results for the airborne concentrations from the PWR-GALE code are well below the regulatory limit for each isotope, even if they are multiplied by the sensitivity factor of 1.25. The total fraction of the concentration limit for expected releases would increase from 9.19E-03 to 1.15E-02, which is still well below the allowable value of 1.0. A summary of the impact of the difference between the built-in and expected capacity factor for the limiting resultant doses, which are based on the expected releases, is provided in the table below.

Limiting Dose	DCD Result (mrem/yr)	Sensitivity (DCDx1.25) (mrem/yr)	Regulatory Limit (mrem/yr)
Gamma in Air	0.21	0.26	10
Beta in Air	1.62	2.03	20
Total Body	0.134	0.168	5
Skin Dose	1.26	1.58	15
Organ [Child's Bone]	10.2	12.8	15

As indicated above, the results of the calculation of gaseous release doses show that there is acceptable margin to the regulatory limits even with the conservative assumptions of the effect of the maximum possible capacity factor.

Therefore, the difference between the capacity factor built-in to the PWR-GALE code and the expected capacity factor of the US-APWR will not impact the ability of the results to meet all of the applicable acceptance criteria. However, in order to clarify this issue with the plant capacity factor, the DCD will be revised, as shown in the "Impact on DCD" section below.

Impact on DCD

DCD Tier 2, Revision 2, Tables 11.2-9 will be revised to include a new note 2 that reads as follows:

2: The basis of the PWR-GALE source term calculation uses a built-in plant capacity factor of 80%, which is less than the expected capacity factor for the US-APWR. The difference in capacity factor has no impact on the calculated liquid effluent release and resultant dose, but there is a minor impact on the gaseous effluent releases and resultant doses. However, the calculated values have sufficient margin to the acceptance criteria to cover any possible US-APWR capacity factor between 80% and 100%.

Additionally, the following editorial errors noted in DCD Tier 2, Revision 2, Table 11.2-9 will also be corrected.

- Delete the second row for "Decontamination factor for Cs and Rb" from the Dirty Waste subsection
- Correct capitalization and spacing errors in note 1.

DCD Tier 2, Revision 2, Table 11.2-16 will be revised to include a new note 4 that reads as follows:

4. The basis of the RATAF source term calculation uses a built-in plant capacity factor of 80%, which is less than the expected capacity factor for the US-APWR. This difference in capacity factor has no impact on liquid effluent release concentrations due to liquid containing tank failures.

Impact on COLA

There are no impacts on the COLA.

Impact on PRA

There is no impact on the PRA

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

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/15/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 523-4246 REVISION 2**
SRP SECTION:	**11.02 – Liquid Waste Management System**
APPLICATION SECTION:	**11.2**
DATE OF RAI ISSUE:	**01/26/2010**

QUESTION NO. : 11.02-31

Staff review of DCD Tier 2, Revision 2, Sections 11.2.2.1 and 14.2.12.1.80 found that information on the Test Method and Acceptance Criteria in the ITP for the LWMS was not fully described. Section 11.2.2.1 describes verification of manual and automatic system controls on key system alarms such as high-level alarms associated with liquid tanks simultaneously activated in the MCR, and other alarms such as radiation monitor and dual isolation valves to monitor and control effluent discharge to the environment and other indications; however, verification of response to response to normal control, alarms, and indications are not identified in Section 14.2.12.1.80. Please revise the DCD to include this information and provide a markup. (See DCD Tier 2, Revision 2, Sections 14.2.12.1.81, 14.2.12.1.82, and 14.2.12.1.83 as examples.)

ANSWER:

DCD Tier 2, Section 14.2.12.1.80, Liquid Waste Management System Preoperational Test, Test Method will be revised as shown below to include the verification of the response to normal control, alarms and indications as described in Section 11.2.2.1. DCD Tier 2, Section 14.2.12.1.80, will be revised to include manual and automatic system controls, interlocks, alarms and indications verification during preoperational testing. This includes process parameters such as liquid levels within the tanks, processing flow rates, differential pressures across filters, ion exchange columns, etc., indication and/or alarms and system controls in order to provide operational information and assess equipment performance in accordance with Section 11.2.2.1 operational requirements. Acceptance Criteria, D.4 states that, "The Liquid Waste Management System operates as described in Section 11.2". This includes all the process parameters to asses LWMS performance including tank alarms and interlocks.

Alarms and controls associated with the radiation monitor and dual isolation valves to monitor and control effluent discharge to the environment is addressed in question 11.02-32 of this RAI.

Impact on DCD

DCD Tier 2, Section 14.2.12.1.80, Liquid Waste Management System Preoperational Test, Test Method, add C.3 to read as follows:

C. Test Method

1. The control circuitry and operation of system pumps and valves is verified.
2. The system is operated and performance characteristics verified.
3. **<u>Verify manual and automatic system controls, interlocks, alarms and indications as described in Section 11.2.</u>**

Impact on COLA

There are no impacts on the COLA.

Impact on PRA

There is no impact on the PRA

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

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/15/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 523-4246 REVISION 2**
SRP SECTION:	**11.02 – Liquid Waste Management System**
APPLICATION SECTION:	**11.2**
DATE OF RAI ISSUE:	**01/26/2010**

QUESTION NO. : 11.02-32

Staff review of DCD Tier 1, Revision 2, Section 2.7.4.1 and Table 2.7.4.1-1 found that information on ITAAC for the LWMS to demonstrate compliance with 10 CFR 52.47(b)(1) and to provide reasonable assurance that a plant that incorporates the US-APWR design certification and operates in accordance with the design certification will meet the provisions of the Atomic Energy Act and NRC regulations was not fully described. Without confirming the initial introduction of the proper types and amounts of filtration
and adsorbent media, the LWMS would fail to meet the design criteria in the DCD Tier 2, Revision 2, Section 11.2.1.2. As a result, liquid releases could exceed 10 CFR 20, Appendix B, Table 2, effluent concentration and dose limits, and 10 CFR 50, Appendix I dose objectives. The staff requests the applicant to address the following:

1. Describe in DCD Tier 1, Section 2.7.4.1.1, how the LWMS is designed to process liquid waste prior to release and ensure compliance with 10 CFR 20, Appendix B, Table 2 effluent concentration and dose limits, and 10 CFR 50, Appendix I dose objectives for liquid effluents when the plant is operational.

2. Describe in DCD Tier 1, Section 2.7.4.1.1, the process design of the LWMS subsystems and how the initial loading of the subsystem demineralizers and vessels includes the appropriate of types of filtration and adsorption media that will meet or exceed the decontamination factors listed in DCD Tier 2, Revision 2, Table 11.2-7. Provide in DCD Tier 1, Table 2.7.4.1-1, the assigned ITAAC to confirm the filter efficiency and demineralizer media.

3. Provide in DCD Tier 1, Table 2.7.4.1-1, the assigned ITAAC to confirm the radiation monitor and dual isolation valves installed on the sole discharge line to monitor and control effluents to the environment, source test of the radiation monitor, alarms, indications, and automatic initiation functions as described in
DCD Tier 1, Revision 2, Section 2.7.4.1.1 and DCD Tier 2, Revision 2, Sections 11.2.2.1 and 11.5.2.5.1.

Please revise the DCD to include this information and provide a markup.

ANSWER:

The LWMS is designed to use cartridge filter (Ultipleat Filter by Pall Corporation, or approved equivalent) with a nominal micron rating of 6 to remove suspended particulates followed by ion exchange to remove dissolved ions. The design uses mixed cation and anion resin in proper ratios (Dowex MR-3 LC NG, or approved equivalent) in the mixed bed ion exchange columns. The filtration and ion exchange technologies have been in use in the nuclear industry and their performances on removal of contaminants are commercially proven. To insure operability and adequate removal to meet 10 CFR Part 20, Appendix B and 10 CFR Part 50, Appendix I, multiple filter and ion exchange columns, and their associated piping and instrumentation are included in the design and the columns are located inside shielded cubicles for ALARA considerations The LWMS shall have sampling provision to confirm the treated effluent meeting 10 CFR Part 20, Appendix B, Table 2 before discharge. The LWMS shall also have recycle capability in order to reprocess liquid in the event that it does not meet the Appendix B requirements. In addition, the LWMS shall have radiation element to monitor discharge. In the event that the effluent exceeds a predetermined setpoint, the radiation element shall close the discharge valves and initiates an alarm for operator actions.

1. Based on the above discussion, DCD Tier 1, Section 2.7.4.1.1 will be revised to address LWMS capability as shown below under "Impact on DCD".

2. The demineralizers are procured with a certain capability to remove ionic species and impurities to meet requirements in NRC Regulations 10 CFR Part 20 and 10 CFR Part 50, Appendix I, to ensure that the decontamination factors for effluent meet or exceed the recommended values provided in NUREG 0017 (repeated in DCD Table 11.2-7). Thus, initial filtration and ion exchange media are specified to be provided by the equipment manufacturers; performance data (including decontamination factors) of the media in similar nuclear applications, and/or media test reports are also required to be submitted by the equipment manufacturers during bid evaluation processes. In addition, engineering review of the vendor design, and pressure and/or hydrostatic tests are also specified. During equipment delivery, inspection of the types, the quality, and the volume of filtration and demineralizer media will be conducted for acceptance. Procedures for loading the media will be prepared to insure that the media loading meets the design and the corresponding vendor specifications for the filter and demineralizer capabilities. DCD Tier 1, Section 2.7.4.1.1 will be revised accordingly.

3. Liquid radwaste discharge monitor RMS-RE-035 is identified in DCD Tier 1 Table 2.7.6.6-1 of Process Effluent Radiation Monitoring and Sampling System (PERMS) equipment, and is subject to the functional arrangement ITAAC Item 1 of Table 2.7.6.6-2. Table 2.7.4.1-1 ITAAC Item 2 requires the LWMS discharge valves to close in response to an LWMS effluent discharge isolation signal.

Impact on DCD

In Tier 1 Section 2.7.4.1.1 Design Description, System Purpose and Functions, revise first paragraph to read as follows:

System Purpose and Functions

The LWMS is non safety-related system. The reactor coolant drain tank and the containment vessel sump include a safety-related containment isolation function as described in Section 2.11.2. The LWMS is designed to safely monitor, control, collect, process, handle, store, and dispose of liquid radioactive waste generated as a result of normal operation, including anticipated operational occurrences (AOOs). **The LWMS is designed to process liquid prior to release and ensure compliance with 10 CFR 20, Appendix B, Table 2, effluent concentration and dose limits, and 10 CFR 50, Appendix I dose objectives for liquid effluents when the plant is operational.**

Tier 1 Section 2.7.4.1.1 Design Description, Key Design Features, revise third and fourth paragraph to read as follows:

Key Design Features

The LWMS provides the capability to segregate, collect and treat the liquid waste to acceptable release or recycle specifications for plant use. **The process equipments are designed to remove ionic species and impurities to meet requirements in NRC Regulations 10 CFR Part 20, Appendix B and 10 CFR Part 50, Appendix I, to ensure that the effluent releases do not exceed regulatory limits.** The LWMS also provides the capability to store, sample, and analyze treated liquid for safe control and disposal.

Tanks, equipment, pumps, **ion exchange columns, filters** etc., used for storing and processing radioactive material are located in controlled areas and shielded in accordance with their design basis source term inventories. After the waste has been processed, it is temporarily stored in monitor tanks ~~where it is sampled prior to recycle or discharge~~. **The LWMS shall have sampling provision to confirm the treated effluent meet 10 CFR Part 20, Appendix B, Table 2 before discharge. The LWMS shall also have recycle capability in order to reprocess liquid in the event that it does not meet the Appendix B requirements.** Connections are provided to forward liquid waste to contracted mobile systems or temporary equipment.

In Tier 1 Section 2.7.4.1.1 Design Description, Alarms, Displays, and Controls, revise the contents to read as follows:

Alarms, Displays, and Controls

A radiation monitor and dual isolation valves are installed on the sole discharge line to monitor and control effluents to the environment. Detection of radioactivity levels in the stream exceeding the predetermined setpoint automatically closes the discharge valves **and initiates an alarm for operator actions.**

In Tier 1 Section 2.7.4.1.1, Table 2.7.4.1-1 Liquid Waste Management System Inspections, Tests, Analyses, and Acceptance Criteria, revise the table as follows:

Table 2.7.4.1-1 Liquid Waste Management System Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. The LWMS process equipments are designed to remove ionic species and impurities to meet 10 CFR Part 20 and 10 CFR Part 50, Appendix I, to ensure that the effluent releases do not exceed regulatory limits.	**6. Inspections of the LWMS process equipment will be performed to verify the type and quality of filtration and demineralization media and volume of the ion exchange resin.**	**6. The as-built LWMS process equipments are capable of removing ionic species and impurities to meet 10 CFR Part 20 and 10 CFR Part 50, Appendix I, to ensure that the effluent releases do not exceed regulatory limits.**

DCD Tier 2, Section 11.2.1.4 Method of Treatment, add last paragraph to read as follows:

"The demineralizers are procured with a certain capability to remove ionic species and impurities to meet requirements in NRC Regulations 10 CFR Part 20, Appendix B and 10 CFR Part 50, Appendix I, to ensure that the effluent releases do not exceed regulatory limits (Table 11.2-7). Thus, an inspection of the amount of filtration and demineralizer media will be conducted to verify that the loading meets the vendor recommended loading for the demineralizer capabilities as specified in the vendor material, such as a vendor manual, for the equipment.

Replacement filters, charcoal, and resins will be purchased to meet performance standards which support overall system decontamination factors listed in Table 11.2-7."

Impact on COLA

There are no impacts on the COLA.

Impact on PRA

There is no impact on the PRA

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